ASSESSMENT ON INNOVATIVE SORBENTS

FINAL REPORT

BSEE Contract No. 140E0119F0106

Prepared for:

Bureau of Safety and Environmental Enforcement (BSEE)
Oil Spill Preparedness Division
45600 Woodland Road, Mailstop VAE-OSRD
Sterling, Virginia 20166

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SOUTHWEST RESEARCH INSTITUTE®

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SwRI® Project No. 18.24882

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EXECUTIVE SUMMARY

Sorbents are used during oil spill response operations to recover spilled oil on either land or water. A variety of different types of sorbents currently exist, and their performance is based on a variety of factors including their use in the intended environment and the oil state. A large amount of research has focused on developing new and innovative sorbent materials that could potentially help improve oil spill response operations. The claimed characteristics of these new sorbents have, however, not been fully characterized or compared against traditional sorbent technologies.

To evaluate the current state of the art of sorbent technologies and to find new and innovative sorbents that could help aid in oil spill response activities, a comprehensive sorbent technology assessment was undertaken. This evaluation was accomplished by reviewing best practices and current uses of sorbents in the field through industry interviews, evaluating commercially available sorbent product documentation, and investigating current sorbent research activities through a literature review. The compiled information in this assessment provides a basis for understanding current sorbent capabilities and development activities, which can be used to select new and innovative sorbents for future testing programs.

The findings from this assessment indicate that sorbents are used in almost every oil spill, where current sorbent designs meet a majority of the response industry’s needs and their use in certain environments is based on industry best practices. Type I sorbents are the most common type of sorbent product commercially available to be purchased, are low in cost, and have been the primary focus of research and development activities. A majority of the sorbents that are commercially available are designed to recover oil spilled on either land or water, are made of synthetic materials, and are single use only. Sorbent research activities have been dedicated to developing new sorbents that are meant for retrieving oil spilled on water only, have equal representation of both natural and synthetic materials, and are reusable. Additionally, response entities are not actively using reusable sorbents largely due to their lifecycle costs.

Based on these suggested improvements and current research and development activities, 13 sorbents were found to have characteristics that are beyond the current state of the art in sorbent technologies and have the potential to help improve oil spill response activities. While these sorbents have shown promise to aid in oil spill response operations, these sorbents would require more development as they are at low market readiness levels. This sorbent technology assessment, including the technical approach taken to conduct the evaluation and the review findings, is included herein.

1. INTRODUCTION

Sorbents are insoluble materials, or a mixture of materials, that can be used to recover spilled oil through absorption or adsorption (NRT, 2007). Sorbent technologies are typically used for oil spill cleanup operations for small spills and spills that occur near shorelines. Because these sorbents tend to be for a single use only, Oil Spill Removal Organizations (OSROs) often stock a large amount of different types of sorbents. These sorbents include synthetic or organic rolls, sock booms, and blankets, all of which must be disposed of in landfills or by burning after use.

Over the past few years, a large amount of research has focused on developing new and innovative sorbent materials that could potentially help improve oil spill response operations. The claimed characteristics of these new sorbents include:

- Higher sorption rate and capacity,
- Refinement, along with the recovered oil,
- Reusable materials to alleviate disposal needs.

The beneficial features of these new sorbents have not been fully characterized or compared against traditional sorbents. Prior to deploying these innovative sorbents, offshore operators and spill response personnel must know how well they perform in oil spill cleanup activities.

To assess the current state of the art of sorbents technologies, a comprehensive product documentation review of commercially available sorbents, as well as a literature assessment of research and development activities with new and emerging sorbents was conducted. The intent of this assessment was to synthesize information on current uses of sorbents, the types of sorbents that are commercially available, and new research and development activities that are being conducted with sorbents. The synthesized information provides a basis for current sorbent capabilities and development activities, which can be used to select new and innovative sorbents for future testing programs.

The objective of this project was to conduct a comprehensive assessment of innovative sorbents. To meet this objective, the scope of work included:

- Documenting information on current uses of sorbents, including the decision-making process of when and how these sorbent technologies are used. This information came from interviews and surveys from offshore operators and OSROs.
- Compiling product information on commercially available sorbents.
- Investigating and compiling information on recent research and development activities with sorbents from publicly available literature.
- Identifying new and emerging types of sorbent technologies that could potentially be used in surface applications or subsurface applications.

The project was organized into three main technical tasks. The full details of the work breakdown for these tasks are described in the following sections. A high-level description of each of these three tasks is represented in Figure 1-1. In addition to the findings of the three main project tasks, background information on sorbents and their typical performance in oil spill response operations has been synthesized and provided in this report.

Offshore Operators/OSRO Survey and Interviews

Information on current uses of sorbents during oil spill response operations was compiled from offshore operators and OSRO interviews and surveys.

Commercial Sorbent Product Review

Relevant information on commercially available sorbents was compiled from technical documentation.

Literature Review on Sorbent Research and Development Activities

Relevant information on current sorbent research and development activities was compiled through a literature review.

Figure 1-1. Assessment of Innovative Sorbents Project Breakdown

The project was organized into three main technical tasks, which allowed for the assessment of the current state of the art in sorbent technologies.

2. BACKGROUND ON SORBENT TECHNOLOGIES

The physical countermeasures that are used at different stages of oil spill cleanup operations are categorized based on their modes of action as being active or passive (Mackay et al, 1979). The oil spill countermeasures and their modes of operation are graphically represented in Figure 2-1, where the countermeasure approaches are defined as:

- **Active measures:** a technique that requires constant engagement in oil spill recovery. An example of an active measure includes the use of skimmers to actively remove the spilled oil on water.
- **Passive measures:** a technique that does not require constant engagement in oil spill recovery. An example of a passive measure includes the use of a boom to contain the oil in a defined area.

Sorbents are classified as being a combination of both an active and a passive spill cleanup approach, as they can be employed for the active removal of oil as well as used for containment purposes. These devices are also effective at recovering spilled oil from both land and water and are oftentimes used after other oil spill countermeasures have been implemented to clean up any residual oil. Sorbents are categorized in different product types and can be comprised of different synthetic, inorganic, or natural materials. These product types, materials, and their typical performance are discussed in detail in the subsequent subsections.

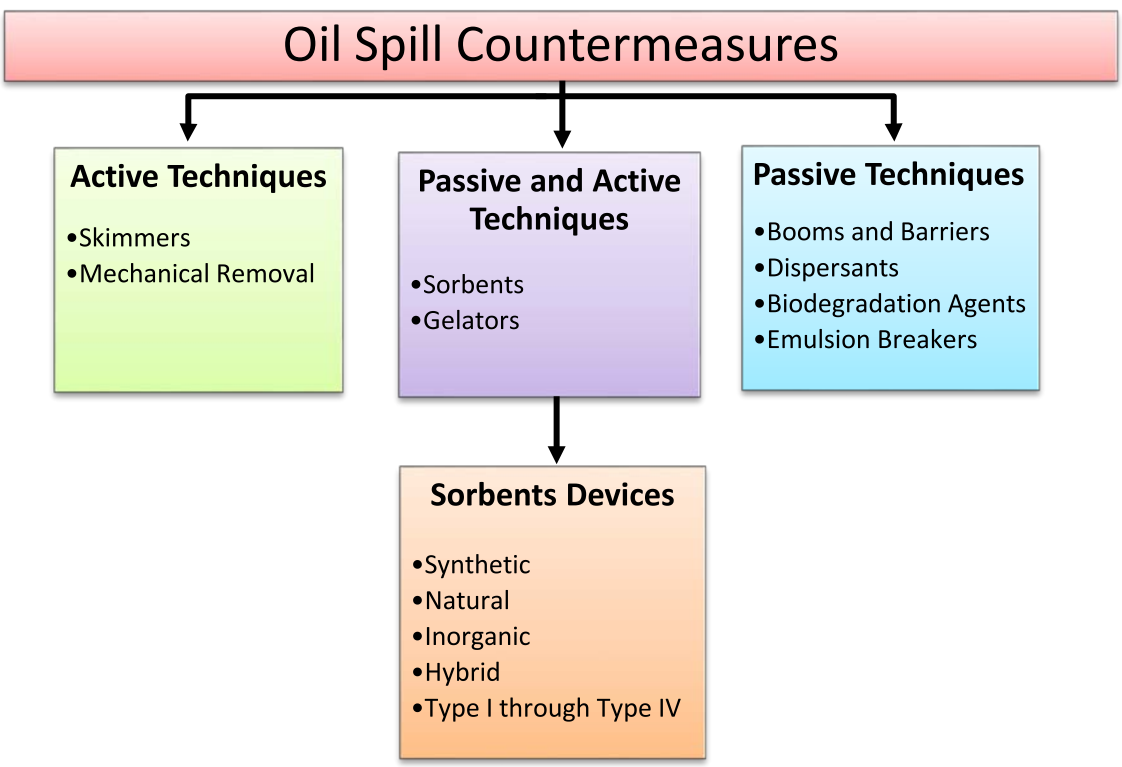

Figure 2-1. Oil Spill Countermeasures
Sorbents are considered a hybrid response technique as they utilize active and passive approaches for oil spill cleanup operations.

2.1 Sorbent Product Types

Sorbents are manufactured in various forms in accordance to their composition and their intended use. There are four main types of sorbent categories, where each can contain different product subcategories. These sorbent types and their associated products are provided in Table 2-1. These sorbent types and products naming convention are specified in ASTM F726 (2017) and will be used throughout this report.

Table 2-1. Sorbent Product Types

Four different product types are used to identify sorbent technologies. Examples of each product type are shown below.

TYPE	PRODUCT	EXAMPLE
Type I	Roll	 (Eco-Tech Inc., 2019)
	Pad/Sheet	 (Sellars, 2019)
	Blanket	 (Ultratech, 2019)
Type II (loose)	Loose/Granular	 (Oil Sponge, 2019)
	Powder	 (New Pig, 2020)
Type IIIa	Enclosed Pillows and Socks	 (Sellars 2019(b))
Type IIIb	Enclosed Booms	 (Brady SPC, 2019)
Type IIIc	Enclosed Sweeps	 (Brady SPC, 2019b)

TYPE	PRODUCT	EXAMPLE
Type IV (agglomeration unit)	Strips	 (Meltblown Technologies, 2016)
	Pom poms	 (Brady SPC, 2019c)
	Open Netting	 (SpillTech, 2019)

A sorbent is typically applied over an oil slick for a period of time to allow the material to sorb the oil. The relative effectiveness of the different sorbent product types to sorb the oil is dependent on the deployment location and the condition of the spilled product, as weathering can cause the oil to undergo chemical and physical changes which can greatly reduce a sorbent's sorption capability. An end user will typically choose the most efficient sorbent based on the oil spill scenario. The typical performance of different sorbent products in certain environments is based on the material structure, composition, and subtype, where the ease of deployment and retrieval of the device is often considered when determining which sorbents to use in the field.

2.2 Sorbent Material Structure and Composition

Oil is removed by sorbent materials either through adsorption and absorption, where the materials are typically oleophilic (i.e., oil attracting) and ideally hydrophobic (i.e., water repelling). Adsorption involves the adherence of oil on the material's surface. The more viscous the oil, the thicker the oil layer that will adhere to the sorbent material. Absorption of oil into the sorbent relies on capillary action, where the spilled oil is drawn up through pores and into the material. The rate of oil penetration into the material, or the sorbent's uptake capacity, is based on the porosity of the material and the viscosity of the oil. Materials that have a high porosity and larger capillary openings in the material structure have been shown to have a higher oil uptake and are most effective on higher viscosity oils, while the use of sorbents on low viscosity oils and those materials that have refined porous structures have shown lower oil uptake.

Sorbents can be comprised of different materials, each having their own advantages and limitations for use in oil spill recovery. These different sorbent materials are classified as being synthetic, natural organic, natural inorganic, or hybrid and are described in detail in their respective subsections.

2.2.1 *Synthetic Sorbents*

Synthetic sorbents are made from polymer materials such as polyurethane and polypropylene. Synthetic sorbents typically have a high sorption capacity and are considered the most effective material type in recovering oil when compared to natural organic and natural inorganic sorbents. In some cases, a sorption capacity of 40 grams of oil retained per gram of synthetic sorbent material is observed (ITOPF, 2012). Additionally, these sorbents usually have high hydrophobic and oleophilic properties, which makes them ideal for effectively removing oil spilled on water. While synthetic sorbents are effective for oil spill cleanup activities, they are not biodegradable and must be disposed either by being placed landfills or by being burned.

2.2.2 *Natural Organic Sorbents*

Natural organic sorbents are typically made from agricultural products such as straw and cotton. Natural organic sorbents can have sorption capacities that are less than 10 grams of oil retained per gram of material (ITOPF, 2012). These materials are also not as hydrophobic as synthetic sorbents, and will sometimes sorb water along with the oil. Natural organic sorbents have an advantage of being biodegradable, reducing the overall waste resulting from oil recovery.

2.2.3 *Natural Inorganic Sorbents*

Natural inorganic sorbents are typically made from materials such as clay and vermiculite. These materials have the lowest sorption capacity when compared against the synthetic and natural organic materials, having around 2 grams of oil retained per gram of material (ITOPF, 2012). Since these sorbents tend to be dense, large disposal transportation efforts are required in comparison to other sorbent materials. These sorbent materials also have the potential of obstructing or clogging small crevices.

2.2.4 *Hybrid Sorbents*

Hybrid sorbents are comprised of a mix of both synthetic and natural materials to enhance the sorption capacity beyond the capabilities of the individual materials that make up the sorbent alone. A hybrid sorbent may be comprised of synthetic polymeric foam or polymer fibers, natural fibers, graphite, or treated cellulous all combined together to form a single sorbent material structure.

2.3 Storage, Transportation, and Disposal of Used Sorbents

Once the sorbent has been used, the sorbent will need to be stored, transported, and finally disposed. A used sorbent will be stored onboard a collection vessel as well as onshore prior to disposal. For both storage locations, the oiled debris is collected in temporary storage containers or temporary licensed storage sites with secondary containment to minimize contamination to the surrounding environment before transportation. For large oil spills, a large volume of oil-contaminated sorbents may be collected, which requires large temporary storage. This can be logistically burdensome, as the capacity of the available storage site may be limited and can additionally make the transportation of large amounts of oiled debris challenging.

The disposal options available for used sorbents are limited and include incineration, landfill, or biodegradation. Burning a contaminated sorbent can occur if the material does not contain large amounts of water and can be combustible. Typically, incinerators such as open-hearth furnaces and rotary kilns can accommodate large amounts of used sorbent materials (ITOPF, 2012). The disposal of sorbents in a landfill is regulated at the local or national level, as different locations may treat these contaminated sorbents as hazardous waste. Depending on these waste regulations, organic sorbent materials may be spread over large areas of land and allowed to undergo biodegradation. The entire degradation process of a used organic sorbent can, however, take a few years to occur.

Some types of sorbents can be reused if the oil can be extracted from the device, which can typically be accomplished by compression, wringing, centrifuge, or solvents (ITOPF, 2012). The end user should consider how many reusable cycles the sorbent can endure before the material becomes unusable due to deterioration or a decrease in sorption capacity upon repeated use. Additional factors that should be considered is the possible recontamination of the environment from the reuse of the sorbent.

2.4 Testing Protocols

Two ASTM standards exist that describe the methods for determining the oil uptake capacity for sorbents: ASTM F716 (2018) and ASTM F726 (2017). The ASTM F716 standard focuses on testing protocols for sorbents that are classified as an absorbent, while ASTM F726 focuses on testing protocols for sorbents that are classified as an adsorbent. The difference between absorption and adsorption, as defined in the test standards are the following:

- **Absorbent** – a material that retains liquid throughout its molecular structure causing it to swell by 50% or more, and is at least 70% insoluble with excess liquid.
- **Adsorbent** – an insoluble material where the liquid coats the materials surface, and does not swell more than 50% with excess liquid.

The definitions for both absorbent and adsorbent are routinely interchanged throughout industry. Regardless of which testing protocol is used, a sorbent is evaluated for its uptake capacity, also referred to as sorption capacity, which is defined as the mass of the sorbent at the end of the oil test over the initial mass of the dry sorbent. While differences between the two testing protocols exist, both ASTM standards provide testing guidance for the uptake capacity for a sorbent, including submergence and draining times. Additionally, these standards provide procedures for testing the reusability of the sorbent.

3. OFFSHORE OPERATORS/OSROS SURVEY AND INTERVIEWS

The objective of this task was to compile information on current uses of sorbents during oil spill response operations from offshore operators or OSROs. The following subsections describe the technical approach for conducting the industry survey and summarize the collective information related to sorbent usage and their best practices in oil spill response activities.

3.1 Industry Survey Technical Approach

Industry experts were interviewed to collect information related to current sorbent usage, specifically focusing on how this technology is successfully deployed during cleanup operations and to also identify common best practices that are not publicly available in the literature. Information on current uses of sorbents was gathered through over-the-phone interviews and with a digital survey using Constant Contact®. The survey questions that were sent to the industry contacts are located in Appendix A. In some cases, the survey authors that responded electronically were contacted to answer follow-on questions to gain clarifying information.

The content for the interview and digital survey questions were developed based on the criteria listed in Table 3-1. The survey focused on multiple regions and spill recovery locations, as the sorbent response approach may differ based on feasibility and capabilities at those locations.

Table 3-1. Interview and Digital Survey Content

The interview and digital survey questions focused on multiple regions and locations, where the requested information provided a full assessment of the current uses of sorbents.

REGIONS	LOCATIONS	REQUESTED INFORMATION
Gulf of Mexico Pacific Alaskan	Offshore Nearshore Shoreline	Sorbent types When Where How Decision-making process Guidelines and considerations

3.2 Industry Survey Findings

The survey was sent to 10 different industry entities. Six of the 10 entities actively participated and provided information to the survey questions. Two additional responses were received by contacts made during the surveying process that were separate from the initial invitation. All of the entities that participated in this survey respond to oil spills that occur in North America, and one company responds to global spills. These entities also manage responses for both inland and offshore oil spills, where each responds to about 10 to 15 reportable spills per year. The key information gathered from this survey is summarized below:

- ***Sorbents are used in nearly every oil spill***. Sorbents can be used in the initial oil spill cleanup phase and as the final product deployment regardless of the spill size or location. Sorbents are typically used to collect small amounts of oil and/or to direct oil away from a roadway or sensitive area.
- ***The most commonly used sorbents are made from synthetic material.*** Polypropylene is the typical material of choice utilized in pads, rolls, and booms. Polyurethane snare

booms were also mentioned as being frequently used. Some responders have experimented with natural materials, open-cell foam, micronized cotton cellulose, and loose sorbents. These materials have proven difficult to use in some scenarios, such as low temperature or in coastal wetland regions, and loose or granular sorbents typically are only used as “floor sweep” inside shop areas as they are hard to retrieve in the field.

- ***Sorbent types are procured based on practical experience from the field***. Products are typically purchased based on what has proven to work best in the oilfield and the type of oil expected to be encountered (light vs. heavy). Resupply of products is also a key driver for the type of sorbent used due to remote locations where spills can occur. Some entities mentioned that geographic response plans and vessel contingency plans prescribe which sorbents are to be purchased. However, there is a substantial amount of responder practical knowledge about what sorbents will be needed and stocked.
- ***Reusable sorbents are not used by any of the responding entities.*** The most common reason for not using reusable sorbents was related to the cost associated with the entire lifecycle (i.e., purchase cost, recovery, liquid retrieval/disposal, storage, certification, etc.) as compared to inexpensive one-time use sorbents. One entity had experimented with reusable sorbents but their experience indicated that they are too difficult to deploy and the sorbent tends to reintroduce oiled material back into the environment. One entity was not aware reusable sorbents were available on the market to purchase.
- ***Sorbent disposal is prescribed in the regional spill response plan or dictated by the state regulatory disposal practices.*** Most used products are placed in the waste flow process, where contracted companies typically bag the sorbents and dispose of them in a landfill. One entity said they permit companies to use them for energy recovery. Another entity indicated some sorbents are incinerated.
- ***Sorbents are stored in containers and undergo regular inspection.*** Sorbent materials are stored in containers where they will not be exposed to direct sunlight. Some are stored in environmentally controlled facilities. Regular inspections are performed either monthly, quarterly, or annually to check shelf life and product degradation. Sorbents are not replaced at predefined intervals unless there is observable damage to the product.
- ***Sorbent usage is dictated by general experience and best practices.*** Some regions have specific guidance that prescribe the application of specific sorbent types for different settings, oil types, and environment conditions. Some entities follow the best practices defined by the International Association of Oil and Gas Producers (IOGP). One entity mentioned that they train personnel in the correct application, handling, management, and disposal of sorbents to maximize effectiveness while minimizing waste. They also instruct personnel on the best times and conditions to introduce sorbents and scenarios when sorbents may not be the best option for cleanup activities.
- ***Sorbents are designed to effectively retrieve oil; however, some conditions lead to poor sorbent performance.*** Heavy oils and crude oil can coat sorbents and reduce their performance. Sorbents are also not as effective at retrieving weathered, emulsified oil, or light/refined oil sheens. Additionally, weather conditions such as low air or water temperature, tides, and sea state can lead to poor sorbent performance. Sorbents can also sorb too much liquid (water and oil) and can rip or tear when retrieved.

- ***Loose granular sorbents have shown promise in oil recovery, but are not always feasible to use in all environments.*** Some entities have seen loose sorbents deployed by municipalities and hydraulic fracturing companies in onshore facilities within tanks and enclosed areas. They commented that loose sorbents have high sorption rates, but they have not seen the benefits of this product on coastal areas and offshore, as they would be difficult to retrieve.

3.3 Future Research

The survey included a couple of questions regarding gaps in existing sorbent technology, including potential technologies that could replace sorbents. This subsection provides a summary of the gap-related responses.

3.3.1 Gaps in Sorbent Technology

It is important to note that most responders stated that sorbents are basic in their design and most meet the needs of the industry. Several entities indicated that making them more complicated would raise the cost of their use. However, most entities offered potential improvements to sorbent technologies. The following statements summarize their responses:

- Defining a global standard for effectiveness (uptake mass per mass of sorbent).
- Developing sorbents that can perform better when placed on water and minimize water uptake. This was particularly noted for sorbents used in "sausage booms."
- Increasing the range of oil types that can be retrieved using sorbents, such has heavy oils, fuels, or refined products.
- Sorbents that offer faster sorption rates.
- Materials that can attract oil to the sorbent.
- Using natural materials, such as loose sorbents, that can be left in the field and naturally degrade. One entity mentioned that sisal rope, burlap, and kapok fiber are abundant, inexpensive, natural plant based materials that could potentially be developed into systems that replace sorbent booms and pads.
- Minimizing the amount of sorbent material that is lost in the field as this is trading one pollutant for another.
- Reducing the amount of sorbents used in oil spills as they generate a lot of waste, as many sorbents that do not collect any oil are treated as waste.

3.3.2 Potential Replacement Technologies for Sorbents

Most responding entities use a wide range of oil recovery techniques and indicated that sorbents will always be used during oil spill cleanup operations. Skimmers are probably the most used and effective tools that minimize solid waste generation. Skimming technologies gather most of the spilled oil, and sorbents are used afterwards for the final cleanup. Direct suction equipment is also used heavily in the field.

3.4 High-Level Findings from the Industry Survey

The industry survey provided information on current sorbent use and best practices used in the field. The major findings of the industry survey are summarized as follows:

- Sorbents are used in nearly every oil spill, are suitable in design, and their use during oil spill response operations are based on industry best practices such as those outlined by IOGP.
- The most regularly used sorbents in the field are made from synthetic materials, mainly polypropylene, where the types of sorbents that are purchased and stocked by the response entities are based on past experience using the products and the anticipated oil conditions.
- Due to their cost, difficulty in deployment, and tendency to reintroduce oil back into the environment, response entities are not using reusable sorbents during oil spill cleanup activities.
- Sorbent disposal is prescribed by state regulations as well as included in the regional spill response plans.
- When not actively being used, sorbents are kept in containers or dedicated facilities to preserve their quality and also undergo regular inspection.
- The sorbents that are commercially available are designed to efficiently recover the spilled oil, however some conditions lead to poor sorbent performance such as their use on high viscosity oils, weathered oils, or with thin layers of oil spilled on water.
- The loose sorbents that are commercially available have advantageous high sorption rates, but are not typically used in coastal areas and offshore regions, as they would be difficult to retrieve.
- The survey responses provided areas for sorbent technology improvement, such as faster sorption rates, materials that can attract oil to the sorbent, use of more natural materials, and global standardization for effectiveness.
- The survey responses indicated that they use skimming-type technologies to gather most of the spilled oil, where sorbents are used afterwards for the final cleanup.

4. COMMERCIAL SORBENT PRODUCT REVIEW

The objective of the commercial sorbent product review was to compile product properties and cost information on commercially available sorbents. In order to meet this objective, a thorough product search was conducted to gather sorbent data and assess commercially available sorbents. The method, results, and major findings of this product review are described in the following subsections.

4.1 Sorbent Product Review Technical Approach

A comprehensive product search was conducted to gather data on 317 different commercially available sorbents from over seventy manufacturers. Because the focus of this project task was to research sorbents currently available for purchase, the data were obtained via the internet. A vast majority of the information was found on manufacturer websites, directly off webpages or through product downloads such as brochures and specification sheets. The manufacturers were also contacted by phone for clarifications and additional information on the sorbents.

A Microsoft Excel sheet was used to organize the data gathered from the product search into a sorbent product table. The product table includes the sorbent name, manufacturer, sorbent website, manufacturer phone number, sorbent cost, and a picture of each sorbent. The source of information for each sorbent was also recorded and was predominantly the product or company website. Several other sorbent properties were researched and recorded in the product table. These sorbent properties are briefly described in Table 4-1. The sorbent product table is located in Appendix B and is additionally provided as a Microsoft Excel file separate from this report.

It is important to note that one sorbent property that was initially researched during this sorbent review was removed from the product search table. The removed property was the classification of the sorbent as an absorbent or adsorbent. It was found that many websites inconsistently referred to their products as both absorbents and adsorbents. Other products seemed to be incorrectly classified as an absorbent or adsorbent, based on the definitions found in the ASTM oil-uptake capacity test standards defined in Section 2. Consequently, this column was removed from the product table.

Some of the sorbent properties were also not available for all of the commercially available sorbents. The manufacturers were contacted over the phone to inquire about properties missing from the sorbent website. However, the company representatives were often not able to provide all of the missing product information. These unknown properties are marked as "Not Available" in the product table.

Table 4-1. Sorbent Properties included in the Product Table

Research conducted on commercially available sorbents focused on these major sorbent properties.

SORBENT PROPERTY	DESCRIPTION
Type	The type of sorbent classifies the product into one of the four major categories: Type I, II, IIIa, IIIb, IIIc, or IV. These categories are defined in Table 2-1.
Subtype	The subtype is a further classification of each sorbent subcategory. Sorbent subtypes are defined in Table 2-1. Subtype examples include rolls, booms, and pom poms.
Category	The sorbent category defines whether the sorbent is recommended for oil spills on land or water. The category naming convention is as follows: • L – Recommended for oil spills on land • W – Recommended for oil spills on water • L-W – Recommended for oil spills on land and water
Material	The main material component of the sorbent.
Manufacturing Process	The manufacturing process is a top-level description of the process used to manufacture the sorbents.
Sorption Claim	The sorption claim is the oil uptake capacity of the sorbent, which defines the amount of oil the sorbent can sorb. This is written most commonly as a ratio of oil volume or weight per unit of the sorbent. The sorption claim is also commonly written as a weight multiplier that can be multiplied by the dry weight of the sorbent to calculate the weight when saturated with sorbed oil.
Test Method	The test method is the method of testing used to determine the oil sorption claim.
Reusability of Sorbed Oil	The reusability of the sorbed oil is the ability of the sorbent to release the sorbed oil and the potential for the released oil to be used for future applications.
Reusability of Sorbent	The reusability of the sorbent is the ability of the sorbent to be used more than once for oil spills. This would involve using the sorbent, removing the sorbed oil by mechanical or other means, and then using the sorbent again.
Size	The sorbent size is the size of one unit of the sorbent, typically defined as the sorbent area. The size of Type II loose sorbents is typically defined as the volume or weight of a unit of sorbent.
Final Disposal Method	The final disposal method is the method of disposal after the sorbent has been saturated with oil and can no longer be used effectively.
Cost Per Gallon	The cost per gallon of sorbed oil was calculated by dividing the sorbent unit cost by the total volume of sorbed oil per unit of sorbent. The volume of sorbed oil per unit of sorbent was determined based on the sorption claim and size of each sorbent unit. This property was calculated from available product information in order to have a consistent unit for sorbent cost comparison.

4.2 Sorbent Product Review Results

The commercial product search resulted in an abundance of sorbent property information over a wide-range of different sorbent technologies. In an attempt to organize the sorbent data and draw conclusions from the research effort, several charts were created to categorize the sorbents based on their properties. The research effort focused on sorbents for oil spill cleanup specifically, so products designed for general liquid spill cleanup were not considered.

The distribution of sorbents in each sorbent type category is displayed in Figure 4-1. A majority of the sorbents researched were categorized as Type 1 sorbents such as rolls, pads, or blankets. These items can be used to clean up small oil spills in industrial applications, which may account for the majority of available sorbents being classified as Type I. The second most common sorbent types were Type IIIa, enclosed pillows or socks, and Type IIIb, enclosed booms. These two sorbent types made up approximately the same percentage of the commercially available sorbents and, when added together, accounted for more of the total sorbents than Type 1 sorbents. This suggests that enclosed booms and socks are very common oil spill response sorbents, especially for oil spills on water. Only three of the Type I sorbents were recommended for oil spills on water only, while 31 of the Type IIIa and Type IIIb sorbents were recommend for spills on water only. There were significantly less Type IIIc, enclosed sweep, sorbents found, accounting for about 3% of the total distribution. Similarly, Type IV sorbents, such as pom poms and open netting, accounted for approximately 3% of the total distribution and were much less common than the other sorbent types. A possible explanation for the small number of these sorbent types is that sweeps, pom poms, and open netting are primarily used for larger spills on water. In fact, none of the sorbents categorized as Type IIIc or Type IV were recommended for spills on land only. Therefore, it is less likely these sorbent types will be needed for a large variety of industrial use purposes. Loose sorbents, categorized as Type II, were the fourth most common, accounting for approximately 17% of the total distribution. Loose sorbents are suitable for small industrial applications or larger spills depending on the size of the purchased unit. A majority of these sorbents are recommended for oil spills on land or water.

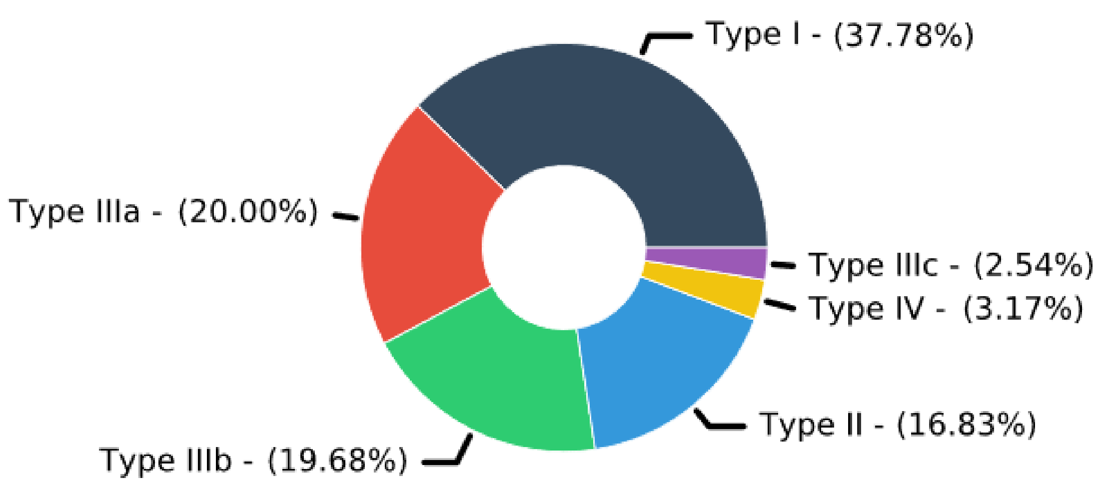

Figure 4-1. Product Search Distribution Based on Sorbent Type
The majority of sorbents included in the product search table were categorized as Type 1 sorbents.

To further understand the available sorbents on the market, the commercial sorbents were categorized based on subtype. Figure 4-2 displays the quantity of sorbents that fall into each subtype category. Figure 4-2 is a nested pie chart that displays the distribution of products based on type and subtype simultaneously. The subtypes are color-coded to match the same color family as the associated sorbent type. For example, all of the Type 1 sorbents are shown in varying shades of navy blue while the Type IIIa sorbents are shown in varying shades of red. There are nine major subtypes, indicating that a wide variety of sorbents are commercially available. Additionally, 26 different products did not fall into one of the major subtype categories. These are denoted as "Other" in Figure 4-2. The majority of sorbents were classified as pads, accounting for approximately 22% of the total distribution. The next most represented sorbent subtypes were booms, rolls, and pillows in descending order. Granular loose sorbents and socks each accounted for approximately 10% of the total distribution while sweeps, pom poms, and loose powders each accounted for approximately 3% of the total distribution.

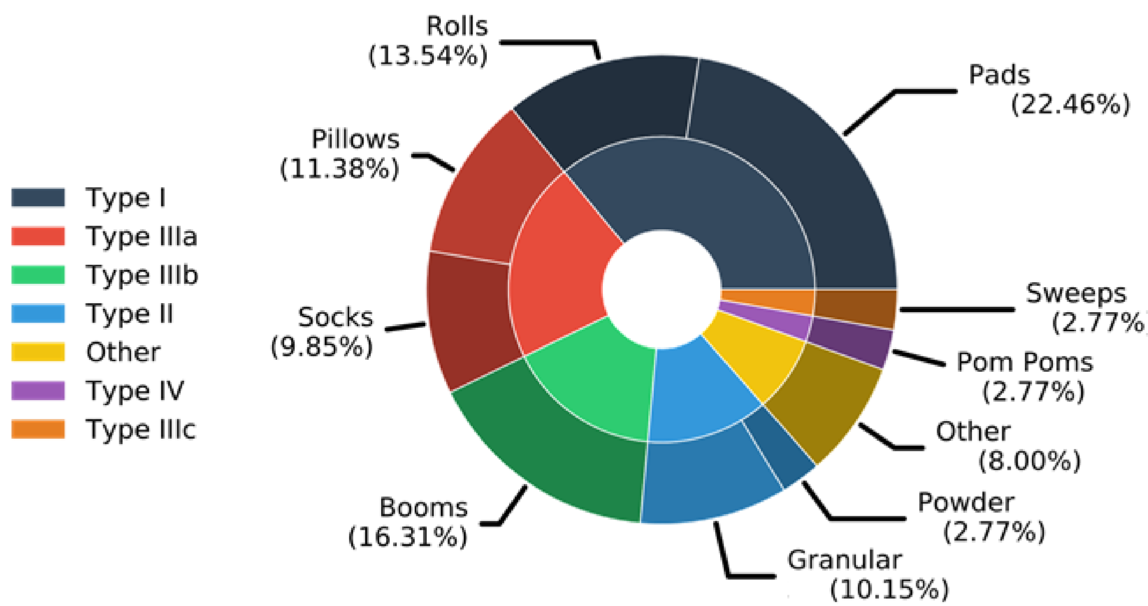

Figure 4-2. Product Search Distribution Based on Sorbent Subtype
A wide variety of sorbent subtypes are commercially available and were included in the product search table.

The distribution of sorbents based on spill category is shown in Figure 4-3. A majority of the sorbents included in the product search table were designated for use with oil spilled on both land and water. The sorbents designated for use on oil spilled on land only accounted for 15% of the total distribution, while those designated for use on oil spilled on water only was approximately 17%.

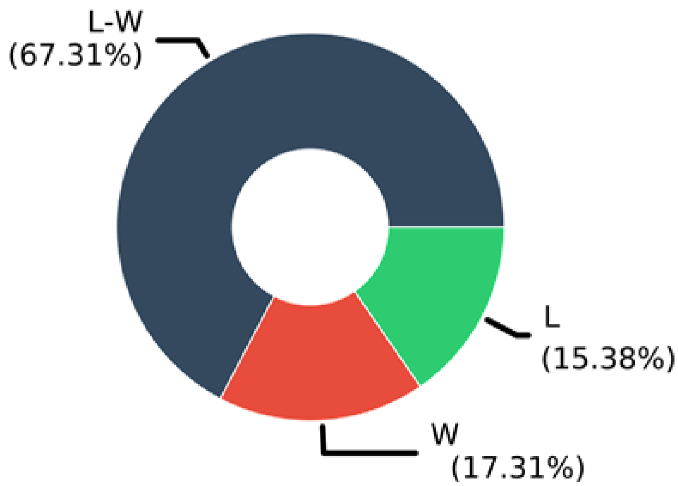

Figure 4-3. Product Search Distribution Based on Sorbent Category
The majority of sorbents included in the product search table were designated for spills on both land and water.

The breakdown of the sorbents according to the primary material component is displayed in Figure 4-4. Synthetic sorbents are the most common commercially available sorbents according to those found during this assessment. Approximately 68% of the commercial sorbents were mainly composed of some type of polymer, with a vast majority being primarily composed of polypropylene. Organic materials were the primary component in about 17% of the sorbents. Materials categorized as organic materials included corn, rice, plants, cellulose, coir, feather, and moss. Cotton, a natural and organic sorbent material, was the primary component in 26 of the researched sorbents, accounting for approximately 9% of the total distribution. Cotton was separated from the organic materials category since it was such a commonly used material. Recycled fibers accounted for about 5% of the researched sorbents, consisting of synthetic and natural sorbent alternatives.

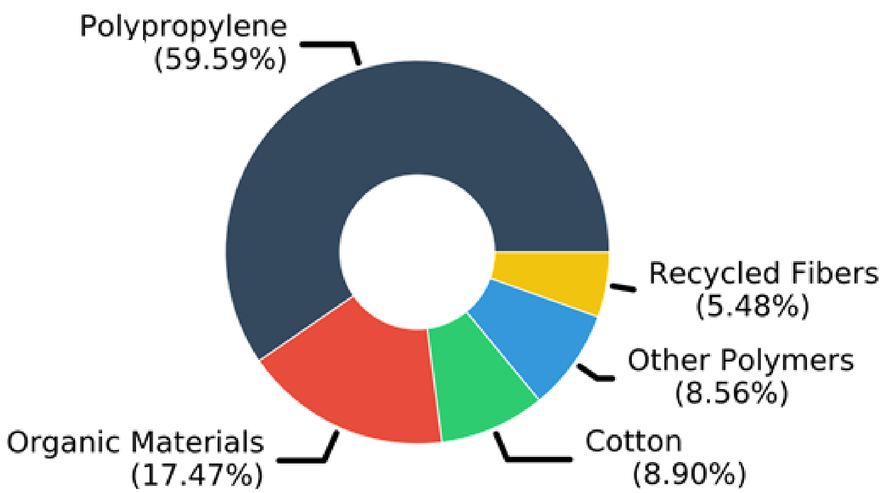

Figure 4-4. Product Search Distribution Based on Sorbent Material
Polymers were the primary component in a majority of the reviewed sorbents, indicating that synthetic sorbents are the most commonly used.

The ability of the sorbent to release the sorbed oil for potential future use was reviewed for each commercial product. The results of the oil reusability distribution are provided in Figure 4-5. "No" indicates the sorbed oil cannot be reused, while "yes" indicates the sorbed oil can be reused, and "not available" indicates that this property was unknown for the sorbent. Due to the large number of sorbent manufacturers that were unable to provide this information, it is difficult to conclude whether the majority of sorbents allow for reuse of the sorbed oil. Of the commercial sorbents that did provide this information, a majority are not designed for the release and reuse of the sorbed oil, representing approximately 34% of the total sorbents. There may be methods that would successfully remove the sorbed oil from these products, but the manufacturers did not advertise this as a selling point for their product. Only 19% of the researched sorbents were designed for reusability of the sorbed oil and were advertised as such.

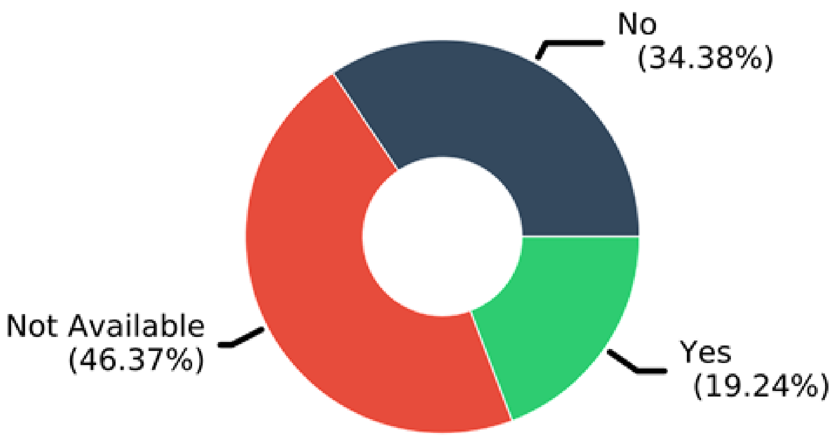

Figure 4-5. Product Search Distribution Based on Reusability of the Sorbed Oil

Most sorbents on the market are not designed for the release and reuse of the sorbed oil. This sorbent characteristic was, however, not available for a significant number of sorbents.

The breakdown of commercially available sorbents based on the reusability of the sorbent was also reviewed. Figure 4-6 displays the results of the sorbent breakdown based on this property. "No" indicates the sorbents cannot be reused, "yes" indicates the sorbents can be reused, and "not available" indicates that this property was unknown for the researched sorbent. Only 20% of the researched sorbents were marketed as reusable while over twice that amount was not marketed as reusable, accounting for 49% of the overall distribution. This property was, however, not available for about 31% of the researched sorbents. It is likely that the sorbents that did not have this information available were not designed for sorbent reusability, as this would most likely be promotionally advertised.

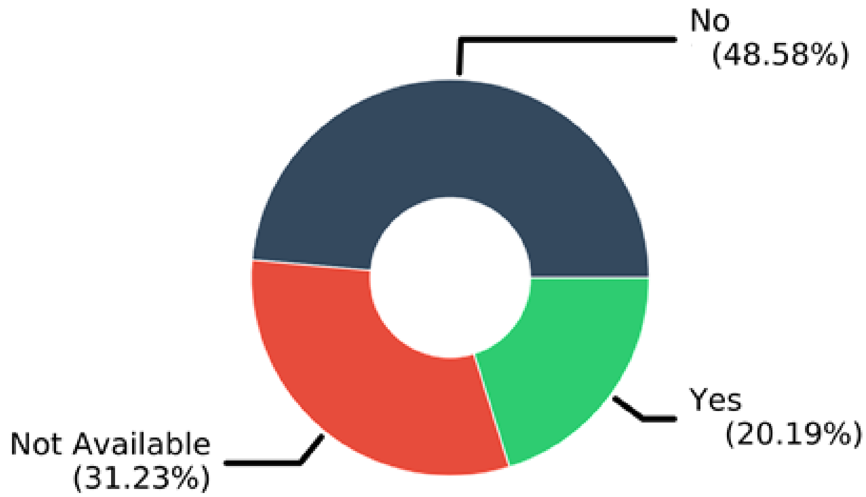

Figure 4-6. Product Search Distribution Based on Reusability of the Sorbent
The number of sorbents marketed as reusable was less than those marketed as single-use only. This property was, however, not available for around 31% of the sorbents reviewed.

Three recommended final disposal methods were found among the commercially available sorbents: incineration, biodegradation, and transfer to a solid waste landfill. Figure 4-7 depicts this distribution of disposal method amongst the different products studied. Incineration was the primary disposal method, noted for approximately 45% of the researched sorbents. Disposal by transferring the sorbents to a solid waste landfill was listed as the final disposal method for 16% of the sorbents. The environmentally friendly disposal method of biodegradation accounted for about 8% of the total distribution. The remaining 30% of the commercial sorbents did not provide a final disposal method. Many of the sorbents were noted as having multiple disposal methods, such as incineration and biodegradation, and these sorbents have been counted under both disposal method categories in Figure 4-7.

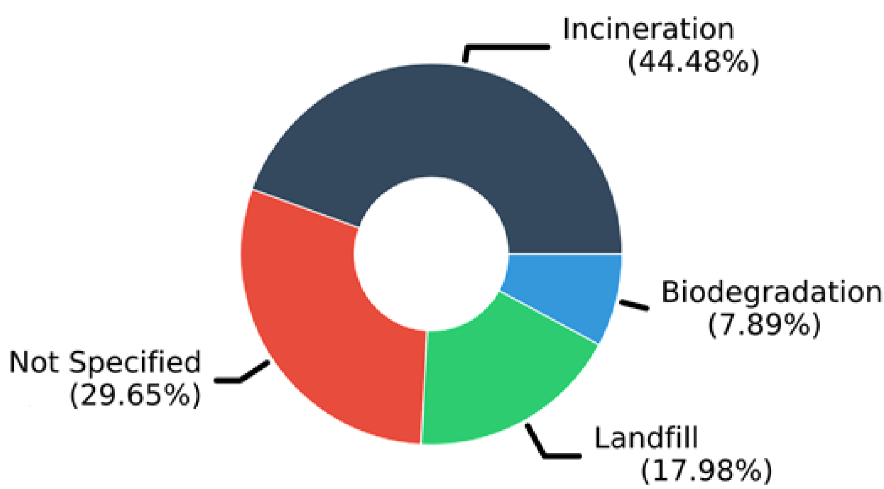

Figure 4-7. Product Search Distribution Based on Final Disposal Method
Disposal by incineration was noted as the most common disposal method for the commercial sorbents.

A cost comparison analysis was also performed utilizing the cost per gallon as a metric. The cost per gallon for each sorbent was calculated based on the cost and total volume of sorbed oil per unit of sorbent. Two box plots were created to compare the cost per gallon between different sorbent types and sorbent subtypes. These two box plots are displayed in Figure 4-8 and Figure 4-9. A box plot was selected to display the cost per gallon data to capture the variability and not simply the central tendency. A horizontal line inside of each box on the plot marks the median cost per gallon for each type or subtype. The colored region inside of each box displays the interquartile range of the data. The lower limit of this colored box is set by determining the middle value between the lowest cost per gallon and the median cost per gallon for each sorbent type and subtype. Similarly, the upper limit of the colored box is set by determining the middle value between the median cost per gallon and the highest cost per gallon for each data set. Consequently, the colored region represents the number of sorbents that were in the 25^{th} to 75^{th} percentile of the cost data distribution.

Two horizontal lines drawn outside of the colored region mark the maximum and minimum values for each data set. Before determining the minimum and maximum values, it was necessary to determine which sorbents should be considered outliers due to their deviation from the median cost value. First, the interquartile range was found by subtracting the lower limit of the colored box from the upper limit. The maximum acceptable value was determined by multiplying the interquartile range by 1.5 and adding that amount to the upper limit of the colored box. Similarly, the minimum acceptable value was determined by multiplying the interquartile range by 1.5 and subtracting that amount from the bottom limit of the colored box. Sorbents that had a cost per gallon within the minimum and maximum range were considered statistically significant and included in the analysis. Any sorbents that had a calculated cost per gallon above or below the minimum and maximum lines on the box plots were considered outliers and were removed from the plot. There were no outliers below the minimum acceptable value for any of the sorbents, so the minimum value shown on the box plots is the true minimum cost per gallon found. However, for all sorbent types except Type IV, there were sorbents for which the cost per gallon was above the maximum acceptable value. These sorbents have been removed from the plot as outliers, and the maximum horizontal line represents the calculated maximum acceptable value.

When comparing the cost per gallon for each sorbent subtype displayed in Figure 4-8, it can be seen that Type II sorbents had the lowest median cost while Type IV sorbents had the highest. Although Type II sorbents had a lower median cost per gallon than Type I sorbents, the price varied much more significantly than for Type I sorbents. Therefore, there are many Type I sorbent options that are cheaper than Type II alternatives. The median cost of Type IIIb sorbents was between $2 and $3 per gallon of sorbed oil while the median cost for Type IIIc and Type IIIa sorbents was between $3 and $5 per gallon of sorbed oil. Type IIIa sorbents had a larger price distribution than Type IIIc and Type IIIb options, demonstrating a wider range in product cost for enclosed pillows and socks. The median cost of Type IV sorbents was the highest compared to other sorbent types and was actually higher than the 75^{th} percentile mark for the other sorbent types. Additionally, the interquartile range was relatively low indicating pom poms and open netting are the most expensive sorbent type per gallon of sorbed oil.

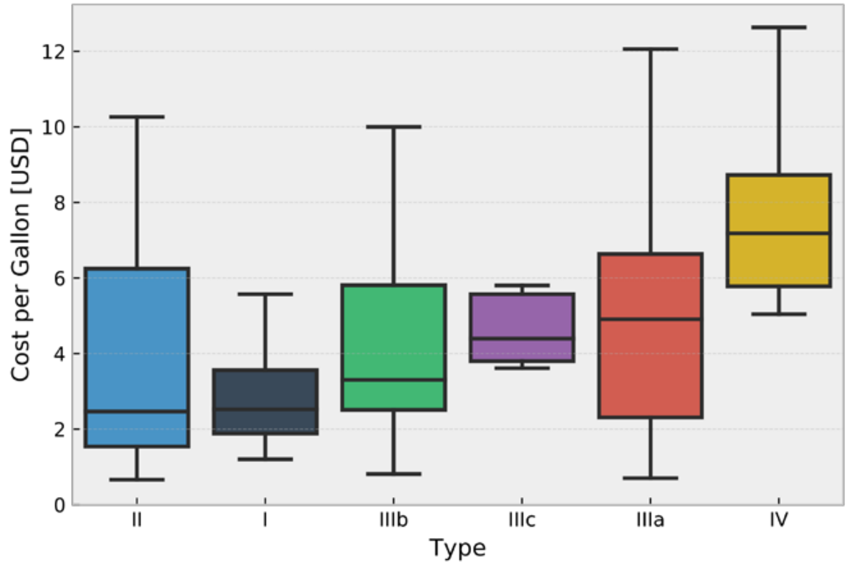

Figure 4-8. The Cost per Gallon of Sorbed Oil for Each Sorbent Type
Type IV sorbents were found to be the most expensive sorbent type.

