FINAL REPORT

DETERMINE IF OHMSETT IS SUITABLE FOR RESEARCHING, TESTING AND TRAINING IN BIOFUEL SPILL RESPONSE

for:

US Department of the Interior

Bureau of Ocean Energy Management, Regulation and Enforcement

Technology Assessment & Research Program

Herndon, VA

by:

S.L. Ross Environmental Research Ltd.

Ottawa, ON

January 13, 2010

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Summary

The