The median price per gallon of sorbed oil for all the sorbent subtypes ranged from roughly \$2 per gallon to \$6 per gallon. Figure 4-9 displays the box plot showing the cost variation and median cost for each subtype. The subtypes are color-coded based on their sorbent type category, as captured by the legend to the left of the plot. The widest cost variation was seen for sorbent socks with an interquartile range from \$3 per gallon to \$9 per gallon. Relatively large cost variation was also seen for powders, pillows, and sweeps. The lowest cost variability was found for rolls with an interquartile range from about \$2 per gallon to \$3.50 per gallon. Similarly, pads and pom poms showed little variation in the cost according to the researched sorbents. Pom poms had the highest median cost per gallon at nearly \$6, while granular sorbents had the lowest at approximately \$2 per gallon.

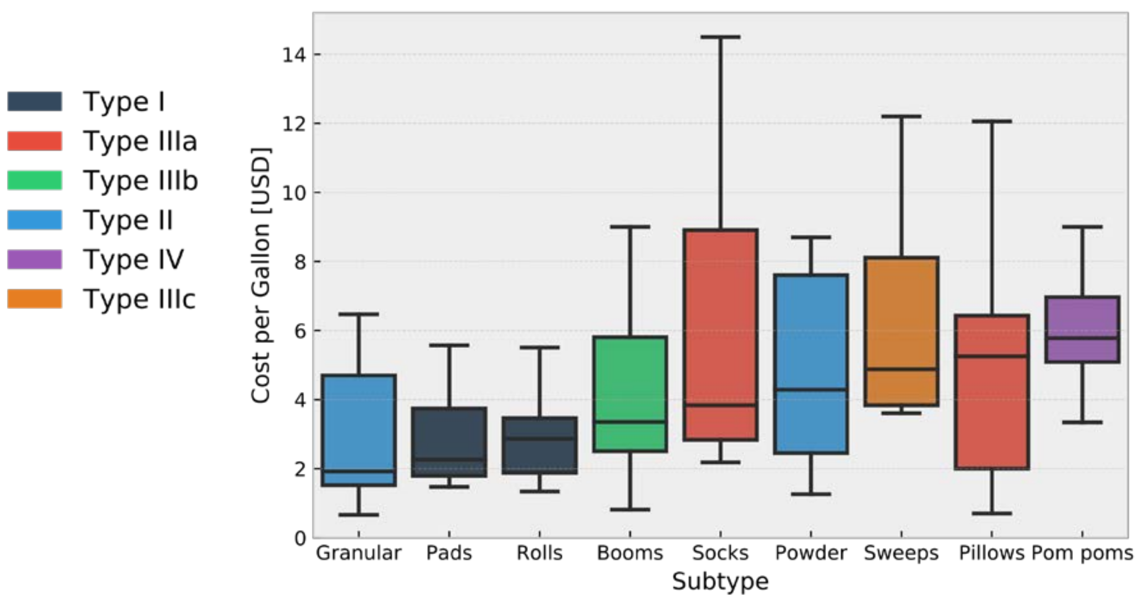

Figure 4-9. The Cost per Gallon of Sorbed Oil for Each Sorbent Subtype
Granular sorbents were found to be the least expensive sorbent subtype.

4.3 High-Level Findings from the Sorbent Product Review

The commercial sorbent product review resulted in property and cost information for a wide variety of sorbent technologies. Organizing the sorbents according to their properties aided in their comparison and promoted a thorough understanding of what is commonly available for current market purchase. The major findings of the commercial sorbent research effort are as follows:

- A large number and variety of sorbents are currently available for purchase. For this study, 317 different sorbents were reviewed.
- Many manufacturers participate in the oil sorbent market, with products from over seventy manufacturers included in the sorbent product table.
- Type I sorbents were the most common sorbent types, while Type IIIc and Type IV were the least common sorbent types commercially available.
- The most common sorbent subtype commercially available are pads, accounting for 22% of the commercially available sorbent products.
- A majority of sorbents are designed for cleaning oil spills on both land and water, having both hydrophobic and oleophilic properties.
- Natural sorbent materials are not as commonly manufactured as synthetic sorbents as polymers were the primary material component in 68% of the researched sorbents.
- Biodegradation was the least common disposal method, accounting for only 8% of the sorbents.
- Only approximately 20% of the commercially available sorbents advertised reusability of the sorbed oil as well as the reusability of the sorbent product.
- Type IV sorbents are the most expensive sorbent type per gallon of sorbed oil while Type II and Type I sorbents are generally the least expensive.
- Pom poms had a higher median cost per gallon than the other sorbent subtypes, with relatively low variability in the cost data. The lowest median cost per gallon was found for granular loose sorbents and pads.

5. LITERATURE REVIEW ON SORBENT RESEARCH AND DEVELOPMENT ACTIVITIES

The objective of the literature review was to compile relevant information on current sorbent research and development activities. Based on the compiled information from the literature review, new and promising types of sorbents that demonstrate the potential to improve oil spill response operations were assessed. The literature review technical approach, high-level findings, and the assessment of new and promising sorbents is described in detail in the following subsections.

5.1 Literature Review Technical Approach

The literature review task began with an initial search for publicly available information on the development of sorbents that are either commercially available or being advanced using standard, industrial, and technical literature databases. Additionally, references that were included in these papers were also used to find additional technical literature sources. An initial summary of each relevant document was compiled, where the pertinent information that was gathered from the reviewed literature included the following items listed in Table 5-1. The publication dates that were reviewed range from the year 1992 up to June 2020, with a majority of the publications spanning the past 10 years from 2010 to 2020.

Table 5-1. Literature Review Compilation

Pertinent information on sorbent research gathered from the literature review was compiled to assess the current research and development activities for sorbent technologies.

LITERATURE REVIEW ASSESSMENT
Sorbent description
Sorbent category
Material type
Cost data (if available)
Reusability
Surface or subsurface use
Market/Technology readiness level
Test data and methodology
Article reference and summary
Publication year
Publication location

5.2 Literature Review Findings

The high-level findings from the reviewed articles are provided in this subsection. A total of 358 documents were found to have pertinent information on sorbent research and development activities during the database literature search. Out of these 358 publications, a total of 175 documents were reviewed. The remaining documents were not reviewed for various reasons, which included: older publications by the same author(s) describing the same sorbent, publications of the same sorbent that were published by the same author(s) in different journals or conference proceedings, or the performance characterization of the same sorbent materials by different authors. The information collected from each article was organized and compiled in a Microsoft Excel document that is provided in Appendix C. This literature review summary file is also provided as a Microsoft Excel document separate from this report. Only one publication mentioned cost information for the sorbents they were developing. Cost was therefore not taken into consideration during the literature review assessment. Several charts were created to categorize the sorbents based on the assessment criteria outlined in Table 5-1. All charts that include both the sorbent assessment criteria in total percentages within pie charts are additionally referenced by their respective article publication year in a corresponding bar graph.

A graphical representation of the number of reviewed literature articles in relation to the research and development activities by country of origin is provided in Figure 5-1. As shown in Figure 5-1, a majority of the sorbent research and development activities are occurring in China, as the number of documents reviewed account for approximately 33% of the total publications. Both the United States and India followed China in the number of publications for sorbent research activities, accounting for around 8% and 7% of the total number of articles, respectively. Additionally, 31 different countries have published articles on sorbent research activities that are not included in Figure 5-1. These countries were not included in this graphic as the total publication contribution for their region was less than 1%.

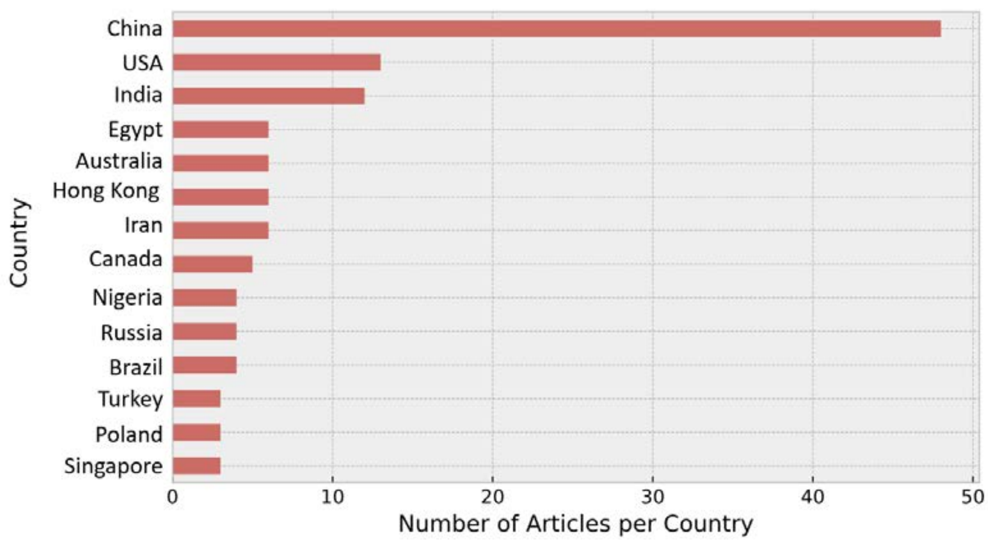

Figure 5-1. Publications by Country

Approximately 33% of the articles that were reviewed included sorbent research activities being conducted in China, followed by the United States at 8%, and India at 7%.

The number of articles reviewed in relation to sorbent type and article publication year is represented in Figure 5-2. As shown in Figure 5-2, approximately 64% of the sorbent research activities have focused on developing Type I sorbents. The development of Type II sorbents accounted for the second highest sorbent type that is being actively researched, comprising around 30% of the total publications reviewed. Research activities for Type II sorbents are also shown an increase starting in the year 2012 up to June 2020. Type III and Type IV sorbents are not being developed as actively compared to Type I and Type II sorbents, and account for approximately 6% of the publications reviewed. Of the articles reviewed, there is no observable trend in publication years for the active development of Type III and Type IV sorbents.

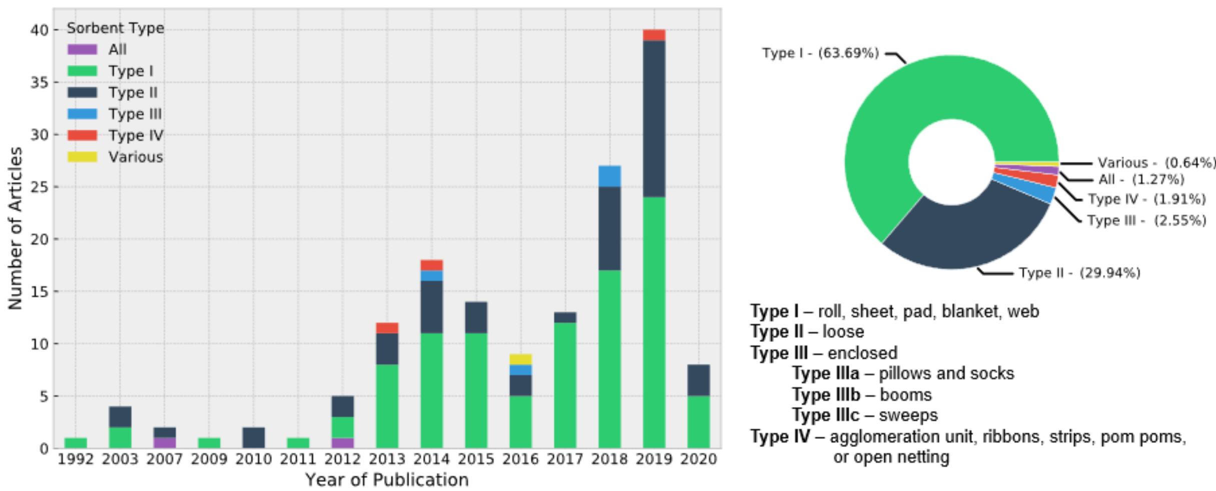

Figure 5-2. Publications by Sorbent Type

60% of the sorbent research activities have focused on developing Type I sorbents, with recent advancements in Type II sorbents starting in the year 2012.

The number of articles reviewed in relation to sorbent category and article publication year is depicted in Figure 5-3. As shown in Figure 5-3, approximately 70% of the sorbent research activities have focused on developing sorbents that are meant to be applied or used to recover oil spilled on water only. The development of sorbents for use on oil spilled on both land and water accounted for 26% of the research activities, while the percentage of sorbents that are solely meant for land use was 4%. Additionally, no observable trend was distinguishable between publication years for the active development of sorbents recommended for use on water, land, or a combination of both water and land.

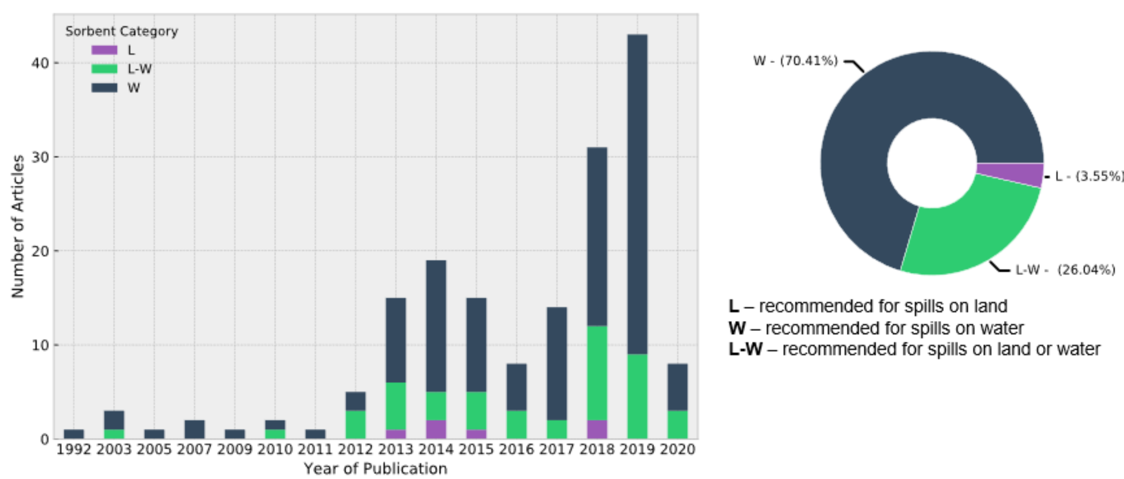

Figure 5-3. Publication by Sorbent Category

Approximately 70% of the sorbent research activities have been focused primarily on sorbents used to recover oil spilled on water.

A graphical representation of the number of reviewed literature articles in relation to their use in surface or subsurface applications as well as publication year is shown in Figure 5-4. As depicted in Figure 5-4, approximately 92% of the sorbent research activities have focused on developing sorbents that are meant to be used for surface applications. The development of sorbents for use on oil spilled on both surface and subsurface accounted for 7% of the research activities, while around 1% of sorbents are solely meant for subsurface use. Additionally, no observable trend was distinguishable between publication years for the active development of sorbents for surface, subsurface, or a combination of both surface and subsurface applications.

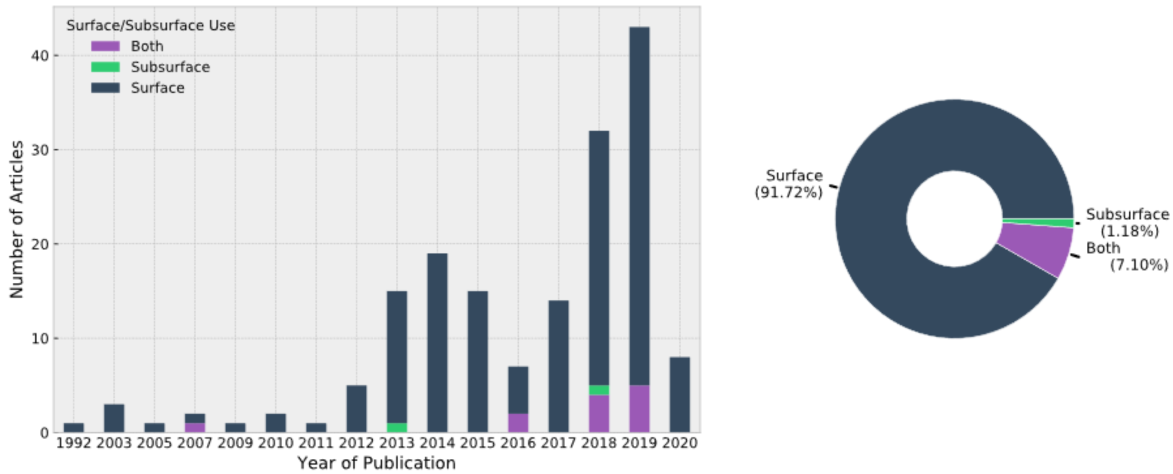

Figure 5-4. Publications by Surface or Subsurface Use

Approximately 92% of research efforts have been dedicated to the development of sorbents for surface applications.

The number of articles reviewed in relation to sorbent material type and article publication year is depicted in Figure 5-5. As shown in Figure 5-5, both natural and synthetic sorbent materials have been explored in great detail, accounting for 36% and 32% of the total number of reviewed publications. Additionally, advanced or hybrid sorbents have also been developed and is the focus of 28% of the research and development activities. Research activities for advanced sorbents is also shown to increase starting in the year 2017 through 2019. Mineral sorbents were shown to be the least researched material, accounting for 3% of the total development activities. No observable trend was distinguishable between publication years for the active development of mineral types of sorbents.

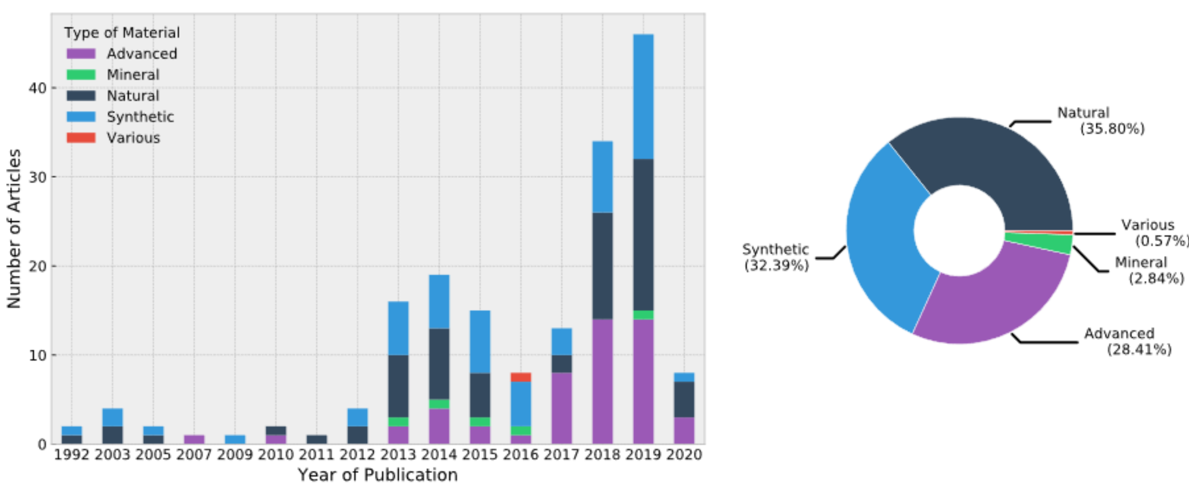

Figure 5-5. Publication by Material Type

The natural, synthetic, and advanced sorbent materials have been studied in great detail, accounting for approximately 36%, 32%, and 28% of the reviewed publications, respectively.

A graphical representation of the number of reviewed literature articles in relation to sorbents being single use or reusable as well as publication year is shown in Figure 5-6. As depicted in Figure 5-6, approximately 53% of the sorbent research activities have focused on developing reusable sorbents, while approximately 30% of the reviewed articles contained no information that indicated the sorbent was either single use or reusable. The development of sorbents for single-use-only constitutes around 17% of the total research activities. Since the year 2009, the development of reusable sorbents has been an actively stable research area up to June 2020.

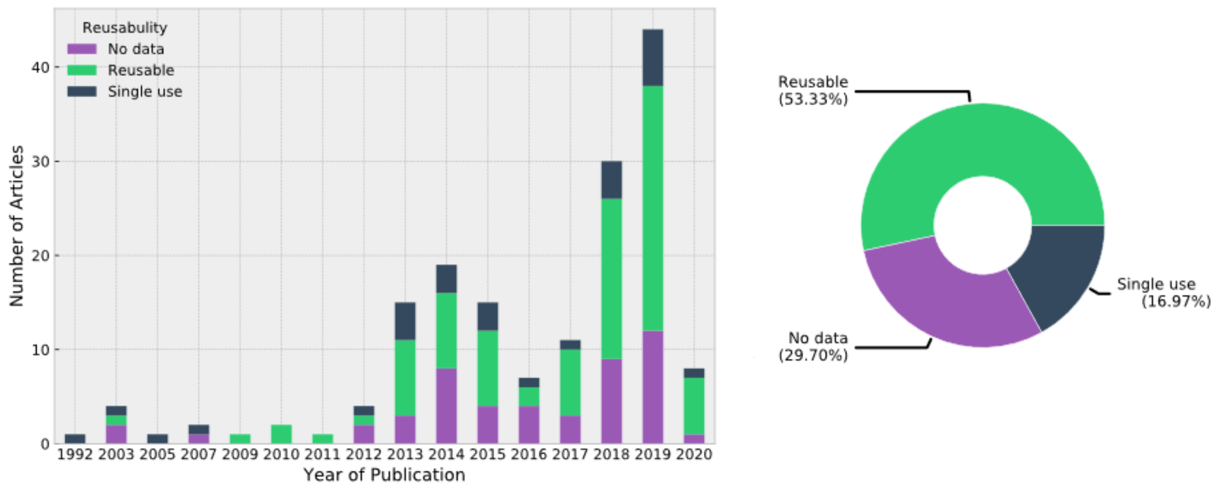

Figure 5-6. Publication by Reusability

Approximately 53% of the research efforts have been dedicated to developing reusable sorbents and has been an actively stable research area since 2009 up to June 2020.

The number of articles reviewed in relation to the developed sorbent market readiness and article publication year is depicted in Figure 5-8. The market readiness of a sorbent was determined using the technology readiness level (TRL) criteria outlined in Figure 5-7. The intent of the information provided in Figure 5-8 is to provide an assessment of the market readiness of the sorbent at the time of article publication. While the reviewed articles were the most recently dated publications from the authors describing their new technology, it is important to note that the potential sorbents described in each of these articles could not be developed any further or could have already reached higher TRL levels. If these potential new sorbents have been further developed, their assessment has not been specified in publicly available literature nor is currently available for purchase, as the market-ready product would have been captured during the commercial sorbent assessment as described in Section 4.

As shown in Figure 5-8, around 75% of the sorbents investigated in the literature were considered a TRL 3, indicating these devices went through small-scale testing efforts to establish their proof of concept. TRL 4 sorbents were approximately 16% of the total number of reviewed publications, indicating material prototype was developed and tested. TRL 2, TRL 5, TRL 6, TRL 9, and current commercially available sorbents accounted for the remaining percentage of articles reviewed, with a combined total of 9%. Additionally, no observable trend was distinguishable between publication years for the active development of different TRL sorbents.

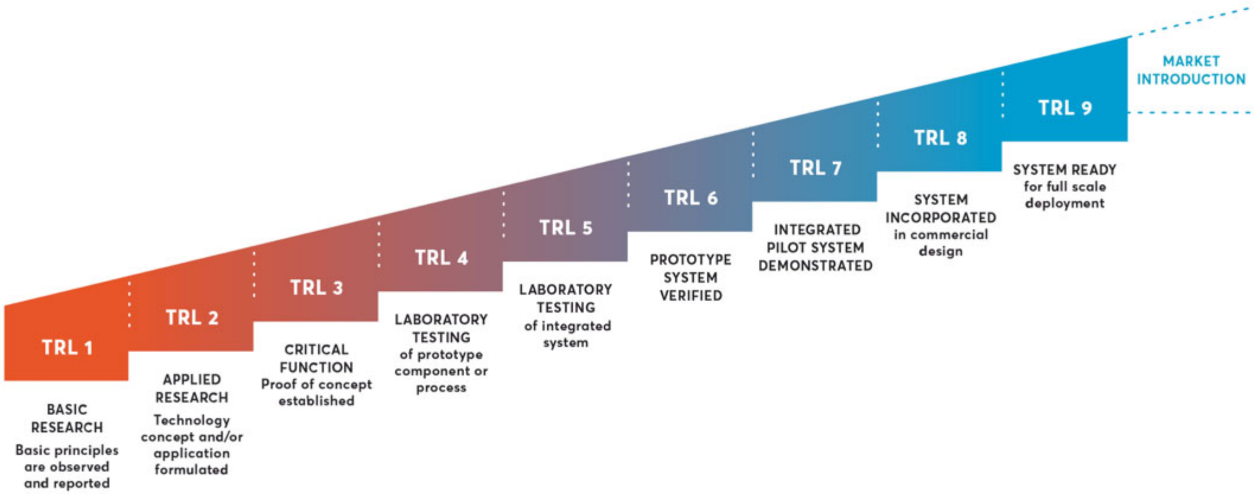

Figure 5-7. Market Readiness Levels (CIW, 2017)

The market readiness of a sorbent was evaluated using nine TRLs performance criteria, each level having discrete descriptions of steps taken for a technology to reach market readiness.

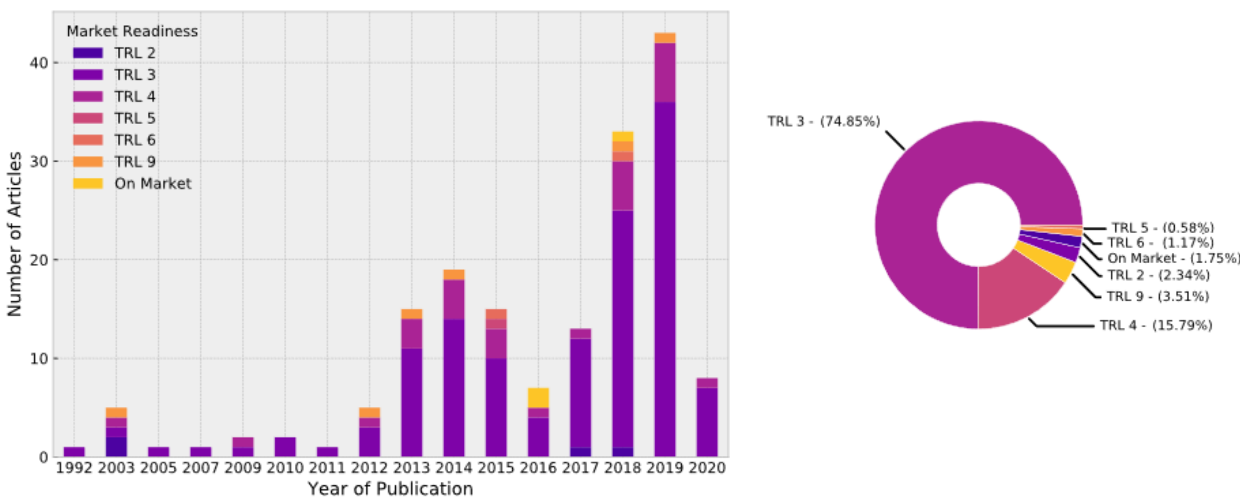

Figure 5-8. Publication by Market Readiness

Approximately 75% of the research activities involved proof of concept testing for TRL 3 sorbents, while approximately 16% involved prototype testing for TRL 4 sorbents.

5.3 Assessment of New and Promising Sorbents

Based on the information on current uses and future needs of sorbents obtained during the OSRO interviews in Section 3 and the review of commercially available products in Section 4, an assessment on the content provided in the literature review was conducted to select new sorbents that have potential to improve oil spill cleanup operations. The intent of this assessment is not to provide a ranking of sorbents, but to highlight innovative sorbent technologies that have characteristics that are beyond the current state of the art. This compiled information can then be used to assess which new sorbents are worth pursuing in future testing endeavors.

The criteria used for this assessment included:

- Unique product characteristics
- Sorption rate
- Oil retention
- Sorption capacity
- Material type
- Ease of manufacturing
- Ease of scaling to field ready products
- Ease of application
- Ease of recovery after use
- Ease of reusability

The new and innovated sorbents that were selected during this assessment are provided in Table 5-2. Thirteen sorbents were found to have characteristics that are beyond the current state of the art in sorbent technologies. All chosen sorbents have a market readiness level of either TRL 3 or TRL 4, but are comprised of different sorbent types and material types. Table 5-2 provides the sorbent type, material type, market readiness level, and the reason for selection for these thirteen innovative sorbents.

Table 5-2. Selected New and Innovative Sorbents

Based on the literature review, 13 sorbents were selected as being innovative beyond the current state of the art in sorbent technologies.

SORBENT	- SORBENT TYPE - MATERIAL TYPE - MARKET READINESS	REASON FOR SELECTION
Superhydrophobic graphene aerogel (Wang et al., 2019b)	Type I Hybrid/Advanced TRL 4	The material graphene was popular among the reviewed articles. The sorbent has very high sorption capacity at 110 to 230 times its own weight. This product has the classification of being superhydrophobic with no detectable water found in the aerogel during testing. This sorbent is also considered reusable.
Graphene oxide foam (He et al., 2013)	Type I Hybrid/Advanced TRL 3	This sorbent has a high sorption capacity up to 124 times its own weight, which is a much greater sorption capacity than commercially available sorbents. This sorbent's effectiveness was also tested using higher viscosity oils. This sorbent is unique based on its reusability, where the oil can be burned off the sorbent. Once the oil has burned off, the sorbent reverts to its initial state and can be reused to recover more oil.
Graphene wrapped sponge with Joule-heating (Ge et al., 2017, Zhao et al., 2017)	Type I Hybrid/Advanced TRL 3	This concept uses active in-situ heating to decrease the oil viscosity, coupled with an integrated pump to increase the rate of absorption. Electricity is applied to the sorbent sponge that has conductive coating to generate heat. This heat reduces the oil viscosity and thereby speeding up sorption uptake by 95%.
Melamine-formaldehyde (MF) sponge with reduced graphene oxide (Wang et al., 2019)	Type I Hybrid/Advanced TRL 4	The dip coating of the sponge with graphene oxide significantly reduces oil absorption time (approximately 50% with sunlight and 75% without sunlight) and is applicable for both land and water use. The dip coating of the sorbent sponge improves the light-to-heat conversion capability, so solar energy locally heats up the oil, which lowers the oil viscosity and improves sorption uptake. This is similar to the Joule-heating sponge except with the use of solar energy. The sorption capacity was also high at 70 times its own weight when tested with lighter oils. The sorbent is also reported as being reusable up to 10 cycles with no absorption loss.

SORBENT	- SORBENT TYPE - MATERIAL TYPE - MARKET READINESS	REASON FOR SELECTION
Cellulose fiber aerogel (Liu et al., 2018)	Type I Hybrid/Advanced TRL 4	This sorbent has superhydrophobic properties capable of filtering out hydrocarbons when an oil/water mixture is poured over the material. The sorption capacity of this sorbent is very high at 90 to 188 times its own weight. The material is low in cost to produce from sisal, is ultralight weight for buoyancy, and is highly recyclable. It is derived from natural materials and is environmentally friendly.
Polyurethane sponge (Kong et al., 2017)	Type I Synthetic TRL 3	Polyurethane is a common material for many of the reviewed articles. This new polyurethane sponge was generated with in-situ polymerization and has a higher sorption capacity than polypropylene, which is the most common sorbent material used. It has a sorption capacity of 700 times its own weight and fast saturation time of approximately 10 seconds. This particular sponge was found to maintain its sorption capacity after 200 cycles while maintaining 99.99% separation efficiency without decrease in overall capacity.
Cotton-cellulose aerogel (Bidgoli et al., 2019)	Type I Natural TRL 3	Cotton is very common among the natural sorbents reviewed in the articles. Cotton seems to have higher sorption capacity than the other natural options at 72.3 times its own weight. A downside of natural sorbents is their oil/water selectivity, but this sorbent has been chemically manipulated to increase hydrophobic properties. The materials are natural and made from recycled waste paper, so it is a cost-effective and an environmentally friendly option.
Hollow carbonized cotton fibers (Wang et al., 2013)	Type I Natural TRL 4	This sorbent has a high sorption capacity, 32 to 77 times its own weight, and is reusable by squeezing while maintaining 91% of the original sorption capacity after five cycles. This sorbent shows oleophilic and hydrophobic properties based on contact angle measurements, an improvement over many raw natural sorbents. Although the sorption capacity is lower than carbon nanotube sponges, the fabrication is cheaper and easier.
Kapok fiber in superhydrophobic fabric bag (Wang et al., 2018)	Type III Advanced/Hybrid TRL 3	Oleophilic-hydrophobic kapok fiber was packed in a superhydrophobic fabric bag. The fabric repels water and the kapok fiber sorbs the oils. This sorbent also shows high efficiency with sorbing higher viscosity oils as well as oil-in-water emulsions, which are separated with an efficiency of 99%. This sorbent shows a sorption capacity that is 20 to 50 times its own weight for six different oils and is reusable with a sorption capacity loss of only 7% after 12 uses.
Poplar Seed Fiber (Xu et al., 2019)	Type I Natural TRL 3	This sorbent uses raw natural fiber, which would be very cost-effective to produce and simple to synthesize. The oil can be released from the sorbent by squeezing and then be reused and can also be used for both land and water applications. This sorbent has a high oil sorption capacity of 68 times its own weight, noted as being higher than kapok and cotton fibers.
3D magnetic graphene balls (Tao et al., 2019)	Type II Advanced/Hybrid TRL 3	This sorbent has the same material advantages as other graphene based sorbents, but has the added benefit of being magnetic, which can aid in the application, use, and easy collection of sorbents. The sorption capacity is very high at 108 to 141times its own weight. Can be reusable showing 79% of the original capacity after 10 cycles.

SORBENT	- SORBENT TYPE - MATERIAL TYPE - MARKET READINESS	REASON FOR SELECTION
Rubber aerogel from recycled car tires (Thai et al., 2019)	Type I Synthetic TRL 3	Recycled car tire fibers were converted into a rubber aerogel using a cost effective freeze-drying method. The coated aerogel exhibits superhydrophobicity. The maximum oil absorption capacity of the rubber aerogel is up to 19.3 times its own weight, which is competitive with some commercial sorbent products. A blanket configuration of this material can also be generated and scaled to larger sorbent sizes.
Recycled polyethylene terephthalate aerogels (Le et al., 2020)	Type I Advanced/Hybrid TRL 4	This sorbent is created from recycled plastic bottles and can therefore also be recycled. The sorbent shows a higher sorption capacity, 46 to 80 times its weight, than polypropylene and cellulose aerogel, and it also has a three times faster sorption rate than cellulose aerogels. The sorption capacity is lower than carbon nanotubes or graphene aerogels, but the fabrication process is easier and cheaper than those sorbent materials.

5.4 High-Level Findings from the Literature Review

The literature review resulted in synthesizing information on past and current research and development activities for sorbent technologies. The major findings of the literature review are as follows:

- A large number of articles were found describing a variety of research activities for developing new sorbents. For this study, 175 different sorbent articles were reviewed.
- A majority of the sorbent research and development activities are occurring in China, as the number of documents reviewed accounted for 33% of the total reviewed publications.
- Type I sorbents were the most common sorbent type being developed, followed by Type II sorbents. The further development of Type III and Type IV sorbents is not as actively pursued as other sorbent types.
- The majority of the sorbents that are currently being researched and developed are meant to be used to recover oil spilled on water only.
- Approximately 92% of the sorbent research activities have focused on developing sorbents for surface applications, with the remaining percentage being focused on sorbents used in either a combination of surface and subsurface applications, or subsurface only.
- Approximately 53% of the reviewed research activities have focused on developing reusable sorbents, while the remaining percentage of articles were focused on single use only sorbents or did not specify the reusability of the sorbent technology.
- A large majority of market readiness of the developed sorbents found in the literature review assessment were at TRL 3, while 16% of the reviewed articles developed prototype sorbents reaching TRL 4.
- Thirteen sorbents were found to have characteristics that are beyond the current state of the art in sorbent technologies. These innovated sorbents were selected based on developed assessment criteria.

6. SUMMARY

To evaluate the current state of the art of sorbents technologies, a comprehensive sorbent technology assessment was conducted by reviewing best practices and current uses of sorbents in the field, evaluating commercially available products, and investigating current sorbent research activities. This assessment was accomplished through interviews with offshore operators and OSROs, a sorbent product compilation from manufacturers, and a literature review on sorbent research and development activities. The synthesized information provides a basis for current sorbent capabilities and development activities, which can be used to select new and innovative sorbents for future testing programs.

The findings from this study indicate that sorbents are used in nearly every oil spill, where current sorbent designs meet a majority of the response industry's needs. The procurement of sorbents is also based on general field experience and industry best practices. While a majority of sorbent technologies are designed to effectively retrieve oil, their performance is dependent on the state of the oil, as weathered oil, high viscosity oil, and oil in thin layers spilled on water is more difficult to recover.

Type I sorbents are the most common type of sorbent products commercially available and are relatively low in cost. The most common product subtype out of the Type I sorbents currently available on the market are pads. Additionally, this sorbent type has been the primary focus of research and development activities. Type IV sorbents are the most expensive sorbents available on the market and are also the sorbent type being least actively developed.

A majority of the sorbents that are commercially available are designed to recover oil spilled on either land or water, while research and development activities have mainly focused on developing new sorbents that are meant for oil spilled on water only. Additionally, these research and development activities have been highly focused on sorbents intended for surface applications rather than subsurface applications.

One-fifth of the sorbent products that are commercially available are marketed as being reusable. Although there are reusable sorbents available, these sorbents are not actively being used by response entities as their lifecycle is costly, they are difficult to deploy, and tend to reintroduce oil back into the environment. While response entities are not utilizing reusable sorbents, over half of the research activities have been focused on developing new sorbents that are reusable.

While survey responses have indicated an interest in the use of natural sorbent materials, a low percentage of sorbents found on the market are comprised of natural materials, as the majority of sorbents primarily consist of synthetic materials such as polymers. The most common sorbents used in the field by response entities are made from synthetic materials. Additionally, synthetic sorbents account for the most common material type currently available for purchase.

Sorbents are typically stored in containers or in facilities that preserve their integrity. After their use, sorbents are disposed as prescribed in a regional spill response plan or as directed by state regulations. Manufacturers of sorbents provide guidance on disposal methods, a majority of which recommend landfill or incineration. Biodegradation is the least common disposal method, as only a low percentage of natural sorbents are commercially available or in use.

A radar graph summarizing the overall findings of this project, as described above, is shown in Figure 6-1. Figure 6-1 is a graphical representation of the sorbent assessment, where each assessment category is located on one of the five axes that makes up the graph, which includes Type I, reusability, water and land use, disposal by landfill, and natural materials. The overall size of the lines that connect each category is proportional to the magnitude of each category relative to the maximum magnitude of the category across all data points. For example, the outermost line is equivalent to a value of 1, indicating all of the sorbents fit into the defined category. These values incrementally decrease towards the center of the graph, where a value of zero is defined in the center, indicating that none of the sorbents fall into this category. The placement of each data point was determined based on the findings from each project task. This graphic shows each category's area of focus, showing both the overlap and outliers between common sorbent uses, current available products, and sorbent development activities.

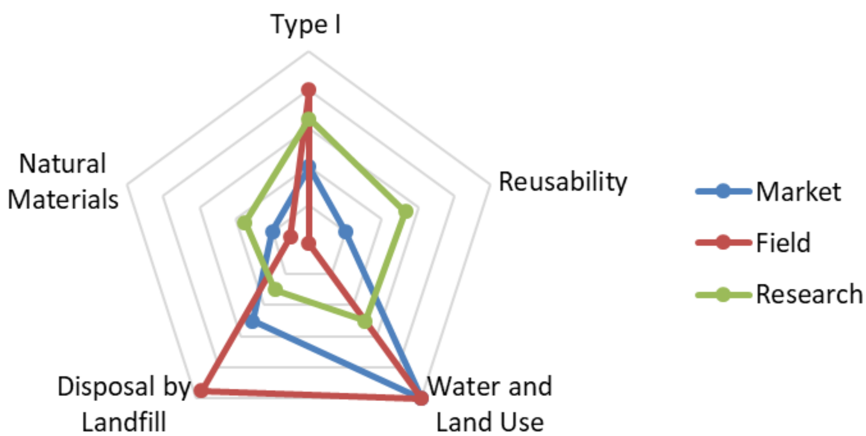

Figure 6-1. Project Findings from Sorbent Assessment

The primary focus of each category shows both the overlap and outliers between common sorbent use in the field, current products available on the market, and research and development activities.

7. RECOMMENDATIONS

While current commercially available sorbents meet most of the industry's needs, the response entities provided recommendations for enhancements to sorbent technologies that would improve oil spill cleanup activities. These recommendations include the following:

- Defining a global standard for effectiveness
- Higher sorbent performance in water-based applications
- Increasing the range of oil types that can be sorbed by sorbents
- Sorbents that offer faster sorption rates
- Materials that can attract oil to the sorbent
- Use of natural materials that can be left to degrade in-situ
- Minimize waste generation

Based on these suggested improvements from the response entities and current research and development activities found during the literature review, 13 sorbents were found to have characteristics that meet these enhancement needs and are beyond the current state of the art in sorbent technologies. A majority of these new sorbents have characteristics that include:

- Advanced materials for better sorption performance
- Use of enhanced natural and recycled materials
- Products that are easy to reuse
- Products that are easy to deploy and retrieve

While these sorbents have shown promise to aid in oil spill response operations, there market readiness is at a TRL 3 or TRL 4 and would require more development to generate a market-ready product. This compiled information on these innovative sorbents can be used to assess which new sorbents are worth pursuing further for future testing endeavors.

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APPENDIX A

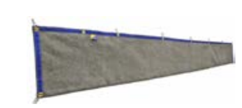
Survey Questions

OSRO Survey Questions

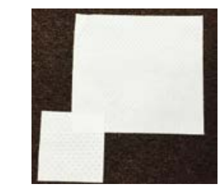
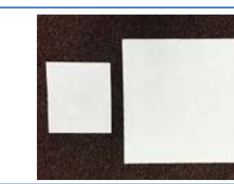
1. In what region(s) do you primarily respond to oil spills (e.g., GOM, Pacific, Alaskan; if multiple regions please specify)?
2. What locations do you typically respond to (e.g., offshore, nearshore, shoreline; if multiple locations please specify)?
3. How many oil spills do you respond to in a typical year?
4. Of these responses, approximately how often do you use sorbents?
5. What sorbents do you typically stock? (Please specify materials such as polypropylene, natural materials, etc. and types such as roll, pad, loose, sorbent boom, etc. Specific manufacturer or distributor, and part numbers would be very helpful, if available.)
6. How do you decide which sorbents to stock? If you respond to multiple regions, do you consider different types of sorbents to stock for each region?
7. Do you use any reusable sorbents? If so, which ones? If not, tell us why you don’t use them?
8. How do you dispose of the sorbent once used?
9. Do your sorbents come with manufacturer guidelines for storage, and/or shelf life information?
10. In what conditions do you store your sorbents (controlled environment, temperature range, in sealed containers, open containers, etc.)?
11. Do you replace your unused sorbents at any predefined intervals?
12. Do you have any operating procedures, guidelines, or best practices for how to use sorbents for spill cleanup? If so, can you provide documentation and/or summarize them for this survey? (Do you look for how they have been tested? Do you look at historical cases/uses? Do you consider spill location etc.?)
13. Have there been scenarios or conditions where oil retrieval is difficult using certain types of sorbents? If so, please elaborate using the space below.
14. What gaps do you see in the existing sorbent technologies? What features are not currently being integrated into the technologies that would make spill cleanup activities more effective?
15. Have you considered or used other technologies to replace sorbents (e.g., small skimmers)?

APPENDIX B

Sorbent Product Table

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
1	Eco-Tec Inc.	http://www.eco-tec-inc.com/Products/Wipes.html	Adsorb-it Wipes	I	Wipes	L-W	Recycled fibers	Needle-woven	10.74x its weight (motor oil)	ASTM F726-81	Yes	Yes	Yes	15" x 15"	
2	Eco-Tec Inc.	http://www.eco-tec-inc.com/Products/Mini-Surfer.html	Adsorb-it Mini-Surfer	IIIa	Socks	W	Recycled fibers	Needle-woven	10.74x its weight (motor oil)	ASTM F726-81	Yes	Yes	Yes	24" long x 15" high, 6" skirt	
3	Eco-Tec Inc.	http://www.eco-tec-inc.com/Products/BoomCover.html	Adsorb-it Boom Cover	IIIb	Booms	W	Recycled fibers	Needle-woven	10.74x its weight (motor oil)	ASTM F726-81	Yes	Yes	Yes	6" in diameter x 10' long	
4	Eco-Tec Inc.	http://www.eco-tec-inc.com/Products/Adsorb-itRolls.html	Adsorb-it Filtration Fabric	I	Rolls	L	Recycled fibers	Needle-woven	20x its weight	ASTM F726-81	Yes	Yes	Yes	250' x 2' or 250' x 5'	
5	Eco-Tec Inc.	http://www.eco-tec-inc.com/Products/ShoreGuard.html	Shore Guard Dumbo Surfer	IIIb	Booms	W	Recycled fibers	Needle-woven	10.74x its weight (motor oil)	ASTM F726-81	Yes	Yes	Yes	5" diameter x 10' long, 4-5" ears	
6	Eco-Tec Inc.	http://www.eco-tec-inc.com/Products/FilterSock.html	Filter Sock	IIIa	Socks	L	Recycled fibers	Needle-woven	10.74x its weight (motor oil)	ASTM F726-81	Yes	Yes	Yes	3" diameter x 30 " long, 5" diameter x 57" long, 8" diameter x 5' long, or 8" diameter x 10' long	
7	Eco-Tec Inc.	http://www.eco-tec-inc.com/Products/Centipede.html	Centipede	IIIb	Booms	L-W	Recycled fibers	Needle-woven	10.74x its weight (motor oil)	ASTM F726-81	Yes	Yes	Yes	3" diameter x 5' flotation boom, 9" legs	
8	Eco-Tec Inc.	https://eco-tec-inc.com/hula-bug/	Hula Bug	IIIb	Booms	L	Recycled fibers	Needle-woven	10.74x its weight (motor oil)	ASTM F726-81	Yes	Yes	Yes	5' long x 19" deep, with a 3" diameter boom	
9	Eco-Tec Inc.	http://www.eco-tec-inc.com/Products/FilterBoom.html	Filter Boom	IIIb	Booms	L-W	Recycled fibers	Needle-woven	10.74x its weight (motor oil)	ASTM F726-81	Yes	Yes	Yes	10' long x 21" height, with a 5" diameter boom	
10	Eco-Tec Inc.	http://www.eco-tec-inc.com/Products/BoomCurtain/	Boom & Dock Curtain	IV	Curtain	W	Recycled fibers	Needle-woven	10.74x its weight (motor oil)	ASTM F726-81	Yes	Yes	Yes	10' long x 15" height	

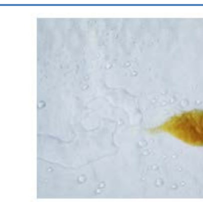
No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
11	Eco-Tec Inc.	http://www.eco-tec-inc.com/Products/ContourBoom.html	Contour Ditch Boom	IIIb	Booms	L	Recycled fibers	Needle-woven	10.74x its weight (motor oil)	ASTM F726-81	Yes	Yes	Yes	5' long x 24" curtain, 3" diameter boom	
12	Eco-Tec Inc.	http://www.eco-tec-inc.com/Products/OilSweep.html	Oil Sweep	I	Pads	L	Recycled fibers	Needle-woven	10.74x its weight (motor oil)	ASTM F726-81	Yes	Yes	Yes	12"W x 30"L	
13	Ultratech	https://www.spillcontainment.com/products/oil-blankets/	Ultra-X-Tex Blankets	I	Blankets	L-W	Recycled fibers (synthetic)	Needle-woven	20.4x its weight (motor oil), 3.9 gal per blanket	ASTM F726-81	Yes (85 to 95%)	Yes	Yes	10' x 5'	
14	Ultratech	https://www.spillcontainment.com/products/oil-filter-Boom/	Ultra-Oil Filter Boom	IIIb	Booms	W	Recycled fibers (synthetic)	Needle-woven	20.4x its weight (motor oil), 5 gal per boom	ASTM F726-81	Yes (85 to 95%)	Yes	Yes	6' long x 5' diameter	
15	Ultratech	https://www.spillcontainment.com/products/oil-filter-Boom-skirted/	Ultra-Oil Filter Skirted Boom	IIIb	Booms	W	Recycled fibers (synthetic)	Needle-woven	20.4x its weight (motor oil), 11 gal per skirt	ASTM F726-81	Yes (85 to 95%)	Yes	Yes	13' long x skirts 34" or 94" (with extension skirt)	
16	Ultratech	https://www.spillcontainment.com/products/spill-fence/	Ultra-Spill Fence	III	Barrier	W	Recycled fibers (synthetic)	Needle-woven	20.4x its weight (motor oil), 7.5 gal	ASTM F726-81	Yes (85 to 95%)	Yes	Yes	16' x 6'	
17	Complete Environmental Products, Inc.	http://www.cepsorbents.com/p100?ReturnUrl=LwBtAGUAbAB0AGIAbABvAHcAbgAtAHAAYQBkAHMA	P100 (heavyweight), EP100 (medium weight), B200 (single weight)	I	Pads	L	Polypropylene	Meltblown	Heavyweight: 24gal per 100 pads Medium weight: 19gal per 100 pads 12.5gal per 100 pads	Not specified	No	No	No	15" x 17"	
18	Complete Environmental Products, Inc.	http://www.cepsorbents.com/p100?ReturnUrl=LwBtAGUAbAB0AGIAbABvAHcAbgAtAHAAYQBkAHMA	P50 (heavy weight), EP50 (medium weight)	I	Pads	L	Polypropylene	Meltblown	Heavyweight: 44 gal per case Medium weight: 39 gal per case	Not specified	No	No	No	P50 - 30" x 30", EP50 - 30" x 34"	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
19	Complete Environmental Products, Inc.	http://www.cepsorbents.com/bonded-pads	Meltblown Pads BP100 (heavyweight), BEP100 (medium weight), BP200 (single weight)	I	Pads	L	Polypropylene	Sonic bonding	Heavyweight: 24gal per 100 pads Medium weight: 19gal per 100 pads 12.5gal per 100 pads	Not specified	No	No	No	15" x 17"	
20	Complete Environmental Products, Inc.	http://www.cepsorbents.com/bonded-pads	Bonded Pads BP50 (heavy weight), BEP50 (medium weight)	I	Pads	L	Polypropylene	Sonic bonding	Heavyweight: 44 gal per case Medium weight: 39 gal per case	Not specified	No	No	No	30" x 30"	
21	Complete Environmental Products, Inc.	http://www.cepsorbents.com/anti-static-pads	Anti-static Pad P100-ASTAT (heavy weight)	I	Pads	L	Polypropylene	Sonic bonding	24 gal per 100 pads	Not specified	No	No	No	15" x 17"	
22	Complete Environmental Products, Inc.	http://www.cepsorbents.com/anti-static-pads	Anti-static Pad P50-25ASTAT	I	Pads	L	Polypropylene	Sonic bonding	21 gal per 25 pads	Not specified	No	No	No	30" x 30"	
23	Complete Environmental Products, Inc.	http://www.cepsorbents.com/anti-static-pads	Anti-static Pad P50-ASTAT	I	Pads	L	Polypropylene	Sonic bonding	54 gal per 50 pads	Not specified	No	No	No	30" x 30"	
24	Complete Environmental Products, Inc.	http://www.cepsorbents.com/r144	Meltblown Rolls R144 and SR144 heavy weight	I	Rolls	L-W	Polypropylene	Meltblown	50 gal per case	Not specified	No	No	No	15" x 150' - SR144; 30" x 150' - R144	
25	Complete Environmental Products, Inc.	http://www.cepsorbents.com/r144	Meltblown Rolls ER144 and ESR144 Med weight	I	Rolls	L-W	Polypropylene	Meltblown	39 gal per case	Not specified	No	No	No	15" x 150' - ESR144; 30" x 150' - ER144	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
26	Complete Environmental Products, Inc.	http://www.cepsorbents.com/r144	Meltblown Rolls LR144 and SLR144 Economy weight	I	Rolls	L-W	Polypropylene	Meltblown	30 gal per case	Not specified	No	No	No	15" x 150' - SLR144; 30" x 150' - LR144	
27	Complete Environmental Products, Inc.	http://www.cepsorbents.com/r144	Bonded Rolls BR144 and BSR144 Heavy weight	I	Rolls	L-W	Polypropylene	Sonic bonding	50 gal per case	Not specified	No	No	No	15" x 150' - BSR144; 30" x 150' - BR144	
28	Complete Environmental Products, Inc.	http://www.cepsorbents.com/r144	Bonded Rolls BER144 and BESR144 Med weight	I	Rolls	L-W	Polypropylene	Sonic bonding	39 gal per case	Not specified	No	No	No	15" x 150' - BESR144; 30" x 150' - BER144	
29	Complete Environmental Products, Inc.	http://www.cepsorbents.com/anti-static-rolls	Anti-static Rolls R144-ASTAT	I	Rolls	L-W	Polypropylene	Sonic bonding	54 gal per roll	Not specified	No	No	No	30" x 150'	
30	U.S. Wiping Company	https://uswiping.com/airlaid-absorbent-pads-oil-absorbent-rolls.aspx	Heavyweight Airlaid Oil Absorbent Rolls	I	Rolls	L	Polypropylene	Airlaid woven material	Heavyweight: 49.8 gal/box 39.5 gal/box	Not specified	No	No	No	(1) 30x150" Roll Or (2) 15x150" Roll	
31	U.S. Wiping Company	https://uswiping.com/blue-heavyweight-oil-absorbent-rolls.aspx	Fine Fiber Heavyweight Oil Absorbent Rolls	I	Rolls	L	Polypropylene	Airlaid woven material	49.8 gal per roll	Not specified	No	No	No	30" x 150"	
32	U.S. Wiping Company	https://uswiping.com/white-oil-only-pads-fine-fiber.aspx	White Fine Fiber Oil Absorbent Pads	I	Pads	L	Polypropylene	Airlaid woven material	28.1 gallons per package	Not specified	No	No	No	15"x19"	
33	U.S. Wiping Company	https://uswiping.com/blue-oil-only-absorbent-pads-fine-fiber.aspx	Fine Fiber Oil Only Absorbent Pads	I	Pads	L	Polypropylene	Airlaid woven material	28.1 gallons per package	Not specified	No	No	No	15"x19"	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
34	Towelie	https://towelieglobal.com/	Towelie	I	Pads	L-W	Cotton	Not available	10.33x its weight	Not specified	Not available	Not available	Not available	15" x 19"	
35	Andax Industries	https://www.andax.com/19--x-100--oil-selective-sorbent-sweep-details.aspx	Andax Absorbent Sweep	IIIc	Sweep	W	Polypropylene	Meltblown	25 gallons per sweep	Lab testing by manufacturer	No	No	No	19" x 100' x 3/8"	
36	Brady	https://www.bradyid.com/category/sweeps-and-nets/202298948	SPC Marine Absorbent Sweep	IIIc	Sweep	W	Polypropylene	Not available	25 gallons per sweep	Lab based testing	No	No	no	19" x 100'	
37	Brady	https://www.bradyid.com/category/oil-only-absorbent-pads-and-rolls/200050003	Oil Absorbent Pad	I	Pads	L-W	Polypropylene	Meltblown	18 gl/gs	Lab based testing	No	No	No	Multiple	
38	Brady	https://www.bradyid.com/en-us/product/spc10	SPC Marine Absorbent Pillow	IIIa	Pillows	W	Polypropylene	Not available	12.5 gl/gs, 5.2 gal per pillow	Lab based testing	No	No	Yes (90%)	14" x 25"	
39	Brady	https://www.bradyid.com/en-us/product/on030#specifications	Drag Net	IV	Pom poms	W	Polypropylene	Not available	15 gl/gs, 15 gallons per 30	Lab based testing	Yes	No	No	50'	
40	Meltblown Technologies	https://meltblowntechnologies.com/marine-absorbents/marine-oil-only-sorbents/?__hstc=249178584.9077650b6d6233210435779d4f49d262.1576764134171.1576764134171.1576764134171.1&__hssc=249178584.3.1576764134171&__hsfp=1929083185	Oil Spill Sweep (S1900)	IIIc	Sweep	W	Polypropylene	Meltblown	16.6 gal/pkg	Not specified	No	No	No	19" x 100'	
41	Meltblown Technologies	https://meltblowntechnologies.com/marine-absorbents/marine-oil-only-sorbents/?__hstc=249178584.9077650b6d6233210435779d4f49d262.1576764134171.1576764134171.1576764134171.1&__hssc=249178584.3.1576764134171&__hsfp=1929083185	B510SN	IIIb	Booms	W	Polypropylene	Meltblown	34.1 gal/pkg	Not specified	No	No	No	5" x 10'	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
42	Meltblown Technologies	https://meltblowntechnologies.com/marine-absorbents/marine-oil-only-sorbents/?__hstc=249178584.9077650b6d6233210435779d4f49d262.1576764134171.1576764134171.1576764134171.1&__hssc=249178584.3.1576764134171&__hsfp=1929083185	B520SN	IIIb	Booms	W	Polypropylene	Meltblown	34.1 gal/pkg	Not specified	No	No	No	5" x 20'	
43	Meltblown Technologies	https://meltblowntechnologies.com/marine-absorbents/marine-oil-only-sorbents/?__hstc=249178584.9077650b6d6233210435779d4f49d262.1576764134171.1576764134171.1576764134171.1&__hssc=249178584.3.1576764134171&__hsfp=1929083185	B810SN	IIIb	Booms	W	Polypropylene	Meltblown	62.3 gal/pkg	Not specified	No	No	No	8" x 10'	
44	Meltblown Technologies	https://meltblowntechnologies.com/marine-absorbents/marine-oil-only-sorbents/?__hstc=249178584.9077650b6d6233210435779d4f49d262.1576764134171.1576764134171.1576764134171.1&__hssc=249178584.3.1576764134171&__hsfp=1929083185	B820SN	IIIb	Booms	W	Polypropylene	Meltblown	62.3 gal/pkg	Not specified	No	No	No	8" x 20'	
45	Meltblown Technologies	https://meltblowntechnologies.com/marine-absorbents/marine-oil-only-sorbents/?__hstc=249178584.9077650b6d6233210435779d4f49d262.1576764134171.1576764134171.1576764134171.1&__hssc=249178584.3.1576764134171&__hsfp=1929083185	Skimming Bilge Boom BB20	IIIb	Booms	W	Polypropylene	Meltblown	19 gal/pkg	Not specified	No	No	No	5" x 18"	
46	Meltblown Technologies	https://meltblowntechnologies.com/marine-absorbents/marine-oil-only-sorbents/?__hstc=249178584.9077650b6d6233210435779d4f49d262.1576764134171.1576764134171.1576764134171.1&__hssc=249178584.3.1576764134171&__hsfp=1929083185	Skimming Boom Pillows B10PSN	IIIa	Pillows	W	Polypropylene	Meltblown	19 gal/pkg	Not specified	No	No	No	8" x 18"	
47	Meltblown Technologies	https://meltblowntechnologies.com/marine-absorbents/containment-booms-and-pom-poms/?__hstc=249178584.9077650b6d6233210435779d4f49d262.1576764134171.1576764134171.1576764134171.1&__hssc=249178584.366.1576764134171&__hsfp=1929083185	PP30-R	IV	Pom poms	W	Not Specified	Meltblown	29.3 gal/pkg	Not specified	Yes	Yes	No	30 nets on 50' rope	
48	Meltblown Technologies	https://meltblowntechnologies.com/marine-absorbents/containment-booms-and-pom-poms/?__hstc=249178584.9077650b6d6233210435779d4f49d262.1576764134171.1576764134171.1576764134171.1&__hssc=249178584.366.1576764134171&__hsfp=1929083185	PP30-L	IV	Pom poms	W	Not Specified	Meltblown	27.4 gal/pkg	Not specified	Yes	Yes	No	30 nets loose	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
49	Meltblown Technologies	https://meltblowntechnologies.com/products/spilltration-spill-control-products/spilltration-husky-absorbent-pads/	Husky pads SPL005	I	Pads	L	Industrial waste	Not available	13.6 gal/pkg (20 pads)	Not specified	Yes	Yes	Yes	8" x 8"	
50	Meltblown Technologies	https://meltblowntechnologies.com/products/spilltration-spill-control-products/spilltration-husky-absorbent-pads/	Husky pads SPL002	I	Pads	L	Industrial waste	Not available	17.2 gal/pkg (5 pads)	Not specified	Yes	Yes	Yes	16" x 16"	
51	Meltblown Technologies	https://meltblowntechnologies.com/products/spilltration-spill-control-products/spilltration-shammy-towel/	Shammy towels SPL009	I	Towels	L	Industrial waste	Not available	29 gal/pkg	Not specified	Yes	Yes	Yes	10" x 16"	
52	Meltblown Technologies	https://meltblowntechnologies.com/products/spilltration-spill-control-products/spilltration-shammy-towel/	Shammy towels SPL003	I	Towels	L	Industrial waste	Not available	47 gal/pkg	Not specified	Yes	Yes	Yes	16" x 16"	
53	Meltblown Technologies	https://meltblowntechnologies.com/husky-oil-absorbent-rugs/	Husky Rugs	I	Blankets	L	Industrial waste	Not available	2.1 gal/pkg	Not specified	Yes	Yes	Yes	32"x 48" x 0.5"	
54	Meltblown Technologies	https://meltblowntechnologies.com/husky-strips/	Husky Strip SPL008	IV	Strips	L-W	Industrial waste	Not available	4 gal/pkg	Not specified	Yes	Yes	Yes	8" x 64" x 0.5"	
55	Meltblown Technologies	https://meltblowntechnologies.com/products/absorbents/oil-only-absorbents/?__hstc=249178584.9077650b6d6233210435779d4f49d262.1576764134171.1576764134171.1576769514452.2&__hssc=249178584.13.1576769514452&__hsfp=1929083185	Standard White Heavyweight Pads WM100	I	Pads	L-W	Polypropylene	Meltblown	28 gal/	Not specified	No	No	No	15" x 18"	
56	New Pig	https://www.newpig.com/pig-oil-solidifying-absorbent-powder/p/PLP500#desc-spec	Oil Solidifying Absorbent Powder PLP500	II	Powder	L	Proprietary co-polymer	Proprietary	1 gal/pound of material	Lab based sorption testing	No	No	No	2 lb container	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
57	New Pig	https://www.newpig.com/pig-peat-absorbent/p/PLP404	Peat Absorbent PLP410	II	Powder	L	Activated Sphagnum Peat Moss	Proprietary	up to 8gal/bag	Lab based sorption testing	No	No	No	11lb bag	
58	New Pig	https://www.newpig.com/pig-oil-only-lite-dri-loose-absorbent/p/PLP410	Oil Only Lite Dry absorbent	II	Cellulose	L	Recycled	Proprietary	up to 8gal/bag	Lab based sorption testing	No	No	Yes	22lb bag	
59	New Pig	https://www.newpig.com/pig-loose-cob-absorbent/p/PLP216	Loose Cob Absorbent PLP216	II	Granular	L	Corn cob	Proprietary	up to 12.5gal / bag	Lab based sorption testing	No	No	No	25lb bag	
60	New Pig	https://www.newpig.com/pig-oil-only-loose-absorbent/p/SA8010	Oil-Only Loose Absorbent SA8010	II	Granular	L-W	Polypropylene	Proprietary	up to 7.5 gal / bag	Lab based sorption testing	No	No	No	5lb bag	
61	Oil Solutions	https://cleaningupoil.com/products/os-powder/	OS Powder	II	Powder	L-W	Polymer	Proprietary	about 10 gal / 1 gal. apply 1-2 lbs per spilled gallon	Lab based sorption testing	No	No	Yes	varies: (2 lb bag, 5 lb bag, 10 lb bag, 30 lb bag, 900 lb crate)	
62	Eco Super Cleaners	https://ecosupercleaners.com/product/solo-super-absorbent-eco-friendly-oil-spill-absorbent-powder-4-gal/	Solo Super Absorbent Eco-Friendly Oil Spill Absorbent Powder	II	Powder	L	Rice husks	Rice husks ground into powder	8x its weight	Internal lab based testing	No	No	No	4 gallon bucket	
63	Acme Environmental	https://www.acmeboom.com/products/sorbents/particulate-sorbents/miraclesorb-ne	ACME MiracleSorb – Micro NE	II	Powder	L-W	Sugarcane bagasse	Dehydrate sugar cane to moisture content between 0% to 10%, activate into high grade of material with strong affinity to encapsulate oils and organic solvents.	8-10x its weight	Not specified	No	No	No	30lb bag	
64	Acme Environmental	https://www.acmeboom.com/products/sorbents/particulate-sorbents/miraclesorb-ne	ACME MiracleSorb – Micro PLAIN	II	Powder	L-W	Sugarcane bagasse	Dehydrate sugar cane to moisture content between 0% to 10%, activate into high grade of material with strong affinity to encapsulate oils and organic solvents.	8-10x its weight	Not specified	No	No	No	22lb bag	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
65	Unirem Technology	http://unireminc.com/portfolio/prp-powder/	PRP Powder	II	Powder	L-W	Wax-coated microencapsulated oil consuming microorganisms	Proprietary	More than 20x its weight	third party lab based test, gathered some field data too	No	No	No	50 lb drums	
66	Unirem Technology	http://unireminc.com/portfolio/oil-buster/	Oil Buster	II	Granular	L	Blend of PRP and ground corncob	Proprietary	71% of spilled oil in one week, 86% over next 4 weeks	third party lab based test, gathered some field data too	No	No	No	Shaker: 6oz Bag: 20 / 50lb	
67	New Pig	https://www.newpig.com/pig-oil-only-absorbent-mat-pad/p/MAT403#desc-spec	Oil-Only Absorbent Mat Pad	I	Pads	L-W	Polypropylene	Thermal bond of eight polypropylene layers	28.16 oz / pad	Lab based sorption testing	No	No	No	Box of 100 pads	
68	New Pig	https://www.newpig.com/pig-oil-only-absorbent-mat-pad/p/MAT455	Oil-Only Absorbent Mat Pad	I	Pads	L-W	Polypropylene	Thermal bond of eight polypropylene layers	22.53 oz / pad	Lab based sorption testing	No	No	No	Box of 100 pads	
69	New Pig	https://www.newpig.com/pig-oil-only-absorbent-mat-pad/p/MAT423	Oil-Only Absorbent Mat Pad	I	Pads	L-W	Polypropylene	Thermal bond of eight polypropylene layers	14.08 oz / pad	Lab based sorption testing	No	No	No	Box of 200 pads	
70	New Pig	https://www.newpig.com/pig-oil-only-absorbent-mat-roll/p/MAT401	Oil-Only Absorbent Mat Roll	I	Rolls	L-W	Polypropylene	Thermal bond of eight polypropylene layers	40.2 gal / roll	Lab based sorption testing	No	No	No	30" W x 150' L	
71	New Pig	https://www.newpig.com/pig-oil-only-absorbent-mat-roll/p/MAT458	Oil-Only Absorbent Mat Roll	I	Rolls	L-W	Polypropylene	Thermal bond of eight polypropylene layers	32 gal / roll	Lab based sorption testing	No	No	No	30" W x 150' L	
72	New Pig	https://www.newpig.com/pig-oil-only-absorbent-mat-roll/p/MAT419	Oil-Only Absorbent Mat Roll	I	Rolls	L-W	Polypropylene	Thermal bond of eight polypropylene layers	40.2 gal / roll	Lab based sorption testing	No	No	No	30" W x 300' L	
73	New Pig	https://www.newpig.com/pig-oil-only-absorbent-mat-roll/p/MAT424	Oil-Only Absorbent Mat Roll	I	Rolls	L-W	Polypropylene	Thermal bond of eight polypropylene layers	32.4 gal / roll	Not specified	No	No	No	24" W x 150' L	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
74	New Pig	https://www.newpig.com/pig-oil-only-absorbent-mat-roll-with-poly-backing/p/MAT498	Oil-Only Absorbent Mat Roll with Poly Backing	I	Rolls	L-W	Polypropylene	Thermal bond of eight polypropylene layers	20.5 gal / roll	Not specified	No	No	No	3" W x 75' L	
75	New Pig	https://www.newpig.com/pig-brown-oil-only-absorbent-mat-roll/p/MAT530	Brown Oil-Only Absorbent Mat Roll	I	Rolls	L-W	Polypropylene	Thermal bond of eight polypropylene layers	40.2 gal / roll	Not specified	No	No	No	30" W x 150' L	
76	New Pig	https://www.newpig.com/pig-brown-oil-only-absorbent-mat-pad/p/MAT503	Brown Oil-Only Absorbent Mat Pad	I	Pads	L-W	Polypropylene	Thermal bond of eight polypropylene layers	28.16 oz / pad	Not specified	No	No	No	Box of 100 pads	
77	New Pig	https://www.newpig.com/pig-fat-mat-oil-only-absorbent-mat-roll/p/MAT4102	Fat Mat Oil-Only Absorbent Mat Roll	I	Rolls	L-W	Polypropylene	Thermal bond of sixteen polypropylene layers	40 gal / roll	Not specified	No	No	No	32" W x 75' L	
78	New Pig	https://www.newpig.com/pig-fat-mat-oil-only-absorbent-mat-pad-in-dispenser-box/p/MAT4101	Fat Mat Oil-Only Absorbent Mat Pad in Dispenser Box	I	Pads	L-W	Polypropylene	Thermal bond of sixteen polypropylene layers	56.32 oz / pad	Not specified	No	No	No	Box of 50 pads	
79	New Pig	https://www.newpig.com/pig-skimmer-oil-only-absorbent-sock/p/104PS	Skimmer Oil-Only Absorbent Sock	IIIa	Socks	W	Polypropylene	Not available	1 gal / sock	Not specified	No	No	No	Box of 10 socks	
80	New Pig	https://www.newpig.com/pig-sheen-clean-oil-only-absorbent-sock/p/SKM600	Sheen Clean Oil-Only Absorbent Sock	IIIa	Socks	W	Hydrophobic cellulose & copolymer proprietary blend, polypropylene skin	Not available	1 gal / sock	Not specified	No	No	No	Box of 12 socks	
81	New Pig	https://www.newpig.com/pig-oil-only-absorbent-boom/p/BOM304	Oil-Only Absorbent Boom	IIIb	Booms	W	Polypropylene, polyester outer mesh	Not available	12 gal / boom	Not specified	No	No	No	Bag of 4 booms	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
82	Oil sponge	https://oilsponge.com/product/oil-sponge-basic/	Oil sponge basic	II	Granular	L	recycled organic cellulose	Not available	8 times more than clay, 0.625 gal per lb	Not specified	No	No	Yes	Not available	
83	Oil sponge	https://oilsponge.com/product/oil-sponge-ab/	Oil sponge AB	II	Granular	L	recycled organic cellulose	Not available	8 times more than clay, 0.625 gal per lb	Not specified	No	No	Yes	30 lbs, 24"x16"x6"	
84	Oil sponge	https://oilsponge.com/product/oil-sponge-ab-2/	Oil sponge basic AB+	II	Granular	L	recycled organic cellulose + oil consuming microbes	Not available	8 times more than clay, 0.625 gal per lb	Not specified	No	No	Yes	30 lbs, 24"x16"x6"	
85	Sokerol	http://www.sokerol.com/commercial-industrial/products/	Sokerol	II	Granular	L-W	Proprietary organic material blend	Not available	2.0 g oil/g product	ASTM F726-99	No	No	No	1 kg, 5kg, 10kg bags	
86	Deurex	https://www.deurex.com/productsearch/DEUREX-PURE-Vliesmatte/	Deurex Pure Fleece Mat	IIIa	Pillows	L-W	Polyethylene wax within fiber mat	Not available	0.5kg/3.5 L	DEKRA test report no.: 55251253/15	No	No	No	50x40cm pads (0.5kg), 25mx50cm rolls	
87	Deurex	https://www.deurex.com/productsearch/DEUREX-PURE-Eimer-gross/	Deurex Pure	II	Granular	L-W	Polyethylene wax granules	Not available	3kg/20 L	DEKRA test report no.: 55251253/16	No	No	No	1kg, 3 kg , 5kg , 150kg containers	
88	Deurex	https://www.deurex.com/products/?pserie=15ACBFB0909	Deurex Pure boom	IIIb	Booms	L-W	Polyethylene wax granules within fiber boom	Not available	0.5kg/3.5 L	DEKRA test report no.: 55251253/17	No	No	No	Various (3m x 8cm (1.8kg), 6m x 8cm, 6m x 10cm, 3m x 15cm, 6m x 10cm (9kg))	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
89	SaveSorb	https://savesorb.com/product-category/loose-fill/	SaveSorb Loose fill	II	Granular	L-W	Dried plant matter (formulated peat)	Not available	approx. 1gal/lb	Not available	No	No	Yes	Various: 55cf (850 lb), 50lb 8.5lb, 3.2lb containers	
90	SaveSorb	https://savesorb.com/product-category/spillow-sox/	SaveSorb Spillow Sox	IIIa	Socks	L-W	Dried plant matter (formulated peat) - encased in fiber material	Not available	approx. 1lb/gal	Not available	No	No	Yes	8'x4", 6'x4"	
91	SaveSorb	https://savesorb.com/product-category/spillow-mats/	SaveSorb Spillow Mats	IIIa	Pillows	L-W	Dried plant matter (formulated peat) - encased in fiber material	Not available	approx. 1lb/gal	Not available	No	No	Yes	10"x16", 3'x3', 2'x2'	
92	Spillfix	https://spillfix.com/organic-spill-absorbent/	Spillfix	II	Granular	L	Coconut Husk, Coir	Not available	2.1 gal/15L of product	Not available	No	No	Yes	Various: 1.18lb (3L), 7lb (15L) , 20lb (50L), 900lb (2150L)	
93	Spillfix	https://spillfix.com/product/boom-socs/	Spillfix SOC	IIIa	Socks	L	Coconut Husk, Coir	Not available	1 qt/L of product	Not available	No	No	Yes	Various: 5'x4cm, 10'x4cm	
94	Log 9 Spill Containment	http://www.sorbene.com/products.html	Sorbene Pads	I	Pads	L-W	Polypropylene and Graphene	Not available	40-80x its weight, 0.8-1.7L (regular vs. ultra high absorbent)	Not available	Not available	5-6 times	No	50x40 cm	
95	Log 9 Spill Containment	http://www.sorbene.com/products.html	Sorbene Socks	IIIa	Socks	L	Polypropylene and Graphene	Not available	60-70x its weight, 5.3L short sock, 12L long sock	Not available	Not available	5-6 times	No	130 or 300 x 8 cm	
96	Log 9 Spill Containment	http://www.sorbene.com/products.html	Sorbene Pillows	IIIa	Pillows	L-W	Polypropylene and Graphene	Not available	23x its weight, up to 9.2L per pillow	Not available	Not available	Not available	No	50x40 cm	

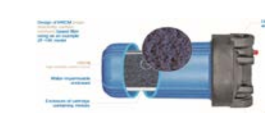
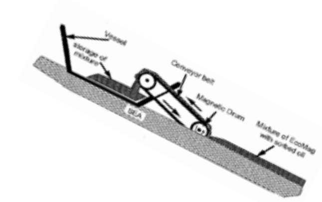
No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
97	Test 1	test1solutions.com	CARPETFLEX 2.5	I	Pads	L-W	FoamFlex200: open-cell polyurethane foam with graphene and nano-fillers	Not available	24x its weight	ASTM F726-99	Yes, low water content	200 times	No	32cm x 2.5 cm x 3-30m	
98	Test 1	test1solutions.com	CARPETFLEX 5.0	I	Pads	L-W	FoamFlex200: open-cell polyurethane foam with graphene and nano-fillers	Not available	24x its weight	ASTM F726-99	Yes, low water content	200 times	No	32cm x 5 cm x 3-30m	
99	Test 1	test1solutions.com	WALLPLEX	IIIa	Barrier	L-W	FoamFlex200: open-cell polyurethane foam with graphene and nano-fillers	Not available	24x its weight	ASTM F726-99	Yes, low water content	200 times	No	32 cm x 20 cm x 100-150 cm	
100	Test 1	test1solutions.com	SERPLEX	IIIa	Buoy	L-W	FoamFlex200: open-cell polyurethane foam with graphene and nano-fillers	Not available	24x its weight	ASTM F726-99	Yes, low water content	200 times	No	20/50 cm x 100-500 cm	
101	Sellars	https://www.sellarscompany.com/product/oil-only-light-weight-sorbent-pads-1504	Oil Only Light Weight Sorbent Pads	I	Pads	L-W	Polypropylene	Meltblown	16 gallons per bale (100 pads)	ASTM F726-06	Not available	No	No	15" x 18"	
102	Sellars	https://www.sellarscompany.com/product/oil-only-laminated-sorbent-pads	Oil Only Laminated Sorbent Pads	I	Pads	L-W	Polypropylene	Meltblown	20 gallons per bale (100 pads)	ASTM F726-06	Not available	No	No	16" x 20"	
103	Sellars	https://www.sellarscompany.com/product/oil-only-heavy-weight-sorbent-pads	Oil Only Heavy Weight Sorbent Pads	I	Pads	L-W	Polypropylene	Meltblown	24 gallons per bale (100 pads)	Not available	Not available	No	No	15" x 18"	
104	Sellars	https://www.sellarscompany.com/product/oil-only-sorbent-king-pads	Oil Only Sorbent King Pads	I	Pads	L-W	Polypropylene	Meltblown	40 gallons per bale (50 pads)	ASTM F726-06	Not available	No	No	30" x 38"	
105	Sellars	https://www.sellarscompany.com/product/oil-only-medium-weight-sorbent-pads	Oil Only Medium Weight Sorbent Pads	I	Pads	L-W	Polypropylene	Meltblown	19 gallons per bale (100 pads)	ASTM F726-06	Not available	No	No	15" x 18"	
106	Sellars	https://www.sellarscompany.com/product/oil-only-medium-weight-sorbent-split-rolls	Oil Only Medium Weight Sorbent Split Rolls	I	Rolls	L-W	Polypropylene	Meltblown	19 gallons per roll	ASTM F726-06	Not available	No	No	15" x 150'	

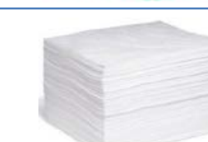
No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
107	Sellars	https://www.sellarscompany.com/product/oil-only-medium-weight-sorbent-rolls	Oil Only Medium Weight Sorbent Rolls	I	Rolls	L-W	Polypropylene	Meltblown	38.5 gallons per roll	ASTM F726-06	Not available	No	No	30" x 150'	
108	Sellars	https://www.sellarscompany.com/product/oil-only-12ft-cotton-sorbent-socks	EverSoak Oil Only 12' Cotton Absorbent Socks	IIIa	Socks	L-W	Cotton with polypropylene sleeve	Not available	39 gallons per case (10 socks)	ASTM F726-06	Not available	No	No	3" x 12'	
109	Sellars	https://www.sellarscompany.com/product/oil-only-8ft-cotton-sorbent-socks	EverSoak Oil Only 8' Cotton Absorbent Socks	IIIa	Socks	L-W	Cotton with polypropylene sleeve	Not available	52 gallons per case (20 socks)	ASTM F726-06	Not available	No	No	3" x 8'	
110	Sellars	https://www.sellarscompany.com/product/oil-only-4ft-cotton-sorbent-socks	EverSoak Oil Only 4' Cotton Absorbent Socks	IIIa	Socks	L-W	Cotton with polypropylene sleeve	Not available	52 gallons per case (40 socks)	ASTM F726-06	Not available	No	No	3" x 4'	
111	Sellars	https://www.sellarscompany.com/product/8in-sorbent-booms	8" Sorbent Booms	IIIb	Booms	W	Polypropylene with polyester netting	Not available	42 gallons per bale (4 booms)	ASTM F726-06	Not available	No	No	6-8" x 10'	
112	Sellars	https://www.sellarscompany.com/product/5in-sorbent-booms	5" Sorbent Booms	IIIb	Booms	W	Polypropylene with polyester netting	Not available	24 gallons per bale (4 booms)	ASTM F726-06	Not available	No	No	5" x 10'	
113	Sellars	https://www.sellarscompany.com/product/durasoak-oil-only-econo-duty-absorbent-pads	DuraSoak Oil Only Econo-Duty Absorbent Pads	I	Pads	L-W	85% cotton, layer of polypropylene netting	Q-CEL technology	20.8 gallons per bale (100 pads)	ASTM F726-06	Not available	No	No	15" x 19"	
114	Sellars	https://www.sellarscompany.com/product/durasoak-oil-only-light-duty-absorbent-pads	DuraSoak Oil Only Light-Duty Absorbent Pads	I	Pads	L-W	65% cotton	Q-CEL technology	18 gallons per bale (100 pads)	ASTM F726-06	Not available	No	No	15" x 19"	
115	Sellars	https://www.sellarscompany.com/product/durasoak-oil-only-medium-duty-absorbent-pads	DuraSoak Oil Only Medium-Duty Absorbent Pads	I	Pads	L-W	50% cotton, layer of meltblown polypropylene	Q-CEL technology	16.4 gallons per bale (100 pads)	ASTM F726-06	Not available	No	No	15" x 19"	
116	Sellars	https://www.sellarscompany.com/product/durasoak-oil-only-heavy-duty-absorbent-pads	DuraSoak Oil Only Heavy-Duty Absorbent Pads	I	Pads	L-W	60% cotton, layer of meltblown polypropylene top and bottom	Q-CEL technology	20.8 gallons per bale (100 pads)	ASTM F726-06	Not available	No	No	15" x 19"	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
117	Sellars	https://www.sellarscompany.com/product/durasoak-oil-only-econo-duty-absorbent-split-rolls	DuraSoak Oil Only Econo-Duty Absorbent Split Rolls	I	Rolls	L-W	85% cotton, layer of polypropylene netting	Q-CEL technology	18.7 gallons per roll	ASTM F726-06	Not available	No	No	14.25" x 150'	
118	Sellars	https://www.sellarscompany.com/product/durasoak-oil-only-econo-duty-absorbent-rolls	DuraSoak Oil Only Econo-Duty Absorbent Rolls	I	Rolls	L-W	85% cotton, layer of polypropylene netting	Q-CEL technology	37.4 gallons per roll	ASTM F726-06	Not available	No	No	28.5" x 150'	
119	Sellars	https://www.sellarscompany.com/product/durasoak-oil-only-light-duty-absorbent-split-rolls	DuraSoak Oil Only Light-Duty Absorbent Split Rolls	I	Rolls	L-W	65% cotton, layer of meltdown polypropylene	Q-CEL technology	16.2 gallons per roll	ASTM F726-06	Not available	No	No	14.25" x 150'	
120	Sellars	https://www.sellarscompany.com/product/durasoak-oil-only-light-duty-absorbent-rolls	DuraSoak Oil Only Light-Duty Absorbent Rolls	I	Rolls	L-W	65% cotton, layer of meltdown polypropylene	Q-CEL technology	32.4 gallons per roll	ASTM F726-06	Not available	No	No	28.5" x 150'	
121	Sellars	https://www.sellarscompany.com/product/durasoak-oil-only-medium-duty-absorbent-split-rolls	DuraSoak Oil Only Medium-Duty Absorbent Split Rolls	I	Rolls	L-W	50% cotton, layer of meltblown polypropylene	Q-CEL technology	14.8 gallons per roll	ASTM F726-06	Not available	No	No	14.25" x 150'	
122	Sellars	https://www.sellarscompany.com/product/durasoak-oil-only-medium-duty-absorbent-rolls	DuraSoak Oil Only Medium-Duty Absorbent Rolls	I	Rolls	L-W	50% cotton, layer of meltblown polypropylene	Q-CEL technology	29.5 gallons per roll	ASTM F726-06	Not available	No	No	28.5" x 150'	
123	Sellars	https://www.sellarscompany.com/product/durasoak-oil-only-heavy-duty-absorbent-split-rolls	DuraSoak Oil Only Heavy-Duty Absorbent Split Rolls	I	Rolls	L-W	60% cotton, layer of meltblown polypropylene top and bottom	Q-CEL technology	15.6 gallons per roll	ASTM F726-06	Not available	No	No	14.25" x 150'	
124	Sellars	https://www.sellarscompany.com/product/durasoak-oil-only-heavy-duty-absorbent-rolls	DuraSoak Oil Only Heavy-Duty Absorbent Rolls	I	Rolls	L-W	60% cotton, layer of meltblown polypropylene top and bottom	Q-CEL technology	31.2 gallons per roll	ASTM F726-06	Not available	No	No	28.5" x 150'	
125	Sellars	https://www.sellarscompany.com/product/eversoak-oil-only-heavy-weight-cotton-sorbent-rolls	EverSoak Oil Only Heavy Weight Cotton Sorbent Rolls	I	Rolls	L-W	80% cotton with coverstock on both sides	Not available	54 gallons per roll	ASTM F726-06	Not available	No	No	28.5" x 125'	

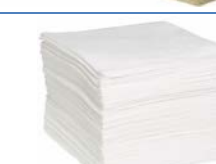
No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
126	Sellars	https://www.sellarscompany.com/product/4in-x-19in-sorbent-bilge-booms	4" Sorbent Bilge Booms	IIIb	Booms	W	Polypropylene with polyester netting	Not available	1 gallon per boom	ASTM F726-06	Not available	No	No	4" x 19"	
127	Sellars	https://www.sellarscompany.com/product/oil-only-onion-sack-sorbent-pillow	Oil Only Onion Sack Sorbent Pillow	IIIa	Pillows	L-W	Polypropylene	Meltblown	18.5 gallons per bale (10 pillows)	ASTM F726-06	Not available	No	No	6" x 16" x 21"	
128	Corksorb	https://www.corksorb.com/en/products/	Corksorb Granules	II	Granular	L-W	Cork	No additives, heat treated	3.5-6.5 liter/kg	ASTM F726-12, ASTM F726-06, ASTM F716-09	Not available	Yes	No	bags of 25, 75, 250, 500 liters	
129	Corksorb	https://www.corksorb.com/en/products/	Corksorb Socks	IIIa	Socks	L-W	Cork	No additives, heat treated	3.5-6.5 liter/kg	ASTM F726-12, ASTM F726-06, ASTM F716-09	Not available	Yes	No	1.2 or 3 meter length	
130	Corksorb	https://www.corksorb.com/en/products/	Corksorb Pillows	IIIa	Pillows	L-W	Cork	No additives, heat treated	3.5-6.5 liter/kg	ASTM F726-12, ASTM F726-06, ASTM F716-09	Not available	Yes	No	30 x 30 cm or 45 x 45 cm	
131	Corksorb	https://www.corksorb.com/en/products/	Corksorb Booms	IIIb	Booms	L-W	Cork	No additives, heat treated	3.5-6.5 liter/kg	ASTM F726-12, ASTM F726-06, ASTM F716-09	Not available	Yes	No	3, 6, or 25 meter length, 6 or 12.5 meter length with skirt	
132	Clearspill	https://www.clearspill.com/products/tubular-knitted-oil-socks	Tubular knitted Oil Socks	IIIa	Socks	L-W		Not available	76 liters per 8 long socks or 20 short socks (or per pallet?)	Not available	Not available	Not available	No	8 cm x 3 m or 1.2 m	
133	Clearspill	https://www.clearspill.com/products/rip-one-oil-only-pads	Rip One Oil Only Pads	I	Pads	L-W		Not available	12 liters per 10 pads (?) or per 24 boxes of 5 packs (?)	Not available	Not available	Not available	No	40 x 50 cm	
134	Clearspill	https://www.clearspill.com/products/oil-socks	Oil Socks	IIIa	Socks	L-W		Not available	76 liters per 8 long socks or 20 short socks (or per pallet?)	Not available	Not available	Not available	No	8 cm x 3 m or 1.2 m	
135	Clearspill	https://www.clearspill.com/products/oil-only-rolls	Oil Only Rolls	I	Rolls	L-W		Not available	0.25 liters/m2 of lightweight, 0.5 liters/m2 of heavyweight	Not available	Not available	Not available	No	lightweight: 1mx100m, 0.5x100m. Heavyweight: 1x50m, 0.5x50m	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
136	Clearspill	https://www.clearspill.com/products/oil-only-pom-poms	Oil Only Pom Poms	IV	Pom poms	L-W	Polypropylene	Not available	20-60 times their weight	Not available	Not available	Not available	No	Not available	
137	Clearspill	https://www.clearspill.com/products/oil-only-pads	Oil Only Pads	I	Pads	L-W		Not available	light: 0.025L per pad. Medium: 0.03L per pad. Heavy: 0.05L per pad	Not available	Not available	Not available	No	40 x 50 cm	
138	Clearspill	https://www.clearspill.com/products/oil-only-drain-booms	Oil Only Drain Booms	IIIb	Booms	L-W		Not available	125 liters per 10 booms or 12 boxes of 10 booms ?	Not available	Not available	Not available	No	20 x 50 cm	
139	Clearspill	https://www.clearspill.com/products/oil-only-curtain-booms	Oil Only Curtain Booms	IIIb	Booms	W		Not available	93.5 liters per 24 booms	Not available	Not available	Not available	No	15 cm x 3 m	
140	Clearspill	https://www.clearspill.com/products/oil-only-booms	Oil Only Booms	IIIb	Booms	L-W		Not available	300 liters per 16 thick booms, 120 liters per 64 skinny booms	Not available	Not available	Not available	No	20 cm x 3 m or 12 cm x 3 m	
141	Clearspill	https://www.clearspill.com/products/oil-cushions	Oil Cushions	IIIa	Pillows	L-W		Not available	47 liters per 25 small pillows, 80 liters per 20 medium, 62 liters per 10 big	Not available	Not available	Not available	No	23 x 23 cm, 30 x 35 cm, 35 x 45 cm	
142	Absodan	https://www.tradeshopdirect.co.uk/absodan-absorbent-granules	Absorbent Granules	II	Granular	L		Not available	20 liters per bag	Not available	No	No	No	10 kg	
143	E-Sorb	https://www.tradeshopdirect.co.uk/e-sorb-absorbent-wood-fibre	E-Sorb Absorbent Recycled Wood Fiber	II	Granular	L	Wood fiber	Resin wood dust, dried at high temperatures	30 liters per bag	Not available	No	No	Yes	30 liters	
144	Isol8	https://www.tradeshopdirect.co.uk/isol8-organic-absorbent-granules-5-pack	Isol8 Organic Absorbent Granules	II	Granular	L	Coir	Not available	10 liters per bag	Not available	No	No	Yes	8 kgs per bag	
145	Multi Zorb	https://www.tradeshopdirect.co.uk/multi-zorb-absorbent-hard-clay-granules	Multi Zorb Absorbent Hard Clay Granules	II	Granular	L	Clay, Perlite	Not available	20 liters per bag	Not available	No	No	No	Not available	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
146	New Safety Tread	https://www.tradeshopdirect.co.uk/new-safety-tread-absorbent-granules	New Safety Tread Premium Absorbent Granules	II	Granular	L	Not available	Not available	30 liters per bag	Not available	No	No	No	30 liter bag	
147	Spill Fix	https://www.tradeshopdirect.co.uk/spill-fix-loose-absorbent-granules	Spill Fix Loose Absorbent Granules	II	Granular	L	Micro sponges, coconut coir	Not available	9 times its weight, 15 liters per bag	Not available	No	No	No	4 gallon bag	
148	Spill Magnet	https://www.tradeshopdirect.co.uk/spill-magnet-oil-chemical-binder-10074	Spill Magnet Oil & Chemical Binder	II	Granular	L	Acrylic polymer granules	Not available	40 times its weight	Not available	No	No	No	1kg or 5kg	
149	Aeroclay	https://www.aeroclay.com/tech	Aeroclay	I	Foam	L-W	Clay and polymer	Forms foam pores via freezing process (ice templating) followed by freeze-drying (ice sublimation)	Not available	Not available	Yes	Yes	No	Not available	
150	Gelanggang Kencana Sdn.Bhd.	http://maerogel.com/maerogel.html	Maerogel	II	Gel		Silica aerogel	Produced from rice husk	Not available	Not available	Not available	Not available	No	Not available	
151	Golden Formula Holding Ltd.	http://goldenformula.org.ua/static/media/katalog/English%20cataloge%20Golden%20Formula.pdf	High-Reactivity Carbon Mixture (HRCM)	I	Pads	W	Graphenes, nanotubes, nanorings, nanofractals, and branched nanotubes	Cold destruction of layered carbon compounds	1 g of HRCM sorbs ~80 g of oil	Not available	Yes	Yes	No	Not available	
152	CleanMag Technology	http://cleanmag.gr/CLEANMAG_ERA_2016%20Eng.pdf	CleanMag	IIIb	Booms	W	Oleophilic, porous, and oil sorbing magnetic material	Not available	Not available	Not available	Yes	No	Yes	Not available	
153	N.C. Christodoulou	https://patents.google.com/patent/US20040108276A1/en	EcoMag	II	Particles	W	Porous inorganic matrix material (like Perlite) and a magnetic nanoscale component	processing and mixing: dry raw material with flash heating and then mix with magnetic material using epoxy/acrylic resin at low temps or polymers at medium temps or inorganic materials at high temps	9.5 L oil per 1 kg of porous matrix (changes based on density of porous matrix)	Not available	Yes	Yes	No	Not available	

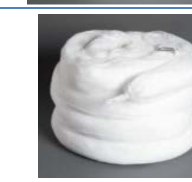
No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
154	AMT&C	http://www.amtc.ru/en/catalog/foam/	Magnetic Foams	II	Liquid Foam	L-W	Hydrophobic liquid foam with magnetic nanosize particles (such as barium ferrite)	On-site production with compact source materials and stationary or portable installations - can be created quickly in large quantities at place of pollution (ships or seaports)	Not available	Not available	Yes	Yes	No	Not available	Not available
155	Nanotec-USA	https://www.nanotech-now.com/news.cgi?story_id=42138	NanoBionic Jute (Burlap)	I	Pads	L-W	Shredded jute treated with hydrophobic NanoBionics Textile treatment	Shred jute, treat with hydrophobic NanoBionics Textile treatment	Not available	Not available	No	No	No	Not available	Not available
156	Nanotec-USA	https://www.nanotech-now.com/news.cgi?story_id=42138	NanoBionic Sand	II	Granular	L-W	Beach sand treated with NanoBionics Sand Guard treatment	Cover each grain of sand with Bionic nanoparticles	Not available	Not available	No	No	No	Not available	Not available
157	First Line Technology, LLC	https://www.firstlinetech.com/product/fibertect/	Fibertect Cotton Soaking	I	Pads, Rolls	L	Polyester, cotton	Center layer of fibrous activated carbon is needle punched into bottom and top composite fabric layers	5-11 times its weight	Performance testing against 30 comparable products for decontamination against toxic chemical	No	Yes	No	Wipes are 12" x 12" squares, roll contains 20 perforated 12"x12" wipes.	
158	Red Lion Scientifics, LLC	http://www.lmcsltd.com/uploads/1/2/9/2/12921205/_sea_reclaim_application_rev4.pdf	Sea ReClaim	II	Granular	L-W	Scoria (a kind of volcanic rock with many holes), natural and modified, obtained by mining and metallurgy	Not available	10% to 30% by weight application required to solidify oils	Not available	Yes	Yes	Yes	Not available	Not available
159	AquaFlex	http://www.aqflx.com/products.php	Open-Cell Foam	I	Pads, Rolls	W	Open-Cell Foam membrane	Not available	20-35 times its weight, 0.69 gal per pad	ASTM F726	Yes	Yes	Some	3/8" x 18" x 20"	
160	AquaFlex	http://www.aqflx.com/products.php	Eelgrass	IIIc	Sweep	W	Open-Cell Foam	Not available	20-35 times its weight, 4.1 gal per 5'	ASTM F726	Yes	Yes	Some	5' with 18" fingers	
161	Abasco	https://www.abasco.com/sorbents.html	Oil Absorbent Pads	I	Pads	L-W	Polypropylene	Meltblown	0.3 gal per heavyweight pad	Not available	Yes	No	No	15" x 18"	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
162	Abasco	https://www.abasco.com/sorbents.html	Oil Absorbent Rolls	I	Rolls	L-W	Polypropylene	Not available	Not available	Not available	Yes	No	No	30" x 150"	
163	Abasco	https://www.abasco.com/sorbents.html	Oil Absorbent Booms	IIIb	Booms	W	Polypropylene	Not available	7.5 gal for a 5"x10' boom	Not available	Not available	Not available	No	4", 5", or 8" x 10'	
164	Brady SPC	https://www.bradyid.com/en-us/product/spc312	SPC Absorbent Sock	IIIa	Socks	L-W	Polypropylene	Not available	9.5 gl/gs, 3 gal per sock	Not available	Not available	Not available	90% recycled	3" x 12'	
165	Brady SPC	https://www.bradyid.com/en-us/product/rfo412	Re-Form Absorbent Sock	IIIa	Socks	L-W	Recycled newsprint and other cellulose, cotton	Not available	13.5 gl/gs, 1.25 gal per sock	Not available	Not available	wringable	Yes	3" x 4'	
166	Brady SPC	https://www.bradyid.com/en-us/family/cps-brus-10861	Oil Only Pillow	IIIa	Pillows	L-W	Polypropylene	Not available	12.5 gl/gs, 0.5 gal per small pillow, 1.75 gal per big pillow	Not available	Not available	Not available	90% recycled	9" x 9" or 18" x 18"	
167	Brady SPC	https://www.bradyid.com/en-us/family/cps-brus-10863?Class=Oil Only	Premium Oil Only Boom	IIIb	Booms	L-W	Polypropylene	Not available	9.5-12.5 gl/gs	Not available	Not available	Not available	90% recycled	3"-8" diameter, 1.5'-20' length	
168	Brady SPC	https://www.bradyid.com/en-us/product/spc5510	SPC Absorbent Double Boom	IIIb	Booms	L-W	Polypropylene	Not available	12.1 gl/gs, 8 gal per double boom	Not available	Not available	Not available	No	5" x 10'	
169	Brady SPC	https://www.bradyid.com/en-us/product/odn08	Drag Net, Roped	IV	Pom poms	W		Not available	15 gl/gs, 15 gallons	Not available	Not available	yes, after draining or dousing with light oil	No	50' long with 30 nets	
170	CONDOR	https://www.grainger.com/category/safety/spill-control-supplies/absorbents?attrs=Spill+Control+-+Fluids+Absorbed%7COil-Based+Liquids&brandName=CONDOR&filters=attrs,brandName	Absorbent Pad	I	Pads	L-W	Polypropylene	Not available	21/33 gallon per 100 light/heavy pads	Not available	Not available	Not available	No	15" x 19"	
171	CONDOR	https://www.grainger.com/category/safety/spill-control-supplies/absorbents?attrs=Spill+Control+-+Fluids+Absorbed%7COil-Based+Liquids&brandName=CONDOR&filters=attrs,brandName	Absorbent Boom	IIIb	Booms	W		Not available	32/65 gallons per 4 small/large booms	Not available	Not available	Not available	No	5" or 8" x 10'	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
172	CONDOR	https://www.grainger.com/category/safety/spill-control-supplies/absorbents?attrs=Spill+Control+-+Fluids+Absorbed%7COil-Based+Liquids&brandName=CONDOR&filters=attrs,brandName	Absorbent Roll	I	Rolls	L-W	Polypropylene	Not available	12.5-24 gal per 150' of light, medium or heavy	Not available	Not available	Not available	No	15" or 30" x 150' or 300'	
173	CONDOR	https://www.grainger.com/category/safety/spill-control-supplies/absorbents?attrs=Spill+Control+-+Fluids+Absorbed%7COil-Based+Liquids&brandName=CONDOR&filters=attrs,brandName	Absorbent Pillow	IIIa	Pillows	L-W	Polypropylene	Not available	0.5 to 2 gal per pillow	Not available	Not available	Not available	No	8.5" to 18"	
174	CONDOR	https://www.grainger.com/category/safety/spill-control-supplies/absorbents?attrs=Spill+Control+-+Fluids+Absorbed%7COil-Based+Liquids&brandName=CONDOR&filters=attrs,brandName	Absorbent Sock	IIIa	Socks	L-W	Polypropylene	Not available	1-5 gal per sock	Not available	Not available	Not available	No	1.5"-3" diameter, 2'-20' length	
175	Brady SPC	https://www.grainger.com/product/BRADY-SPC-ABSORBENTS-Oil-Based-Liquids-Corn-Cob-3RPP6	Oil-Based Liquids Corn Cob Loose Absorbent	II	Granular		Corn Cob	Not available	8.5 gal per 40 lb bag	Not available	No	No		40 lbs	
176	Oil Gator	https://www.grainger.com/product/BRADY-SPC-ABSORBENTS-Oil-Based-Liquids-Natural-2VYX1	Oil-Based Liquids Natural Cellulosic Fibers Loose Absorbent	II	Granular		Natural Cellulosic Fibers	Not available	2-6 gal per 30 lb bag	Not available	No	No	Yes	30 lbs	
177	Ability ONE	https://www.grainger.com/product/ABILITY-ONE-18-Absorbent-Pad-54ZH74	SKILCRAFT Absorbent Pads	I	Pads		Cotton, Polyester	Not available	25 gal per 100 pads	Not available	Not available	No	No	18" x 18.5"	
178	SPILLTECH	https://www.spilltech.com/webapp/wcs/stores/servlet/ProductDisplay?storeId=10052&catalogId=10151&langId=-1&categoryId=10943&subCategoryId=10968&topCategoryId=10975&productId=16665	Oil-Only Responder Pads and Rolls	I	Pads	L-W	Polypropylene	Meltblown	0.33 gal per heavyweight pad	Not available	Yes	No	No	15" x 19"	
179	SPILLTECH	https://www.spilltech.com/webapp/wcs/stores/servlet/CategoryDisplayView?storeId=10052&catalogId=10151&langId=-1&categoryId=10918&subCategoryId=10968&topCategoryId=10975	Oil-Only Defender Pads and Rolls	I	Pads	L-W	Polypropylene	Meltblown with Spunbond Cover	0.3 gal per heavyweight pad	Not available	Yes	No	No	15" x 19"	
180	SPILLTECH	https://www.spilltech.com/webapp/wcs/stores/servlet/CategoryDisplayView?storeId=10052&catalogId=10151&langId=-1&categoryId=10944&subCategoryId=10961&topCategoryId=10976	Oil-Only Boom	IIIb	Booms	W	Polypropylene	Not available	7.5 gal for a 5"x10' boom	Not available	Not available	Not available	No	4"-8" x 10'	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
181	SPILLTECH	https://www.spilltech.com/webapp/wcs/stores/servlet/CategoryDisplayView?storeId=10052&catalogId=10151&langId=-1&categoryId=10908&subCategoryId=10972&topCategoryId=10976	Pompoms	IV	Pom poms	W	Polypropylene	Not available	50 oz. per pom pom	Not available	Not available	Not available	No	single or several on a rope	
182	SPILLTECH	https://www.spilltech.com/webapp/wcs/stores/servlet/ProductDisplay?storeId=10052&catalogId=10151&langId=-1&categoryId=10908&subCategoryId=10972&topCategoryId=10976&productId=17019	Oil-Only Net Bags	IV	Net bags	W	Poly blend in nylon mesh bag	Not available	3.7 gal per bag	Not available	Not available	Not available	No	16.5" x 20..5" x 31"	
183	SPILLTECH	https://www.spilltech.com/webapp/wcs/stores/servlet/ProductDisplay?storeId=10052&catalogId=10151&langId=-1&categoryId=10908&subCategoryId=10972&topCategoryId=10976&productId=17733	Oil-Only Protector Folded Sweep	IIIc	Sweep	W	Polypropylene	Not available	25 gal	Not available	Not available	Not available	No	19" x 100'	
184	SPILLTECH	https://www.spilltech.com/webapp/wcs/stores/servlet/ProductDisplay?storeId=10052&catalogId=10151&langId=&categoryId=16447&subCategoryId=16444&topCategoryId=16426&productId=16847	Oil-Only Loose Particulate	II	Granular	L-W	Polypropylene	Not available	58 gal per bag	Not available	No	No	Yes	25 lbs	
185	SPILLTECH	https://www.spilltech.com/webapp/wcs/stores/servlet/ProductDisplay?storeId=10052&catalogId=10151&langId=&categoryId=16447&subCategoryId=16444&topCategoryId=16426&productId=15137	Loose Peat Moss	II	Granular	L	Peat Moss	Not available	16 gal per bag	Not available	No	No	No	18 lbs	
186	SPILLTECH	https://www.spilltech.com/webapp/wcs/stores/servlet/CategoryDisplayView?storeId=10052&catalogId=10151&langId=-1&categoryId=10923&subCategoryId=10969&topCategoryId=10978	Oil-Only Poly Blend Pillow	IIIa	Pillows	L-W	Poly Blend	Not available	0.75-2.3 gal per pillow	Not available	Not available	Not available	No	10"x10", 18"x18", 8"x18"	
187	Spill Magic	https://www.grainger.com/product/SPILL-MAGIC-Oil-Based-Liquids-Amorphous-437J97	Amorphous Aluminua Silicate Absorbent Powder	II	Powder		Amorphous Alumina Silicate	Not available	9 gal per bag	Not available	No	No	No	30 lbs	
188	ZEP	https://www.grainger.com/product/ZEP-Oil-Based-Liquids-Inert-449V71	Organic Loose Absorbent	II	Granular	L-W	Peat Moss	Not available	1 gal per lb	Not available	No	No	No	2 cu. Ft. per bag (54 lbs)	
189	Parker Systems, Inc.	http://www.parkersystemsinc.com/sorbents/sorbent-pads/	Oil Sorbent Pads	I	Pads	L-W	Not available	Not available	0.18-0.34 gal per pad (lightweight to heavy)	Not available	Not available	Not available	No	15"x19"	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
190	Parker Systems, Inc.	http://www.parkersystemsinc.com/sorbents/booms-socks/	Light Oil Sorbent Boom	IIIb	Booms	W	Not available	Not available	Not available	Not available	Not available	Not available	No	5" or 8" x 10'	
191	Parker Systems, Inc.	http://www.parkersystemsinc.com/sorbents/booms-socks/	Sorbent Socks	IIIa	Socks	L-W	Not available	Not available	1-5 gal per sock	Not available	Not available	Not available	No	3" x 4'-20'	
192	Parker Systems, Inc.	http://www.parkersystemsinc.com/sorbents/pillows/	Pillow	IIIa	Pillows	L-W	Not available	Not available	Not available	Not available	Not available	Not available	No	9"x15" to 18"x24"	
193	Parker Systems, Inc.	http://www.parkersystemsinc.com/sorbents/sorbent-sweep/	Sorbent Sweep	IIIc	Sweep	W	Reinforced with nylon straps and laminated spunbond fabric	Not available	18 gal	Not available	No	No	No	19" x 100'	
194	Parker Systems, Inc.	http://www.parkersystemsinc.com/sorbents/sorbent-blankets-rolls/	Sorbent Blanket	I	Blankets	L-W	Not available	Not available	64 gal per roll	Not available	Not available	Not available	No	30" x 150'	
195	Parker Systems, Inc.	http://www.parkersystemsinc.com/products/loose-sorbents/	Oil Sorbent Particulate	II	Fibers	L-W	Polypropylene	Not available	Not available	Not available	No	No	No	27 lbs	
196	Parker Systems, Inc.	http://www.parkersystemsinc.com/products/loose-sorbents/	Absorbent W, Oil Only Cellulose	II	Loose	L	Cellulose Pulp	Not available	3 times its weight	Not available	No	No	Yes	10 lbs	
197	Spill Tackle	https://new.spilltackle.com/products/sock/	Spill Tackle Socks	IIIa	Socks	L-W	Rice, wood, mineral oil	Not available	5 x its weight	Not available	No	No	Yes	4' or 10' length	
198	Spill Tackle	https://new.spilltackle.com/products/super-sack/	Spill Tackle Super Sack	II	Granular	L-W	Rice, wood, mineral oil	Not available	8-10 gal per 20 lbs	Not available	No	No	Yes	1200-1400 lbs	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
199	Ambere	http://ambere.net/en/products/	Adsorboil Organic Spill Mats	I	Mats	L-W	Bird feather	Not available	7-24 times its weight, depending on oil viscosity	Not available	No	No	No	Not available	
200	Osprey Spill Control	https://ospreyspillcontrol.com/products/	Bonded Pads and Rolls	I	Pads	L-W	Polypropylene	Bonded	about 0.2 gal per pad (15"x17")	Not available	Not available	Not available	No	15"x17", 30"x30"	
201	Osprey Spill Control	https://ospreyspillcontrol.com/products/	Meltblown Pads and Rolls	I	Pads	L-W	Polypropylene	Meltblown	about 0.2 gal per pad (15"x17"), 25x their weight	Not available	Not available	Not available	No	15"x17", 30"x30"	
202	Osprey Spill Control	https://ospreyspillcontrol.com/products/	Oil-Only Boom	IIIb	Booms	L-W	Polypropylene Particulate	Not available	8 gal for a 5"x10', 356 gal for an 8"x200'	Not available	Not available	Not available	No	5" or 8" x 5'-200'	
203	Osprey Spill Control	https://ospreyspillcontrol.com/products/	Particulate	II	Particles	L-W	Polypropylene Particulate	Meltblown	50 gal per bag	Not available	Not available	Not available	No	25 lbs	Not available
204	Osprey Spill Control	https://ospreyspillcontrol.com/products/	Boom Pillow	IIIa	Pillows	L-W	Not available	Not available	4.2 gal per pillow	Not available	Not available	Not available	No	8" x 18"	
205	Osprey Spill Control	https://ospreyspillcontrol.com/products/	Sack Pillow	IIIa	Pillows	L-W	Not available	Not available	4.2 gal per pillow	Not available	Not available	Not available	No	14" x 25"	
206	Osprey Spill Control	https://ospreyspillcontrol.com/products/	Sock	IIIa	Socks	L-W	Polypropylene	Not available	0.3-5 gal	Not available	Not available	Not available	No	3" x 2'-12'	
207	Osprey Spill Control	https://ospreyspillcontrol.com/products/	Pillow	IIIa	Pillows	L-W	Polypropylene	Not available	0.75-4 gal per pillow	Not available	Not available	Not available	No	9"x9" to 18"x24" 3" thick	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
208	Osprey Spill Control	https://ospreyspillcontrol.com/products/	Cotton Sock	IIIa	Socks	L-W	Cotton	Not available	1.65-4 gal per sock	Not available	Not available	Not available	Yes	3" x 4'-10'	
209	Osprey Spill Control	https://ospreyspillcontrol.com/products/	Cotton Pillow	IIIa	Pillows	L-W	Cotton	Not available	0.85-1.4 gal per pillow	Not available	Not available	Not available	Yes	11"x13" or 10"x10" 3" thick	
210	Osprey Spill Control	https://ospreyspillcontrol.com/products/	Peat Pillow	IIIa	Pillows	L-W	Peat Moss	Not available	Not available	Not available	No	No	No	18" x 18"	
211	Osprey Spill Control	https://ospreyspillcontrol.com/products/	Peat Sock	IIIa	Socks	L-W	Peat Moss	Not available	Not available	Not available	No	No	No	2"x10', 4"x4', 4"x8'	
212	Fluid Environmental Services	http://www.fluidenvironmental.com/cellusorb.html	Cell-U-Sorb	II	Granular	L-W	Cellulose	Not available	13-25 gal per bag, 8-12 times its weight	Not available	No	No	Yes	20 lbs	
213	CHEMTEX	https://www.chemtexinc.com/marine-spill-response/oil-snare.html	Oil Snare	IV	Pom poms	W	Polypropylene	Not available	16-64 lbs of oil per lb of product, depending on oil type	Not available	No	No	No	singles or 30 on a rope	
214	CHEMTEX	https://www.chemtexinc.com/granulars-neutralizers-bioremediation/granulars/biodegradable-granulars/peat-moss.html	Peat Moss	II	Loose	L-W	Peat Moss	Not available	16 gal per bag	Not available	No	No	No	18 lbs	
215	CHEMTEX	https://www.chemtexinc.com/absorbents/oil-only-pads-rolls.html	Oil Only Pads and Rolls	I	Pads	L-W	Polypropylene	Meltblown	0.32 gal per heavyweight 15"x19" pad	Not available	Not available	No	No	Pads: 15"x19", 30"x30". Rolls: 15" or 30" x 150'-300'	
216	CHEMTEX	https://www.chemtexinc.com/absorbents/booms-sweeps/oil-only-booms.html	Oil Only Booms	IIIb	Booms	L-W	Polypropylene	Not available	8 gal for a 3"x20' boom	Not available	Yes	No	No	3"-8" x 10'-20'	

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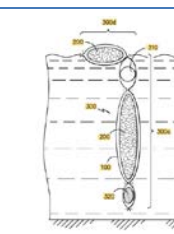
217	CHEMTEX	https://www.chemtexinc.com/absorbents/booms-sweeps/oil-only-boom-xt.html	Oil Only Boom XT	IIIb	Booms	L-W	Polypropylene	Not available	8.75-16.25 gal per boom	Not available	Not available	No	No	5" or 8" x 10'	
218	CHEMTEX	https://www.chemtexinc.com/absorbents/booms-sweeps/oil-only-sweeps.html	Oil Only Sweeps	IIIc	Sweep	W	Polypropylene	Meltblown with Spunbond Cover	25 gal per sweep	Not available	Not available	No	No	19" x 100'	
219	CHEMTEX	https://www.chemtexinc.com/absorbents/pillows/oil-only-pillows.html	Oil Only Pillows	IIIa	Pillows	L-W	Polypropylene	Not available	1-2 gal per pillow	Not available	Not available	No	No	9"x15" to 18"x24"	
220	CHEMTEX	https://www.chemtexinc.com/absorbents/pillows/oil-only-mesh-bag-pillow.html	Oil Only Mesh Bag Pillow	IIIa	Pillows	L-W	Polypropylene particulate in nylon mesh bag	Not available	5 gal per pillow	Not available	Not available	No	No	14" x 24"	
221	CHEMTEX	https://www.chemtexinc.com/absorbents/pillows/spaghetti-pillow.html	Spaghetti Pillow	IIIa	Pillows	W	Polypropylene spaghetti strands	Not available	3 gal per pillow	Not available	Not available	No	No	15" x 15"	
222	CHEMTEX	https://www.chemtexinc.com/absorbents/socks/oil-only-socks/oil-only-polypropylene.html	Oil Only Polypropylene Socks	IIIa	Socks	L-W	Polypropylene	Not available	1-5 gal per sock	Not available	Not available	No	No	3" x 4'-20'	
223	Dove Biotech Company	https://dovebiotech.com/product-categories/oil-spill-clean-up-organozorb/	Organozorb	II	Granular	L-W	Naturally occurring aluminosilicates: Polyhexamethylene Biguanide (PHMB), biocide, microporous mineral surfactants impregnated with microbes, Bacillus subtillis	Not available	Not available	Not available	No	No	No	55 lb bag	
224	Milliken & Company	https://patents.google.com/patent/US20110280660A1/en	Polymer Nanofiber-based Sorbent	I	Pads	L-W	Hydrophobic polypropylene nanofiber	List several options for processing fibers. One is melt-film fibrillation that extrudes a film which is fibrillated into small fibers via a high velocity gas that shears the film. Process can produce nanofiber diameters down to <500 nanometers	50 times its weight in oil	Not available	Yes	Yes	No	Not available	
225	Ekosorber Ltd., Russia		Gigasorb	I	Rolls	W	Non-woven, multicomponent, thermo-bonded polymer fiber web	Made from Megasorb by immobilizing nanoparticles (10-50 nm) of activated carbon on surface of fibers	36 kg of oil for 1 kg of sorbent	Not available	Not available	Yes	No	Not available	Not available

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226	SA Envitech	http://demo239.webbazaar.com/uploads/aquaspherenew/SA_borchure2011.pdf	Recam	II	Loose	W	Reactive nanostructured carbon (graphene cells)	The RECAM® base structure comprises graphene planes that are modelled and inclined during the production process to form a structure with regular cells and channels, physical process and no chemicals required	92 kg of oil for 1 kg of sorbent	Not available	Yes (can recover 90%)	Yes	No	Not available	Not available
227	Can-Ross	https://www.canross.com/product/oil-only-absorbent-booms/	Oil Only Absorbent Booms	IIIb	Booms	L-W	Polypropylene	Meltblown	9 times its weight (boom weighs 4.5 or 11 lbs)	Not available	Not available	Not available	No	5" or 8" x 10'	
228	Can-Ross	https://www.canross.com/product/oil-only-absorbent-flat-pillows-3-x-16-10-case/	Oil Only Absorbent Flat Pillows	IIIa	Pillows	L-W	Polypropylene	Meltblown	10 times its weight (pillow weighs 2.3 lbs)	Not available	Not available	Not available	No	3" x 16" x 24"	
229	Can-Ross	https://www.canross.com/product/oil-only-absorbent-pads-sbop	Oil Only Absorbent Pads, Rolls	I	Pads, Rolls	L-W	Polypropylene	Meltblown	10 times its weight (17 lbs for 100 double weight pads)	Not available	Not available	Not available	No	17" x 19" pads, 38" x 144' rolls	
230	Can-Ross	https://www.canross.com/product/spill-busterstm-oil-only-premium	Spill Buster Oil Only Premium	IIIb	Booms	L-W	Polypropylene	Meltblown	10 times its weight (boom weighs 4.5 or 11 lbs)	Not available	Not available	Not available	No	5" or 8" x 10'	
231	Can-Ross	https://www.canross.com/product/pom-pom-oil-only-6oz/	Pom Pom Oil Only	IV	Pom pom	L-W	Not available	Not available	20-60 times its weight (1 weighs 6 oz.)	Not available	Not available	Not available		11" x 14" x 24"	
232	DSS Marine	http://www.dssmarine.com/products_details.asp?ID=370&DivisionID=1&SubCategoryID=1160&CategoryID=49	Oil Only Sorbent Boom	IIIb	Booms	L-W	Polypropylene	Not available	7.5-9.5 gal per boom	Not available	Not available	Not available	Yes	5" or 8" x 10'	
233	DSS Marine	http://www.dssmarine.com/products_details.asp?ID=355&DivisionID=1&SubCategoryID=965&CategoryID=49	Oil Only AirLaid Sorbent Pads and Rolls	I	Pads	L-W	Polypropylene	Spunbond	40 oz. per pad	Not available	Not available	Not available	Yes	15" x 19"	
234	DSS Marine	http://www.dssmarine.com/products_details.asp?ID=367&DivisionID=1&SubCategoryID=965&CategoryID=49	Oil Only SonicBonded Sorbent Pads	I	Pads	L-W	Polypropylene	Meltblown	20-37 oz. per pad (light vs. heavyweight)	Not available	Not available	Not available	No	15" x 19"	

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235	Hi-Point Industries	https://www.oclansorb.com/oclansorb-oil-absorbent	Oclansorb	II	Granular	L-W	Peat Moss	Not available	1 gal per lb	Not available	No	No	No	13 or 44 L	
236	Hi-Point Industries	https://www.oclansorb.com/other-products-1	Sorb-Sox	IIIb	Booms, Socks	L-W	Peat Moss	Not available	1 gal per lb	Not available	No	No	No	4" x 2', 4', or 8', 7" x 10'	
237	Hi-Point Industries	https://www.oclansorb.com/other-products-1	Spillow	IIIa	Pillows	L-W	Polypropylene cover filled with Peat Moss	Not available	0.75-1.5 gal per pillow	Not available	No	No	No	17" x 9.5" x 2", 17" x 19" x 2"	
238	SpilKleen	https://spilkleen.com/products/granulars/peat/n-a-414.html	Cansorb	II	Granular	L-W	Peat Moss	Not available	8-12 times its weight	Not available	No	No	No	5 lbs	
239	SpilKleen	https://spilkleen.com/products/absorbents/oil-only/green-initiative-oil-only-pads/n-a.html	RETEC Cellulose Oil Only Pads	I	Pads	L-W	Cellulose	Not available	Not available	Not available	Not available	Not available	Yes	20" x 16"	
240	SpilKleen	https://spilkleen.com/products/absorbents/oil-only/socks.html	Socks Oil Only	IIIb	Socks	L-W	Polypropylene	Meltblown	25 times their weight	Not available	Not available	Not available	No	3" x 4', 8', 10'	
241	SpilKleen	https://spilkleen.com/products/absorbents/oil-only/pillows.html	Pillows Oil Only	IIIa	Pillows	L-W	Polypropylene	Meltblown	25 times their weight	Not available	Not available	Not available	No	8" or 18" x 18"	
242	SpilKleen	https://spilkleen.com/products/absorbents/oil-only/pillows/n-a-242.html	Sack Pillow	IIIa	Pillows	L-W	Polypropylene	Not available	25 times their weight	Not available	Not available	Not available	No	14" x 25"	
243	SpilKleen	https://spilkleen.com/products/absorbents/oil-only/booms.html	Boom Oil Only	IIIb	Booms	L-W	Polypropylene	Meltblown	25 times their weight	Not available	Not available	Not available	No	5" or 8" x 10'	
244	Integrity Industrial Absorbent Products	http://www.integrityabsorbents.com/content/rollsPads.php	Rolls and Pads for Oils	I	Pads	L-W	Polypropylene	Not available	up to 2 liters	Not available	Not available	Not available	No	16.5" or 33" x 150' or 300' rolls, 16" x 18" or 33" x 36" pads	

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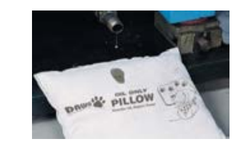
245	Integrity Industrial Absorbent Products	http://www.integrityabsorbents.com/content/socksPillows.php	Socks & Pillows for Oils	IIIa	Pillows	L-W	Not available	Not available	Not available	Not available	Not available	Not available	No	15" x 12" or 25" pill	
246	Integrity Industrial Absorbent Products	http://www.integrityabsorbents.com/content/socksPillows.php	Socks & Pillows for Oils	IIIb	Socks	L-W	Not available	Not available	Not available	Not available	Not available	Not available	No	3" x 4', 6', 8', 10' socks	
247	Integrity Industrial Absorbent Products	http://www.integrityabsorbents.com/content/boomsOils.php	Booms for Oils	IIIb	Booms	L-W	Polypropylene	Meltblown	Not available	Not available	Not available	Not available	No	5" or 8" x 10'	
248	esp CANADA	http://ca.espsorbents.com/en/cat/pads-and-rolls/11	Meltblown Pads and Rolls	I	Pads and Rolls	L-W	Polypropylene	Meltblown	0.14 gal per lightweight pad, 0.18 gal per medium and heavy pad	ASTM 726	Not available	Not available	No	15" x 18"	
249	esp CANADA	http://ca.espsorbents.com/en/cat/pads-and-rolls/11	Coldform2 Pads and Rolls	I	Pads and Rolls	L	Cellulose	Not available	0.15 gal per lightweight pad, 0.21 gal per medium and heavy pad	ASTM 726	Not available	Not available	Yes	16" x 18"	
250	esp CANADA	http://ca.espsorbents.com/en/cat/pads-and-rolls/11	Airmatrix Pads and Rolls	I	Pads and Rolls	L	Polypropylene	Not available	0.3 gal per heavyweight pad	ASTM 726	Not available	Not available	Yes	16" x 18"	
251	esp CANADA	http://ca.espsorbents.com/en/prod/other-absorbents/booms/single-skin-boom/single-skin-boom-in-oil-only/246	Single Skin Boom in Oil Only	IIIb	Booms	W	Polypropylene	Meltblown	6.5 or 10 gal per boom	ASTM 726	Not available	Not available	Yes	5" or 8" x 10'	
252	esp CANADA	http://ca.espsorbents.com/en/prod/other-absorbents/booms/sock-in-net-boom/sock-in-net-oil-only-boom/444	Sock-in-net Oil only Boom	IIIb	Booms	W	Polypropylene	Spunbond	6 or 9.5 gal per boom	ASTM 726	Not available	Not available	Yes	4-7" x 10'	
253	esp CANADA	http://ca.espsorbents.com/en/prod/other-absorbents/socks/spun-bond-range/spun-bond-socks-in-oil-only/158	Spun-bond Socks in Oil only	IIIb	Socks	L	Polypropylene	Spunbond	1.5 gal per sock	ASTM 726	Not available	Not available	Yes	3" x 4'	

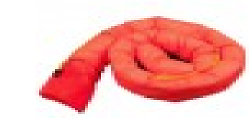
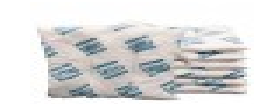
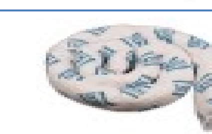
No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
254	esp CANADA	http://ca.espsorbents.com/en/prod/other-absorbents/pillows/pillow-in-oil-only-1/174	Pillow in Oil only	IIIa	Pillows	L	Polypropylene	Spunbond	1.6 gal per pillow	ASTM 726	Not available	Not available	Yes	18" x 18" or 9" x 15"	
255	esp CANADA	http://ca.espsorbents.com/en/prod/other-absorbents/pillows/net-bag-pillows-in-oil-only/336	Net Bag Pillows in Oil only	IIIa	Pillows	L-W	Polypropylene	Not available	3.2 gal per pillow	ASTM 726	Not available	Not available	No	6" x 16" x 21"	
256	WYK Sorbent Products	https://wyksorbents.com/wp-content/uploads/2019/02/Pg-40-Poly-Heavy-Grade.pdf	Hi-Capacity Sorbent Pads & Rolls	I	Pads	L-W	Polypropylene	Meltblown with Spunbond Cover	0.31 gal per pad	Not available	Not available	Not available	No	19" x 15" pads, 15" or 30" x 150' rolls	
257	WYK Sorbent Products	https://wyksorbents.com/wp-content/uploads/2019/02/Pg-43-Poly-Contractor-Grade.pdf	Contractor Grade Pads & Rolls	I	Pads	L-W	Polypropylene	Not available	0.22 gal per pad	Not available	Not available	Not available	No	18" x 15" pads, 30" x 150' rolls	
258	WYK Sorbent Products	https://wyksorbents.com/product/oil-selective-pillows-7818/	Oil Selective Pillows	IIIa	Pillows	L-W	Polypropylene	Not available	0.7 to 2.3 gal per pillow	Not available	Yes	Yes	No	10" x 10" x 2" to 18" x 18" x 2"	
259	WYK Sorbent Products	https://wyksorbents.com/product/oil-selective-polypropylene-8-booms-745/	Oil Selective Polypropylene Booms	IIIb	Booms	L-W	Polypropylene	Not available	7.5 gal per boom	Not available	Yes	Yes	No	5" and 8" x 10'	
260	WYK Sorbent Products	https://wyksorbents.com/product/oil-selective-socks-3x12-787/	Oil Selective Socks	IIIb	Socks	L-W	Polypropylene	Not available	0.8 to 2.5 gal per sock	Not available	Yes	Yes	No	3" x 4' and 12'	
261	SETON	https://www.seton.com/dawgr-oil-only-economy-pads-and-rolls-659.html#PAD118	Dawg Oil Only Economy Pads	I	Pads	L-W	Fiber	Not available	0.26 gal per lightweight, 0.36 gal per heavyweight	Not available	Not available	Not available	No	15" x 19" or 30" x 30"	
262	SETON	https://www.seton.com/dawgr-oil-only-premium-pads-and-rolls-660.html	Dawg Oil Only Premium Pads	I	Pads	L-W	Polypropylene	Not available	0.15 gal per lightweight, 0.35 gal per heavyweight	Not available	Not available	Not available	No	15" x 19" or 30" x 30"	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
263	SETON	https://www.seton.com/dawgr-oil-only-deluxe-pads-and-rolls-661.html	Dawg Oil Only Deluxe Pads & Rolls	I	Pads and Rolls	L-W	Polypropylene	Meltblown	0.15 gal per lightweight, 0.2 gal per heavyweight	Not available	Not available	Not available	No	15" x 19"	
264	SETON	https://www.seton.com/dawgr-skimming-booms-679.html#BOM820	Dawg Skimming Booms	IIIb	Booms	L-W	Polypropylene	Not available	8-16 gal per boom	Not available	Not available	Not available	No	5" or 8" x 10'	
265	SETON	https://www.seton.com/dawgr-oil-only-socks-793.html	Dawg Oil Only Socks	IIIb	Socks	L-W	Polypropylene	Not available	1-2 gal per sock	Not available	Yes	Yes	No	3" x 4' or 8'	
266	SETON	https://www.seton.com/dawgr-pillows-681.html	Dawg Pillows	IIIa	Pillows	L-W	Polypropylene	Not available	0.6-1.75 gal per pillow	Not available	Not available	Not available	No	9" x 9" or 18" x 18"	
267	Cansorb	http://www.avpeat.com/cansorb.html	Socks	IIIb	Socks	L-W	Peat Moss	Not available	8 times its weight, 1.5-3 gal per sock	Not available	No	No	No	3.5" x 4' or 8'	
268	Cansorb	http://www.avpeat.com/cansorb.html	Pillows Oil Only	IIIa	Pillows	L-W	Peat Moss	Not available	8 times its weight, 0.75-1.5 gal per pillow	Not available	No	No	No	12" x 12" or 12" x 24"	
269	OILEX	https://www.poseidonms.com/product/oilex-binding-agent/	OILEX Binding Agent	II	Granular	L-W	hydrophobic biogenic sediment	Not available	2.84 liters/kg	lab tested in Germany	No	No	No	50L, 10L, 1L bags	
270	OILEX	https://www.poseidonms.com/product/oilex-pads/	OILEX Pads	I	Pads	L-W	spun fleece filled with hydrophobic biogenic sediment	Not available	1-14 liters per pad	lab tested in Germany	No	No	No	20x30cm to 60x80cm	
271	OILEX	https://www.poseidonms.com/wp-content/uploads/OILEX_Product_Datasheet_Boom1.pdf	OILEX Boom	IIIb	Booms	L-W	spun fleece filled with hydrophobic biogenic sediment	Not available	14-17 liters per boom	lab tested in Germany	No	No	No	20 x 150 cm	
272	EP Minerals	https://epminerals.com/products/oil-absorbent-de	Oil Absorbent DE	II	Granular	L	Diatomaceous Earth	Not available	50% more per lb than clay products	Not available	No	No	No	25 lb bag	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
273	DENIOS	https://www.denios-us.com/shop/oil-only-commander-roll-15-x-100-1-roll-package/	Oil-Only Commander Roll	I	Rolls	L-W	Polypropylene	Not available	40 gal / roll	Not available	No	No	No	15" x 100'	
274	DENIOS	https://www.denios-us.com/shop/drum-tug-4-drum-capacity-removable-grating-steel-construction-secure-storage/	Absorbent Boom	IIIb	Booms	L-W	Poly blend	Not available	7.5 gal per 5"x10' boom	Not available	No	No	No	5"x10', 8"x20', 8"x10'	
275	DENIOS	https://www.denios-us.com/shop/spill-control/densorb-absorbents/absorbent-pillows/filter/670/?cHash=e761ee8569fb4e097f340ad609299e8c	Absorbent Pillow	IIIa	Pillows	L-W	Polypropylene	Not available	1.3-2.9 gal per pillow	Not available	No	No	No	8" x 18", 18"x18"	
276	DENIOS	https://www.denios-us.com/shop/spill-control/densorb-absorbents/absorbent-pads/filter/670/?cHash=e761ee8569fb4e097f340ad609299e8c	Absorbent Pads	I	Pads	L-W	Polypropylene	Meltblown	0.2-0.26	Not available	No	No	No	15" x 19"	
277	3M	https://www.3m.com/3M/en_US/company-us/all-3m-products/~/3M-Petroleum-Sorbent-Pad-HP-156-High-Capacity-100-Each-Case/?N=5002385+8709322+8710653+3294754400&rt=rud	3M Petroleum Sorbent Pad HP-156, High Capacity	I	Pads	L-W	Polypropylene	Not available	0.375 gal/pad	ASTM F726	Yes (90%)	Yes	25% recycled material	19" x 17"	
278	3M	https://www.3m.com/3M/en_US/company-us/all-3m-products/~/3M-Oil-Sorbent-Sheets-HP-255-430-mm-x-480-mm-50-Sheet-Case/?N=5002385+8709322+8710653+3294755087&rt=rud	3M Oil Sorbent Sheets HP-255	I	Pads	L-W	Polypropylene / Polyester	Not available	0.67 gal/pad	ASTM F726	Yes (90%)	Yes	25% recycled material	19" x 17"	
279	3M	https://www.3m.com/3M/en_US/company-us/all-3m-products/~/3M-Petroleum-Sorbent-Pad-T-156-100-Each-Case/?N=5002385+8709322+8710653+3294750266&rt=rud	3M Petroleum Sorbent Pad T-156	I	Pads	L-W	Polypropylene / Polyester	Not available	0.362 gal/pad	ASTM F726	Yes (90%)	Yes	25% recycled material	19" x 17"	
280	3M	https://www.3m.com/3M/en_US/company-us/all-3m-products/~/3M-Petroleum-Sorbent-Folded-P-FL550DD-T-F2001-07173-AAD-High-Capacity-3-Box-Case/?N=5002385+8709322+3294755028&rt=rud	3M Petroleum Sorbent Folded, High Capacity, P-FL550DD	I	Pads	L-W	Polypropylene / Polyester	Not available	10.5 gal	ASTM F726	Yes (90%)	Yes	25% recycled material	19" x 50', perforated every 16"	
281	3M	https://www.3m.com/3M/en_US/company-us/all-3m-products/~/3M-Petroleum-Sorbent-Pad-HP-157-High-Capacity-50-Each-Case/?N=5002385+8709322+8710653+3294755072&rt=rud	3M Petroleum Sorbent Pad HP-157, High Capacity	I	Pads	L-W	Polypropylene / Polyester	Not available	1.55 gal/pad	ASTM F726	Yes (90%)	Yes	25% recycled material	38" x 34"	
282	3M	https://www.3m.com/3M/en_US/company-us/all-3m-products/~/3M-Petroleum-Sorbent-Sweep-T-126-1-Each-Case/?N=5002385+8709322+8710653+3294750268&rt=rud	3M Petroleum Sorbent Sweep T-126	IIIc	Sweep	W	Polypropylene	Not available	16.8 gal	ASTM F726	Yes (90%)	Yes	25% recycled material	21" x 100'	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
283	3M	https://www.3m.com/3M/en_US/company-us/all-3m-products/~/3M-Petroleum-Sorbent-Double-Boom-T-280-4-Each-Case/?N=5002385+8709322+8710653+3294750261&rt=rud	3M Petroleum Sorbent Double Boom T-280	IIIb	Booms	W	Polypropylene / Polyester	Spunbond	9.2 gal per boom	ASTM F726	Not available	Not available	Not available	two 4" x 10'	
284	3M	https://www.3m.com/3M/en_US/company-us/all-3m-products/~/3M-Petroleum-Sorbent-Mini-Boom-T-4-12-Each-Case/?N=5002385+8709322+8710653+3294754339&rt=rud	3M Petroleum Sorbent Mini-Boom T-4	IIIb	Booms	L-W	Polypropylene / Polyester	Spunbond	1.31 gal, 2 gal, 3 gal	ASTM F726	Not available	Not available	Not available	3" x 4', 8', 12'	
285	3M	https://www.3m.com/3M/en_US/company-us/all-3m-products/~/3M-Petroleum-Sorbent-Roll-T-190-1-Each-Case/?N=5002385+8709322+8710653+3294609355&rt=rud	3M Petroleum Sorbent Roll T-190	I	Rolls	L-W	Polypropylene	Not available	36.8 gal	ASTM F726	Not available	Not available	Not available	19" x 144'	
286	3M	https://www.3m.com/3M/en_US/company-us/all-3m-products/~/3M-Petroleum-Sorbent-Boom-T-270-4-Each-Case/?N=5002385+8709322+8710653+3294750263&rt=rud	3M Petroleum Sorbent Boom T-270	IIIb	Booms	W	Polypropylene / Polyester	Spunbond	17.3 gal per boom	ASTM F726	Not available	Not available	Not available	8" x 10'	
287	3M	https://www.grainger.com/product/3M-17-Absorbent-Pad-39CD72	17" Absorbent Pad	I	Pads	L-W	Polypropylene / Polyester	Not available	0.18 gal/pad	ASTM F726	Yes (90%)	Yes	50% recycled material	17" x 15"	
288	3M	https://www.grainger.com/product/3M-150-ft-Absorbent-Roll-39CD77	150 ft Absorbent Roll MCP	I	Rolls	L-W	Polypropylene / Polyester	Not available	19 gal, 30 gal	ASTM F726	Yes (90%)	Yes	50% recycled material	15" x 150', 25" x 150'	
289	3M	https://www.grainger.com/product/3M-144-ft-Absorbent-Roll-39CD46	144 ft Absorbent Roll, Heavy HP-100	I	Rolls	L-W	Polypropylene / Polyester	Not available	73 gal	ASTM F726	Yes (90%)	Yes	25% recycled material	38" x 144'	
290	3M	https://www.grainger.com/product/3M-Absorbent-Pillow-39CD42	Absorbent Pillow T-30	IIIa	Pillows	L-W	Polypropylene / Polyester	Spunbond	0.5 gal	ASTM F726	Not available	Not available	Not available	7" x 15"	
291	3M	https://www.grainger.com/product/3M-Absorbent-Pillow-39CD41	Absorbent Pillow T-240	IIIa	Pillows	L-W	Polypropylene / Polyester	Spunbond	3.5 gal	ASTM F726	Not available	Not available	Not available	14" x 25"	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
292	3M	https://www.alliedelectronics.com/98-0711-0412-3.html	3M Petroleum Sorbent Particulate T-210	II	Particles	L-W	Not available	Not available	35 gal	Not available	Not available	Not available	Not available	25 lb	
293	EnSafeCo	https://www.ensafeco.com/imbiber-beads/	Enpac Imbiber Beads Pillow	IIIa	Pillows	L-W	Polymer Alkylstyrene Copolymer	Not available	1 gal/pound of material	Not available	Not available	No	Not available	1.4 lbs per pillow, 21" L x 14" W	
294	EnSafeCo	https://www.ensafeco.com/imbiber-beads/	Enpac Imbiber Beads Blanket	I	Blankets	L-W	Polymer Alkylstyrene Copolymer	Not available	1 gal/pound of material	Not available	Not available	No	Not available	4 lbs per blanket, 35" L x 21" W	
295	EnSafeCo	https://www.ensafeco.com/imbiber-beads/	Enpac Imbiber Beads Mini-Boom	IIIb	Booms	L-W	Polymer Alkylstyrene Copolymer	Not available	1 gal/pound of material	Not available	Not available	No	Not available	1.6 lbs per boom, 7" L x 42"	
296	EnSafeCo	https://www.ensafeco.com/imbiber-beads-sand-mix/	Enpac Imbiber Beads Sand Mix	II	Particles	L-W	Polymer Alkylstyrene Copolymer	Not available	0.7 gal/pound of material	Not available	Not available	No	Not available	20 lbs	
297	Blossom Enterprise	http://blossomenterprise.in/#features	Tuffsorb Pillows	IIIa	Pillows	L-W	Organic cotton with polypropylene filling, cellulose	Not available	0.68 gal per small pillow, 1.58 gal per large pillow	ASTM F726, BS 7959	Yes	Yes	Not available	10:" x 10", 18" x 18"	
298	Blossom Enterprise	http://blossomenterprise.in/#features	Tuffsorb Socks	IIIb	Socks	L-W	Organic cotton with polypropylene filling, cellulose	Not available	1.58 gal per sock	ASTM F726, BS 7959	Yes	Yes	Not available	3" x 4'	
299	Blossom Enterprise	http://blossomenterprise.in/#features	Tuffsorb Booms	IIIb	Booms	L-W	Organic cotton with polypropylene filling, cellulose	Not available	4, 11, 25 gal per boom	ASTM F726, BS 7959	Yes	Yes	Not available	3", 5", 8" x 10'	
300	Blossom Enterprise	http://blossomenterprise.in/#features	Tuffsorb Pads	I	Pads	L-W	Organic cotton	Not available	0.32 gal per heavyweight 15"x19" pad	ASTM F726, BS 7959	Yes	Yes	Not available	15" x 19"	
301	Blossom Enterprise	http://blossomenterprise.in/#features	Spill Nill KSPEAT-2	II	Powder	L-W	Peat Moss	Not available	47.4 gal	Not available	Not available	Not available	Not available	Not available	Not available

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
302	Blossom Enterprise	http://blossomenterprise.in/#features	Spill Nill KSCORK-5	II	Granular	L-W	Cork	Not available	23.7 gal	Not available	Not available	Not available	Not available	4.5 kg	Not available
303	Breg Absorbents	https://www.bregenvironmental.com/absorbents/absorbent-booms/breg-oil-only-absorbent-booms-5x10-4.html	Breg Oil Only Absorbent Booms	IIIb	Booms	L-W	Polypropylene	Mesh casing, spunbond inner skin	7-14 gal/boom	Not available	Not available	Not available	Yes	5", 8" x 10'	
304	Breg Absorbents	https://www.bregenvironmental.com/absorbents/absorbent-booms/boom-economy-5-x10-4-bag.html	Breg Oil Only Economy Booms	IIIb	Booms	L-W	Polypropylene	Spunbond skin	7.2 gal per boom	Not available	Not available	Not available	Yes	5" x 10'	
305	Breg Absorbents	https://www.bregenvironmental.com/absorbents/absorbent-booms/boom-oil-only-5-x-10-waterbroom-2-box.html	Breg Oil Only Water Broom	IIIb	Booms	W	PVC mesh skin, polypropylene filler	Not available	8 gal per boom	Not available	Not available	Not available	No	5" x 10'	
306	Breg Absorbents	https://www.bregenvironmental.com/absorbents/absorbent-pads-rolls/oil-only-pads-rolls.html	Breg Oil Only Economy Pads	I	Pads	L-W	Polypropylene	Meltblown	0.25 gal per lightweight, 0.28 gal per medium, 0.33 gal per heavyweight pad	Not available	Not available	Not available	No	15" x 19"	
307	Breg Absorbents	https://www.bregenvironmental.com/absorbents/absorbent-pads-rolls/oil-only-pads-rolls/oil-absorbent-economy-king-pad-30x36-50.html	Breg Oil Only Economy King Pads	I	Pads	L-W	Polypropylene	Meltblown	1.02 gal per pad	Not available	Not available	Not available	No	30" x 36"	
308	Breg Absorbents	https://www.bregenvironmental.com/absorbents/absorbent-pads-rolls/oil-only-pads-rolls/oil-only-roll-heavy-15x150.html	Breg Oil Only Roll	I	Rolls	L-W	Polypropylene	Meltblown	25 gal, 49 gal	Not available	Not available	Not available	No	15", 30" x 150'	
309	Breg Absorbents	https://www.bregenvironmental.com/absorbents/absorbent-pillows/oil-only-pillows.html	Breg Oil Only Pillows	IIIa	Pillows	L-W	Polypropylene	Not available	0.5 gal, 1.35 gal per pillow	Not available	Not available	Not available	Yes	10" x 10", 17" x 17"	
310	Breg Absorbents	https://www.bregenvironmental.com/absorbents/absorbent-socks/oil-only-socks/breg-oil-only-absorbent-socks-3x48-40-box.html	Breg Oil Only Absorbent Socks	IIIb	Socks	L-W	Polypropylene	Spunbond skin	1.61 gal	Not available	Not available	Not available	Yes	3" x 4'	
311	Breg Absorbents	https://www.bregenvironmental.com/absorbents/absorbent-socks/oil-only-socks/oil-absorbent-sock-4x120-4.html	Breg Oil Only Jumbo Sock	IIIb	Socks	L-W	Polypropylene	Spunbond skin	5.76 gal	Not available	Not available	Not available	Yes	4" x 10'	

No.	Manufacturer	Website	Product Name	Type	Subtype	Category	Material	Manufacturer Process	Sorption Claim	Test Method	Reuse Sorbed Oil	Reusable	Recycled	Size	Picture
312	Elastec	https://www.elastec.com/products/oil-spill-absorbents/	Oil Absorbent Boom	IIIb	Booms	L-W	Poly blend filler, polyester sleeve	Not available	7.5, 9.5 gal per boom	Not available	Not available	Not available	Yes	5", 8" x 10'	
313	Elastec	https://www.elastec.com/products/oil-spill-absorbents/	Absorbent Pads	I	Pads	L-W	Polypropylene	Not available	0.18-0.22 gal per pad	Not available	Not available	Not available	No	15" x 18"	
314	Elastec	https://www.elastec.com/products/oil-spill-absorbents/	Absorbent Blanket/Roll	I	Roll	L-W	Polypropylene	Not available	55.2 gal	Not available	Not available	Not available	No	30" x 150'	Not available
315	Elastec	https://www.elastec.com/products/oil-spill-absorbents/	Absorbent Folded Sweep	IIIc	Sweep	W	Polypropylene	Not available	25.3 gal	Not available	Not available	Not available	Not available	19" x 100'	
316	Elastec	https://www.elastec.com/products/oil-spill-absorbents/	Oil Spill Absorbent Pillows	IIIa	Pillows	L-W	Not available	Not available	Not available	Not available	Not available	Not available	Not available	Not available	
317	Elastec	https://www.elastec.com/products/oil-spill-absorbents/	Oil Absorbent PomPoms	IV	Pom Pom	W	Polypropylene	Not available	11.6 gal	Not available	Not available	Not available	Not available	30 on 50' rope	

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor- mation	Cost per gallon
1	Incineration (<1% ash)	50 pack - $115	(888) 668-8982		Website	
2	Incineration (<1% ash)	12 pack - $504	(888) 668-8982	Uses a removable 5" flotation boom; multiple units can be interconnected	Website	
3	Incineration (<1% ash)	12 pack - $1,500	(888) 668-8982		Website	
4	Incineration (<1% ash)	2' wide roll - $685; 5' wide roll - $1,142	(888) 668-8982	Unrestricted flow of salt or fresh water through the fabric at rates in excess of 100 gallons per minute per square foot	Website	
5	Incineration (<1% ash)	4 pack - $1,040	(888) 668-8982	Designed for turbulent water and light surf. Constructed with 4 ears surrounding a boom gallery	Website	
6	Incineration (<1% ash)	5"x30" 10 pack - $388.40; 5"x57"10 pack - $530; 8"x5' 10 pack - $1,270; 8"x5' 10 pack (single layer) - $570; 8"x10' 5	(888) 668-8982	Filters suspended solids btw 100 to 140 micron	Website	
7	Incineration (<1% ash)	4 pack - $452	(888) 668-8982	Used to adsorb oil, oil sheen and sediments in ditches and piping	Website	
8	Incineration (<1% ash)	4 pack - $360	(888) 668-8982	Used in catch basins, sumps, and vaults	Website	
9	Incineration (<1% ash)	4 pack - $1,188	(888) 668-8982		Website	
10	Incineration (<1% ash)	5 pack - $790	(888) 668-8982		Website	

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
11	Incineration (<1% ash)	10 pack - $1,150	(888) 668-8982	Designed for deployment in waterways and ditches	Website	
12	Incineration (<1% ash)	10 pack oil sweep covers - $630; oil sweep frame -$10	(888) 668-8982	Sell the sweep handle for $20	Website	
13	Incineration	60" W x 250' L - $986	(904) 292-9019	Material specs: https://www.spillcontainment.com/media/2738/ultra-x-tex-test-data-updated-2-7-18.pdf, distributor website: https://www.globalindustrial.com/p/safety/spill-control-supplies/particualte-sorbents/ultraxtex-rolled-fabric-5feet-wide-x-250feet-long?infoParam.campaignId=T9F&gclid=CjwKCAjwh472BRAGEiwAvHVfGqN26KkAI7OOl5hoMBNwCcKM0tN271WaUQxoyLUsHo9AJ_V3hrKdjBoCcXoQAvD_BwE	Website	$10.11
14	Incineration	$76.95	(904) 292-9019	Material specs: https://www.spillcontainment.com/media/2738/ultra-x-tex-test-data-updated-2-7-18.pdf, distributor website: https://www.globalindustrial.com/p/safety/spill-control-supplies/particualte-sorbents/6feet-ultraoil-filter-boom-with-connectors-10-gallon-capacity?infoParam.campaignId=T9F&gclid=CjwKCAjwh472BRAGEiwAvHVfGuX5hP0DqKoDuRGQmkM2QokK_pGPXSWcaWgx4J5VJuH2YElkoUj_CxoCBlcQAvD_BwE	Website	$15.39
15	Incineration	$555.81 for 34" skirt	(904) 292-9019	Material specs: https://www.spillcontainment.com/media/2738/ultra-x-tex-test-data-updated-2-7-18.pdf, distributor website: https://iscsales.com/item/oil-filter-boom-skirted-ultratech-5240/	Website	$50.53
16	Incineration	$319.20	(904) 292-9019	Extends below surface level to capture some sub-surface. Material specs: https://www.spillcontainment.com/media/2738/ultra-x-tex-test-data-updated-2-7-18.pdf, distributor website: https://industrialsafety.com/personal-protective-equipment-s/industrial-safety-supplies/ultratech-oil-spill-containment-environmental-compliance-products.html?gclid=CjwKCAjwh472BRAGEiwAvHVfGtgxNy0adlEZB98XHs1vK395LjyAJzcZALipu0COmI9hnkG7IsFyeRoCZs0QAvD_BwE	Website	$42.56
17	Incineration to less than 2% ash	P100 (100 pack) - $39.08; EP100 (100 pack) - $29.13; B200 (200 pack) - $41.51	888-920-1831	P100 distributor website: https://www.safetycompany.com/facility-maintenance/spill-control/pillows/cep-p100-heavy-weight-oil-only-sorbent-pads/?sku=CE-P100	Website	$1.65
18	Incineration to less than 2% ash	P50 (50 pack) - $77.96; EP50 (50 pack) - $111.24	888-920-1831	P50 distributor website: https://www.safetycompany.com/facility-maintenance/spill-control/pillows/cep-p50-heavy-weight-oil-only-king-sorbent-pads/; EP 50 distributor website: https://www.safewareinc.com/itemdetail/CEP%20EP50	Website	$2.26

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
19	Incineration to less than 2% ash	BP100 (100 pack) - $43.26; BEP100 (100 pack) - $29.98; BP200 (200 pack) - $54.06	888-920-1831	BP100 distributor website: https://www.safetycompany.com/facility-maintenance/spill-control/pillows/cep-pb100-heavy-weight-oil-only-bonded-sorbent-pads/, BEP100 distributor website: https://store.interstateproducts.com/products/Absorbents/BEP100-Oil-Only-Bonded-Sorbent-Pads-Medium-Weight; BP200 distributor website: https://www.safewareinc.com/itemdetail/CEP%20BP200	Website	$1.98
20	Incineration to less than 2% ash	BP50 (50 pack) - $83.41; BEP50 (50 pack) - $75.91	888-920-1831	BP50 distributor website: https://store.interstateproducts.com/products/Absorbents/BP50-Oil-Only-Bonded-King-Sorbent-Pads-Heavy-Weight; BEP50 distributor website: https://store.interstateproducts.com/products/Oil-Only-Bonded-Absorbent-Pads-Rolls/BEP50-Oil-Only-Bonded-Absorbent-Pads-Medium-Weight	Website	$1.92
21	Incineration to less than 2% ash	50 pack - $66.80	888-920-1831	Design for no-spark environment, distributor website: https://store.interstateproducts.com/products/Absorbents/P100-ASTAT-Oil-Only-Static-Resistant-Sorbent-Pads-Heavy-Weight	Website	$5.57
22	Incineration to less than 2% ash	Not available	888-920-1831	Design for no-spark environment	Website	
23	Incineration to less than 2% ash	Not available	888-920-1831	Design for no-spark environment	Website	
24	Incineration to less than 2% ash	R144 - $86.51; SR144 - $97.54	888-920-1831	R144 distributor website: https://www.safetycompany.com/facility-maintenance/spill-control/pillows/cep-r144-oil-only-sorbent-roll/	Website	$1.84
25	Incineration to less than 2% ash	ER144 - $70.81; ESR 144 (2 pack) - $70.81	888-920-1831	ER144 distributor website: https://store.interstateproducts.com/products/Absorbents/ER144-Oil-Only-Sorbent-Roll-Medium-Weight	Website	$1.82

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
26	Incineration to less than 2% ash	LR144 - $40.23; SLR144 (2 pack) - $40.23	888-920-1831	LR144 distributor website: https://store.interstateproducts.com/products/lr144-oil-only-absorbent-roll-economy-weight.html	Website	$1.34
27	Incineration to less than 2% ash	BR144 - $94.12; BSR144 (2 pack) - $94.12	888-920-1831	Also available in blue color, BR144 distributor website: https://store.interstateproducts.com/products/Absorbents/BR144-Oil-Only-Bonded-Sorbent-Roll-Heavy-Weight	Website	$1.88
28	Incineration to less than 2% ash	BER144 - $81.98; BESR144 (2 pack) - $81.98	888-920-1831	Also available in blue color, BER144 distributor website: https://store.interstateproducts.com/products/Absorbents/BER144-Oil-Only-Blue-Bonded-Sorbent-Roll-Medium-Weight	Website	$2.10
29	Incineration to less than 2% ash	$113.48	888-920-1831	Design for no-spark environment, distributor website: https://store.interstateproducts.com/products/Absorbents/R144-ASTAT-Oil-Only-Static-Resistant-Sorbent-Roll-Heavy-Weight	Website	$2.10
30	Not available	$97.77 for 6 to 20 or $92.62 for 21 to 50	(314) 421-3311		Website	$2.12
31	Not available	$93.37 to $98.56	(314) 421-3311		Website	$1.93
32	Not available	Single weight: $51.37 to $54.22 Medium weight: $43.87 to $46.31 Heavyweight: $51.37 to $54.22	(314) 421-3311		Website	$1.79
33	Not available	Single weight: $57.74 to $60.95 Heavyweight: $55.5 to $58.58	(314) 421-3311		Website	$2.07

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
34	Not available	$200 for 100 pads	Not available		Website	
35	Incineration generally, landfill safe	$122.00/bale	800-999-1358	Can reuse if not fully loaded but not once saturated, Andax is distributor of sweep (not manufacturer)	Website	$4.88
36	landfill safe unless used to absorb hazardous chemicals	$144.99/bale	888-250-3082		Website	$5.80
37	landfill safe unless used to absorb hazardous chemicals	$59.99 / 100 pack (light weight , 20 gal absorbency capacity) to $219.99 / 50 pack (heavy weight, 73 gal absorbency capacity)	888-250-3082		Website	$3
38	landfill safe unless used to absorb hazardous chemicals	$149.99/10	888-250-3082		Website	$2.88
39	landfill safe unless used to absorb hazardous chemicals	$94.99/30	888-250-3082	Reusable after draining or dousing with #1 or #2 weight oils, extracted oil can be recycled or downgraded as fuel oil	Website	$6.33
40	Not specified	$60	770-754-0600	distributor website: https://www.acetool.com/Melt-Blown-Tech-S1900-Absorbent-Sweep-19-in-x-100-p/mbt-s1900.htm	Website	$3.61
41	Not specified	$71.55	770-754-0600	distributor website: https://www.airgas.com/product/Safety-Products/Environmental/Sorbents-%26-Clean-Up/p/MBWB510SN	Website	$2.10

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor- mation	Cost per gallon
42	Not specified	$98.24	770-754-0600	distributor website: https://www.airgas.com/p/MBWB520SN	Website	$2.88
43	Not specified	$158.70	770-754-0600	distributor website: https://www.hanessupply.com/meltblown-b810sn	Website	$2.55
44	Not specified	$155.65	770-754-0600	distributor website: https://www.hanessupply.com/safety-and-security/spill-control-supplies/meltblown-b820sn	Website	$2.50
45	Not specified	$110.48	770-754-0600	distributor website: https://www.hanessupply.com/safety-and-security/spill-control-supplies/meltblown-bb20	Website	$5.81
46	Not specified	$127.31	770-754-0600	Made from recycled meltblown material, distributor website: https://www.hanessupply.com/safety-and-security/meltblown-b10psn	Website	$6.70
47	Not specified	$153.25 (30 nets, 50' rope)	770-754-0600	distributor website: https://www.hanessupply.com/safety-and-security/spill-control-supplies/meltblown-pp30-r	Website	$5.23
48	Not specified	$138.12 (30 nets loose)	770-754-0600	distributor website: https://www.hanessupply.com/safety-and-security/spill-control-supplies/meltblown-pp30-l	Website	$5.04

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
49	nonhazardous landfill approved	$1.45 per pad	770-754-0600	Reusable sorbent but at a lower sorbency. Oil can be squeezed out after but amount is diminished. Distributor website: https://www.airgas.com/product/Safety-Products/Environmental/Sorbents-%26-Clean-Up/p/MBWSPL005	Website	$2.13
50	Not specified	$6.03 per pad	770-754-0600	Reusable sorbent but at a lower sorbency. Oil can be squeezed out after but amount is diminished. Distributor website: https://www.airgas.com/product/Safety-Products/Environmental/Sorbents-%26-Clean-Up/p/MBWSPL002	Website	$1.75
51	Not specified	$41.50 for 50 pack	770-754-0600	Reusable sorbent but at a lower sorbency. Oil can be squeezed out after but amount is diminished. Distributor website: https://www.tenaquip.com/product/spilltration-oil-shammy-towels-sgc503	Website	$1.43
52	Not specified	$56.50 for 50 pack	770-754-0600	Reusable sorbent but at a lower sorbency. Oil can be squeezed out after but amount is diminished. Distributor website: https://www.tenaquip.com/product/spilltration-oil-shammy-towels-sgc504	Website	$1.20
53	Not specified	$45.50	770-754-0600	Reusable sorbent but at a lower sorbency. Oil can be squeezed out after but amount is diminished. Distributor website: https://www.tenaquip.com/product/spilltration-husky-rugs-sgc499	Website	$21.67
54	Not specified	$50.50 per 4 pack	770-754-0600	Reusable sorbent but at a lower sorbency. Oil can be squeezed out after but amount is diminished. Distributor website: https://www.tenaquip.com/product/spilltration-husky-strips-sgc505	Website	$12.63
55	Not specified	$70.62	770-754-0600	distributor website: https://www.hanessupply.com/meltblown-wm100	Website	$2.52
56	Incineration (<0.1% ash) or landfill	$59.25/ 2lb container	855-493-4647	High BTU value, less than 0.1% ash when incinerated, repels water, ask for Rudy if call	Website	$29.63

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor- mation	Cost per gallon
57	Incineration	$34 / 11lb bag	855-493-4647	Not recommended for oil spills on water, used for oil-based liquid absorption, ask for Rudy if call	Website	$4.25
58	Incineration	$28 / bag	855-493-4647	100% Pre and Post consumer recycled cellulose, repels water, ask for Rudy if call	Website	$3.50
59	Incineration	$24 / bag	855-493-4647	Absorbs and retains fluids, High BTU value, will absorb water as well.U65, ask for Rudy if call	Website	$1.92
60	Incineration	$106 / bag	855-493-4647	Loose packaging for hard to reach areas, ideal for shorelines and calm water confined by booms. Repels water, retains absorbed fluid, ask for Rudy if call	Website	$14.13
61	Based on local disposal methods, landfill approved usually if not flowing oil	$23 / 2 lb bag $5,220 / 900 lb crate	631-608-8889	Microencapsulation of oil spills on water or any surface, absorbed powder bonds into floating mats, will not adhere to shorelines, exceeds EPA leeching guidelines for non-hazardous disposal, max of 13 gal per 1 gal but varies for oil type	Website	$8.70
62	Biodegradable	$58 / 4-gallon bucket	336-944-8033	Natural, carcinogen-free, non-toxic, silica-free, odor less powder, Absorbs liquids and semi-liquids, formulated for high viscosity fluids, for use on solid surfaces only	Website	
63	Biodegradable, easily incinerated to <5% ash, safe for landfills and composting	Not available	855-563-2666	Biodegradable, use for hydrocarbons (oils, acetone, solvents, paints), non-toxic. **"oil eating" microbes added.** Produced by a patented fiberizing process that produces a highly porous structure with significantly increased absorption and hydrocarbon-encapsulation ability.	Website	
64	Biodegradable, easily incinerated to <5% ash, safe for landfills and composting	$30	855-563-2666	Biodegradable, use for hydrocarbons (oils, acetone, solvents, paints), non-toxic. Produced by a patented fiberizing process that produces a highly porous structure with significantly increased absorption and hydrocarbon-encapsulation ability.	Website	$1.26

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
65	Material depletes as consumed by bio organism/oil contact into CO2 and water	$520	412-788-2444	Wax powder is hydrophobic, not-toxic, degrades oil through bioconsumption, also have 4 lb, 18 lb, and 25 lb size options, full field demonstrations in US, Europe, Nigeria, and Brazil	Website	$4.32
66	Material depletes as consumed by bio organism/oil contact	$90 for 20 lb, $150 for 50 lb	412-788-2444	For use on hard surfaces, concrete asphalt, wood. Biodegradable and non-toxic, also have 4 gallon shaker size	Website	
67	Wrung out and incinerated	$84 / box	855-493-4647	Noted as heavyweight, price is cheaper if buy in bulk, 15" x 20" dimensions, will float on water to clean spills at surface, does not absorb water	Website	$3.82
68	Wrung out and incinerated	$69 / box	855-493-4647	Noted as medium weight, price is cheaper if buy in bulk, 15" x 20" dimensions, will float on water to clean spills at surface, does not absorb water	Website	$3.92
69	Wrung out and incinerated	$84 / box	855-493-4647	Noted as lightweight, price is cheaper if buy in bulk, 15" x 20" dimensions, will float on water to clean spills at surface, does not absorb water	Website	$3.82
70	Wrung out and incinerated	$143 / roll	855-493-4647	Noted as heavyweight, price is cheaper if buy in bulk, will float on water to clean spills at surface, does not absorb water	Website	$3.56
71	Wrung out and incinerated	$107 / roll	855-493-4647	Noted as medium weight, price is cheaper if buy in bulk, will float on water to clean spills at surface, does not absorb water	Website	$3.34
72	Wrung out and incinerated	$143 / roll	855-493-4647	Noted as lightweight (half as absorbent as heavyweight), price is cheaper if buy in bulk, will float on water to clean spills at surface, does not absorb water	Website	$3.56
73	Wrung out and incinerated	$114 / roll	855-493-4647	Noted as heavyweight, price is cheaper if buy in bulk, will float on water to clean spills at surface, does not absorb water.	Website	$3.52

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
74	Wrung out and incinerated	$113 / roll	855-493-4647	Poly backing feature to prevent absorbed liquids from reaching surfaces or suppress vapors, noted as heavyweight, price is cheaper if buy in bulk, will float on water to clean spills at surface, does not absorb water.	Website	$5.51
75	Wrung out and incinerated	$185 / roll	855-493-4647	Brown color to hide dirt and prolong use, noted as heavyweight, price is cheaper if buy in bulk, will float on water to clean spills at surface, does not absorb water.	Website	$4.60
76	Wrung out and incinerated	$84 / box	855-493-4647	Brown color to hide dirt and prolong use, noted as heavyweight, price is cheaper if buy in bulk, 15" x 20" dimensions, will float on water to clean spills at surface, does not absorb water.	Website	$3.82
77	Wrung out and incinerated	$148 / roll	855-493-4647	Noted as extreme weight, tough top layer to stand up to foot traffic, fast-wicking to keep moisture away from surface, price is cheaper if buy in bulk, will float on water to clean spills at surface, does not absorb water.	Website	$3.70
78	Wrung out and incinerated	$89 / box	855-493-4647	Noted as extreme weight, tough top layer to stand up to foot traffic, fast-wicking to keep moisture away from surface,16" x 20" dimensions, price is cheaper if buy in bulk, will float on water to clean spills at surface, does not absorb water.	Website	$4.05
79	Not specified	$136 / box	855-493-4647	Sock dimensions are 3" ext diameter x 48" L. Floats at surface for easy retrieval. Absorbs oil-based liquids and repels water-based liquids. Price is cheaper if buy in bulk.	Website	$13.60
80	Incineration	$174 / box	855-493-4647	Proprietary blend pulls in thin sheens of oil, sock dimensions are 3" ext diameter x 48" L. Floats at surface for easy retrieval. Absorbs oil-based liquids and repels water-based liquids. Price is cheaper if buy in bulk.	Website	$14.50
81	Incineration	$162 / bag	855-493-4647	Boom dimensions are 8" ext diameter x 10' L. Floats at surface for easy retrieval. Absorbs oil-based liquids and repels water-based liquids. Price is cheaper if buy in bulk.	Website	$3.38

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
82	biodegradable	$15/bag (volume unspecified)	480-503-2847	Despite name, product description does not indicate buoyancy or oil/water selectivity, believe this product will absorb water as well. Does not contain dust reduction agents.	Website	$0.80
83	biodegradable	$28/bag	480-503-2847	Despite name, product description does not indicate buoyancy or oil/water selectivity, believe this product will absorb water as well. Contains dust reduction agents.	Website	$1.49
84	biodegradable	$34/bag	480-503-2847	Despite name, product description does not indicate buoyancy or oil/water selectivity, believe this product will absorb water as well. Contains dust reduction agents and oil consuming microbes.	Website	$1.81
85	Landfill	Not available		non-leaching hydrocarbon absorbent. Non-toxic, use on land or water, oleophilic, lots of test data on website (absorbency, inertness, compatibility, MSDS)	Website	
86	Incineration, landfill mentioned	$1.44 per pad, $106 per roll	49 - 3441 / 8 29 29 29 Germany	Inert oil and chemical adsorbing material. Buoyant and hydrophobic so can be used in all water types, dust free application. Large surface area (3m2/g).	Website	$1.56
87	Incineration, landfill mentioned	$17-$19 per kg, $12 per kg if in bulk	49 - 3441 / 8 29 29 29 Germany	Inert oil and chemical adsorbing material. Buoyant and hydrophobic so can be used in all water types, dust free application. Large surface area (3m2/g).	Website	$10.26
88	Incineration, landfill mentioned	$47-$152 per boom	49 - 3441 / 8 29 29 29 Germany	Inert oil and chemical adsorbing material. Buoyant and hydrophobic so can be used in all water types, dust free application. Large surface area (3m2/g).	Website	$12.47

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
89	Incineration, landfill mentioned	$70 for 50 gal	310-795–4011	Hydrophobic, non-toxic, buoyant, lightweight, non-leaching absorbent, 17,000 BTU per pound.	Website	$0.66
90	Incineration, landfill mentioned	$12 for long, $10 for shorter sock	310-795–4011	Hydrophobic, non-toxic, buoyant, lightweight, non-leaching absorbent, 17,000 BTU per pound.	Website	
91	Incineration, landfill mentioned	$9 for smallest one	310-795–4011	Hydrophobic, non-toxic, buoyant, lightweight, non-leaching absorbent, 17,000 BTU per pound.	Website	
92	Incineration, landfill mentioned	$28 for 15L, $33 for 50L	919-648-0488	Not hydrophobic, 100% recycled material, non-leaching (safe for landfill disposal), lightweight compared to conventional absorbents (clay).	Website	$13.33
93	Incineration, landfill mentioned	$32 per 5' sock	919-648-0489	Not hydrophobic, 100% recycled material, non-leaching (safe for landfill disposal), lightweight compared to conventional absorbents (clay).	Website	$64???
94	Incineration	$0.67-$1.43 per pad (regular to ultra high absorbent)	Not available	Absorbs oil and repels water. Seems to sink after absorbing.	Brochure	$3.19
95	Incineration	$6.89 for the short ones, $17.02 for the long ones	Not available	Absorbs oil and repels water. Can be velcroed together.	Brochure	$5.16
96	Incineration	$15.57 per pillow	Not available	Absorbs oil and repels water. Floats on water.	Brochure	$6.43

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
97	"regenerated" with 30% old and 70% new material	Not available	+39 030 30 99 371 Italy	Oleophilic and hydrophobic. 2-10 minutes absorption time	Brochure	
98	"regenerated" with 30% old and 70% new material	Not available	+39 030 30 99 371 Italy	Oleophilic and hydrophobic. 30-40 minutes absorption time	Brochure	
99	"regenerated" with 30% old and 70% new material	Not available	+39 030 30 99 371 Italy	Oleophilic and hydrophobic	Brochure	
100	"regenerated" with 30% old and 70% new material	Not available	+39 030 30 99 371 Italy	Oleophilic and hydrophobic	Brochure	
101	Not available	$0.35 per pad	800-237-8454		Website	$2.19
102	Not available	$0.46 per pad	800-237-8454	Floats on water. Laminated layer of spunbond on top for additional strength.	Website	$2.30
103	Not available	$0.42 per pad	800-237-8454	Ideal for use with marine oil spill clean-up as well as outdoor oil spills or leaks on land.	Website	$1.75
104	Not available	$2.92 per pad	800-237-8454		Website	$3.65
105	Not available	Not available	800-237-8454		Website	
106	Not available	$111	800-237-8454	Economical absorbent product to use for marine oil spill clean-up	Website	$2.92

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
107	Not available	$111	800-237-8454	Economical absorbent product to use for marine oil spill clean-up	Website	$2.88
108	Not available	$11-$17 per boom	800-237-8454	Absorbs oil, repels water	Website	$3.59
109	Not available	$7 per sock	800-237-8454	Absorbs oil, repels water	Website	$2.69
110	Not available	$2.83 per sock	800-237-8454	Absorbs oil, repels water	Website	$2.18
111	Not available	$8.50 per boom	800-237-8454	Floats on water. Used on Deepwater Horizon.	Website	$0.81
112	Not available	$7.70 per boom	800-237-8454	Floats on water. Used on Deepwater Horizon.	Website	$1.28
113	Not available	$0.32 per pad	800-237-8454	Perfect for spills response. Green product	Website	$1.54
114	Not available	$0.37 per pad	800-237-8454	Perfect for spills response. Green product	Website	$2.06
115	Not available	$0.64 per pad	800-237-8454	Perfect for spills response. Green product	Website	$3.90
116	Not available	$0.89 per pad	800-237-8454	Perfect for spills response. Green product	Website	$4.28

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
117	Not available	$108 for 2 rolls	800-237-8454	Perfect for spills response. Green product	Website	$2.89
118	Not available	$50	800-237-8454	Perfect for spills response. Green product	Website	$1.37
119	Not available	$51 for 2 rolls	800-237-8454	Perfect for spills response. Green product	Website	$1.57
120	Not available	$101	800-237-8454	Perfect for spills response. Green product	Website	$3.12
121	Not available	$57 for 2 rolls	800-237-8454	Perfect for spills response. Green product	Website	$1.93
122	Not available	$112	800-237-8454	Perfect for spills response. Green product	Website	$3.80
123	Not available	$108 for 2 rolls	800-237-8454	Perfect for spills response. Green product	Website	$3.46
124	Not available	$121	800-237-8454	Perfect for spills response. Green product	Website	$3.88
125	Not available	$94	800-237-8454		Website	$1.74

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor- mation	Cost per gallon
126	Not available	Not available	800-237-8454	Floats on water	Website	
127	Not available	$13	800-237-8454	Floats on water	Website	$0.70
128	Landfill, incineration, alternative fuel, biodegradation	Not available	+351 227 419 100 Portugal	Floats on water, unlimited shelf life. Cork is removed from trees every 9 years without damaging the tree.	Website	
129	Landfill, incineration, alternative fuel, biodegradation	Not available	+351 227 419 100 Portugal	Floats on water, unlimited shelf life. Cork is removed from trees every 9 years without damaging the tree.	Website	
130	Landfill, incineration, alternative fuel, biodegradation	Not available	+351 227 419 100 Portugal	Floats on water, unlimited shelf life. Cork is removed from trees every 9 years without damaging the tree.	Website	
131	Landfill, incineration, alternative fuel, biodegradation	Not available	+351 227 419 100 Portugal	Floats on water, unlimited shelf life. Cork is removed from trees every 9 years without damaging the tree.	Website	
132	Not available	Not available	0166 271 9436 UK		Website	
133	Not available	Not available	0166 271 9436 UK		Website	
134	Not available	Not available	0166 271 9436 UK		Website	
135	Not available	Not available	0166 271 9436 UK		Website	

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
136	Not available	Not available	0166 271 9436 UK		Website	
137	Not available	Not available	0166 271 9436 UK		Website	
138	Not available	Not available	0166 271 9436 UK		Website	
139	Not available	Not available	0166 271 9436 UK		Website	
140	Not available	Not available	0166 271 9436 UK		Website	
141	Not available	Not available	0166 271 9436 UK		Website	
142	Not available	about 12 GBP per bag	01353 665141 (UK)	Not clear if hydrophobic	Website	$2.77
143	incineration	10 GBP per bag	01353 665141 (UK)	Not clear if hydrophobic	Website	$1.54
144	incineration	70 GBP for 5 bags	01353 665141 (UK)	Not hydrophobic	Website	$6.47
145	Not available	10 GBP per bag	01353 665141 (UK)		Website	$2.31

No	Final Disposal Method	Cost	Phone	Notes	Source of Information	Cost per gallon
146	Not available	17 GBP per bag	01353 665141 (UK)	Dust free	Website	$2.62
147	landfill, biodegradable	20 GBP per bag	01353 665141 (UK)	Dust free, organic, absorbs most hydrocarbons	Website	$6.17
148	Not available	28 GBP per kg	01353 665141 (UK)		Website	$3.23
149	Not available	Not available	512 334 1000	Can re-collect sublimed solvent using a condenser and reuse after solvent is removed	Website; Article "Nanotechnology-Based Solutions for Oil Spills"; YouTube: https://www.youtube.com/watch?v=Kr32BO	
150	Not available	Not available	6-03-2180 5430 Malaysia	Not a lot of information on website. They said they don't currently provide this in the US	Website; Article "Nanotechnology-Based Solutions for Oil Spills"	
151	Not available	Filter cartridges range from $60 to $279	8 800 775 82 21 Russia	Commercially available in form of filters for drinking water purification systems. Don't see it currently sold in large pads for oil spill clean up. Looses sorbing ability 30-40% after squeezing out oil but continues to work.	Website; Article "Nanotechnology-Based Solutions for Oil Spills"	
152	incineration	Not available	3 069 4058 0333 Greece	Technology based on magnetic separation method of two immiscible liquid phases, have a magnetic skimmer vessel with a conveyer belt system for collecting material, potential to remove extracted oil by compression after use.	Website (http://www.cleanmag.gr/); Article "Nanotechnology-Based Solutions for Oil Spills"	
153	Not available	Not available		Not commercially available, patent filed in 2000 and application status is "Abandoned" as of 3/17/20, ecomag mix can be used directly as a fuel in cement factories.	Website; Article "Nanotechnology-Based Solutions for Oil Spills"	

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
154	Not available	Not available	7(495)777-72-26 Russia	Don't see pricing information for ordering. I think this might be a service that comes out in the event of a spill and produces on-site.	Website; Article "Nanotechnology-Based Solutions for Oil Spills"	
155	Not available	Not available	Not available	There is not much information on product on company website. Don't see material packaging or pricing.	Website; Article "Nanotechnology-Based Solutions for Oil Spills"	
156	Not available	Not available	Not available	There is not much information on product on company website. Article states that oil becomes attached to treated sand and then oil-sand mixture drops to bottom of the ocean. Don't see material packaging or pricing.	Website; Article "Nanotechnology-Based Solutions for Oil Spills"	
157	Not available	$20 per pad, $399 per roll	(703)9557510	Claims to adsorb and absorb toxic materials, have to request a quote for pricing but product is commercially available	Website; Article "Nanotechnology-Based Solutions for Oil Spills"	
158	Landfilled, incinerated, used as secondary fuel, returned to manufacturer for reprocessing and reclamation	Not available	(858) 705 6678	Can work on light, medium, and heavy oils. Works in fresh or salt water. Solidification is slowed in cold weather (<32F). Must be applied by aerial application for large spills	Website; Article "Nanotechnology-Based Solutions for Oil Spills"	
159	Biodegradable, Incineration	$2.20 per pad	800- 511-9430	Used on Deepwater Horizon. Tested at Ohmsett.	Website	$3.19
160	Biodegradable, Incineration	$50	800- 511-9430	Can also remove other chemicals used in oil spill cleanups	Website	$12.20
161	Not available	about $0.50 per pad	800-242-7745		Website	$1.67

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
162	Not available	Not available	800-242-7745		Website	
163	Not available	$14-$21 per boom	800-242-7745		Website	$2.13
164	Not available	$11 per sock	888-250-3082		Website	$3.67
165	incineration	$60 for 12 socks	888-250-3082		Website	$4
166	Not available	$3.75 per small pillow, 6.5 per big pillow	888-250-3082		Website	$5.61
167	Not available	$3.8 per smallest sock, $140 per largest	888-250-3082		Website	$5.80
168	Not available	$40 per double boom	888-250-3082		Website	$5
169	Not available	$135	888-250-3082	Drag between two boats or deploy on shoreline. Traps heavy oils.	Website	$9
170	Not available	$35 per 100 lightweight, $65 per 100 medium, $70 per 100 heavy			Website	$1.90
171	Not available	$104/$118 per 4 booms			Website	$2.53

No	Final Disposal Method	Cost	Phone	Notes	Source of Information	Cost per gallon
172	Not available	$30-$80 for a 150' roll			Website	$2.87
173	Not available	$3.5-$7 per pillow			Website	$5.25
174	Not available	$6.5-$24			Website	$5.65
175	Not available	$17.45			Website	$2.05
176	Not available	$41			Website	$10.25
177	incineration	$131.50			Website	$5.26
178	incineration	about $0.50 per heavyweight pad, $0.40 per mediumweight pad, $0.26 for lightweight pad	800 228 3877		Website	$1.52
179	incineration	about $0.50 per pad	800 228 3877		Website	$1.67
180	Not available	$14-$21 per boom	800 228 3877		Website	$2.13

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
181	Incineration	$84 for 30	800 228 3877		Website	$7.18
182	Incineration	$6.10 per bag	800 228 3877		Website	$1.65
183	Incineration	$94	800 228 3877	To remove oil sheen	Website	$3.76
184	Incineration	$58	800 228 3877	Floats on water	Website	$1
185	Incineration	$26	800 228 3877		Website	$1.63
186	Incineration	$1.50-$4 per pillow	800 228 3877		Website	$1.87
187	Not available	$16.65			Website	$1.85
188	landfill, incineration	$83 per bag			Website	$1.54
189	Not available	Not available	757-485-2952		Website	

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
190	Not available	Not available	757-485-2952		Website	
191	Not available	Not available	757-485-2952		Website	
192	Not available	Not available	757-485-2952		Website	
193	Not available	Not available	757-485-2952		Website	
194	Not available	Not available	757-485-2952		Website	
195	Not available	Not available	757-485-2952		Website	
196	landfill, incineration, biodegradable	Not available	757-485-2952	There are also booms and pads made from Absorbent W, but didn't find any info about them	Website	
197	Landfill safe	Not available	228-206-1449		Website	
198	Landfill safe	$16 for 20lbs (super sack cheaper)	228-206-1449		Website	$1.78

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
199	Incineration, alternative fuel	Not available			Website	
200	Incineration	Not available	757-401-9444		Website	
201	Incineration	Not available	757-401-9444		Website	
202	Not available	Not available	757-401-9444	UV resistant for up to 12 months	Website	
203	Not available	Not available	757-401-9444		Website	
204	Not available	Not available	757-401-9444		Website	
205	Not available	Not available	757-401-9444		Website	
206	Not available	Not available	757-401-9444		Website	
207	Not available	Not available	757-401-9444		Website	

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
208	Not available	Not available	757-401-9444		Website	
209	Not available	Not available	757-401-9444		Website	
210	Biodegradable	Not available	757-401-9444		Website	
211	Biodegradable	Not available	757-401-9444		Website	
212	Incineration	$30 per bag	773-262-8888		Website	$1.50
213	Not available	Not available	877-431-0200	indefinite shelf life	Website	
214	Biodegradable, Incineration	Not available	877-431-0200		Website	
215	Not available	Various. $0.55 per pad	877-431-0200		Website	$1.72
216	Not available	$20 for 5" x 10', $40 for 8" x 10'	877-431-0200		Website	$2.50

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
217	Not available	Not available	877-431-0200	Stronger netting than regular booms for use on rocky shores	Website	
218	Not available	Not available	877-431-0200	Ideal for thin slicks/sheen on water	Website	
219	Not available	$8 for 9" x 15"	877-431-0200		Website	$8
220	Not available	$10	877-431-0200	For larger spills on water	Website	$2
221	Not available	Not available	877-431-0200	Designed for thick oils on water. Ideal for fast flowing water.	Website	
222	Not available	Not available	877-431-0200		Website	
223	Not available	Not available	(+662) 689-3750	Works by emulsifying and separating hydrocarbon molecules into tiny micro emulsions. The end result is biodegradable-bacteria and Aluminosilicates found in nature (clay). Total spill clean up.	Website; Article "Nanotechnology-Based Solutions for Oil Spills"	
224	Not available	Not available	(864) 503-2020	Not commercially-available for purchase. Information source was a patent application, and there's no information about this produce on the Milliken & Co website. Nanofibers selected to optimize based on environment of spill.	Website; Article "Nanotechnology-Based Solutions for Oil Spills"	
225	Not available	Not available	+7 910 480-25-42	Could not find website. Can be reused about 250 times. Can use on floating guard boom to contain spill	Article "Nanotechnology-Based Solutions for Oil Spills"	

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
226	Not available	Not available	Not available	hydrophobic, inert (passed toxicity tests), non-flammable, completely stable, can be spread on the water surface or injected in deep water to collect oil subsurface and bring it up to surface, use nets to recover product on surface, more effective for heavy oils than light.	Website; Article "Nanotechnology-Based Solutions for Oil Spills"	
227	Not available	Not available	888 847 7190		Website	
228	Not available	$9.70 per pillow	888 847 7190	for spills that are too large for pads	Website	$3.50
229	Not available	$0.70 per pad, $127 per roll	888 847 7190		Website	$3.40
230	Not available	$28-$42 per boom	888 847 7190		Website	$4.16
231	Not available	$190 for 30 pom poms on a 50' rope	888 847 7190	The thicker the oil, the better they work	Website	$3.34
232	Incineration	Not available	902 835 4848		Website	
233	Incineration	Not available	902 835 4848		Website	
234	Incineration	Not available	902 835 4848		Website	

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
235	Landfill, Incineration	Not available	800 661 1675		Website	
236	Landfill, Incineration	Not available	800 661 1675		Website	
237	Not available	Not available	800 661 1675		Website	
238	Biodegradable, Incineration	$5	905 293 9995		Website	$1
239	Not available	Not available	905 293 9995		Website	
240	Not available	Not available	905 293 9995		Website	
241	Not available	Not available	905 293 9995		Website	
242	Not available	Not available	905 293 9995		Website	
243	Not available	Not available	905 293 9995		Website	
244	Not available	Not available	519 677 6662		Website	

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
245	Not available	Not available	519 677 6662		Website	
246	Not available	Not available	519 677 6662		Website	
247	Not available	Not available	519 677 6662		Website	
248	Not available	$0.50 per pad	905 670 5401		Website	$3.13
249	Not available	$0.42-$0.78 per pad	905 670 5401		Website	$3.26
250	Not available	$0.59 per pad	905 670 5401		Website	$1.97
251	Not available	$23 per 5" x 10' boom, $31 per 8" x 10' boom	905 670 5401		Website	$3.32
252	Not available	Not available	905 670 5401		Website	
253	Not available	Not available	905 670 5401		Website	

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
254	Not available	Not available	905 670 5401		Website	
255	Not available	Not available	905 670 5401		Website	
256	Not available	$1.16 per pad	800 248 7007, 314 426 3336		Website	$3.74
257	Not available	$0.62 per pad	800 248 7007, 314 426 3336		Website	$2.82
258	Not available	$3.44 for 18" x 18" pillow	800 248 7007, 314 426 3336		Website	$1.50
259	Not available	$31.5-$38 per boom	800 248 7007, 314 426 3336		Website	$4.20
260	Not available	$6.65 for 3" x 12' sock	800 248 7007, 314 426 3336		Website	$2.66
261	Incineration	$0.33-$0.60 per 15"x19" pad	800 243 6624		Website	$1.47
262	Not available	$0.25-$0.60 per 15"x19" pad	800 243 6624		Website	$1.69

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
263	Not available	$0.43-$0.70 per pad	800 243 6624		Website	$3.19
264	Not available	$26-$37	800 243 6624		Website	$2.78
265	Not available	$7.5-$25 per sock	800 243 6624		Website	$10
266	Not available	$3-$10	800 243 6624		Website	$5.35
267	incineration, landfill	Not available	902 538 8022	**DISCONTINUED**	Website	
268	incineration, landfill	Not available	902 538 8022	**DISCONTINUED**	Website	
269	incineration, biodegradable	Not available	+30 210 4225 930 Greece		Website	
270	incineration	Not available	+30 210 4225 930 Greece		Website	
271	incineration	Not available	+30 210 4225 930 Greece		Website	
272	Not available	Not available	800 366 7607	Absorbs water too	Website	

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
273	incineration	$81 per roll	877 388 0187		Website	$2.03
274	incineration	$15 for a 5" x 10' boom	877 388 0187		Website	$2
275	incineration	$2.35-$4.50 per pillow	877 388 0187		Website	$1.68
276	incineration	$0.39-$0.48	877 388 0187		Website	$1.91
277	incineration, waste to fuel, landfill	$0.78 per pad	800 626 8578		Website	$2.08
278	incineration, waste to fuel, landfill	$1.60 per pad	800 626 8578		Website	$2.40
279	incineration, waste to fuel, landfill	$1.50 per pad	800 626 8578		Website	$4.14
280	incineration, waste to fuel, landfill	$55.50	800 626 8578	Can be used folded up as a boom or unfolded as a pad	Website	$5.29
281	incineration, waste to fuel, landfill	$3.42 per pad	800 626 8578		Website	$2.21
282	incineration, waste to fuel, landfill	$175	800 626 8578		Website	$10.42

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
283	incineration, waste to fuel, landfill	$55	800 626 8578		Website	$5.98
284	incineration, waste to fuel, landfill	$7.92, $16.25, $24.38	800 626 8578		Website	$7.43
285	incineration, waste to fuel, landfill	$69	800 626 8578		Website	$1.88
286	incineration, waste to fuel, landfill	$65	800 626 8578		Website	$3.75
287	incineration, waste to fuel, landfill	$0.47 per pad	800 626 8578		Website	$2.61
288	incineration, waste to fuel, landfill	$54, $95.50	800 626 8578		Website	$3.01
289	incineration, waste to fuel, landfill	$177.00	800 626 8578		Website	$2.42
290	incineration, waste to fuel, landfill	$6.03	800 626 8578		Website	$12.06
291	incineration, waste to fuel, landfill	$21.17	800 626 8578		Website	$6.05

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
292	incineration, waste to fuel, landfill	$101-$217	800 626 8578		Website	$4.57
293	incineration, landfill	$46.8 per pillow	800 778 8154		Website	$33.43
294	incineration, landfill	$117 per blanket	800 778 8154		Website	$29.25
295	incineration, landfill	$53.4 per boom	800 778 8154		Website	$33.38
296	incineration, landfill	$234	800 778 8154		Website	$16.71
297	Biodegradable, Incineration, Landfill	Not available	+91 9619203034 India	absorbs more than 30 times its weight	Website	
298	Biodegradable, Incineration, Landfill	Not available	+91 9619203034 India	absorbs more than 30 times its weight	Website	
299	Biodegradable, Incineration, Landfill	Not available	+91 9619203034 India	absorbs more than 30 times its weight	Website	
300	Biodegradable, Incineration, Landfill	Not available	+91 9619203034 India	absorbs more than 30 times its weight	Website	
301	Not available	Not available	+91 9619203034 India	absorbs more than 30 times its weight	Website	

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
302	Not available	Not available	+91 9619203034 India	absorbs more than 30 times its weight	Website	
303	Not available	$32.5 per small boom, $40 per large boom	800 433 1013		Website	$3.75
304	Not available	$21 per boom	800 433 1013		Website	$2.92
305	Incineration	$72	800 433 1013		Website	$9
306	Incineration	$0.29 per lightweight, $0.59 per medium, $0.69 per heavy pad	800 433 1013		Website	$1.79
307	Incineration	$2.60 per pad	800 433 1013		Website	$2.55
308	Incineration	$82.45, $151.80	800 433 1013		Website	$3.20
309	Incineration	$2.50, $5.81	800 433 1013		Website	$4.65
310	Incineration	$3.57	800 433 1013		Website	$2.21
311	Not available	$18.88	800 433 1013		Website	$3.28

No	Final Disposal Method	Cost	Phone	Notes	Source of Infor-mation	Cost per gallon
312	Incineration	$22.25, $24.75	618 382 2525		Quote	$2.79
313	Incineration	$0.50-$0.77	618 382 2525		Quote	$3.16
314	Incineration	$99	618 382 2525		Quote	$1.79
315	Incineration	$99	618 382 2525		Quote	$3.91
316	Incineration	Not available	618 382 2525		Website	
317	Incineration	$98	618 382 2525		Quote	$8.45

APPENDIX C

Literature Review Summary File

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
1	NA - ASTM Standardized Testing Article	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Gap Analysis of ASTM F726 and ASTM F716
2	I - Bonded oil pads (polypropylene), cotton pad, EP-100 (polypropylene), fine oil pads (polypropylene), laminated oil pads (polypropylene), OB-100 (polypropylene), wool pad, II - absorbent floor dry (clay), absorbent W (treated cellulose), Corksorb (cork), Oclansorb (wood fiber), Oil Buster (wax + corn), Oil Gater (cellulose), optisorb (diatomaceous earth), peat moss, vermiculite, volcanic ash, III - HydroNature M4 (milkweed), Oil Sock (polypropylene)	Type I (pads), Type II(loose), Type III (socks)	L-W	Synthetic	on the market	N/A	N/A	N/A	Y	ASTM F726
3	Superhydrophobic graphene aerogel (SGA)	Type I	W	Advanced	TRL 4	N/A	Both	Reusable	Y	Lab based sorption test (weight measurement)
4	Oleic Acid (OA) modified pine sawdust	Type II	W	Natural	TRL 3	N/A	Surface	Single Use	Y	Lab-based sorption test (weight measurement)

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
5	NA - ASTM Standardized Testing Article	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	ASTM F726
6	Luffa fibers	N/A	L-W	Natural	TRL 3	N/A	Surface	Reusable	Y	Custom sorption test: weight of oil and retention in salt water. Reusability tested by three repetitions.
7	Azolla folliculoid plant, a small free-floating water fern	N/A	W	Natural	TRL 3	N/A	Surface	Single Use	Y	Custom sorption test: weight of oil and retention in salt water.
8	Polypropylene nonwoven web, rice hull, and bagasse	N/A	W	Synthetic and Natural	TRL 3	N/A	Surface	Single Use	Y	Custom sorption test: weight of oil and retention in salt water.
9	Perlite and zeolite	N/A	W	Mineral	TRL 3	N/A	Surface	No data	Y	Custom sorption test: weight of oil and retention in seawater.
10	Banana peels	N/A	W	Natural	TRL 3	N/A	Surface	Reusable	y	ASTM D4007–81

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
11	Graphite/Isobutylene-isoprene rubber cryogel	N/A	W	Advanced	TRL 3	N/A	Surface	Reusable	Y	Custom sorption test: weight of sorbed oil
12	Palm fruit bunch fiber	N/A	W	Natural	TRL 3	N/A	Surface	No data	Y	Custom sorption test: weight of sorbed oil
13	12-Hydroxystearic acid xerogel prepared with acetonitrile, pentane, and diethyl ether	N/A	W	Advanced	TRL 3	N/A	Surface	Reusable	Y	Custom sorption test: weight of sorbed oil
14	Graphene-melamine foam (rGO)	N/A	W	Advanced	TRL 3	N/A	Surface	Reusable	Y	Custom sorption test: weight of sorbed oil
15	Polysulfone, poly(lactic acid), and polysulfone/poly(lactic acid) nanoporous fibrous mats	N/A	W	Advanced	TRL 3	N/A	Surface	No data	Y	Custom sorption test: weight of sorbed oil
16	Graphene aerogel	Type I	W	Advanced	TRL 3	N/A	Surface	No data	Y	Custom sorption test: weight of sorbed oil
17	Booms made with cotton, human hair, K-Sorb, and polypropylene	Type IIIb	W	Natural and Synthetic	TRL 3	N/A	Surface	No data	Y	ASTM F726

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
18	cotton, milkweed, kenaf, polypropylene	Type I	W	Natural and Synthetic	TRL 3	N/A	Surface	Single Use	Y	ASTM D95-70
19	recycled car tire fibers converted into rubber aerogel	Type I (sheet)	W	Synthetic	TRL 3	N/A	Surface	No data	Y	Lab-based sorption test (weight measurement)
20	Composite MS-CMC-HPU-13 (metal organic framework/crystals and melamine sponge)	Type I (sheet)	W	Advanced	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement)
21	Acetylated Nettle Fiber	Type IV (strands)	W	Natural	TRL 3	N/A	Both	No data	Y	Lab-based sorption test (weight measurement)
22	Polymers (acrylic ester resin adsorbents, polyurethane), inorganic material (carbon-based, metal-based, polymer), biomass (carbon-based, cellulose-based aerogel & membrane filter)	Type I	L-W	Synthetic	TRL 4	N/A	Both	Reusable	N	Lab-based sorption test (weight measurement)
23	Porous spray foam	Type II	L-W	Synthetic	TRL 3	N/A	Surface	Single Use	N	N/A
24	Multiple Sorbents addressed: Aerogel (various formulations), zeolites, organophilic clays, synthetic organic and natural (organic) sorbents.	Type I (pads), Type II(loose)	L-W	Natural and Synthetic	TRL 2-4	N/A	Surface	Single Use, Reusable	Y	Lab-based sorption test (weight measurement)

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
25	Polyurethane foam (modified and unmodified)	Type I (foam sheets)	L-W	Synthetic	TRL 4	N/A	Surface	Single Use	Y	Lab-based sorption test (weight measurement)
26	Exfoliated Graphite	Type II	W	Natural	TRL 2	N/A	Surface	No data	Y	Lab-based sorption test (weight measurement)
27	Peat-derived Biochar	Type II	W	Natural	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement)
28	nonwoven polypropylene sorbents	Type I	W	Synthetic	TRL 9	N/A	Surface	No data	Y	Lab-based sorption test (weight measurement)
29	NA - a review on sorbent devices for oil-spill control	N/A	L-W	Natural and Synthetic	TRL 2-9	N/A	Surface	No data	N	N/A

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
30	organo-clays	Type II (Granular/Loose)	W	Advanced	TRL 3	N/A	Both	Single Use	Y	ASTM F726
31	Magnetic exfoliated graphite(MEG)	Type II (Granular/Loose)	W	Advanced	TRL 3	N/A	Surface	Reusable up to 3 cycles	Y	Lab-based sorption test (weight measurement)
32	High molecular weight porous polymer sheets	Type I (Sheet)	L-W	Synthetic	TRL 4	N/A	Surface	No data	Y	Lab-based sorption test (weight measurement)
33	Melamine-formaldehyde sponge with reduced graphene oxide	Type I	L-W	Synthetic	TRL 4	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement)
34	Milkweed fibers	Type I	L	Natural	TRL 9	N/A	Surface	Single Use	N	N/A
35	Sorbent powders: Lessorb, exfoliated graphite sorbent (EGS), peat dust oil sorbent (PDOS), and biomatrix	Type II	L-W	Synthetic	TRL 9	N/A	Surface	Single Use	Y	Lab-based sorption test (weight measurement)
36	Polylactic acid porous monoliths modified with reduced graphene oxide	Type I	W	Advanced	TRL 4	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement)

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
37	Greasy raw wool (sheep)	Type I	W	Natural	TRL 6	cheap	Surface	Reusable	Y	Lab-based sorption test (weight measurement)
38	Polyurethane foams	Type I (sheets)	L-W	Synthetic	TRL 5	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement)
39	Butyl Rubber	Type I (sheets)	W	Synthetic	TRL 3 - TRL 4	N/A	Surface	Reusable (Up to 3 cycles)	Y	Lab-based sorption test (weight measurement)
40	Ultralight Magnetic Foam	Type I (foam sponge)	W	Synthetic	TRL 3	N/A	Surface	No data	Y	Lab-based sorption test (weight measurement)
41	Macroporous Rubber Gels	Type I (sheets)	W	Advanced	TRL 3	N/A	Surface	Reusable (Up to 3 cycles)	Y	Lab-based sorption test (weight measurement)
42	Exfoliated Graphite	Type I	W	Natural	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement)
43	Shellfish-derived Chitosan Aerogel	Type II	W	Natural / Advanced	TRL 3	N/A	Surface	Reusable	Y	ASTM F726-06
44	Recycled HDPE bottles (HD-75)	Type I (film)	W	Synthetic	TRL 4	N/A	Surface	No data	Y	Lab-based sorption test (weight measurement)

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
45	Electrospun PS/PAN Fibers	Type I (combined fibers)	W	Synthetic	TRL 3	N/A	Surface	No data	Y	Lab-based sorption test (weight measurement), Buoyancy change over time also evaluated.
46	Enhanced Polyurethane (PU) Sponges	Type I (foam sponge)	W	Synthetic	TRL 4	N/A	Surface	Reusable Up to 15 cycles)	Y	Lab-based sorption test (weight , oil/water selectivity, oil retention, reusability)
47	Nanocomposite "teabag" system, exfoliated graphite wrapped in PS membrane	Type III (composite)	W	Synthetic	TRL 4	N/A	Surface	No data	Y	Lab-based sorption test (weight measurement, oil water selectivity)
48	Raw Jute Fiber (biodegradable)	Type IV (fibers)	W	Natural	TRL 3	N/A	Surface	Reusable (Up to 3 cycles)	Y	Lab-based sorption test (weight measurement+reusability with squeezing)
49	Graphene	Type I	W	Natural	TRL 3	N/A	Surface	No data	Y	Lab-based sorption test (weight measurement)
50	Rice Husks	Type I	L	Natural	TRL 3	N/A	Surface	No data	Y	Lab-based sorption test (weight measurement)
51	Synthetic Zeolites (Na-P1 and Na-X) derived from fly ash	Type II (Granular/Loose)	L	Synthetic	TRL 3	N/A	Surface	Single Use	Y	Lab-based sorption test (weight measurement)

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
52	Rice Husk Ash	Type I	W	Natural	TRL 3	N/A	Surface	Single Use	Y	Lab-based (microadsorption measurement)
53	Blended Polypropylene fiber	Type I	W	Synthetic	TRL 3	N/A	Surface	Reusable (Up to 5 cycles)	Y	Lab-based sorption test (weight measurement)
54	Alkali treated rice husks	Type I	W	Natural		N/A	Surface	Single Use	Y	Lab-based sorption test (weight measurement)
55	Porous microspheres	Type II	W	Synthetic	TRL 3	N/A	Surface	Single Use	Y	Lab-based sorption test (weight measurement)
56	Carbon nanofiber aerogel	Type I (pad/sheet)	W	Advanced	TRL 3	N/A	Surface	Reusable (Up to 10 cycles)	Y	Lab-based sorption test (weight measurement)
57	polyurethane sponge	Type I (sponge)	W	Synthetic	TRL 3	N/A	Surface	Reusable (Up to 200 cycles)	Y	Lab-based sorption test (weight measurement)
58	Algal biomass	Type II (Granular/Loose)	W	Natural	TRL 3	N/A	Surface	Single Use	Y	Lab-based sorption test (weight measurement & extraction method)

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
59	Ultrafine polypropylene fibers	Type I (sheet) and Type IV (strands)	W	Synthetic	TRL 3	N/A	Surface	Reusable (Up to 7 cycles)	Y	Lab-based sorption test (weight measurement)
60	Nylon textile	Type I (sheet)	W	Synthetic	TRL 3	N/A	Both	Reusable (18 month continual use lifespan)	Y	Lab-based sorption test (weight measurement)
61	Polysulfone microspheres	Type II (Granular/Loose)	W	Synthetic	TRL 3	N/A	Surface	Reusable (Up to 3 cycles)	Y	Lab-based sorption test (weight measurement)
62	Natural rubber/reduced-graphene oxide composite material (NR/rGO)	Type I (Pad/Foam)	W	Synthetic (natural rubber, rGO synthesized from graphite waste from metal smelting company)	TRL 4	N/A	Surface	Reusable (up to at least 30 cycles)	Y	Lab-based sorption test (weight measurement) - Followed ASTM F726-12 test method for adsorbent performance
63	Magnetic graphene foam	Type I (Pad/Foam)	W	Synthetic	TRL 4	N/A	Surface	Reusable (98% of original capability after 8 cycles)	Y	Lab-based sorption test (weight measurement), various techniques to categorize graphene foam composition , surface chemistry, and morphology
64	Carbon aerogel	Type I (sponge)	W	Advanced	TRL 3	N/A	Surface	Reusable (Up to 10 cycles)	Y	Lab-based sorption test (weight measurement)
65	Overview of different products	All	L-W	Overview of different types	TRL 9	N/A	Surface	N/A	N	N/A

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
66	Comparison of Sorbents vs. Solidifiers	All	W	Various	N/A	N/A	Surface	N/A	N	N/A
67	Polyurethane sponge with acid pretreatment and reduce graphene oxide	Type I (sponge)	L-W	Synthetic	TRL 4	N/A	Surface	Reusable	Y	modified from ASTM F726-9.2, 9.3 and lab-based tests
68	Polymer foams	Type I (sponge)	L-W	Synthetic	TRL 4	N/A	Surface	N/A	Y	Lab-based sorption test (weight measurement)
69	Loose sorbents	Type II	W	Natural, mineral	TRL 9	N/A	Surface	Single Use	Y	Lab-based sorption test (images of sorbent color over time)
70	Heat treated sapropels	Type II	W	Natural	TRL 4	N/A	Surface	Didn't test for this	Y	Lab-based sorption test (weight measurement)
71	Algal biomass	Type II	W	Natural	TRL 3	N/A	Surface	Didn't test for this	Y	Lab-based sorption test (weight measurement)

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
72	Polyether Sulfone with Calotropis gigantea fiber (PES/CGF)	Type I (pad)	W	Natural, synthetic	TRL 3	N/A	Surface	Reusable (Up to 10 cycles)	Y	Lab-based sorption test (weight measurement)
73	Cotton cellulose aerogel	Type I (pad)	W	Natural, mineral	TRL 3	N/A	Surface	Reusable (Up to 3 cycles)	Y	ASTM F726-06
74	Organic-inorganic magnetic particles	Type II (loose)	W	Natural		cheap	Surface	reusable (up to 5 cycles)	Y	ASTM F726-99, D4006
75	Natural chitosan on polyurethane	not specified (Type II likely)	W	Natural	TRL 3	N/A	Surface	N/A	Y	n/a
76	Palmitic acid-modified dolomite (rock limestone)	Type II	W	Natural, mineral (treated)	TRL 3	N/A	Surface	N/A	Y	Lab-based gravimetric analysis (weight?)
77	Thermally treated Calotropis Procera fiber (Sodom apple or rubber bush)	Type II	W	Natural	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement)
78	Overview of different sorbents and dispersants	Various	W	Various	N/A	N/A	Surface	N/A	N	N/A

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
79	Superhydrophobic magnetic sawdust	Type II	W	Natural with advanced treatment	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement)
80	Cellulose aerogel from raw cotton fiber	Type I (?)	W	Natural	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement)
81	Cork granules	Type II	W	Natural		N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement)
82	Vegetable raw material (barley, buckwheat, radish, peanut)	Type II	L	Natural	TRL 3	N/A	Surface	Single Use	Y	Lab-based testing
83	Moss	Type II	W	Natural	TRL 3	N/A	Surface	No data	Y	ASTM F726-12
84	PVA foam with camphor	Type II (small foam pieces)	W	Advanced	TRL 3	N/A	Surface	No data	Y	Lab-based sorption test (weight measurement)
85	Cu_2O sponge composites	Type I	W	Advanced	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement)

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
86	Carbonized Rice Husk (RH), Apricot Stone (AS), and rubber crump (RC)	Type I	W	Natural and Synthetic	TRL 3	N/A	Surface	Single Use	Y	Lab-based sorption test (weight measurement)
87	Hydroscopic magnesium carbonate	Type II (loose)	W	Advanced	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement)
88	Cotton with silica nanoparticles and MTCS surface treatment	Type I	W	Advanced	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement)
89	Polystyrene fibers	Type I	W	Synthetic	TRL 3	N/A	Surface	Didn't test for this	Y	Lab-based sorption test (weight measurement)
90	Mangrove bark (treated)	Type II	W	Natural (with treatment)	TRL 3	N/A	Surface	Single use	Y	Lab-based sorption test (weight measurement), Magnified surface images, pH and temperature effects on surface absorption.
91	Corn Straw (cellulose fibers)	Type II	W	Natural (with treatment)	TRL 3	N/A	Surface	Single use	Y	Lab-based sorption test (weight measurement), Magnified surface images, FTIR analysis, contact angle evaluations (static and dynamic).

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
92	Cotton / Cotton-cellulose aerogels	Type I	W	Natural (with treatment)	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement), Magnified surface images, water contact angle evaluation (static). Application of squeezing and distillation to remove oil.
93	Superhydrophobic cotton fiber	Type I	W	Natural (with treatment)	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement), Magnified surface images, FTIR analysis, water contact angle evaluation (static). Reusability evaluation by application of vacuum to remove oil.
94	Hydrophobic poly(alkoxysilane) organogels	Type I	W	Synthetic	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement), FTIR analysis, Thermal gravimetric analysis (TGA), water contact angle evaluation (static). Reusability evaluation of a single sample configuration
95	Review of multiple sorbent technologies	N/A	W	N/A	N/A	N/A	Surface	N/A	N/A	N/A
96	Comparison of four natural sorbents (straw, peat, moss, wool)	Type II	W	Natural	N/A	N/A	Surface	N/A	Y	Lab-based sorption test (weight measurement and chromatography)
97	3D polyimide-graphene aerogel nanocomposite	Type I	W	Synthetic	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement), FTIR analysis, water contact angle evaluation, SEM, XRD, XPS

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
98	Waste Cigarette Filters	Type II	W	Synthetic	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement), SEM, FTIR, contact angles
99	Spaceloft Aerogel	Type I	W	Advanced	on the market	Y	Surface	Reusable	Y	ISO 14040:2006
100	loosely packed fibers and nonwoven fabrics of kapok, cotton, and milkweed	Type I	L	Natural	TRL 3	N	Surface	Single Use	Y	Lab-based sorption test (weight measurement)
101	Nanocomposite graphene membrane	Type I	W	Advanced	TRL 3	N	Subsurface	No data	Y	Lab separation test
102	Coco peat fiber fertilizer	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Y	Various
103	Review of multiple bio-based materials	N/A	W	Natural (with treatment)	N/A	N/A	Surface	Both	N	N/A

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
104	Wheat straw	Type II	W	Natural	TRL 3	N	Surface	No data	Y	ASTM F726
105	Graphene oxide foam	Type I	W	Synthetic	TRL 3	N	Surface	Reusable	Y	Lab-based sorption test (weight measurement)
106	3D solid foam from emulsion (stearic acid and Al2O3)	Type I	W	Synthetic	TRL 3	N/A	Surface	Didn't test for this	Y	Lab-based sorption test (weight measurement)
107	Reduced graphene oxide-based polyurethane sponge hollow tube	Type I	W	Advanced	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement), ASTM F726-81, SEM, FTIR, TGA, contact angle
108	Bacterial cellulose aerogels / silica aerogels	Type I	W	Advanced	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement), SEM, FTIR, TGA, stress-strain compression
109	Octyl Graphene Oxide-Modified Nickel Foam	Type I	W	Advanced	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement), SEM , FTIR, contact angle
110	Silica-reduced graphene oxide hybrid sponges (SiO2-rGO)	Type I	W	Advanced	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement)

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
111	Macroporous polypropylene sponges	Type I	W	Synthetic	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement)
112	Melamine sponges modified with graphene oxide	Type I	W	Synthetic	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement)
113	Methyl methacrylate and butyl methacrylate grafted onto natural rubber foam	Type I	L (possibly water but didn't test with water and oil)	Synthetic	TRL 3	N/A	Surface	No data	Y	Lab-based sorption weight tests according to ASTM F726-12
114	Leaves and roots of pistia stratiotes	Type I	L-W	Natural	TRL 3	N/A	Surface	No data	Y	Lab-based sorption weight tests
115	Orange peel waste	Type I	L-W	Natural	TRL 3	N/A	Surface	Reusable (up to 4-5 cycles depending on oil type)	Y	Lab-based sorption weight tests

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
116	Chicken feather	Type I	L-W	Natural	TRL 3	N/A	Surface	No data	Y	Lab-based sorption weight tests
117	Free-floating aquatic plants (Pistia stratiotes and Eichhornia crassipes)	Type I (Pad)	L-W	Natural	TRL 3+F120	N/A	Surface	No data	Y	Lab-based soprtion weight tests
118	Carbon nanotube (CNT) sponges	Type I	L-W	Synthetic	TRL 4	N/A	Surface	No data	Y	Lab-based sorption weight tests
119	Raw Cotton Fiber Batts	Type I (Pad)	W	Natural	TRL 4	N/A	Surface	No cycle testing	Y	Lab based sorption weight tests, water uptake capacity, long-term oil sorption capacity, and dynamic degradation according to ASTM Standard F 726-06

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
120	Hollow carbonized cotton fibers	Type I (Pad)	L-W	Natural	TRL 4	N/A	Surface	Reusable (tested 5 cycles)	Y	Lab based sorption weight tests, contact-angle measurements
121	Melamine-formaldehyde sponge	Type I (Pad)	W	Synthetic	TRL 3	N/A	Both	Reusable (tested 12 cycles)	Y	Lab based sorption weight tests
122	Microtubes from Polypore Mushrooms	Type I	L-W	Natural	TRL 3	N/A	Surface	Reusable (tested 4 cycles)	Y	Lab based sorption weight tests
123	Polyurethane sponge with reduced graphene nanosheet and perfluorodecanethiol	Type I	L-W	Advanced	TRL 3	N/A	Surface	Reusable (tested 10 cycles)	Y	Lab based sorption weight tests
124	3-D magnetic graphene balls	Type I	W	Synthetic	TRL 3	N/A	Surface	Reusable (tested up to 10 cycles)	Y	Lab based sorption test (weight measurement)
125	Cotton, cotton waste, cotton/kapok blend, and nettle fibre nonwovens	Type I	W	Natural	TRL 3	N/A	Surface	Single Use (4 cycles tested)	Y	ASTM F716-82 and ASTM 726-81

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
126	Magnetic Iron Oxide Nanoparticles with Hexadecylphosphonic acid	Type II	L-W	Advanced	TRL 3	N/A	Surface	Reusable	Y	Lab based sorption weight tests
127	Foam from Liquid Natural Rubber	Type I	L-W	Natural	TRL 4	N/A	Surface	Reusable	Y	Lab based sorption test (weight measurement)
128	Cellulose fiber aerogel	Type I	L-W	Advanced	TRL 4	N/A	Both	Reusable	Y	Lab based sorption test (weight measurement)
129	Electromagnetic boom and mop system with magnetite particles	Type II	W	Synthetic	TRL 3	N/A	Both	Reusable	N	Proof of concept of system
130	Acetylated and unacetylated lignocellulose (oil palm empty fruit bunch and cocoa pod)	Type II	W	Natural	TRL 3	N/A	Surface	Single Use	Y	Lab based sorption test (weight measurement)
131	Spunbond nylon 6,6 nonwoven fabric	Type I	W	Synthetic	on the market	N/A	Both	Single Use	Y	Lab based sorption test (weight measurement), filtration test, field testing
132	Aerogel based on methane derived carbon nanotubes	Type I	W	Advanced	TRL 3	N/A	Surface	Reusable (5 cycles)	Y	ASTM F726-99

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
133	Nanocellulose-based aerogel	Type I	W	Advanced	TRL 3	N/A	Surface	Reusable	Y	Lab based sorption test (weight measurement)
134	3D graphene-based nanostructured materials	Type I	W	Advanced	TRL 3	N/A	Surface	N/A	N	N/A
135	Flexible polyurethane foam coated with a hydrophobic monomer	Type I	W	Advanced	TRL 3	N/A	Surface	Reusable	Y	ASTM F726-99
136	Kenaf shive aerogel	Type I	W	Natural	TRL 3	N/A	Surface	Didn't test	Y	Lab based sorption test (weight measurement)
137	Electrospun PSF and PVDF ultrathin fibers	Type I	W	Advanced	TRL 3	N/A	Surface	Didn't test	Y	ASTM F726-12
138	Foamed Polyurethane/Graphene Reinforced Membrane	Type I	W	Advanced	TRL 3	N/A	Filtration	Reusable	Y	Continuous filtration
139	Formaldehyde-melamine-sodium bisulfite copolymer foam	Type I	W	Advanced	TRL 3	N/A	Surface	Reusable	Y	Lab based sorption test (weight measurement)

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
140	Polyurethane foam with lignin filler	Type I	W	Synthetic	TRL 3	N/A	Surface	Reusable	Y	Lab based sorption test (weight measurement), ASTM F726-99, ASTM D4006
141	Posidonia oceanica (L.) beach balls (dead seagrass)	Type II	W	Natural	TRL 3	N/A	Surface	Single Use	Y	Lab based sorption test (weight measurement)
142	Porous polymers with PET fibers and crosslinked copolymer coatings	Type I	L-W	Synthetic	TRL 4	N/A	Surface	Reusable (tested up to 7 cycles)	Y	ASTM F726-81
143	Three-dimensional graphene sponges	Type I	L-W	Synthetic	TRL 4	N/A	Surface	Reusable (tested up to 5 cycles)	Y	Lab based sorption test (weight measurement)
144	Magnetic nanoparticles and yeast-based magnetic bionanocomposite	Type I	L-W	Synthetic	TRL 4	N/A	Surface	Didn't test for this	Y	ASTM F726-12

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
145	SiO2 nanoparticles modified by fluoroalkylisilane immobilized on polyurethane sponges	Type I	W	Synthetic	TRL 4	N/A	Surface	Reusable (tested up to 5 cycles)	Y	Lab based sorption test (weight measurement)
146	Kiwi peel modified with sodium hydroxide and sulfuric acid	Type II	L-W	Natural	TRL 3	N/A	Surface	Single Use	Y	Lab based sorption test (weight measurement)
147	Closed hollow microspheres	Type II	W	Advanced	TRL 3	N/A	Surface	Didn't test for this	N	Lab based sorption test (weight measurement)
148	Aluminum foil coated with titanium oxide	Type I	W	Advanced	TRL 3	N/A	Both	Reusable	Y	Lab-based sorption test (weight measurement)
149	Graphene wrapped sponge with Joule-heating	Type I	W	Advanced	TRL 3	N/A	Surface	N/A	Y	Lab-based sorption test (weight measurement)
150	Gelator-adsorbed cellulose pulp (GACP)	Type II	W	Advanced	TRL 3	N/A	Surface	Single Use	Y	Lab-based sorption test (weight measurement)
151	Magnetic polystyrene foam	Type I	W	Advanced	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurement)

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
152	Palm fibers and modified palm fibers	Type I	W	Natural	TRL 3	N/A	Surface	Didn't test for this	Y	Lab-based sorption test (weight measurements)
153	Recycled polyethylene terephthalate a+B150erogels	Type I	L-W	Advanced	TRL 4	N/A	Surface	Didn't test for this	Y	Lab-based sorption test (weight measurements)
154	Calotropis gigantea fiber derived carbon fiber	Type II	L-W	Advanced	TRL 3	N/A	Surface	Reusable, 10 cycles	Y	Lab-based sorption test (weight measurements)
155	Kapok fiber	Type II	L-W	Natural	TRL 3	N/A	Surface	Reusable 15 cycles	Y	ASTM F726-99
156	Surfactant modified eggshell	Type II	L-W	Natural	TRL 3	N/A	Surface	Didn't test for this	Y	Lab-based sorption test (weight measurements)
157	Abrasive paper	Type I	L-W	Mineral	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurements)

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
158	Molting cuticles of the Theraphosidae spider Avicularia sp.	Type II	L-W	Natural	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurements)
159	Poplar seed fiber	Type I (loose granuals compacted)	L-W	Natural	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurements)
160	Aminated chitosan	Type II	L-W	Advanced	TRL 3	N/A	Surface	Didn't test for this	Y	ASTM F726-99
161	Sodium silicate and TiO2 nanoparticle on stainless steel mesh	N/A	W	Advanced	TRL 3	N/A	Subsurface	Reusable	Y (contact angles only)	Lab-based filtration test
162	Commercial sponge wrapped with graphene nanosheets	Type I	W	Advanced	TRL 2	N/A	Surface	Didn't test for this	N	N/A
163	Kapok fiber in superhydrophobic fabric bag	Type III	W	Advanced	TRL 3	N/A	Both	Reusable	Y	Lab-based sorption test (weight measurements)
164	Silanized Melamine Sponge	Type I	L-W	Advanced	TRL 3	N/A	Surface	Reusable	Y	Lab-based sorption test (weight measurements)

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
165	Ultra-high molecular weight polyethylene sheets	Type I	L-W	Synthetic	TRL 3	N/A	Surface	Didn't test for this	Y	Lab-based sorption test (weight measurements)
166	Alginate-based aerogel	Type I	L-W	Advanced	TRL 3	N/A	Surface	Didn't test for this	Y (not much)	Lab-based sorption test (weight measurements)
167	Rice straw cellulose polyurethane sponge	Type I	L-W	Synthetic	TRL 3	N/A	Surface	Didn't test for this	Y	ASTM F726 99
168	PVA aerogel with boron nitride	Type I	L-W	Advanced	TRL 3	N/A	Surface	Didn't test for this	Y	Lab-based sorption test (weight measurements)
169	Cellulosic materials coated with graphene flakes	Type I	L-W	Advanced	TRL 3	N/A	Surface	Somewhat Reusable	Y	Lab-based sorption test (weight measurements)
170	PVA-based porous material	Type I	L-W	Advanced	TRL 3	N/A	Surface	Reusable (10 cycles tested)	Y	Lab-based sorption test (weight measurements)
171	Barium sulfate sorbent powder	Type II	L-W	Mineral	TRL 3	N/A	Surface	Reusable (at least 3 times)		Lab-based sorption test (weight measurements)

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
172	Polymer-infiltrated nanoparticle film-coated stainless-steel mesh (PINF-SSM)	N/A	W	Advanced	TRL 3	N/A	Surface	Reusable	Y	Lab based separation test
173	Review article	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Article #	Sorbent Description	Sorbent Type (I,II,III,IV)	Sorbent Category (L,W,L-W,I)	Type of Material (natural, synthetic, mineral, advanced)	Market Readiness	Cost Data	Surface or subsurface use	Single Use or Reusable	Test Data (Y/N)	Test Method Used
174	Review article	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
175	Composite polyurethane foam functionalized with colloidal superparamagnetic iron oxide nanoparticles and submicrometer PTFE particles	Type I	W	Synthetic	TRL 3	N/A	Surface	Reusable (nanoparticles)	Y	Lab based sorption test (weight measurements), contact angle measurements

Article #	Article Reference (bibliography)	Year of Publication	Location of University	Summary of Article
1	Bazargan, A., Tan., J., and McKay, G.,2015, Standardization of Oil Sorbent Performance Testing. Journal of Testing and Evaluation, Vol 43, No. 6.	2015	HKG/GBR	Describes the shortcomings of ASTM F716-09 and ASTM F726-12 Standards for testing oil sorbents. The authors recommend improvements to the standards. These improvements include: 1. Instead of the use of separated words of adsorbent and absorbent with separate standards, have one combined standard and use the general term sorbent. 2. When removing a sorbent from a liquid bath during testing, researches should report the no dripping point, the uptake capacity at discrete points during draining, and the time to reach a no longer dripping equilibrium (capacity and time) 3. Researchers should report the dynamic loss of liquid from sorbent. 4. fluid uptake tests should be repeated to determine measurement errors. 5. Liquid properties should be reported when conducting experiments (density and viscosity) as these properties affect sorption and capacity.
2	Eskhan A, Banat F, 2018. Removal of Oil from Water by Calcium Alginate Hydrogel Modified with Maleic Anhydride. Journal of Polymers and the Environment (2018) 26:2901-2916.	2016	UAE	Tests the effectiveness of different sorbent types using ASTM F726 against 11 different oil types (light, medium, heavy, and weathered) with high viscosity fluids. Type I products showed a general trend towards greater oil retention with increasing viscosity although there was varying results between polypropylene pad products. Type II also had increased retention for light, medium, and heavy oils, but had a decrease in efficiency with highly weathered oil. Type III sorbents had higher efficiency with low viscosity products, but did not perform as well once the viscosity increased as a longer residency time was needed/required to achieve similar uptake of the heavier oils. Conclusion: uptake of oil increases with viscosity of the test oil for pads and socks due to bulk adhesion onto the base material structure. Higher viscosity oils require longer contact times to allow penetration of oil into sorbent structure. Loose sorbents generally achieve lower oil uptake.
3	Wang. H., Wang., C., Liu, S., Chen, L., Yang, S., 2019, Superhydrophobic and superoleophilic graphene aerogel for adsorption of oil pollutants from water, RSC Adv, 9, pp. 8569-8574	2019	CHN	The absorption of this new superhydrophobic (water retarding) graphene aerogel was tested to see its absorption capacity/wetting behavior (proof of concept) with different oils (crude oil, gasoline, diesel, engine oil, peanut oil, hexane). The water repelling part of the material was tested by looking at the wenzel state of the water droplet on the surface (image analysis) and the oil absorption capacity was tested using small scale sorption tests with oil on water. Results indicated that there was no detectable water in the aerogel material, and the adsorption capacity was 110-230 times higher than the materials own weight for the various oils and organic solvents tested. The tests also indicated that the adsorption capacity of the SGA was approximately proportional to the density of the various solvents, and the material can be reused if the material goes through a drying process.
4	Shin, Y., Winder, E.M., Han, K.S., Lee, H., Bonheyo, G.T., 2019, Enhanced capacities of mixed fatty acid-modified sawdust aggregators for remediation of crude oil spill, ACS Omega, 4, pp. 412-420.	2019	USA	The OA-modified pine sawdust prototype material's sorption capacity was tested in a laboratory setting. Unmodified pine sawdust showed a high capacity of about 4.0 grams or crude oil per 1 gram of sawdust, but showed less than 2 grams of crude oil sorption in the presence of sea water, and had little buoyancy in the presence of waves. With the modified OA sawdust, a 45.6% maximum sorption capacity was achieved compared to the non-modified sawdust. This new modified sawdust showed higher hydrophobic, oleophilic, higher sorption capacity, and buoyancy in sea water when compared to unmodified saw dust.

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5	ASTM F726-17, 2017, Standard test method for sorbent performance of adsorbents for use on crude oil and related spills, ASTM International, West Conshohocken, PA	2017	USA	This is the standardized test method for testing adsorbents. The standard goes through the performance properties for the different sorbent types, calculations for absorbency, and test methods to obtain this information.
6	Abdelwahab, O. (2014). Assessment of raw luffa as a natural hollow oleophilic fibrous sorbent for oil spill cleanup. Alexandria Engineering Journal, 53(1), 213–218. https://doi.org/10.1016/j.aej.2013.11.001	2013	EGY	The study evaluates the adsorption capacity of luffa fibers when used to remove crude oil from salt water. The study used diesel oil and heavy crude oil to evaluate the potential of the fibers. The study also assess the reusability of the material. The fiber was able to adsorbed up to 12x its weight in oil. The material lost about 50% of its sorption capacity after three uses.
7	Sayyad Amin, J., Vared Abkenar, M., & Zendehboudi, S. (2015). Natural Sorbent for Oil Spill Cleanup from Water Surface: Environmental Implication. Industrial and Engineering Chemistry Research, 54(43), 10615–10621. https://doi.org/10.1021/acs.iecr.5b01715	2015	IRN/USA	Investigates the potential of using Azolla, a plant, as sorbents for oil spills in seas. The study characterizes the structure of the Azolla plant using electron microscopy, and infrared spectroscopy. The study claims an adsorption of 10.2 g/g for engine oil and 5.3 g/g for crude oil. The electron microscopy confirmed a highly porous structure of the plant. Engine oil experienced higher sorption capacity compared to crude oil (11 g/g v. 5g/g). Adsorption capacity increases with increasing temperature (explained by the decrease in oil viscosity); but after 25C, it decreases do to reduced intermolecular forces. The pH also impacts the adsorption capacity, increasing with pH and peaking at around 9. Similarly, adsorption increases with salinity, since the salt lowers the functional group electrostatic repulsion in the adsorbed layer. The Azolla achieves acceptable adsorption rates. Up to 95% of the adsorbed oil is extractable.
8	Bayat, A., Aghamiri, S. F., Moheb, A., & Vakili-Nezhaad, G. R. (2005). Oil spill cleanup from sea water by sorbent materials. Chemical Engineering and Technology, 28(12), 1525–1528. https://doi.org/10.1002/ceat.200407083	2005	IRN	Characterization of the sorption capacity of three synthetic and natural materials: polypropylene nonwoven web, rice hull, and bagasse. The polypropylene had the highest sorption capacity (7-9 g/g), followed by bagasse (5-6 g/g), and then rice hull (5-6 g/g). The two natural materials had similar sorption capacity for light and heavy crude oil.
9	Danehpash, S., Farshchi, P., Roayaei, E., Ghoddousi, J., & Hassani, A. H. (2016). Utilizing the Low Cost Adsorbents for the Removal of Oil Spills from Seawater. Oil, Gas and Petrochemicals Letters 1, 1, 38–42.	2016	IRN	The adsorption capacity of two natural materials, perlite and zeolite, are analyzed. Perlite had a sorption capacity of 3.5g/g, while zeolite showed a 2.2 g/g capacity.
10	Alaa El-Din, G., Amer, A. A., Malsh, G., & Hussein, M. (2018). Study on the use of banana peels for oil spill removal. Alexandria Engineering Journal, 57(3), 2061–2068. https://doi.org/10.1016/j.aej.2017.05.020	2018	EGY	The study assess the potential of banana peels as oil sorbents. The factors considered on the performance of the material include: oil type, oil film thickness, sorption time, temperature, salinity, and morphology of the peel surface. The peels were washed, dried, and milled into particles with multiple average sizes (0.225 to 0.725 mm). The sorption capacity of banana peels is reported to be 5.3 to 6.6 g/g depending on the type of oil used; this value puts banana peel at around the average sorption capacity for natural organic materials. Sorption capacity correlated with particle size, peaking at 0.36 mm; the authors attribute this to the effects of surface area and pore plugging. Maximum sorption capacity is achieved at 15 minutes after exposure. Increasing temperature decreases sorption capacity. The material sorptivity peaks at 3.5% water salinity. After 10 cycles, the material showed 90% sorption capacity wrt to its original value.

Article #	Article Reference (bibliography)	Year of Publication	Location of University	Summary of Article
11	Hu, Y., Liu, X., Zou, J., Gu, T., Chai, W., & Li, H. (2013). Graphite/isobutylene-isoprene rubber highly porous cryogels as new sorbents for oil spills and organic liquids. ACS Applied Materials and Interfaces, 5(16), 7737–7742. https://doi.org/10.1021/am303294m	2013	CHN	This paper presents the development of a graphite/isobutylene-isoprene rubber cryogel for oil sorption. Different conditions for the cryogelation procedure tested and the characteristics of the resulting cryogel are reported. The material is characterized through electron microscopy and adsorption capacity of different oils is tested. The cryogel presented macropores ranging 20 to 30 µm. The sorption capacity for the material was 17.8g/g for crude oil, 21.6 g/g for diesel oil, and 23.4 g/g for lubrication oil. The cryogel also had great sorption capacity for aromatic compounds and alkanes (17.6 g/g - 22.8 g/g). The material also showed high reusability with similar capacity for least for 30 cycles.
12	Idris, J., Eyu, G. D., Mansor, A. M., Ahmad, Z., & Chukwuekezie, C. S. (2014). A preliminary study of biodegradable waste as sorbent material for oil-spill cleanup. The Scientific World Journal, 2014. https://doi.org/10.1155/2014/638687.	2014	MYS	The structure of empty fruit bunch fiber was characterized using electron microscopy and the absorption capacity evaluated using engine oil (5W-30). The fiber had a capacity of around 2.8 g/g.
13	Lee, P., & Rogers, M. A. (2013). Phase-Selective Sorbent Xerogels as Reclamation Agents for Oil Spills. *Langmuir* , *29* (18), 5617–5621. https://doi.org/10.1021/la400805c.	2014	USA	The study evaluates the microscopic structure and oil sorption capacity of 12-HSA xerogels prepared with three different solvents: acetonitrile, pentane, and diethyl ether. The samples are tested using motor oil, diesel fuel, and regular gasoline. The xerogel prepared with acetonitrile had a capacity of approximately 4 g/g and around 15% of the oil was reclaimed.
14	Liu, D., Tai, T., & He, Y. (2019). Solar heated graphene-melamine foam for absorbing oil and organic solvents. Energy Procedia, 158, 490–496. https://doi.org/10.1016/j.egypro.2019.01.140	2019	CHN	The paper describes the structure and fabrication of graphene-melamine foam and characterizes the performance of this material as an oil sorbent. The study also considers the effect of solar heating on the viscosity of the oil as a way to improve sorption performance. The sorption of multiple organic solutions was evaluated and the material showed absorption capacities of ~60 g/g for all cases. The recovery efficiency was around 80% for 10 cycles.
15	Liu, L., Lin, Z., Niu, J., Tian, D., & He, J. (2019). Electrospun polysulfone/poly(lactic acid) nanoporous fibrous mats for oil removal from water. Adsorption Science & Technology, 37(5–6), 438–450. https://doi.org/10.1177/0263617419828059	2019	CHN	The study presents the preparation of nanoporous fibrous mats made of polysulfone (PSF) and poly(lactic acid) (PLA). The material structures were characterized using electron microscope, surface area using nitrogen adsorption-desorption. PSF had higher surface area compared to PLA and PSF/PLA mats. PSF had the higher oil sorption capacity of 147.8g/g when using motor oil. PLA had a capacity of 50.1 g/g. Oil retention is directly controlled by oil viscosity, as lower viscosity oil are lost at faster rates. Results indicate that sorption capacity is not related to the mesoporous structure of the fibers, but rather to the microporosity among the fibers and the specific surface area.
16	Lu, Y., Wang, H., & Lu, Y. (2019). An architectural exfoliated-graphene carbon aerogel with super hydrophobicity and efficient selectivity. Materials & Design, 184, 108134. https://doi.org/10.1016/j.matdes.2019.108134	2019	CHN	A fabrication method to prepare a carbon based aerogel is presented in this paper. The aerogel matrix consists of layers of graphene connected by nano-fibrillated cellulose. The material vas a reported pore volume of 0.55 cm3/g and a specific surface area of 441m2/g, which are two times higher compared to other carbon aerogels. The adsorption efficiency of the aerogel is reported to be around 62 g/g for lubricating oil. The adsorption capacity for other organic liquids are also reported and range from 40 g/g to 80g/g.
17	Pagnucco, R., & Phillips, M. L. (2018). Comparative effectiveness of natural by-products and synthetic sorbents in oil spill booms. Journal of Environmental Management, 225(April), 10–16. https://doi.org/10.1016/j.jenvman.2018.07.094	2018	AUS	The study compares the performance of booms made with human hair to other natural and synthetic materials. The adsorption of oil and water is characterized, as well as the buoyancy characteristics of the materials. Human hair had the higher adsorption performance (0.84 g/g) of the material tested; however it also had the lowest natural buoyancy and highest variability between tests; polypropylene had the most consistent results.

Article #	Article Reference (bibliography)	Year of Publication	Location of University	Summary of Article
18	Choi, H and Cloud R.M. (1992) Natural Sorbents in Oil Spill Cleanup. Environmental Sci. Technology., Vol 25, No. 4.	1992	USA	This study compares the absorbency of milkweed floss, cotton, and propylene products in a simulated seawater bath containing crude oil and in a pure oil bath to examine feasibility of use. Milkweed showed the highest oil sorption capacity followed by cotton fiber. This high sorption capacity of milkweed was due to the large amount of wax on the fiber. Both milkweed and cotton absorbed larger amounts of crude than the polypropylene commercial products.
19	Thai, Q.B., Siang, T.E., Le, D.K., Shah, W.A., Phan-Thien, N. (2019). Advanced fabrication and multi-properties of rubber aerogels from care tire waste, Colloids and Surfaces A, 577, 702-708.	2019	SGP	Recycled car tire fibers were converted into a rubber aerogel using a cost effective freeze drying method. The coated aerogel exhibits super-hydrophobicity with water contact angle. The maximum oil absorption capacity of the rubber aerogel is up to 19.3 g/g which is competitive with some commercial sorbent products. The blanket can be scaled to larger sorbent blankets then what was testing in this article.
20	Xu, Z., Wang, J., Li, H., Wang, Y. (2019). Coating sponge with multifunctional and porous metal-organic framework for oil spill remediation, Chemical Engineering Journal, 370, 1181-1187.	2019	CHN	This composite is made from cost-effective and light-weight materials, easily modified and made of materials that are commercially available. The composite is easily portable and quickly adsorbs oil from water, reaching up to a capacity of 13,000%.
21	Viju, S., Thilagavathi, G., Vignesh, B., Brindha, R. (2019). Oil sorption behavior of acetylated nettle fiber.Journal of Textile Institute, 110: 10, 1415-1423.	2019	IND	Raw nettle fibers were acetylated with acetic anhydride. The oil sorption capacity of raw nettle fibers were 10.59 and 8.32 g/g for diesel engine oil and crude oil, respectively. These values were much lower than the sorption capacity of acetylated nettle, which are 23.21 and 18.75 g/g sorption for diesel engine oil and crude oil. It is noted that sorption capacity of acetylated nettle fibers were higher than that of synthetic polypropylene sorbent. Experimental data details method used to determine optimum acetylation time, reaction temperature, and catalyst concentration presented in this article.
22	Zhang T., et al., Recent progress and future prospects of oil-absorbing materials, Chin. J. Chem. Eng. (2018), https://doi.org/10.1016/j.cjche.2018.09.001	2018	CHN	This article summarizes a literature review of recent research conducted on various oil-absorbing materials. The oil absorption capacities, water-oil separation efficiency, and reusability of many different materials (biomass materials, polymers, and inorganic materials) is disused. The paper also goes into the chemical processes to create these synthetics and addresses the need for low-cost production and reusability for future industrial use.
23	Queensland University of Technology. "Safe solution to mop up oil spills." Science Daily. Science Daily, 24 September 2019. <www.sciencedaily.com/releases/2019/09/190924104103.htm>	2019	AUS	Researchers have developed a "hybrid surfactant" to absorb oil at the oil-water interface. The foam would be sprayed on an oil spill and then scraped off to remove oil by adsorption. The foam can reversibly switch between hydrophilic and lipophilic behavior and can be readily prepared for quick use.
24	Adebajo M.O. , R.L. FROST, J.T. KLOPROGGE, O. CARMODY AND S. KOKOT School of Physical & Chemical Sciences, Queensland University of Technology "Porous Materials for Oil Spill Cleanup: A Review of Synthesis and Absorbing Properties " Journal of Porous Materials 10: 159–170, 2003	2003	AUS	This article discusses various porous materials that can be used for oil absorption. Specifically focusing on hydrophobic aerogels (various formulations), zeolites, organoclays and natural absorbents. Laboratory data are provided for many of the materials discussed in the article. No specific conclusion or sorbent recommendation is determined, only a highlight of the each type mentioned with mention that additional work for each is necessary to get to a commercial form.

Article #	Article Reference (bibliography)	Year of Publication	Location of University	Summary of Article
25	Li Hua, Kifen Liu, Feglin Yang "Hydrophobic modification of polyurethane foam for oil spill cleanup" Marine Pollution Bulletin 64, 2012	2012	CHN	The article discusses a chemical process to modify polyurethane (PU) foam to increase hydrophobic and oleophilic properties. PU is light, has an open-cell structure and low density making a good candidate for an oil sorbent, however it also will absorb water. PU for this study was enhanced by grafting polymerization with LMA, and oleophobic monomer, as well as coating LMA microspheres. Test fluids were diesel and kerosene. Test cases were water only (water absorption), oil only, water-oil. Untreated PU showed least oil absorption, highest water absorption in all cases. Water absorption was shown to be reduced up to 50% with the treated samples, oil absorption capacity increased up to 27% when compared to untreated PU.
26	Tryba, B., Morawski, A.W., Kalenczuk, R.J., Inagaki, M. (2003). Exfoliated Graphite as a New Sorbent for Removal of Engine Oils from Wastewater. Spill Science and Technology Bulletin, Vol. 8, Nos. 5-6, pp. 569 - 571.	2003	POL/JPN	This study looked at the effects of oxidation of exfoliated graphite on sorption of oil and some organic substances dispersed in water. The material did not have a high sorption capacity for oil, but adsorption capacities for dyes dissolved in water were found to be improved by slight oxidation in air at 400 °C.
27	AlAmeri, K., Giwa, A., Yousef, L., Alraeesi, A., Taher, H. (2019). Sorption and removal of crude oil spills from seawater using peat-derived biochar: an optimization study. Journal of Environmental Management 250, 109465.	2019	ARE	The use of peat-derived biochar was tested for the removal of crude oil spills from synthetic sea-water. The material had held a capacity of 32 g/g achieved after 70 mins of contact time, with a sorbent crude oil weight ratio of 3.2, and a temperature of 45 °C. This sorbent demonstrated better performance compared to commercial activated carbon. Characterization analysis showed that the sorbent can be regenerated and is reusable for up to three cycles.
28	Wei, Q.F., Mather, R.R., Fotheringham, A.F., Yan, R.D. (2003). Evaluation of nonwoven polypropylene oil sorbents in marine oil spill recovery. Marine Pollution Bulletin 46, 780-783.	2003	GBR	This study evaluated the different forms of nonwoven polypropylene sorbents in terms of oil sorption capacity and retention properties. The article mentions that natural based sorbents possess high water sorption, while polypropylene fibre sorbents have a higher oil-sorption capacity, but lower uptake in water and also lighter than fresh or sea water and will float on it. The types of sorbents tested included stitch-bonded, needle-punched, and melt-blown. The results indicate that the sorbent with the higher porosity tends to have a higher initial sorption ratio and that the high viscosity of heavy oil tested under this effort significantly affects the penetration of the oil into the small pores of the sorbent materials. Light oil tends t be released from the sorbent fast with high release rate compared to the heavy oil. The sorbent construction also plays an important role in the retention behavior of a sorbent. The sorbent with a higher porosity has a higher initial oil pickup, but poor retention capacity. The rate of release can be reduced if a sorbent has a fine fibre structure. (some test performed with highly weathered oil).
29	Bhardwaj, N. and Bhaskarwar, A.N. (2018). A review on sorbent devices for oil-spill control. Environmental Pollution 243, 1758 - 1771.	2018	IND	This document provides a good overview of sorbent devices for oil spill cleanup operations. The authors bring up R&D activities for different sorbent types, materials, test methods, and functionality. They provide advantages and disadvantages for sorbents. Additionally, they highlight relevant factors affecting the performance of sorbent assemblies which are: structural features and modes of sorption, effect of weather on oil-sorption capacity, mode of distribution and harvesting of absorbent units, and the final disposal after feasible cycles of sorption and release.

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30	Carmody, O., Frost, R., Xi, Y., Kokot, S., (2007). Adsorption of hydrocarbons on organo-clays - Implications for oil spill remediation. Journal of Collois and Interface Science 303, 17-24	2007	AUS	This study looked at the effects of organo-clays for oil spill sorption, which are clays that have ions replaced with surfactant to create a hydrophobic clay. When tested using diesel, hydraulic oil, and engine oil, the sorption rate was 7.2 g/g, 3.6 g/g, and 3.6 g/g respectively. Based on key performance criteria, the organo-clays out performed two cellulose-based reference sorbents, but were higher in cost and not as biodegradable.
31	Wang. G., Sun, Q., Zhang., Y., Fan, J., Ma, L. (2010). Sorption and regeneration of magnetic exfoliated graphite as a new sorbent for oil pollution. Desalination 263, 183-188.	2010	CHN	MEG with high sorption capacity and magnesium was prepared by citric acid sol-gel method. For sorption tests with engine oil and crude oil over a 2 minute period, the sorption capacity of the MEG was 48.93 g/g and 42.75 g/g, respectively. Additionally, MEG was able to remove heavy oil on surface water easily and was able to be reused up to 3 times.
32	Saleem, J., Bazargan, A., Barford, J., McKay, G. (2015). Application of strong porous polymeter sheets for superior oil spill recovery. Chem. Eng. Technol, 38, No. 3, 482-488.	2015	HKG/QAT	This study looks at increasing the sorption oil capacity, mechanical strength, and cost effectiveness of a new polymer sorbent that is made up of molecular-weight polyethylene. When tested with sorption capacity with diesel, the sorbet showed a capacity of 125 g/g to 275 g/g after two minutes, and 40 g/g to 90 g/g after 60 minutes of dripping.
33	Wang, Y., Zhou L., Luo, X., Zhang, Y., Sun, J., Ning, X., Yuan, Y. (2019). Solar-heated graphene sponge for high-efficiency clean-up of viscous crude oil spill. Journal of Cleaner Production 230 (2019), 995-1002.	2019	CHN	A commercially-available melamine-formaldehyde (MF) sponge was dip-coated with graphene oxide and reduced by hydrazine hydrate to create a MF/educed graphene oxide (MF/rGO) sponge. The sponge was tested against a traditional MF sponge for crude oil absorption on sea water and significantly reduced the absorption time (about 50% without sunlight and 75% with sunlight). The increased oil absorption is due to the improved light-to-heat conversion capability (~98% sunlight absorption) that lowers the oil viscosity. The sponge is reusable with consistent oil absorption after 10 compress-release cycles and little deformation after 500 compress-release cycles. The product needs to be created and tested on a large-scale.
34	Lindholm, Jane, and Ric Cengeri. "Canadian Company Uses Milkweed Fibers To Absorb Oil Spills, Help Monarchs." Vermont Public Radio, VPR News, 8 Dec. 2014, www.vpr.org/post/canadian-company-uses-milkweed-fibers-absorb-oil-spills-help-monarchs#stream/0.	2014	CAN	Protec Style, a company in Quebec, is creating natural milkweed fiber spill kits for oil spills. As of 2015, these spill kits were to be used in all the parks in Canada. Milkweed fiber is said to absorb 50 L/kg of fiber, making it five times more absorbent than polypropylene. The fiber is ready to be used once the seeds and pods are removed, and the seed are re-planted for future milkweed crops. Milkweed offers a sustainable, environmentally-friendly option that also benefits the monarch butterfly population.
35	Blinovskaya Ya Yu 2019 IOP Conf. Ser.: Earth Environ. Sci. 272 032116.	2019	RUS	This study tested the oil absorption, water absorption, and buoyancy of four commercially-available loose sorbent powders. The oil absorption was tested at three different temperatures (23 C, 5 C, and -9 C) to study the effect of low temperatures on oil absorption for arctic applications. Overall, EGS performed the best when comparing results from all three tests and had the highest oil absorption at all temperatures. Significant differences were found between manufacturer published technical requirements and actual lab data (three performed much worse, and one performed better). Improvements can be made to sorbents for arctic applications by reducing water absorption. The structure of materials at arctic temperatures must also be considered and improved upon for ease of application..
36	Liu Yue, Guanbo Huang, Chunjuan Gao, Lei Zhang, Mingxi Chen, Xiaoyang Xu, Jianping Gao, Cheng Pan, Nian Yang, Yu Liu (2015). Biodegradable polylactic acid porous monoliths as effective oil sorbents. Composites Science and Technology 118 (2015), 9-15.	2015	CHN	PLA monoliths are prepared by freeze drying and then modified with reduce graphene oxide to make them hydrophobic and oleophilic. Oil absorption was measured at 20C. Each sample was spun in a centrifuge to remove the oil and then re-immersed six times. Monoliths with a PLA concentration of 1.5% wt and 2.0% wt of rGO had an oil absorption capacity of 45-50g per gram of monolith and retained 75% of their capacity after centrifuging. If placed on an oil-water mixture, the monoliths absorb the oil and then float on the water. PLA is biodegradable.

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37	Periolatto Monica, Giuseppe Gozzelino (2015). Greasy Raw Wool for Clean-up Process of Marine Oil Spill: from Laboratory Test to Scaled Prototype. Chemical Engineering Transactions, Vol. 43, 2015 (2269-2274).	2015	ITA	Raw sheep wool was characterized as to lipid and dirt contents, moisture content etc. It was tested with salt water and fuel oil. Saturation was reached after a contact time of 30s. After 50s, fibers tend to sink and recovery is more difficult. Dirty wool absorbed considerably more water than clean wool, but it can be reused more often (15 times vs. 10 times) before it becomes too stringy and recovery becomes difficult. Oil absorption capacity 86 g/g.
38	Kumpanenko I. V., A. V. Roshin, N. A. Ivanova, E. O. Panin, and N. A. Sakharova, 2015. Application of sorbents to the Collection of Crude Oil and Refined Product Spills. Russian Journal of Physical Chemistry B, 2015, Vol. 9, No. 2, 295-299.	2015	RUS	Round pieces of polyurethane sheets are placed on hydrocarbons (various types) on water or on a glass surface. Saturations is reached after about 30 minutes. Capacity on water and on glass was the same, since the foam is very hydrophobic. For regeneration testing, a roller squeeze mechanism was used. Capacity decrease no more than 10% over 30 cycles.
39	Ceylan, D., Dogu, S., Karacik, B., Yakan, S.D., Okay, O.S., Okay, A.O. (2009). Evaluation of Butyl rubber as sorbent material for the removal of oil and polycyclic aromatic hydrocarbons from seawater. Environ Sci. Technol, 43, 3846-3852.	2009	TUR	Tissue sheets of butyl rubber were created and tested for their sorption capacity for crude oil and petroleum products. The sorption capacity of these sheets was between 15-23 g/g as compared to 10-16 g/g obtained using nonwoven polypropylene (widely used commercial sorbent). These sheets were also reusable to its full capacity up to three times.
40	Chen, N and Pan Q. (2013). Versatile fabrication of ultralight magnetic foams and application for oil-water separation. ACS Nano, Vol 7, No. 8, 6875-6883.	2013	CHN	A commercial polyurethane sponge was rafted with ammonium nitrate to generate an ultralight magnetic foam. The sorption of the foam was tested with crude oil, bean oil, lubricating oil and hexane on water. The sorption capacity of the foam was 61 to 102 times the weight of the sorbent and was dependent on the oils density, viscosity, and surface tension of the absorbed liquids. The authors note that the raw materials are easily available and these sponges are easy to manufacture, these sponges may be a low cost product to generate and use for oil spill cleanup operations.
41	Karakutuk., I., and Okay, O. (2019). Macroporous rubber gels as reusable sorbents for the removal of oil from surface waters. Reactive and Functional Polymers, 70, 585 - 595.	2019	TUR	Macroporous organogels were generated by crosslinking with 4 different rubbers. These organogels were tough and could be completely compressed without any cracks developing in the sorbent. This sorbent was tested for its sorption capacity to remove crude oil, gasoline, diesel, fuel oil and olive oil, with sorption capacities between 24 to 38 g/g. These organogels are also reusable once they are squeezed (up to three times).
42	Karan, C.P., Renasamy, R.S., Das, D. (2011). Oil spill cleanup by structured fire assembly. Indian Journal of Fibre and Textile Research. Vol. 36, pp. 190-200.	2011	IND	Tested exfoliated graphite by centrifugation, mechanical pressing, and squeezing resulted in a sorption capacity that was 86 g/g when sorption capacity was tested with heavy crude oil on the surface of water.
43	Bidgoli, H., Khodadadi, A. A., & Mortazavi, Y. (2019). A hydrophobic/oleophilic chitosan-based sorbent: Toward an effective oil spill remediation technology. Journal of Environmental Chemical Engineering, 7(5). https://doi.org/10.1016/j.jece.2019.103340	2019	IRN	The study discusses a novel process to generate an aerogel using chitosan derived from shellfish based on cross-linking and freeze-drying. The aerogel showed a strong oil selectivity with a high hydrophobic performance (contact angle ~145 deg). The aerogel achieved a absorbency of 41.7 to 48.3 g/g of different crude oils.
44	Saleem, J., Ning, C., Barford, J., McKay, G. (2015) Combating oil spill problem using plastic waste. Waste Management 44, 34-38.	2015	PAK/QAT/HKG	This study the use of recycled HDPE bottles generated into films for oil sorption. Both oil uptake and swelling tests were accomplished were RMG380, Mineral, and corn oil (spilled on water) was absorbed by the film after a 1 hour dripping period. The sorption capacity of the oil showed a 100 g/g, 45 g/g, and 35 g/g uptake respectively. Additionally, the contact angle of water on the film was measured and indicated that the film is hydrophobic and can repel water.

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45	Peng L. et al, Electrospun PS/PAN fibers with improved mechanical property for removal of oil from water, Marine Pollution Bulletin 93 (2015), 75-80	2015	CHN	This study evaluates electrospinning blends of polystyrene (PS) and polyacrylonitrile (PAN). The morphology, oil sorption, mechanical properties, and buoyancy of various PS/PAN blends are evaluated. The addition of PAN is shown to significantly improve mechanical properties of PS fibers. Oil sorbtion is also found to increase with decreasing fiber diameter. Pump oil, peanut oil, diesel, and gasoline were used in testing
46	Wu D. et al, Oil sorbents with high sorption capacity, oil/water selectivity, and reusability for oil spill cleanup, Marine Pollution Bulletin 84 (2014), 263-267.	2014	CHN	This study evaluates a preparation method for treating polyurethane (PU) sponges with silica sol and gasoline to develop a hydrophobic surface, thereby enhancing oil/water selectivity. Study showed a sorption capacity of more than 10x when compared to widely used commercial PP with minimal water absorbed (0.1g) Testing showed oil can be recovered by squeezing of sponge and the sorbent reused more than 15 times (70% sorption capacity remained). Motor oil, peanut oil, and diesel were used in testing.
47	Avila A.F. et al, Nano-based systems for oil spills control and cleanup, Journal of Hazardous materials 272 (2014), 20-27.	2014	BRA	This study evaluates a nanocomposite system in a "teabag" configuration that contains exfoliated graphite surrounded by a hydrophobic polystyrene (PS) membrane. Study discussed manufacturing methods for the PS hydrophobic membrane which involved electrospinning treated PS on to a cotton fabric. Observations show oil adsorption rate is dependent on soil surface tension and absorption rate is dependent on graphite surface area. New and used motor oil and vacuum pump oil were used in testing.
48	Teli, M.D., Valia, S.P, 2013, Acetylation of jute fiber to improve oil absorbency, Fibers and Polymers, Vol 14, No. 6, 915-919.	2013	IND	This study evaluates the use of jute fiber (a natural biodegradable fiber) that has some chemical modification from acetylation to make it more oleophilic as a sorbent. The lab-based test used machine oil suspended on water in a beaker. The sorbent had a sorption capacity of 21 g/g, which is much higher than traditional commercial synthetic sorbents. The fibers were also tested for their reusability, and were able to be used up to three cycles, but lost some of its sorption efficiency by a third after the last cycle.
49	Wang, Z., Zhang, Y, Zhu, F., Li, J., Liu, S., Na, P., 2014, Adsorption of soluble oil from water to graphene. Environmental Sci Pollut Res, 21: 6495-6505.	2014	CHN	This study looked at the adsorption of oil from water using graphene prepared according to oxidation and thermal reduction methods. The adsorption rate was tested on two different oil types, diesel oil and crude oil. This was tested at a small scale with 50 ml of oil sample. It was found the soluble diesel oil, had an equilibrium adsortion capacity of 241.88 mg/g (original 76.86 mg/g). and 9.98 mg/g (original 2.638 mg/g) . The adsorption rate of the graphene reached an equilibrium within 30 mins.
50	Bazargan, A., Tan, J., Hui, C.W., McKay, G, 2014, Utilization of rice husks for the production of oil sorbent materials. Cellulose, 21: 1679-1688.	2014	HKG	This study evaluated the use of treated rice husks as an oil sorbent material. Rice husks are abundant as it is the third most widely produced crop in the world. The authors used alkali treated husks and conducted lab-based measurements using this product on the sorption of diesel oil only. Their results indicate that the husk has continuous sorption up to 12 hours, and with a strong alkali treatment, had a measured uptake of 20.1 g/g, which is a higher sorption that previously tested rice husks (uptake of 4.5 g/g).
51	Bandura, L., Franus, M., Jozefaciuk, G., Franus, W., 2015, Synthetic zeolites from fly ash as effective mineral sorbents for land-based petroleum spills cleanup. Fuel, 147, 100-107.	2015	POL	This study looks at the sorption of diesel fuels and used oil on natural clinoptilolite, synthetic zeolites Na-PI and Na-X, and a commercial sorbent Absodan. Both the synthetic zerolites had a higher sorption rate than both the natural and commercial sorbent, reaching up to 0.9 g/g for 24 hour left on top of oil. (2 times higher sorption capacity than commercial product) .

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52	Kenes, K., Yerdos, O., Zulkhair, M., Marat, T., Yerbol, T., 2013, Applied Mechanics and Materials, Vol. 446 - 447, pp 1508-1511	2013	KAZ	This study investigated the oil sorbent efficiency of thermal treated rice husks for the removal of heavy crude and oil products from a water surface. The oil sorption capacity showed crude oil sorption of a capacity up to 15 g/g.
53	Meng, X., Wu, H., Zeng, Y., 2014, Blended polypropylene fiber of various MFR via a melt-blowing device for oil spill cleanup, Applied Mechanics and Materials, Vol. 624 pp. 669-672.	2014	CHN	This study investigated blending different types of polypropylene fibers together using different melt blowing flow rates (high-speed air flow field to attenuate the polymer jet) and seeing with the sorption capacity was for these types of fiber blends. Samples were placed on an oil in water sample and weighed. The results of this study indicate that the new blended fibers resulted in porosities that were between 52.74 g/g and 94.05 g/g, where the higher the porosity of the woven sorbent, the higher the sorption capacity. The reusability of the sorbent was also tested, and could be used up to 5 cycles, with a sorption value of 18.36 g/g after the 5 cycles.
54	Bazargan, A., Hui, C.W., Mckay, G., 2014, Marine residual fuel sorption and desorption kinetics by alkali treated rice husks, Cellulose, 21: 1997-2006.	2014	HGK	This study investigated the use of alkali treated rice husks on oil spilled on water. This was compared against a common sorbent Corksorb. The test indicated that the rice husk reached saturation less than 2 minutes, and had a sorption capacity that was 18 g/g (Corksorb had 10 g/g). However, the rice husk, also has a large uptake in water (12 g/g), while the Corksorb has a lower uptake in water (2 g/g).
55	Abirami, A.A., Kumar, P.S., Prakash, D.G., Ravirajan, A., Umasankaran, A., Narayanan, P., Ravishankar, K., Kuma, C.S., Nagaraju, S., Reddy, K.P.J., 2020, Synthesis and application of porous oil-sorbent microspheres: Characterization , retention capacity and sorbtion kinetics. Separation and Purification Technology, 234, 116095.	2020	IND	This study focuses on the sorption performance of three polymeric microsphere sorbents of oil spilled on water. The porous microspheres were synthesized through suspension polymersation and were tested on three different oils: petrol, diesel, and lube oil. All sorbents had a higher sorption capacity with the petrol oil (300 - 500 wt%), the second being diesel (275 - 425 wt%), and lastly lube oil (275 - 325 wt%).
56	Wu, Z., Liang, H., Zhang, Y., Wang, X., Chen, J., Yu, S., 2014, Carbon nanofiber aerogels for emergent cleanup of oil spillage and chemical leakage under harsh conditions, Scientific Reports, 4:4079, DOI: 10.1038.	2014	CHN	This study investigated carbon nanofiber aerogels for sorption of oil on water. This developed sorbent has a large sorption capacity, high uptake rate, and potential recyclability. The generated aerogel have a self-assembled, interconnected, three-dimensional network with a low apparent density. They are also hydrophobic and superoleophilic. The sorption capacity of this sorbent was tested against 12 different test oils ranging in viscosity and density. The total sorption weight gain of the sorbent was between 5,000 % and 14,000% the original weight of the sorbent. This study also looked at the reusability of the sorbent, and over a cycle of 10 times (squeezing to remove oil), the sorption capacity did not decrease.
57	Kong, Z., Wang, J., Lu, X., Zhu, Y., Jiang, L., 2017, In situ fastening graphene sheets into a polyurethane sponge for the highly efficient continuous cleanup of oil spills. Nano Research, 10 (5), 1756-1766.	2017	CHN	This study investigated the use of polyurethane sponge for sorption of oil spilled on water. The sponge was generated using in situ polymerization and is hydrophilic (water repellant). The sorption of the sponge was tested on hexane, engine oil, crude oil and emulsified oil, within HCL, NaOH, hot water, and cold water. The sponge was able to remove oil from water about 700 times the weight of the sponge within 10 seconds, and had a separation efficiency of 99.99%. Additionally, the sponge was reusable up to 200 times with the same sorption efficiency.
58	Boleydei, H., Mirghaffari, N., Farhadian, O., 2018, Comparative study on adsorption of crude oil and spent engine oil from seawater and freshwater using algal biomass. Environmental Science and Pollution Research, 25:21024-21035	2018	IRN	This study compared the adsorption of an algal biomass testing against a light crude oil and spent oil adsorbed from seawater and freshwater. The sorption results indicate that the removal of oil compounds were constant after 10 mins (tested for 120 mins), and had 72% and 80% efficiency at removing the crude and spent oil from freshwater and seawater respectively. Additionally, the authors tested decreasing the size of the loose sorbent particulates and it reduced the sorption capacity by 45%, indicating the larger granulars have more sorption ability.

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59	Li, H., Wu, W., Bubakir, M.M., Chen, H., Zhong, X., Liu, Z., Ding, Y, Yang, W., 2014, Polypropylene fibers fabricated via a needless melt-electrospinning device for marine oil-spill cleanup. J. App. Poly Sci, DOI:10.1002/APP 40080	2013	CHN	This study looked at ultrafine polypropylene fibers for use as oil on water sorbents. These sorbents were made with various diameters and porosities by manipulating the electric field during the manufacturer processing (melt-electrospinning). The maximum oil sorption capacity of the sorbent when tested with motor oil and peanut oil were 129 and 80 g/g respectively. This sorbtion is higher than commercial polypropylene sorbents (6 to 7 times higher). After 7 sorption cycles, the sorbent showed good recoverability and reusability, and maintained 80 g/g sorption capacity.
60	Hoshyarger, F., Mahajan Mahan, A., Bhosale, S.V., Kyratzis L., Bhatt, A.I., O'Mullane, A.P., 2016, Superhydrophobic Fabrics for Oil/Water Separation Based on the Metal-Organic Charge-Transfer Complex CuTCNAQ. ChemPubChem, 81, 378 - 383	2016	AUS	This study investigated the use of superhydrophobic nylon textile/fiber. The study showed that the sorbent was water repellant, and could separate dichloromethane, olive oil, and crude oil from water up to 99% in 7.3 m^2/s. The sorbent also maintained its functionality up to 18 months (reusability).
61	Li, X., Guo, Y., Zhang, J., Zhang, L., 2013, Preparation of Polysulfone Microspheres with a Hollow Core/Porous Shell structure and their application for oil spill cleanup. J. Applied Polym. Sci. DOI:10.1002/APP.38355.	2013	CHN	This study investigated polysulfone microspheres, prepared by water-in-oil emulsion solvent evaporation method, to remove oil spilled on water. Three kinds of microspheres were prepared, these microspheres are monodispersed, and had an average diameter of 25 micron. The sorption study indicated that the sorbents had a capacity that ranged from 12.5 to 33 g/g. Additionally, the sorbent could be reused up to three times, but the sorption capacity decreased in half by the third cycle.
62	Songsaeng, S., Thamyongkit, P., Poompradub, S., 2019, Natural Rubber/Reduced-graphene Oxide Composite Materials: Morphological and Oil Adsorption Properties for Treatment of Oil Spills. Journal of Advanced Research 20 (2019) 79-89, https://doi.org/10.1016/j.jare.2019.05.007.	2019	THA	A green sorbent material was fabricated by adding reduced graphene oxide to natural rubber latex. It was found that the formulation of 0.5 rGO content in parts by weight per hundred parts of rubber (NRG-0.5) had the optimum oil adsorption capacity compared to pure natural rubber foam, rubber foam with different weight concentrations of rGO (0.25, 1, and 1.5), and commercial polypropylene sorbent pads. The improved performance was seen with water and sea water and with gasoline and crude oil. NRG-0.5 is promising for ocean field conditions as it was tested at different temperatures and with wave activity. Oil adsorption capacity was optimized at a temperature of 45C and increased with increasing wave activity, while remaining buoyant at the surface. It also exhibited good mechanical strength and reusability for 30 cycles without damage.
63	Yang, S., Chen, L., Mu, L., Ma, P. Magnetic Graphene Foam for Efficient Adsorption of Oil and Organic Solvents. Journal of Colloid and Interface Science 430 (2014) 337-344. http://dx.doi.org/10.1016/j.jcis.2014.05.062.L68	2014	CHN	A magnetic graphene foam loaded with magnetite nanoparticles was prepared and tested for oil adsorption capacity. The foam exhibited weight gains more than 10 times the original weight for a variety of solvents and oils. Data suggests the introduction of magnetite nanoparticles does not sacrifice adsorption capacity. The addition of the magnetite nanoparticles will simplify application using magnetic driven oil-water separation technology. The foam exhibited excellent reusability under cyclic operations, maintaining 98% of its original adsorption capability after 8 cyclic applications. The foam can be regenerated after use by submerging in hexane to recycle the foam and absorbed oil.
64	Meng, Y., Young, T.M., Liu, P., Contescu, C.I., Huang, B., Wang, S., 2015, Ultralight carbon aerogel from nanocellulose as a highly selective oil absorption material. Cellulose, 22:435-447.	2015	USA	The authors in this study generated a sponge-like carbon aerogel from microfibril cellulose which has a high porosity and low density. They tested this sorbent for oil on water, and assessed the sorbents reusability over 10 cycles. When tested on canola oil, pump, oil, paraffin oil, and diesel oil, the sorbent had a capacity that ranged from 55 g/g to 86 g/g, and was able to maintain the same high level of sorption after the 10 reusable cycles.
65	PIG, 2012, Choosing and Using Absorbents	2012	USA	Training slides for selection and use of sorbents. Difference between universal and oil only, description of different forms (socks, booms, etc.). Socks tend to be used on land, booms on water (socks smaller than booms). Oil only usually white, usually filled with polypropylene or hydrophobic cellulose. PP better for landfills, both PP and cellulose can be incinerated. Loose sorbents are cheaper, but harder to clean up and not as efficient.

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66	National Response Team Science & Technology Committee, 2007, NRT-RRT Factsheet.	2007	USA	Sorbents vs. Solidifiers. Solidifiers have to be on the US EPA National Contingency Plan, Subpart J Product Schedule. Sorbents are inert and insoluble. Summarizes benefits and shortcomings of sorbents vs. solidifiers. Better on thin films of light oils than sorbents. better for land fill than sorbents.
67	Sung, T., 2017, Oil Adsorption Performance and Efficiency Study on Novel Silane Functionalized Graphene Polyurethane Sponge. Thesis.	2017	CAN	Oil adsorption and retention performance was studied on samples of polyurethane sponge to quantify the effects of acid pretreatment, coating with MPTS or reduced graphene oxide. Net adsorption capacity improved from 18.5 g/g to 28.61 g/g. Oil retention also improved. 99.4% recyclability after 10 adsorption-desorption cycles. Extensive discussion of oil properties, adsorption behavior for different types of adsorbents and treatments
68	Pinto, J., Athanassiou, A., Fragouli, D. 2016. Effect of the porous structure of polymer foams on the remediation of oil spills. J. Phys. D: Appl. Phys. 49 (2016) 145601	2016	ITA	Authors show that the structural parameters of the pores of polymeric foams are critical for oil removal from water. Foams with highly interconnected open porous structures and pore sizes below 500 micron can have absorption capacities of 30 g/g. Chemical treatments don't improve efficiency, but improve selectivity. But the structure of the foam is more important for sorption capacity.
69	Konczewicz W, Grabowska O, Lachowicz D, Otremba Z, 2013. Study on oil sorbents effectiveness. Journal of KONES Powertrain and Transport, Vol. 20, No. 1 2013	2013	POL	Authors introduce new lab test on sorptivity of mineral and natural sorbents to assess usefulness of various loose sorbents. They placed loose sorbent on top of oil volume and took pictures every 10 seconds to see how much of the sorbent was changing color, indicating that it had absorbed oil. Oil only, room temperature, one type of oil, one type of mineral and one type of natural (peat moss) sorbent.
70	Krivonos O I, Zaporogan S D, Raiskaya E A, Belskaya O B, 2019. Sapropels as a source of sorbents for cleaning the surface of water areas from petroleum products. AIP Conference Proceedings 2143, 020051 (2019)	2019	RUS	Different types of sapropel (bottom sediment of fresh water lakes - its residue from heat treatment is a by product) with different heat treatments were tested. Organic sapropels with heat treatment at 110C and 300C had the best sorption properties and buoyancy, compared to silica sapropels and other heat treatments, both on fresh and salt water. Sorption capacity of 2-3 g/g.
71	Mishra P K, Mukherji S, 2012. Biosorption of diesel and lubricating oil on algal biomass. 3 Biotech (2012) 2:301-310	2012	IND	Oil sorption on algae was found to be comparable to other spill clean-up sorbents. Sorption is affected by type of oil and type of algae. Tests were conducted over several days. They focus on fitting models to the data.

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72	Xiao W., Wang, N., Niu, B., Fu., C., Zhaou, L., Zheng, Y., 2019, Polyether sulfone assisted share construction of Calatropis gigantea fiber for preparing a sustainable and reusable oil sorbent. Cellulose, 26:pp. 3923 - 3933.	2019	CHN	Oil sorption of PES/CEF (hybrid material) was compared against just the sorption of just PES in a lab-based weight measurement. The PES/CEF material is malleable and can be processed into any shape. These were tested against twelve different oil types. The PES/CEF sorbent had a sorption capacity between 4.26 g/g up to 9.24 g/g, which was higher than just he PES material (1.15 - 6.95 g/g). The PES/CEF sorbent was also tested for reusability for up to 10 cycles. From its original sorption after 10 cycles with the different oils, the sorbent was able to maintain around 75% its sorption capacity.
73	Bidgoli, H., Mortazavi, Y., Khodadadi, A.A., 2019, A functionalized nanostructured cellulosic sorbent aerogel for oil spill cleanup: Synthesis and characterization. Journal of Hazardous Materials, 366, 229 - 239.	2019	IRN	The authors in this study developed a methodology to convert cellulose to a biodegradable cotton sorbent which can selectively absorb oil through solid phase swelling instead of capillary force. They tested their cotton cellulose, synthesized by OC and combined with a hydrophobic aerogel, that was compared with just a non-processed cotton sorbent on three different crudes. The results indicate that the newly processed cotton could absorb 20x more oil than the regular cotton sorbent, with a sorption capacity between 40.7 g/g to 57 g/g. Additionally, the sorbent was tested for reusability up through 3 cycles, where the sorption capacity dropped by half after the 3rd cycle.
74	Costa G., PinhoN., Silva I., Costa J., Silva C., Romao L., 2019, Removal of heavy crude oil from water surfaces using a magnetic inorganic-organic hybrid powder and membrane system	2019	BRZ	Organic-inorganic hybrid materials- coconut husks, sugar cane bagasse, sawdust, and water hyacinth with magnetic Cobalt Ferrite were placed on oil spilled onto fresh, distilled and sea water in petri dishes for 2 minutes. The adsorbed oil was extracted using magnets and efficiencies determined by ASTM F726-99 and D4006. Oil extraction rates from about 85% to 70% depending on material used. Regenerative processes were mostly constant until about the fifth time. The separation process involves magnets, mechanical separation, and some chemical separation with hexane. Oil extracted can be refined. All materials show great potential not only for effectiveness but overall costs due to materials cost and availability, and fewer steps and reagents in extraction and refinement.
75	Anh, Q. T. Q., and Zenitova, L. A., "Liquidation of Oil Spills Using a Sorbent Based Chitosan," Earth and Environmental Sciences, Vol. 337, 2019	2019	RUS	Urethane foams were treated with chitosan (a naturally occurring material extracted from shellfish. Chitosan is a polysaccharide. Tests show that the material can adsorb up to 12.6 gm oil per gram of sorbent. No data are provided regarding the removal of oils or the reusability of the material.
76	Davoodi S M, Taheran M, Brar S K, Galvez-Cloutier R, Martel R, 2019. Hydrophobic dolomite sorbent for oil spill clean-ups: Kinetic modeling and isotherm study. Fuel 251 (2019) 57-72	2019	CAN	A low-cost chemical hydrophobic sorbent (rock limestone) was dip-coated and characterized with different methods and adsorption was tested under different parameters (salinity, temperature, contact time, etc.). Capacity was about 500 mg/g
77	Sobral Hilario L, Batista dos Anjos R, Borges de Moraes Juviniano H, Ribeiro da Silva D, 2019. Evaluation of Thermally Treated Calotropis Procera Fiber for the Removal of Crude Oil on the Water Surface. Materials 2019, 12, 3894	2019	BRA	Thermally treated Calotropis Procera fiber (from the fruit) absorbs up to 180 g/g, compared to untreated fiber at 76 g/g. Thermal treatment was at 150C and 200C for 1 hour. The sorption test data mentioned in the text doesn't match the graphs, so it's confusing. Reusability: 60% in third cycle, 40% in sixth cycle. Testing was conducted with crude oil. Some further testing with diesel, marine diesel, lube oil, engine oil, and benzene was also done.
78	Nyankson E, Rodene D, Gupta RB, 2016. Advancements in Crude Oil Spill Remediation Research After the Deepwater Horizon Oil Spill. Water Air Soil Pollut (2016) 227:29	2016	Switzerland	In the five years after Deepwater Horizon, a lot of research was done on oil spill remediation. This article summarizes the different types of sorbents and dispersants. It describes the sorption capacities of cotton, kapok, and other plant-derived cellulosic and lignin fibers and mentions different treatment options to increase sorption capabilities. Capacities of natural sorbents are summarized in Table 1. Synthetic materials can be fine-tuned to enhance their properties. The article mentions nanostructured carbon allotropes, spongy graphene, polyurethane, microspheres and gels, polymeric materials, nanomaterials. Table 2 gives a summary of the capacities of synthetic materials.

Article #	Article Reference (bibliography)	Year of Publication	Location of University	Summary of Article
79	Fan S, Pei S, Shen T, Xu G, Li Y, Fan W, 2019. Fabrication of Syperhydrophobic Magnetic Sawdust as Effective and Recyclable Oil Sorbents. Materials 2019, 12, 3432	2019	CHN	Superhydrophobic magnetic sawdust was fabricated, functionalized with Fe_3O_4 nanoparticles and treated with hexadecyltrimethoxysilane for hydrophobicity. Due to its magnetic characteristics, it can be easily controlled. High oil absorption capacity (10-18 g/g, depending on oil type) and good reusability after rinsing with acetone and water (slight decline after 20 cycles). It floats on water, but can be taken to the bottom of a flask by placing a magnet there.
80	Wang J, Liu S, 2019. Remodeling of raw cotton fiber into flexible, squeezing-resistant macroporous cellulose aerogel with high oil retention capability for oil/water separation. Separation and Purification Technology 221 (2019) 303-310	2019	CHN	Simple and low-cost preparation of superhydrophobic aerogel by using raw cotton fiber as starting material. The sorption capacities are up to 20-30 times the weight of the aerogel (tested with very light oils). Good oil retention. Excellent recyclability. It is still hydrophobic after 18 cycles (absorbed oil was recovered by vacuum suction filtration - aerogel is not deformed, which helps retain capacity).
81	Todescato D, Hackbarth FV, Carvalho PJ, Ulson de Souza AA, Ulson de souza SMAG, Boaventura RAR, Granato MA, Vilar VJP, 2020. Use of cork granules as an effective sustainable material to clean-up spills of crude oil and derivatives. Environmental Science and Pollution Research (2020) 27:366-378	2020	Portugal	Heat treated cork (380C steam injection) was tested with five types of oil and sorption capacity ranged from 2g/g to 5.7g/g. The API gravity of the oils was between 19 and 36. Higher viscosity oil is absorbed better. About 80% of the oil could be recovered by mechanical compression and the cork could be reused. Sorption capacity was retained after 30 cycles. Dependence on temperature, particle size, sorption time was studied.
82	Bulauka YA, Mayorava KI, Ayoub Z, 2018. Emergency sorbents for oil and petroleum product spills based on vegetable raw materials. IOP Conf. Series: Materials Science and Engineering 451 (2018) 012218.	2018	Belarus	The sorption capabilities of buckwheat and barley husks, pericarp radish, and pericarp shell of peanuts was studied for crude oil and other oils on solid surfaces (Pericarp: part of a fruit formed from the wall of the ripened ovary). Having to heat treat raw materials requires a lot of energy and equipment. Acid treatment requires acids and produces toxic waste. Therefore, raw materials are of great interest. The samples of raw materials were dried and ground. They were prepared in three different way, including no heat, heat, and heat and sodium hydroxide. Untreated material had a sorption capacity of about 2-3 g/g. The three treatment methods increased the capacity to 3-9 g/g, 4-10 g/g, and 5-15 g/g respectively for different materials. These materials are economic and the used sorbents can be used as fuel.
83	Anuzyte E, Vaisis V, 2018. Natural oil sorbents modification methods for hydrophobicity improvement. Energy Procedia 147 (2018) 295-300	2018	LIT	This work investigates eco-friendly treatment methods to improve hydrophobicity and oleophilicity. Moss was treated with an alkaline solution (NaOH 5%), with hot water (80C and 100C), or coated with oil. Treatment with NaOH increased sorption capacity by 22% (8.99 g/g), treatment with 80C water increased it by 12.4% (8.27 g/g). Oil coating reduced the sorption capacity.
84	Li X, Mou F, Guo J, Deng Z, Chen C, Xu L, Luo M, Guan J, 2018. Hydrophobic Janus Foam Motors: Self-Propulsion and On-The-Fly Oil Absorption	2018	CHN	There has been research with self-propelled micromotors/microengines, but they need surfactants or chemical fuels to power them, which introduces more pollution. This study uses polyvinyl alcohol (PVA) foam, loaded with camphor/stearic acid (SA) on one side. The asymmetric release of camphor propels the foam. They also self-assemble into aggregates after absorbing oil, facilitating recovery. It moves at about 24mm/s, decreasing to about 8mm/s after 50 minutes. The SA slowed down release of camphor, which increased the motor's lifetime (from 0.5 to 4 hours). Oil droplets on the water attract the motor due to differences in surface tension. Capacity 0.6g/g.
85	Li J, Huang ZQ, Xue C, Zhao Y, Hao W, Yang G, 2018. Facile preparation of novel hydrophobic sponges coated by Cu_2O with different crystal facet structure for selective oil absorption and oil/water separation	2018	CHN	Melamine sponges were dip coated with Cu_2O (cuprous oxide) particles to improve hydrophobicity and oleophilicity. Octahedral Cu_2O crystals were the most promising. Simple and environmentally friendly process. The highest sorption capacity was about 50 g/g with silicone oil, 70 g/g with corn oil, and 45 g/g with pump oil. Still good reusability after 8 cycles. Excellent oil/water selectivity.

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86	Ongarbayev, Y.K., Belgibayeva, A.S., Kudaybergenov, K.K., Mansurov, Z.A., 2015, Oil Spill Cleanup from Sea Water by Porous Sorbents, Eurasian Chemico-Technological Journal 17, 41-45.	2015	Kazakhstan	This study looked at the sorption capacity of rice husk, rubber crump, and apricot stone by carbonization using a lab-based sorption test. Each sorbent showed a capacity of 18, 14, and 7 g/g of sorption, where each were able to absorb more oil as the water temperature increased. The author recommends only considering risk husks for future testing work as it required less time to absorb the oil than the other sorbents.
87	Patowary, M., Anathakrishnan, R., Pathak, K., 2014, Chemical Modification of hygroscopic magnesium carbonate into superhydrophobic and oleophilic sorbent suitable for removal of oil spill in water	2015	IND	This study looked at the sorption capacity of hygroscopic magnesium carbonate for removal of oil spilled on water The sorption capacity was tested against crude oil, diesel oil, engine oil, and kerosene oil. This is a powder that floats on the water surface after its application. The lab-based sorption test indicated that the sorbent has a capacity of 3.595 g/g of crude oil, 3.017 g/g of diesel oil, and 3.35 g/g of kerosene oil. Reusability tests were also conducted (by washing and drying the powder), After three uses, the sorbent was able to have a sorption of 2.33 g/g with crude oil. Indicating in can be reused slightly beyond three times.
88	Dashairya L, Barik DD, Saha P, 2019. Methyltrichlorosilane functionalized silica nanoparticles-treated superhydrophobic cotton for oil-water separation. J. Coat. Technol. Res., 16 (4) 1021-1032, 2019	2019	IND	Cotton was treated with silica nanoparticles (800 nm) and the surface was then functionalized with methyltrichlorosilane (MTCS). Absorption capacity was 30-40 times its weight with different oil types. 10 reusability cycles were tested. Reusability stayed above 75%, with some losses due to oil residue in the cotton. Reusability stayed pretty constant from cycle 5 to 10.
89	Doan HN, Nguyen DK, Vo PP, Hayashi K, Kinashi K, Sakai W, Tsutsumi N, Huynh DP, 2020. Facile and Scalable Fabrication of Porous Polystyrene Fibers for Oil Removal by Centrifugal Spinning. ACS Omega 2019, 4, 15992-16000	2019	JAP	Polystyrene (PS) fibers were fabricated by centrifugal spinning, treated with tetrahydrofuran (THF) and dimethylformamide (DMF), and tested with different types of oil. Centrifugal spinning (also called force spinning or rotary jet spinning) overcomes many of the disadvantages of electrospinning, such as low productivity and the requirement of a high electric field. Sorption capacity of the best performing sample (THF/DMF weight ratio 1/3) was close to 50 g/g. The capacity of CS fibers is lower than that of electrospun PS fibers, but the productivity is higher. The tensile strength of CS fibers (0.3-0.5 MPa) is close to that of electrospun fibers. The fibers are still relatively thick. Making them thinner would increase their sorption capacity. Further research is needed.
90	Asadpour, Sapari N, Isa M, Orji K. Enhancing the hydrophobicity of mangrove bark by esterification for oil adsorption, Water Science & Technology 70.7 (2014) 1220-1228	2014	Malaysia	This work focuses on raw and chemically treated mangrove bark, a local lignocellulosic waste of the charcoal industry, which has potential as a low-cost adsorbent. The mangrove bark was tested in an untreated form, oleic acid treated, and palmitic acid treated form. The acid treatment was intended to increase hydrophobicity of the bark. Oil adsorption of the three forms was investigated, as well as influence of particle size (300 vs 450 micron), oil dosage, pH, and temperature effects on adsorption. Test results showed that the oleic acid treated form had the best adsorption capacity with the Tapis crude oil.
91	Li D, Zhu F, Li J, Na P, Wang A, Preparation and Characterization of Cellulose Fibers from Corn Straw as Natural Oil Sorbents. Industrial & Engineering Research, 2013, 52, 516-524.	2013	CHN	This work investigates chemically treated corn straw fibers as a low-cost sorbent material. The cellulose fibers undergo acetylation in a process using sodium chlorite and sodium hydroxide to increase the hydrophobic-oleophilic properties of the straw fibers. Various acetylation reactions times and temperatures were evaluated to determine the optimum conditions for Weight Percent Gain of fibers. The modified and unmodified cellulose fibers were characterized by FTIR, scanning electron microscopy, X-ray diffraction, and contact angle analysis Test results show that the modified straw fibers became significantly oleophillic and hydrophobic. Diesel oil, crude oil, and vacuum pump oil were evaluated in this study.

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92	Cheng, Hanlin, et al, Cotton aerogels and cotton-cellulose aerogels from environmental wast for oil spill clean up. Materials and Design, v. 130, pp 452-458.	2017	Singapore	This study evaluates cotton and cotton-cellulose aerogels using recycled fibers from paper waste. The goal of the study is to create and evaluate a cost effective sorbent using natural and recycled materials. Pure cotton (PC) and cotton/cellulose (CC) aerogel sorbents were synthesized using various formulation methods and mass ratios of pure cotton and cellulose. All variants were chemically manipulated to increase hydrophobic properties. The samples were characterized by SEM analysis, water contact angle evaluation, and absorption capability using machine oil. CC samples performed better than PC samples exhibiting a 72.3 g/g sorbtion with matching oil and a slightly better reusability.
93	Wang, Jintao, et al, Double biomimetic fabrication of robustly superhydrophobic cotton fiber and its application in oil spill cleanup. Industrial Crops and Products, V.77, pp 36-45.	2015	CHN	This study evaluates superhydrophobic cotton fiber as an oil absorbing material using cotton fibers, silica nanoparticles, and chemical hydrophobic modifications. Per the study, the superhydrophobic modifications are simple, low cost, and scalable. This absorbent can effectively absorb a wide range of oils with a sorbtion capacity up to 35-65 times original weight. The modified fiber showed excellent water/oil selectivity and was found to be reusable (cycle tested 80x) with minimal sorption loss capability. Crude oil, paraffin oil, linseed oil, chloroform, toluene, n-hexane were evaluated for this study.
94	Aydin G., et al, Hydrophobic poly(alkoxysilane) oranogels as sorbent material for oil spill cleanup	2015	Turkey	This study evaluates the synthesis multiple variants of poly(alkoxysilane) organogels to be used as oil absorbents. The reusability of the absorbents was qualitatively evaluated, and showed minimal sorbent degradation after 9 cycles. TGA showed indicated that no water was retained in the gels during sorption tests. The sorbents show high sorbtion capacity and excellent oil/water selectivity. The oils evaluated were dichloromethane, tetrahydrofuran, hexane, crude oil, benzene, and toluene.
95	Usman, A. D., & Okoro, L. N. (2017). Innovations in Oil Spill Clean-up Techniques. 6(23), 1908–1916.	2017	NGA	The article reviews multiple innovative materials with potential to become effective and economical alternatives for oil sorption. The authors discuss the need for developing novel biodegradable materials to minimize the impact of the sorbents. The paper includes review on studies about paper sludge, cotton, clay, mass, and hair/mushroom fibers.
96	Paulauskiene T, 2018. Ecologically friendly ways to clean up oil spills in harbor water areas: crude oil and diesel sorption behavior of natural sorbents. Environmental Science and Pollution Research (2018) 25:9981-9991.	2018	LIT	Natural sorbents (wool, moss, straw, peat) and their composites were tested with light crude oil and arctic diesel on water. Natural sorbents commonly have higher sorption capacity than synthetic materials, but poor oil/water selectivity. In this study, the materials were dried and crushed. The composites are different mixtures of straw and peat. With pure crude oil, the sorption capacity ranged from 5.1g/g (straw) to 9.4g/g (wool). With pure diesel, it was 3.9g/g (straw) to 6.3g/g (peat). With crude oil on water, the absorption was 1.7g/g (moss) to 5.3g/g (composite). Of the absorbed liquid, less than 30% was oil with the single materials. With the composites, the amount of oil was around 40%. With diesel on water, moss had the best selectivity with 60% diesel.
97	Ren RP, Wang Z, Ren J, Lv YK, 2018. Highly compressible polyimide/graphene aerogel for efficient oil/water separation. J Mater Sci (2019) 54:5918-5926	2018	CHN	PI-GA has ultralow density, excellent compressibility and hydrophobicity. Sorption capacity up to 37.4g/g. Reusability (mechanical squeezing) after 10 cycles still great, 34 g/g. Hydrophobicity shown by droplet contact angle.

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98	Ifelebuegu AO, Lale EE, Mbanaso FU, Theophilus SC, 2018. Facile Fabrication of Recyclable, Syperhydrophobic, and Oleophilic Sorbent from Waste Cigarette Filters for the Sequestration of Oil Pollutants from an Aqueous Environment. Processes 2018, 6, 140	2018	UK	Ultrasonically cleaned cigarette filters were surface modified by chemical vapor deposition using methyltrichlorosilane. They were able to absorb 16-26 g/g of various oils. Capacity did not significantly deteriorate after 20 cycles of reuse, retaining 75% of capacity. Filters were shredded, soaked in ethanol, cleaned, and hydrolyzed in sodium hydroxide solution. Then, the surfaces were coated with MTS vapor deposition.
99	Karatum O, Bhuiza MMH, Carroll MK, Anderson AM, Plata DL, 2018. Life Cycle Assess of Aerogel Manufacture on Small and Large Scales. Journal of Industrial Ecology (2018) 22 (6) 1365-1375	2018	USA	The authors perform a cradle to grave streamlined life cycle assessment following ISO 14040 2006 and compare it to conventional polyurethane foam. In a previous study, the authors showed that three types of aerogel blankets had higher oil uptake, excellent reusability, and high oil recovery (40-60%) with mechanical pressing. Polyurethane and polypropylene are usually landfilled due to high water uptake (can't incinerate). The study looked at the impact of materials, manufacturing, transportation, and disposal. Materials had the highest contribution. For the same amount of absorbed oil, the materials for PUF "cost" about three times as much as those for the aerogel. Transportation and disposal emissions are negligible, except for the energy gain from waste to energy incineration for the aerogel. Additionally, cleanup of a 1,000 ton spill would cost $1.4mio with PUF and only $380k with the aerogel. The aerogel can be deployed and recovered by machines, because of its mechanical strength.
100	Vijayasekar R., Saravanan, D., 2018, Some studies on oil sorption properties of loosely packed fibre assemblies and needle punched nonwoven fabrics produced from natural fibers, Journal o Advanced Research in Dynamical & Control Systems, Vol 10, 10-Special Issue	2018	IND	The oil sorption and retention of loosely packed fibers of cotton, kapok, and milkweed were tested in a lab-based sorption test were studied against furnace oil. The sorption capacity of the loosely packed fibers were 37.54 g, 42,26, and 50.44 g. The needle punched nonwoven fabrics showed a lower absorption of oil 21.02 g, 25.07 g, and 30.71 g. The authors suggest that milkweed could be used as a good sorbent since it showed the highest sorption capacity, and the loosely packed fibers indicated better results than the nonwoven assembly.
101	Yoon, H., Na, S., Choi, J., Latthe, S., Swihart, N., Al-Deyab, S., Yoon, S., 2014, Graviry-Driven Hybride Membrane for Oleophobic-Superhydrophilic Oil-Water Separation and Water Purification by Graphene, American Chemical Society Publications, dx.doi.or/10.1021/la50315261.	2018	Korea	The graphene flakes were dipped coated with various chemicals to generate graphene nanoplatelets. The intent of this material is not to absorb/adsorb, but to separate fluids and should not be used as a sorbent.
102	Ramli RA, Lian YM, Nor NM, Azman NIZ, 2019. Synthesis, characterization, and morphology study of coco peat-grafted-poly(acrylic acid)/NPK slow release fertilizer hydrogel	2019	Taiwan	Fertilizer hydrogel was prepared by grafting coco peat fiber onto acrylic acid. The amount of nutrient release was greatly improved. This study is not applicable to oil spill cleanups.
103	Doshi B, Sillanpaa M, Kalliola S, 2018. A review of bio-based materials for oil spill treatment. Water Research 135 (2018) 262-277	2018	Finland	This study reviews various bio-based materials for oil recovery. Materials such as cotton, kapok, rice, straw, etc. are abundant, low-cost, biodegradable, non-toxic, but have poor hydrophobicity, buoyancy, and sorption capacity. Properties can be enhanced by modification, which may result in decreased biocompatibility. Aerogels are promising and derived from bio materials, but they also need to be modified and may be expensive. Gelators and separation are also mentioned in this study.

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104	Konstantinuou, I, Sidiras, D, 2014, Oil spill cleaning using modified wheat straw in the presence of chemical dispersant. World Journal of Environmental Research, Vol 4, Issue 2, 66-73	2014	Greece	This study focused on the sorption capacity of wheat straw with diesel and crude oil after dispersants were applied on water. For the diesel, the total adsorption was 8 g/g, while for the crude oil is 9 g/g.
105	He, Y., Liu, Y., Wu, T., Ma, J., Wang, X., Gong, Q., Kong, W., Xing, F, Liu, Y, Gao, J., 2013, Journal of Hazardous Materials, 260, pp. 796 - 805	2013	CHN	This study looked at the sorption capacity of graphene oxide foam with oil spilled on water. The lab experiments tested three kinds of porous GO foams with different pore structures by freeze-drying methods against gasoline, diesel fuel, pump oil, lubricating oil, and olive oil. The results of the tests show that the sorption capacity ranged from 84 g/g to 122 g/g. The sorbent was also shown to be used as a separation device, as well as could be reused again by burning.
106	Han C, Waclawik ER, Yang X, Meng P, Yang H, Sun Z, Xu J, 2019. Reversible Switching of the Amphiphilicity of Organic-Inorganic Hybrids by Adsorption-Desorption Manipulation. J. Phys. Chem. C 2019, 123, 21097-21102	2019	Australia	A "hybrid surfactant" was prepared by combining an oil-soluble molecule, stearic acid, with water-dispersible Al_2O_3 nanofibers. They can reversibly switch back and forth between water in oil and oil in water emulsions by shaking. The emulsions are stable and could be used as a skeleton for hydrophobic foams by drying in a vacuum oven.
107	Hao J, Wang Z, Xiao C, Zhao J, Chen L, 2017. In situ reduced graphene oxide-based polyurethane sponge hollow tube for continuous oil removal from water surface. Environ Sci Pollut Res (2018) 25:4837-4845	2017	CHN	Graphene oxide was anchored on the surface of polyurethane sponge. The adsorption capacity was 21.7-55 g/g for various oils and oil water selectivity was 99.6%. A sorption test was conducted with sponge alone. Additionally, a tube was placed in a sponge and connected to vacuum suction. Several cycles were done, with good adhesion between coatings and sponge. A suction pressure of -0.06 MPa worked well, but when suction was increased to -0.07 MPa, more water was suctioned along with the oil and efficiency decreased. A large scale application was simulated in supporting material to the article, indicating that the hollow tube could be scaled up for large-scale oil spills.
108	He J, Zhao H, Li X, Su D, Zhang F, Ji H, Liu R, 2018. Superelastic and syperhydrophobic bacterial cellulose/silica aerogels with hierarchical cellular structure for oil absorption and recovery. Journal of Hazardous Materials 346 (2018) 199-207	2018	CHN	Bacterial cellulose aerogels / silica aerogels (BCAs/Sas) are prepared with a BS skeleton and SA filler through infiltration and freeze drying. Oil can be recovered by mechanical squeezing and the aerogel can be reused. It can bear a compressive strain up to 80% and recover the original volume. Samples were cycled 50 times with a strain of 40%. Sorption capacity is given as a quality factor Q, which is not defined in this paper.
109	Huang H, Wang X, Liu X, Li Y, Sun H, Li Q, 2020. One-Step Solution-Immersion Process of Hydrophobic Octyl Graphene Oxide-Modified Nickel Foam for Highly Efficient Oil-Water Separation. ACS Omega 2020, 5, 766-771	2020	CHN	Nickel foam was immersed in a dispersion of octyl group-grafted graphene oxide. Metal foam have great mechanical properties. Nickel foam is difficult to functionalize, because the surface is inactive. Most procedures have 2-3 steps. Oil-water separation was 96.5% or better. 14 cycles of adsorption and desorption by heating the foam to 80C were performed. the oil-water separation efficiency was retained. Sorption capability data are not provided.
110	Zhao, X., Zhu, Y., Wang, Y., Li, Z., Sun, Y., Zhao, S., Wu, X., & Cao, D. (2019). Hydrophobic, blocky silica-reduced graphene oxide hybrid sponges as highly efficient and recyclable sorbents. Applied Surface Science, 486, 303–311. https://doi.org/10.1016/j.apsusc.2019.05.017	2019	CHN	The article presents a novel manufacturing method for generating silica aerogel, which solves concerns of brittleness and poor mechanical properties. The resulting material exhibits significant structural strength (support 146 times its weight), has a high hydrophobicity (contact angle of 129°) and can absorb 8 to 10 times its weight in oil/solvents (toluene, ethanol, plant oil. methane, motor oil). Additionally, the material can be reused by combusting the absorbed, while maintaining its absorption efficiency.

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111	Wang, G., & Uyama, H. (2016). Facile synthesis of flexible macroporous polypropylene sponges for separation of oil and water. Scientific Reports, 6(February), 1–6. https://doi.org/10.1038/srep21265	2016	JPN	The paper reports the development of a technique to generate a polypropylene sponge by use o a thermally-induced phase separation. The developed sponge showed macroporosity adequate for increasing the absorption of the blank polypropylene. The material had a water contact angle of 130°, which shows its high hydrophobicity. The PP sponge had adsorbed 5 to 20 times its weight for different fuels and oils (fuel oil, ethanol, octanol, toluene, chloroform).
112	Zhou, J., Zhang, Y., Yang, Y., Chen, Z., Jia, G., & Zhang, L. (2019). Silk fibroin-graphene oxide functionalized melamine sponge for efficient oil absorption and oil/water separation. Applied Surface Science, 497, 143762. https://doi.org/10.1016/j.apsusc.2019.143762	2019	CHN	Commercial melamine sponges have a high porosity, good elasticity, and a low price, which makes the material an attractive alternative for oil sorption. However, melamine is hydrophilic. The paper proposes a method of modifying the melamine sponges using graphene oxide, achieving water contact angles of 130°, while maintaining high oil adsorption capacity for oils and organic solvents (30x to 75x its weight).
113	Ratcha, A., Yoosuk, B., Kongparakul, S., 2013, Grafted Methyl Methacrylate and Butyl Methacrylate onto Natural Rubber Foam for Oil Sorbent, Adanced Materials Research (2013) ISSN: 1662-8985, Vol. 844, pp 385-390, doi:10.4028/www.scientific.net/AMR.844.385	2013	THA	The oil absorbancy of natural rubber (NR) foam modified via graft copolymerization wth methyl methacrylate (MMA) or butyl methacrylate (BMA) was studied. The effect of oleophilic monomer type on oil absorbency was studied as well as thermal properties of modified NR. The absorbency was tested with gasoline, diesel, engine oil, toluene, and xylene. The maximum oil absorbency was found with toluene at 11.81 g/g. The modified NR foam showed lower thermal stability than the unmodified NR foam, but the modified NR foam had higher maximum oil absorbency with all oil types. However, there were some instances of modified foam at different parts per hundred rubber (phr) and oil combinations that showed lower absorbency than unmodified foam. The oil absorbency was higher for lower viscosity oils due to a higher diffusion rate into the foam.
114	Sanchez-Galvan, G., Mercado, F., Olguin, E. Leaves and Roots of Pistia stratiotes as Sorbent Materials for the Removal of Crude Oil from Saline Solutions, 2012, Water Air Soil Pollut (2013) 224:1421, doi 10.1007/s11270-012-1421-0	2012	MEX	This was the first paper published on studying the use of leaves and roots of Pistia stratiotes for oil sorption from saline solutions. The high oil removal and sorption that was observed may be due to high degree of hydrophobicity for leaves, capillary action, and/or high surface area (due to fold-like formations and protruding hairs). Variables evaluated were biomass dose, contact time, and initial oil concentration. Crude oil was used. The leaves were more hydrophobic than the roots, most likely because of hydrophobic hairs on leaves. Capillary action was observed, showing higher capillary rise of hexane compared to water in both roots and leaves, with roots showing slightly higher hexane rise than leaves. Significantly more oil was absorbed when biomass was doubled. Contact time affected sorption using leaves but not roots. Perfect linear correlation found between initial oil concentration and amount of sorbed oil. Adsorption and absorption contribute to leaves, but mainly absorption in roots.
115	El Gheriany, I.A., El Saqa, F.A., El Razek Amer, A.A., Hussein, M. Oil Spill Sorption Capacity of Raw and Thermally Modified Orange Peel Waste, 2020, Alexandria Engineering Journal (2020) 59, 925-932, https://doi.org/10.1016/j.aej.2020.03.024	2020	EGY	Purpose of study was to evaluate the oil sorption capacity of orange peel due to large waste production of orange peels in Egypt and recent oil spills in the Nile River. Dried raw orange peel waste (OP) and thermally modified (300C and 500C) orange peel waste (TMOP) sorption and reusability was tested with varying oil type (crude, used engine oil, and diesel), particle size, and sorption time. Oil uptake of OP was between 3 and 5 g/g at 25C, and water uptake was 1 g/g, showing oil relatively higher than other biosorbents. However, oil sorption capacity was lower than other biosorbents, leading to suggestions of increasing permeability using thermal modification. TMOP showed a slight increase in oil sorption (18-40%), with better oil retention, but significantly higher water uptake than OP. Highest sorption capacity was found with the weathered crude oil. Dried OP can be reused for up to 5 cycles for crude and 4 cycles for diesel, with decreased sorption capacity, and oil selectivity lost after the third cycle.

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116	Kelle, H., Eboatu, A. Determination of the Viability of Chicken Feather as Oil Spill Clean-Up Sorbent for Crude Oil and its Lower Fractions, 2018, J. Appl. Sci. Environ. Manage. Vol 22 (2) 267-273. https://dx.doi.org/10.4314/jasem.v22i2.19	2018	NGA	A comparative study was performed with chicken feather and a conventional synthetic oil sorbent mat to compare oil sorbency. The chicken feather showed higher oil sorption capacity and sorbed oil recoverability than the synthetic mat and showed similar but lower oil retainability. Lab tests were conducted with crude oil, diesel, and kerosene. Chicken feathers were washed, dried in the sun for three weeks, and ground with a mechanical blender into a fluffy form. The sorbed oil recoverability was found by weighing the sorbents before and after pressing it with a hydraulic press. The sorbency was also tested with an oil sample on water, with minimal water sorbed, competing well with the synthetic mat.. Chicken feather reached equilibrium sorption at a later time than the synthetic mat. The highest sorption for the chicken feather was seen with crude (13.1 g/g), followed by diesel (11.15 g/g), and then kerosene (9.7 g/g).
117	Yang, X., Chen, S., Zhang, R., 2013, Utilization of two invasive free-floating aquatic plants (Pistia stratiotes and Eichhornia crassipes) as sorbents for oil removal, Environ Sci Pollut Res (2014) 21: 781-786, DOI 10.1007/s11356-013-2232-6	2013	CHN	Pistia stratiotes leaf (PL), Eichhornia crassipes leaf (EL), and Eichhornia crassipes stalk (ES) were tested for oil sorption capabilities using mineral oil, motor oil, and diesel. The sorbents were evaluated on pure oil and a mixture of oil and water. PL, EL, and ES all exhibited high hydrophobicity. The oil sorption capabilities were lower than some other fiber-type sorbents (cotton, wool fiber, kapok, silkworm cocoon) but better than some others (rice husk, walnut shells, mineral sorbents). ES exhibited the highest sorption capacity (in g of oil per g of sorbent) with 11.7 for pure oil and 13.1 for oil/water mix. Sorption capacities were tested at temperatures ranging from 5C to 35C, and no significant difference was seen. Sorbed oil can be recovered through centrifugation, but used sorbents can't be reused, but could be used as combustible material. In natural environment, PL, EL, and ES bring adverse effects to aquatic systems, so removal benefits aquatic environment too.
118	Zhu, K., Shang, Y., et al., 2013, Oil Spill Cleanup from Sea Water by Carbon Nanotube Sponges, Front. Mater. Sci. (2013) 7(2): 170-176, DOI 10.1007/s11706-013-0200-1	2013	CHN	Carbon nanotube (CNT) sponges were compared with polypropylene fiber fabric and woolen felt sorbents in a oil sorption capacity test. The CNT sponge was found to be 12 to 13.5 times more sorbent with a maximum oil sorption capacity of 92.3 g/g. The sorbents were tested with a mixture of crude oil and diesel on sea water, and the CNT sponge did not absorb any water, demonstrating superhydrophobic properties, while the woolen felt and polypropylene fiber absorbed some water. The oil sorption speed of the polypropylene fiber fabric and woolen felt was higher than that of the CNT sponge, but the CNT sorption capacity was higher. The polypropylene fiber fabric and woolen felt sank below the surface level when oil was absorbed, but the CNT sponge remained floating on the surface.
119	Singh, V., Jinka, S., Hake, K., Parameswaran, S., Kendall, R., Ramkumar, S., 2014, Novel Natural Sorbent for Oil Spill Cleanup, Industrial & Engineering Chemistry Research (2014) 53, 11954-11961, http://dx.doi.org/10.102/ie50194361	2014	USA	This study investigated the oil sorption capacity of raw unprocessed cotton batts developed using a fiber-aligning carding process without synthetic binders or needlepunching which significantly lowered sorption capacity in previous studies. Two different cottons were studied: 3.16 micronaire immature cotton and 4.31 micronaire mature cotton. Significantly higher oil sorption capacity (50.27 g/g) was observed for low micronaire cotton batt. The characteristics of the raw cotton (fiber characteristics, immature fiber content, maturity ratio, micronaire index) influence the oil sorption capacity.

Article #	Article Reference (bibliography)	Year of Publication	Location of University	Summary of Article
120	Wang, B., Karthikeyan, R., Lu, X., Xuan, J., Leung, M., 2013, Hollow Carbon Fibers Derived from Natural Cotton as Effective Sorbents for Oil Spill Cleanup, Industrial & Engineering Chemistry Research (2013) 52, 18251-18261, http://dx.doi.org/10.1021/ie402371	2013	CHN	Hollow carbonized cotton fibers (CCFs) from natural cotton were fabricated by nitrogen annealing at temperatures from 400C to 1,000C. The annealing temperature of 400C (CCFs-400) was found to be optimal for effective CCF sorbents, with the highest oil sorption capacity. Maximum oil adsorption capacity was found to be 32 to 77 times its own weight for CCFs-400 which demonstrates 27-126% increase compared with cotton fibers. Contact-angle measurements were taken to verify the oleophilic/hydrophobic properties of CCFs. CCFs showed lower oil sorption capacities than carbon nanotube sponges but would be cheaper and easier to fabricate. Oil absorbed by CCFs can be reused by squeezing oil from sorbents. Sorbents can also be reused and showed 9% decrease in oil extraction after 5 cycles, compared with 27% for plain cotton fibers. CCFs showed good floating ability after oil sorption.
121	Zhu, J., Hu, J., Peng, T., Jiang, C., Liu, S., Li, Y., Gua, T., Xie, L., Superhydrophobic Melamine-Formaldehyde Sponge Functionalized by Coupling Agent - Isocyanate Siloxane as Efficient Absorbents for Oil and Organic Solvents. Advanced Materials Interfaces 2019, 6, 1900025.	2019	CHN	The sorption capacity of a superhydrophobic Melamine-Formaldehyde (MF) Sponge was tested for its sorption capabilities on 11 different oils. The MF sponge was initially made by modifying the MF with ICEPTES as a functional coupling agent to generate a sorbent that was superhydrophobic. The results of the sorption test indicate that the sorbent has a sorption capacity that ranges form 75 g/g up to 160 g/g, where the lower sorption values were from more viscous oils. The sorbent also went through a reusable test, and could be used up to 12 times and still maintain 90% of its efficiency.
122	Balzamo G, Singh N, Wang N, Vladisavljevic GT, Bolognesi G, Mele E, 2019. 3D Arrays of Super-Hydrophobic Microtubes from Polypore Mushrooms as Naturally-Derived Systems for Oil Absorption. Materials 2019, 12, 132	2019	UK	The fruiting body of polypore mushrooms (bracket fungi - Ganoderma Applanatum) consists of a regular array of long capillaries in a fibrous matrix. This was treated with paraffin wax, octadecyltrichlorosilane or trichloro(1H,1H,2H,2H-perfluorooctyl)silane. The wax affected the micro-porosity of the samples, whereas OTS and FOTS did not. The resulting sorption capacity for the OTS sample was 1.8-3.1g/g for different oils and superhydrophobicity. Reusability was tested for four cycles by rinsing with ethanol. There was no deterioration.
123	Cao N, Guo JY, Boukherroub R, Shao QG, Zang XB, Li J, Lin XQ, Ju H, Liu EY, Zhou CF, Li HP, 2019. Robust superhydrophobic polyurethane sponge functionalized with perfluorinated graphene oxide for efficient immiscible oil/water mixture, stable emulsion separation and crude oil dehydration. Sci China Tech Sci, 2019, 62 No. 9: 1585-1595	2019	CHN	Graphene oxide nanosheets were coated with polydopamine (PDA) and exposed to 1H,1H,2H,2H-perfluorodecanethiol to obtain fPDA modified rGO nanosheets (rGO-fPDA). This was crafted onto polyurethane sponge. Oil sorption was tested with different oil-water emulsions and with oil only. The sponge absorbed 21-118 times its weight. When filtering emulsions, 99.9% purity was reached. Reusability was tested by squeezing and drying. Sorption stability was about 94% after 10 cycles.
124	Tao, T., Li, G., He, Y., Yang, X., 2019. 3-D Magnetic Graphene Balls as Sorbents for Cleaning Oil Spills. Nanomaterials and Nanotechnology, Volume 9: 1-7.	2019	CHN	A 3-D magnetic graphene ball (MGB) material was synthesized with cellulose powder as the carbon source. The 3-D MGBs was prepared by integrating carbon-encapsulated iron nanoparticles (CEINs) and graphene nanoplatelets peeled off of graphene-encapsulated iron nanoparticles (GEINs). The oil absorption capacity was tested in a water and solvent/oil mixture. The solvents/oils tested were diesel, gasoline, hexane, chloroform, toluene, and dichlorobenzene. Absorption capacity ranged from 108 g/g to 141 g/g. The 3-D MGBs were tested over 10 absorption cycles with diesel, maintain 79.2% of the saturated absorption capacity.
125	Sinha SK, Kanagasabapathi P, Maity S, 2020, Performance of Natural Fibre Nonwoven for Oil Sorption from Sea Water. Tekstilec, 2020, 63(1), 14-26	2020	IND	Cotton and cotton/kapok blends performed better than polypropylene nonwovens, while nettle fibre performed poorly. More than 95% of the absorbed oil could be recovered by compression, but absorption capacity was reduced significantly. Sorption capacity was measured in an oil bath and in oil in sea water. In the oil bath, capacity was about 25g/g for diesel and 45g/g for engine oil for the cotton and cotton/kapok samples. Sorption capacity in the water bath was very similar. Sorption rate is fastest in the first minute. Saturation is reached within 5 minutes. Sorption capacity after mechanical squeezing drops to 1/3 in the second cycle and then remains stable (4 total cycles were tested).

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126	Sarcletti M, Vivod D, Luchs T, Rejek T, Portilla L, Mueller L, Dietrick H, Hirsch A, Zahn D, Halik M, 2019. Superoleophilic Magnetic Iron Oxide Nanoparticles for Effective Hydrocarbon Removal from Water. Adv. Funct. Mater. 2019, 29, 1805742	2019	Germany	Magnetite nanoparticles with a layer of hexadecylphosphonic acid are oleophilic and can be collected magnetically. They can collect up to 14 times their volume (different oil types and two crude oil blends, 6-14 times by volume). They are reusable over several cycles (oil extracted by washing with solvent). This was tested with a crude oil blend which showed a stable sorption capacity of approx. 11 times by volume and 2.5 g/g. When stored for several weeks before use, performance did not suffer. Performance slightly decreased with increasing temperature. Performance also slightly decreased in salt water.
127	Chin CC, Musbah NDL, Abdullah I, Lazim AM, 2018. Characterization and Evaluation of Prudent Liquid Natural Rubber-Based Foam for Oil Spill Control Application. Arabian Journal for Science and Engineering (2018) 43:6097-6108	2018	Malaysia	Liquid natural rubber with foaming agents was vulcanized into absorbent material with a capacity of 1-7g/g (different oils) and a reusability of up to 13 times. Higher viscosity oils decreased the sorption capacity. Reusability was tested for 20 cycles of sorption and squeezing. The material is hydrophobic (not superhydrophobic).
128	Liu Y, Peng Y, Zhang T, Qiu F, Yuan D, 2018. Superhydrophobic, ultralight and flexible biomass carbon aerogels derived from sisal fibers for highly efficient oil-water separation. Cellulose (2018) 25:3067-3078	2018	CHN	A low-cost, ultralight, elastic, highly recyclable superhydrophobic cellulose fiber aerogel (CFA) from sisal was produced by alkalinization, bleaching, freeze-drying and carbonization. It can absorb oil on water and under water and also filter out hydrocarbons when an oil/water mixture is poured over it. Sorption capacity is 90-188g/g for different oils. After 10 cycles of squeezing and washing with ethanol, capacity decreased by about 15%.
129	Warner A, Cathey D, Cullen G, Nelson J, Kasper P, Lumpkin A, 2018. Development of the electromagnetic boom and mop systems (EMOP). 6th International Beam Instrumentation Conference IBIC2017, Grand Rapids, MI, USA.	2018	USA	Micron-sized magnetite (Fe_3O_4) particles are reusable, recoverable, and environmentally safe. They sink in water, enabling them to also bond with heavy oils below the surface. If they fall on oil on the surface, they stay there. In both cases, they can then be collected by magnetism. A boom made of solenoid magnets with a time dependent pulsed current transports the magnetized oil towards a ramp, which delivers it to a separation container. In the container bottom, there is a very strong magnet, that can separate the particles from the oil. The oil can be removed and the particles reused. Three patents have been filed for this.
130	Onwuka JC, Agbaji EB, Ajibola VO, Okibe FG, 2018. Treatment of crude oil-contaminated water with chemically modified natural fiber	2018	Nigeria	Empty fruit oil palm bunch and cocoa pods are widely available in Nigeria. Ground and washed samples were placed in acetic anhydride. The sorption capacity test was done with crude oil in water with different oil concentrations and for different periods of time. Before weighing, samples were left to drain for 4 hours. Unmodified samples absorbed 3-4g/g, modified samples 7-8g/g. Cocoa pods performed better than oil palm waste. Saturation was reached at about 15 minutes. Hydrophobicity was not determined.
131	Ortega RA, Carter ES, Ortega AE, 2016. Nylon 6,6 Nonwoven Fabric Separates Oil Contaminates from Oil-in-Water Emulsions. PLoS ONE 11(7)	2016	USA	Spunbond nylon can absorb over 16g/g of low viscosity crude and over 26g/g of higher viscosity gear lube oil. It separated over 95% of a 4.5% gear lube oil in water emulsion. This study used Type SK Oil Shark® fabric from Cerex Advanced Fabrics, who funded this work. Nylon is both hydrophilic and oleophilic. In field tests at two actual spills, nylon fences were used effectively to prevent the oil from spreading along the water ways.
132	Parmar KR, Dora DTK, Pant KK, Roy S, 2019. An ultra-light flexible aerogel-based on methane derived CNTs as a reinforcing agent in silica-CMC matrix for efficient oil adsorption. Journal of Hazardous Materials 375 (2019) 206-215	2019	IND	Carbon nanotubes (CNTs) were synthesized by thermo-catalytic decomposition of methane in chemical vapor deposition and reinforced in mero-hydrophobic carboxymethyl cellulose and silica matrix to produce a highly flexible aerogel. Adsorption capacity was 22-28g/g with motor oil and singer oil. The samples reached saturation after 11 minutes. 5 cycles of adsorption, mechanical squeezing, and cleaning with acetone showed reusability with the adsorption capacity decreasing slightly. Testing at higher temperatures increased oil adsorption due to the lower viscosity of the oils

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133	Rafieian F, Hosseini M, Jonoobi M, Yu Q, 2018. Development of hydrophobic nanocellulose-based aerogel via chemical vapor deposition for oil separation for water treatment. Cellulose (2018) 25:4695-4710	2018	Iran	Aerogel was produced by freeze drying of cellulose nanofiber dispersions and modified with chemical vapor deposition of hexadecyltrimethoxylan. Cooking and motor oils were used at different temperatures between 10 and 60C. The highest capacity was at 25-40C, because at lower temperatures, the high viscosity impedes diffusion into the sorbent, but at higher temperature, the oil drains more due to poor adherence. At 25C, motor oil adsorption was 79 g/g, cooking oil 162 g/g. Reusability with mechanical squeezing was tested for 20 cycles. Due to residual oil in the sample, the second cycle shows a decline, but then the capacity remains stable.
134	Riaz MA, McKay G, Saleem J, 2017. 3D graphene-based nanostructured materials as sorbents for cleaning oil spills and for the removal of dyes and miscellaneous pollutants present in water. Environ Sci Pollut Res (2017) 24:27731-27745	2017	Hongkong	This article is a review of 3D graphene in oil and dye sorption studies. Different types of graphene sorbents have sorption capacities of 80-743g/g. Different methods of production are described. Reduced graphene oxide foams, graphene sponge, polymer-based graphene foam, graphene mesh, graphene aerogel, and carbon nanotube graphene hybrid aerogel are among the reviewed oil sorbents. The review concludes that 3D graphene is a promising sorbent due to its sorption capacity and recyclability. However, other nanomaterials are still better, so graphene can still be improved. The study found that most studies neglect to evaluate the rate of sorption. Additionally, easier, less expensive methods of synthesis need to be developed.
135	Keshawy M, Farag RK, Gaffer A, 2020. Egyptian crude oil sorbent based on coated polyurethane foam waste. Egyptian Journal of Petroleum 29 (2020) 67-73	2020	Egypt	Flexible polyurethane foam waste is coated with hydrophobic monomer (lauryl methacrylate and hexadecane). The sorption capacity was 132g/g for diesel and 125g/g for crude oil. The effects of different amounts of crosslinker were tested, as well as nano magnetite content. Apparently a smaller amount of crosslinker led to higher sorption capacity.
136	Salisu ZM, Ishiaku SU, Abdullahi D, Yakubu MK, Diya'uddeen BH, 2019. Development of kenaf shive bio-mop via surface deposit technique for water remediation from crude oil spill contamination. Results in Engineering 3 (2019) 100020	2019	Nigeria	Kenaf shive aerogel was optimized using different particle sizes, stirring times, and methyltrimethoxysilane (MTMS) concentrations. The best combination reached a sorption capacity of 15g/g with crude oil.
137	Dorneanu P, Cojocaru C, Samoila P, Olaru N, Airinei A, Rotaru A, 2017. Novel fibrous composites based on electrospun PSF and PVDF ultrathin fibers reinforced with inorganic nanoparticles: Evaluation as oil spill sorbents. Polym Adv Technol. 2018;29:1435-1446	2018	Romania	Polyvinylidene fluoride and polysulfone ultrathin fibers were reinforced with Halloysite nanoclay and $CoFe_2O_4$ (for magnetic properties) via electrospinning. Sorbent capacities ranged from 3.7-10g/g for PVDF and 16-28g/g for PSF, tested in pure oil baths. Testing was done with decane, dodecane, diesel, and two motor oils. Capacity increased with increasing viscosity. The sorbent was also tested with an oil spot on water and performed well, although no data is given. 65-75% of the sorbed oil could be recovered from the sorbent by centrifugal force. Mechanical strength was tested as well. PVDF had a tensile strength of 1-4 MPa and elongated 20-80% before breaking. PSF was 0.06-0.08 MPa and 3-8%, respectively.
138	Wu YJ, Xiao CF, Liu HL, 2019. Preparation and Performance of Online Chemically Foamed Polyurethane/Graphene Reinforced Membrane. Journal of Polymer Research (2019) 26:202	2019	CHN	Heterogeneous-reinforced chemically foamed PU/GE hollow fiber membranes were prepared by a one-step method consisting of a water-blown PU/GE spongy separation layer and polyester fiber tubular braids as support. No addition of solvent or pore-forming agent was necessary. Oil/water separation was tested in a continuous process with a 1:1 oil/water mixture. The separation efficiency was more than 90%. After 100 minutes of separation, the membrane was rinsed with ethanol and water and the separation was repeated two more times. The separation efficiency remained at 90%. The sample with 1.8% by weight of graphene showed the best performance.
139	Oribayo O, Feng X, Rempel GL, Pan Q, 2017. Modification of formaldehyde-melamine-sodium bisulfite copolymer foam and its application as effective sorbents for clean up of oil spills. Chemical Engineering Science 160 (2017) 384-395	2017	CHN	Commercially available formaldehyde-melamine-sodium bisulfite copolymer foam (FMSF) was modified with octadecylamine (ODA) or perfluorodecanethiol (PFD) in a two-step method. The sorption capacity was tested in pure oil and in an oil/water mixture at rest and with stirring. The measured capacity was 66-152g/g. Its capacity and hydrophobicity were retained after 50 cycles or sorption and squeezing.

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140	Santos OSH, Coelho da Silva M, Silva VR, Mussel WN, Yoshida MI, 2017. Polyurethane foam impregnated with lignin as a filler for the removal of crude oil from contaminated water. Journal of Hazardous Materials 324 (2017) 406-413	2017	Brazil	The effect of lignin as a filler in polyurethane foam is studied. Some properties such as permeability, elasticity, chemical resistance, and hydrophobicity can be improved with fillers. Lignin is a waste product of the paper, cellulose, and ethanol industry. Contact angle analysis showed that the hydrophobicity of the foam decreases with increasing lignin concentration (0-20%), but the oil sorption capacity in an oil/water mixture increased (from 17g/g to 24g/g). Reusability was over 95% after five cycles of sorption and washing with xylene and distilled water. The samples were dried in an oven for 4h before the next cycle.
141	Jmaa SB, Kallel A, 2019. Assessment of Performance of Posidona oceanica (L.) as Biosorbent for Crude Oil-Spill Cleanup in Seawater. Hindawi BioMed Research International 2019, Article ID 6029654, 9 pages	2019	Tunisia	Raw fibers of Posidonia oceanica beach balls absorb 5.5g/g of oil or 15g/g of water in single phase systems. In an oil/water mixture, they absorb 5 g/g of oil and 13 g/g of water. Milled fibers absorb 14 g/g of oil or 16 g/g of water in single phase and 7g/g and 8g/g respectively in the mixture. Milled fibers absorbed more, because of the higher surface area. Saturation is reached after 10 minutes. They do absorb water, however, they are widely available and low cost. The soaked up crude could be easily recovered and the used fibers could be used for energy generation.
142	Atta, A., Brostow, W., Hagg Lobland, H.E., Hasan, A.M., Perez, J.M., 2013. Porous polymer oil sorbents based on PET fibers with crosslinked copolymer coatings. RSC Advances, 2013, 3, 25849	2013	Egypt, United States, Saudi Arabia	Oil sorbents were fabricated from non-woven polyethylene terephthalate (NWPET) fibers modified with crosslinked polymer coatings. Crosslinking forms 3D network structure that allows sorbers to swell instead of dissolve which is critical to developing better oil sorbents. Absorption is limited with too low or high crosslinking efficiency. Oil absorption was tested with toluene and a crude oil diluted to 10% with toluene. Sorbency was slightly lower for the crude oil/toluene mixture. Water was not used for the testing. Suspension polymerization resulted in higher absorption capacity. Sorbents prepared by solution polymerization (instead of bulk polymerization) showed higher sorbency due to less crosslinking which limited diffusion of the solvent into the material for bulk polymerized specimens. Sorbents were tested over seven cycles for reusability, with slightly decreased efficiency that remained constant after the second cycle.
143	Bagoole, O., Rahman, M.M., Shah, S., Hong, H., Chen, H., Ghaferi, A., Younes, H., 2018. Functionalized three-dimensional graphene sponges for highly efficient crude and diesel oil adsorption. Environmental Science and Pollution Research (2018) 25:23091-23105.	2018	Abu Dhabi, Bangladesh, USA	Three-dimensional (3D) graphene sponges were functionalized through a vapor-based surface enhancement with trichloro silane to enhance wettability because of the super-hydrophobic nature (contact angles greater than 150°). The sponges removed more than 3300 wt.% of crude oil (with respect to original sorbent mass). Heat treatment and squeezing can be used to remove sorbed oil and reuse sponges. The sorption capacity above 90% of the original value after five cycles. Oil uptake by sponges characterized as adsorption. Diesel, crude oil, and hexane were tested. The sponge prepared with 0.5 mg/mL of graphene oxide (GO) had higher adsorption for all the oils compared to the sponge prepared with 2 mg/mL of GO. The 0.5 mg/mL GO sponge also had 5% higher regeneration efficiency. The sorption capacity of these sponges is tabulated with many other sorbent types showing higher sorbency than most, with an easier fabrication process than the two technologies with higher sorbency.
144	Debs, K., Cardona, D., Silba, H., Nassar, N., Carrilho, E., Haddad, P., Labuto, G., 2019. Oil spill cleanup employing magnetite nanoparticles and yeast-based magnetic bionanocomposite. Journal of Environmental Management 230 (2019) 405-412.	2019	Brazil, Canada	Magnetite nanoparticles (MNP) and yeast magnetic bionanocomposite (YB-MNP) were produced and tested for removal of Petroleum 28° API (P28API), mixed used motor oil (MUMO), and new motor oil (NMO) from water. Temperature, type, contact time, and the amount of magnetic material were varied. Oil removal was considered a physic phenomenon and not an adsorption process. A magnetic field was applied to the oil/water samples to remove magnetic materials and oil constituents from the surface. For all three oil samples, temperature was the most significant parameter with better oil removal at low temperatures for NMO and P28API and better oil removal at high temperatures for MUMO. Between 55% and 89% of oil was removed during these experiments.

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145	Lin, B., Chen, J., Li, Z., He, F., Li, D., 2019. Superhydrophobic modification of polyurethane sponge for the oil-water separation. Surface & Coatings Technology 359 (2019) 216-226.	2019	CHN	A drop-coating method using different polymer adhesives was used to immobilize fluoroalkylsilane-modified SiO_2 nanoparticles (NPs) on polyurethane sponges. The surface modified sponges showed high absorption capability and could effectively remove oil from an oil/water mixture with different oils: peanut oil, pump oil, silicone oil. The sponges were tested for direct oil absorption by placing the sponge on a sample of water with oil at the surface. The sponges were also tested for gravity-driven oil/water separation capabilities by pouring a water/oil mixture into a funnel with a piece of sponge in the narrow neck. The absorption capacity was highest for the silicone oil compared to pump oil and peanut oil. Absorption capacities ranged from 16 g/g to 43 g/g. No obvious decrease in absorption capacity was found after 5 absorbing-squeezing cycles.
146	Jafer AS, Hassan AA, 2019. Removal of oil content in oilfield produced water using chemically modified kiwi peels as efficient low-cost adsorbent. J. Phys.: Conf. Ser. 1294 072013	2019	Iraq	Washed and dried kiwi peels were hydrolyzed with sodium hydroxide and heated to 150C in sulfuric acid. Different amounts of kiwi peels were added to produced water to determine the amount of oil removed. Contact time and the effect of the pH value were also investigated. At a pH of 9.7, 25% of the oil was removed. At 2.2, 85% was removed. It looks like the sorption capacity was 13.3 mg/g.
147	Shishkin A, Mironovs V, Lapkovskis V, Treijs J, Korjakins A, 2014. Ferromagnetic Sorbents For Collection and Utilization of Oil Products. Key Engineering Materials Vol. 604, 122-125	2014	Latvia	Comsor sorbent material has improved buoyancy and magnetic properties. Its performance was tested with 10W-40 motor oil. The Comsor sorbent particles are hollow spheres (10-500 microns) with attached ferromagnetic particles. It worked especially well on thin oil films, but can also be used on rough surfaces on land where traditional sorbents are not effective. The particles retained up to 57 w% of oil.
148	Zhou, Q., Wang, L., Xu, Q., & Zhao, Y. (2019). Effective cleanup of oil contamination on bio-inspired superhydrophobic surface. *Environmental Science and Pollution Research*, *26* (21), 21321–21328. https://doi.org/10.1007/s11356-019-05157-3	2019	CHN	This paper proposes the used of aluminum foil as a substrate for a surface-treated sorbent, due the low cost and accessibility of the base material. The authors present a method for coating the aluminum foil using titanium oxide nanoparticles. Image analysis of water droplets showed that the material is highly hydrophobic, with water contact angle of around 150°. The material also showed a high sorption capacity of 21 g/g.
149	Ge, J., Shi, L., Wang, Y. *et al.* Joule-heated graphene-wrapped sponge enables fast clean-up of viscous crude-oil spill. *Nature Nanotech* 12**,** 434–440 (2017). https://doi.org/10.1038/nnano.2017.33	2017	CHN	A novel oil sorbent system was developed based on a graphene-wrapped sponge and Joule-heating.. The authors argue that one of the limitation of classical sorbents is that the rate of sorption is limited due to the high viscosity of crude oil. To address this constrain, the authors propose an in situ heated sorbent sponge, in which an applied voltage heats the oil to increase the diffusion coefficient of the oil into the pores of a graphene-based sorbent. The system decreased the sorption time by 94.6% which enabled continuous collection of the oil using an integrated pump. The authors state that his is the first sorbent that uses Joule-heating to enhance the performance of a sorbent.
150	Prathap A, Sureshan KM, 2017. Organogelator-Cellulose Composite for Practical and Eco-Friendly Marine Oil-Spill Recovery. Angew. Chem. Int. Ed. 2017, 56, 9405-9409	2017	IND	Cellulose was impregnated with a sugar-derived oleogelator, making the fibers temporarily hydrophobic. The gelator molecules get released into the absorbed oil and congeal it. The granules absorb 16 times their mass. The congealed oil is stiff enough to be recovered easily. After absorbing the oil, nothing leaks out. Oil can be recovered by applying pressure. The materials and the process are cheap and eco-friendly.
151	Yu L, Hao G, Xiao L, Yin Q, Xia M, Jiang W, 2017. Robust magnetic polystyrene foam for high efficiency and removal oil from water surface. Separation and Purification Technology 173 (2017) 121-128	2017	CHN	Magnetic Fe_3O_4 particles were introduced into polystyrene foam through ultrasonic dispersion and the foam was synthesized by emulsion polymerization. Absorbed oil could be recovered by mechanical squeezing and performance of the foam was retained after 10 cycles (more than 90%). The sorption capacity was between 9 and 18 g/g for different oils.

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152	Abdelwahab, Ola, Nasr, Samir, Thabet, Walaa, 2017, Palm Fibers and Modified Palm Fibers Adsorbents for Different Oils. Alexandria Engineering Journal (2017) 56, 749-755	2017	Egypt	Raw and modified palm fibers were tested for oil sorption efficiency and capacity using diesel, crude oil, and vegetable oil in a sample of artificial sea water. Oil sorption efficiency was found to be dependent on sorption time, oil film thickness, sorbent dosage, particle size, and temperature. The modified palm fiber was chemically treated by acid and alkali separately. The sorption efficiency was calculated as the mass of oil removed divided by the initial mass of oil. The maximum sorption capacity was 35.7 g/g for diesel, 22.7 g/g for crude, and 21.7 g/g for vegetable oil. The adsorption efficiency remained almost constant between the raw and modified palm fibers but increased with sorption time, thickness of oil film, particle size, and temperature. The water uptake was also studied and approached zero as oil film thickness increased.
153	Le DK, NG GN, Koh HW, Zhang X, Thai QB, Phan-Thien N, Duong HM, 2020. Methyltrimethoxysilane-coated recycled polyethylene terephthalate aerogels for oil spill cleaning applications. Materials Chemistry and Physics 239 (2020) 122064	2020	Singapore	Recycled PET was converted into an aerogel from plastic bottles via freeze-drying with polyvinyl alcohol and glutaraldehyde crosslinking agents and then coated with methyltrimethoxysilane (MTMS). Different concentrations of fibers and crosslinkers were tested. The oil absorption capacity was 46-80 times its weight. The absorption rate was up to 3 times faster than for cellulose-based aerogels. The fabrication method is environment friendly, cost effective, and easy to scale up. Absorption capacity is better than that of polypropylene and cellulose aerogel. It is lower than that of carbon nanotube or graphene aerogels, but the fabrication method is easier and cheaper.
154	Tu L, Duan W, Xiao W, Fu C, Wang A, Zhen Y, 2018. Calotropis gigantea fiber derived carbon fiber enables fast and efficient absorption of oils and organic solvents. Separation and Purification Technology 192 (2018) 30-35	2018	CHN	A green plant fiber, Calotropis gigantea, is used as the raw material for a pyrolysis process (600-900C in inert gas). The resulting carbon fiber retains the hollow structure and can absorb up to 130g/g within seconds in single phase oil. Sorption capacity with oil/water mixtures was not tested. Higher pyrolysis temperatures led to higher sorption capacity. The fibers are reusable more than 10 times by washing with ethanol. Reusability by mechanical squeezing was not tested. The pyrolysis process is simple and cost-effective with cheap raw materials.
155	Abdullah MA, Rahmah AU, Man Z, 2010. Physicochemical and sorption characteristics of Malaysian Ceiba pentandra (L.) Gaertn. as a natural oil sorbent. Journal of Hazardous Materials 177 (2010) 683-691	2010	Malaysia	The effects of packing density, oil types (diesel, engine oil) and solvent treatment on sorption characteristics of kapok were studied. Higher packing density showed lower sorption capacity, but higher oil retention. At a low packing density, the sorption capacity was 37-51g/g, depending on the oil type. Saturation was reached in less than 200 seconds with diesel, but took several thousand seconds with heavier oils. Higher oil viscosity meant higher sorption capacity. Treatment with chloroform (solvent) showed no change in sorption capacity. Treatment with alkali (NaOH) showed a reduction in capacity by up to 25% from the raw fibers. Sorption capacity was reduced by 30% after 15 cycles of sorption and desorption by vacuum pump. Most of the reduction happened after the first cycle due to about 20% of the oil remaining in the fibers.
156	Muhammad IM, El-Nafaty UA, Surajudeen A, Makarfi YI, 2015. Oil Removal from Produced Water Using Surfactant Modified Eggshell. 2015 4th International Conference on Environmental, Energy and Biotechnology, Volume 85 of IPCBEE (2015)	2015	Nigeria	Eggshell was crushed, washed, and modified with a hexadecyl-trimethyl-ammonium-bromide surfactant solution. The eggshell was tested in an oil-water mixture and was able to remove 91% of the oil within 5 min and 100% after 25 min. Capacity was 1.6g/g.
157	Shi S, Sadullah MS, Gondal MA, Sui Y, Liu S, Yamani ZH, Shen K, Xu Q, Mao J, 2015. Wetting and non-wetting behavior of abrasive paper for oil water separation and oil spill cleanup. Res Chem Intermed (2015) 41:8019-8029	2015	CHN	Waste materials of abrasive papers were investigated as hydrophobic absorption surfaces. They are buoyant and absorb various kinds of oil. Sorption capacity was 5-13 mg/cm^2. They were reusable after washing with ethanol and drying. The coarser paper (#400) performed better than finer ones (up to #2000), especially when water was present, because of its better hydrophobicity.

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158	Machalowski T, Wysokowski M, Petrenko I, Fursov A, Rahimi-Nasrabadi M, Amro MM, Meissner H, Joseph Y, Fazilov B, Ehrlich H, Jesionowski T, 2020. Naturally pre-designed biomaterials: Spider molting cuticle as a functional crude oil sorbent. Journal of Environmental Management 261 (2020)110218	2020	Poland	The molting cuticles of the Theraphosidae spider Avicularia sp. "Peru purple" exhibited a sorption capacity of 12.6g/g of crude oil in sea water, 15.8g/g in distilled water and 16.6g/g in fresh water. 71% of the max capacity was absorbed in the first 30 seconds. It floats on water with less than 0.1g/g of water absorbed after 24 hours. In water-oil mixtures, 60-80% of oil were removed. Four cycles of sorption/desorption by washing with hexane showed some decrease in capacity (40-45%), along with a mass loss with every cycle.
159	Xu Y, Su Q, Shen H, Xu G, 2019. Physicochemical and sorption characteristics of poplar seed fiber as a natural oil sorbent. Textile Research Journal 2019, Vol. 89(19-20) 4186-4194	2019	CHN	The sorption capacity of poplar seed fiber is closely related to packing density and reached 54-68g/g for various oils (diesel, motor, vegetable), better than kapok and cotton. The sorption rate was fastest for diesel due to the low viscosity. Effect of packing density was measured by packing the fiber into a hollow tube and then wicking oil. The sorption test was done with single-phase oil, but pictures of a demonstration with oil on water are also provided without data. The test methods state that reusability was tested by squeezing oil out mechanically, but no data is provided in the results section.
160	Eldin MS, Amma YA, Tamer TM, Omer AM, Ali AA, 2016. Development of a low-cost oelophilic adsorbent based on aminated chitosan-poly (butyl acrylate) graft copolymer for marine oil spill cleanup. Int. J. Adv. Res. 4(11), 2080-2094	2016	Saudi Arabia	Aminated chitosan was prepared from chitin from marine waste sources and aminated with p-benzoquinone and ethylenediamine and grafted with a hydrophobic butyl acrylate monomer. After cellulose, chitin is the second most abundant biopolymer. In a seawater-oil system with shaking, 49-84% of oil were adsorbed (2.5-15g of oil on 300 ml of water), depending on the oil viscosity. The more viscous the oil, the higher the oil uptake. Saturation was reached after 180 minutes. The optimum temperature for oil adsorption was 35C. Sorption capacity in g/g is not given.
161	Zhang L, Zhong Y, Cha D, Wang P, 2013. A self-cleaning underwater superoleophobic mesh for oil-water separation. Scientific Reports 3:2326	2013	Saudi Arabia	A self-cleaning underwater superoleophobic mesh for oil-water separation was prepared by the layer-by-layer assembly of sodium silicate and TiO_2 nanoparticles on stainless steel mesh. It allows water to pass through. No visible oil was left in the filtered water and no visible water was left in the oil after filtration. The mesh was then contaminated with oleic acid and was not able to separate oil and water anymore. It was then subjected to UV light for 30 minutes and due to the TiO_2 was able to recover its hydrophilicity and was able to separate oil and water again. This was successfully done for 5 cycles.
162	Zhao D, 2017. Speed up the absorption of viscous crude oil spill by Joule-heated sorbent design. Sci China Chem, 2017, 60: 1113-1114	2017	CHN	Commercial sponge was wrapped with graphene nanosheets. An electric current applied to the graphene coating introduced Joule-heating, warming the surrounding oil and lowering its viscosity. The oil quickly passed into the sponge, decreasing sorption time by almost 95%. A continuous sorption could be realized by pumping through the sponge.
163	Wang J, Wang H, 2018. Eco-friendly construction of oil collector with superhydrophobic coating for efficient oil layer sorption and oil-in-water emulsion separation	2018	CHN	Oleophilic-hydrophobic kapok fiber was filled into a superhydrophobic fabric bag. The fabric repels water and the kapok fiber absorbs the oil. Even oil droplets from oil-in-water emulsions can be separated out with an efficiency of 99%. Separation efficiency was tested in an emulsion of toluene and acid, alkali, and salty water by agitating the emulsion with the oil collector for 5 minutes. Sorption capacity was 20-50g/g for six different light oils. A tighter fill of the bag with kapok fiber led to lower sorption capacities, because the available void fraction was reduced. Saturation was reached after 15 seconds. After 12 cycles of sorption/desorption by vacuum, the capacity loss was 7%.
164	Pham VH, Dickerson JH, 2014. Superhydrophobic Silanized Melamine Sponge as High Efficiency Oil Absorbent Materials. ACS Appl. Mater. Interfaces 2014, 6, 14181-14188	2014	USA	Commercial melamine sponges are silanized in a one-step solution-immersion process on the surface with alkylsilane compounds. The covalent bonding of the self-assembled monolayer is more robust during mechanical squeezing than previously studied coatings. The sorption capacity for different oils was 82-163g/g. The recyclability was tested by cycles of sorption/desorption by squeezing (90% after 1000 cycles)

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165	Saleem J, Bazargan A, Barford J, McKay G, 2014. Super-fast oil uptake using porous ultra-high molecular weight polyethylene sheets. Polym. Adv. Technol. 2014, 25 1181-1185	2014	Hongkong	Ultra-high molecular weight polyethylene sheets were produced with a cost effective and easy process. The sheets were placed on oil and weighed at various intervals to determine uptake rate. They were saturated 60% within 30 seconds and fully saturated after 2 minutes. They were left dripping for up to an hour after removal from the oil to determine loss of oil. After 60 minutes, more than half the soaked up oil is drained, so prompt removal to a basin is recommended. If left to drip for 2 minutes, the sorption capacity was about 300 g/g. If left for 60 minutes, it was approx. 100 g/g.
166	Meng C, Zhang H, Zhang S, Guo J, Zou X, 2018. The preparation of hydrophobic alginate-based fibrous aerogel and its oil absorption property. Journal of Sol-Gel Science and Technology (2018) 87:704-712	2018	CHN	Alginate-based fibrous aerogel was prepared by soaking sodium alginate and polyacrylamide hydrogel in a methyltrimethoxysilane / ethyl orthosilicate / ethanol mixture. The sorption capacity of the modified alginate aerogel is 65 g/g, whereas the unmodified gel is only 25 g/g.
167	Hoang PH, Hoang AT, Chung NH, Dien LQ, Nguyen XP, Pham XD, 2018. The efficient lignocellulose-based sorbent for oil spill treatment from polyurethane and agricultural residue of Vietnam. Energy Sources, PartA: Recovery, Utilization, and Environmental Effects, 40:3, 312-319	2018	Vietnam	Rice straw was incorporated into a polyurethane matrix to help it float better. Rice straw is a very abundant waste material in Vietnam. Different amounts of rice straw content (5-30 wt%) were investigated. The best performing sample had 25% rice straw and a capacity of 11 g/g, while still maintaining mechanical integrity. A smaller rice straw particle size was best, with 0.5mm having the highest sorption capacity (12 g/g). Most of the saturation was reached within 60 minutes. Another 60 minutes only slightly increased the uptake.
168	Zhang R, Wan W, Qiu L, Wang Y, Zhou Y, 2017. Preparation of hydrophobic polyvinyl alcohol aerogel via the surface modification of boron nitride for environmental remediation. Applied Surface Science 419 (2017) 342-347	2017	CHN	Polyvinyl alcohol supports boron nitride nanosheets, which make the PVA hydrophobic. The fabrication method by freeze-drying is cost-effective. The sorption capacity is 12-38 g/g for hexane and carbon tetrachloride. Unmodified PVA has a higher capacity, but is hydrophilic. The addition of BN enable it to separate oil from water.
169	Lukawski D, Lisiecki F, Dudkowiak A, 2018. Coating Cellulosic Materials with Graphene for Selective Absorption of Oils and Organic Solvents from Water. Fibers and Polymers 2018, 19:3, 524-530	2018	Poland	Cellulosic materials (cotton, gauze, fabric, wipes, filter paper) are coated with graphene flakes in a one-step method. The most important factor for practical applications is ease of fabrication, so this study focuses on applying this simple process to different cellulose materials. The raw materials absorbed up to 11 g/g of water, single coated material a little less, and six times coated material almost no water. Selectivity increased from around 50% to over 90%. Sorption capacity of the treated materials for chloroform was 2-32g/g. Repeated cycles with low-viscosity petroleum ether did not reduce the hydrophobicity by much, but cycles with higher viscosity motor oil seemed to wipe off the protective Gr layer.
170	Wang Q, Li Q, Akram MY, Ali S, Nie J, Zhu X, 2018. Decomposable Polyvinyl Alcohol-Based Super-Hydrophobic Three-Dimensional Porous Material for Effective Water/Oil Separation. Langmuir 2018, 34, 15700-15707	2018	CHN	Macroporous material was prepare by PVA and sodium silicate in aqueous solution. Trimethoxy(octadecyl)silane was grafted onto the surface, creating a super hydrophobic membrane. Usually, toxic glutaraldehyde is used as the crosslinker for PVA, hence this study uses eco-friendly, low-cost Na_2SiO_3. The material was easily decomposable and dissolvable in acidic medium. The sorption capacity was 1.8-7 g/g, depending on the type of oil. Close to saturation was reached within a few minutes for the low viscosity oils (<1cP) and in 30 minutes for the high viscosity oils (up to 650 cP). The separation efficiency was over 90% for all oils with water, even after 10 cycles of filtering and washing with ethyl acetate.
171	Patowary, M., Anathakrishnan, R., Pathak, K., 2013, Superhydrophobic and oleophilic barium sulfate material for oil spill clean-ups: Fabrication of surface modified sorbent by a one-step interaction approach. Journal of Environmental Chemical Engineering 2 (2014) 2078-2084	2014	IND	Barium sulfate was surface modified with palmitic acid in a one-step interaction approach. Oil sorption was tested in oil/seawater mixtures and was 0.14-0.68 g/g. The reusability was tested by washing with tetrahydrofuran. The water contact angle decreased slightly, as did the sorption capacity by 20-30%.

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172	Zeng X, Xu S, Pi P, Cheng J, Wang L, Wang S, Wen X, 2018. Polymer-infiltrated approach to produce robust and easy repairable superhydrophobic mesh for high-efficiency oil/water separation. J Mater Sci (): 10554-10568	2018	CHN	Silica nanoparticles were spray coated onto SS mesh. This was annealed with resin and produced a robust material that could separate various oil/water mixtures for at least 50 cycles of abrasion with sand paper. The coating's resistance to acidic, alkaline, and saline solutions, UV radiation and storage time was also tested and found to be very robust judging from the water contact angles. The only reduction in contact angle was found after an immersion in pH 14 alkaline solution. The infiltration process was also tested on cotton fabric, filter paper, and polyester fiber and made them superhydrophobic. Separation efficiency of the coated SS mesh was tested with a 1:1 oil/water mixture that was poured over the filter mesh. All of the water stayed on top of the filter, while all the oil filtered through the mesh. The separation efficiency was over 99%. The filter could be used repeatedly, with the efficiency still being 99% after 50 separation cycles. Water started penetrating the mesh only when a water column of 53.5cm was sitting on top of it. Continuous oil collection was tested with a mesh basket placed into an oil layer on top of water. Oil was siphoned out of the basket with a tube placed at its top. Almost all the oil could be removed from the water and no water was carried with it.
173	Asadpour, R., Sapari, N., Tuan, Z.Z., Jusoh, H., Riahi, A., Uka, O.K., 2013. Application of Sorbent materials in Oil Spill management: A review. Caspian Journal of Applied Sciences Research, 2(2), pp. 46-58	2013	Malaysia	A review is conducted on different oil spill response measurers, particularly sorbents. The paper discusses three sorbent categories: natural organic, inorganic, and synthetic. Characteristics discussed include oil sorption rate, oil retention, absorbency, oil sorption capacity, reusability, and recovery of sorbed oil. Organic sorbents mentioned include kapok, cotton fiber, milk-weed floss, silk-floss, sponge gourd, sawdust, sisal, coir fiber, walnut shell, non-viable fungal biomasses, citosan, canary grass flax, hemp fiber, aquatic plant (Salvinia), peat, rice husk, carbon fiber, carbon felts, exfoliated graphite, carbonized fir, and bagasse, and carbonized pith bagasse. Organic sorbents were found to have excellent buoyancy, hydrophobic-oleophilic characteristics, and high absorption capacities. A disadvantage of natural sorbents was the tendency to absorb water when used in aqueous mediums. Inorganic sorbents mentioned include perlite, exfoliated graphite, magnetic exfoliated graphite, oil absorption felt created with absorption felt and expanded graphite, high calcium fly ash, sepiolite, and calcium carbonate powder. This article found that inorganic sorbents were expensive, not biodegradable, had relatively low oil sorption capacity, had insufficient buoyancy, and had low re-usability. Synthetic sorbents mentioned include non-woven polypropylene, natural/synthetic blend of polypropylene/kapok/milkweed fibers, nanoporous polystyrene fibers, commercial cellulosic material (from processed wood, expanded perlite, and polypropylene), polyvinyl chloride/polystyrene fibers, FIBROIL, tire rubber, coated mesh, and sol-gel on ceramic tube. Benefits of synthetic sorbents were defined as high oil/water uptake, oleophilic/hydrophobic characteristics, low density/high buoyancy, and availability for large scale fabrication. Non-biodegradability was noted as a disadvantage of synthetic sorbents. This article concludes that organic sorbents have greater potential than synthetic because they're readily available, eco-friendly, and bio-degradable. Some natural sorbents such as kenaf, wool, milkweed, and cotton were found to have higher oil sorption capacities than most commercially synthetic sorbents. Synthetic polypropylene foam is most commonly used due to recyclability and extremely high sorption capacity.

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174	Al-Jammal, N., Juzsakova, T., 2016. Review on the Effectiveness of Adsorbent Materials in Oil Spills Clean Up. 7th International Conference of ICEEE, 17-19 November 2016, Budapest, Hungary	2016	Hungary	This paper provided a review of sorbent effectiveness discussing four different sorbent types: natural, synthetic, inorganic, and nanotubes/nanoparticles. Factors considered in comparing the sorbents included oil retention, adsorption capacity, rate of absorption/adsorption, and ease of application. The paper includes a table comparing the different sorbent types and properties. Natural sorbents are encouraged due to their sustainability and renewability. Drawbacks of plant-based sorbents include relatively low oil sorption, low hydrophobicity, and poor buoyancy. Polypropylene and polyurethane (characterized as synthetic sorbents) are noted as the most commonly used commercial sorbents due to hydrophobic and oleophilic properties. A drawback of synthetic sorbents are that they are not biodegradable and must go into a landfill or be incinerated which is expensive and not environmentally friendly. Inorganic sorbents are described as having high adsorption capacity and being low cost due to cheap and abundant materials. Frequent studies on Zeolites as inorganic sorbents are mentioned. The advantages of carbon nanotubes (CNTs) and nanoparticles as sorbents are their hydrophobic properties, light weight construction, the flexibility of surface modifications, high sorption capacity, oil-water separation capabilities, excellent recyclability, and environmental friendliness. CNTs are noted as a new area of research requiring work to turn tested products into commercial products for large-scale oil spill removal. The authors conclude that CNTs are the best candidate for oil sorbents. Recommendations for future work include improving environmentally friendliness and economic feasibility of sorbents, considering complexity of use and reducing logistical complications associated with recovery, disposal, storage, and secondary containment.
175	Calcagnile, P., Fragouli, D., Bayer, I., Anyfantis, G., Martiradonna, L., Cozzoli, P., Cingolani, R., Athanassiou, A., 2012. Magnetically Driven Floating Foams for the Removal of Oil Contaminants from Water. ACSNANO, Vol. 6, No. 6, 5413-5419, 2012.	2012	Italy	Untreated polyurethane (PU) foam is already hydrophobic and oleophilic but modifying the foam surface with polytetrafluoroethylene (PTFE) particles and colloidal iron oxide nanoparticles (NPs) significantly increased oil absorption rate. The treated foam is water-repelling, oil-absorbing, light weight for buoyancy, and magnetically responsive. Magnets can be used to move foam around on the water surface for spill clean up. The paper suggests that polymeric or nanocomposite foams are simpler and less expensive to fabricate for mass production than carbon foam systems. The PU foam is readily available, easily recycled, and easily reused allowing for fast cleanup. Four samples were tested: one with PTFE only, one with NPs only, and two with both PTFE and NPs but with treatments in reversed sequence. The hydrophobic nature greatly increase with the addition of PTFE, and the oleophilic nature greatly increases with both PTFE and NP. The foam can absorb up to 13 times its own weight. Up to 80% of the NPs with sorbed oil can be removed from the foam using a magnet and reused. It was found that depositing NPs before PTFE is the most effective foam treatment sequence.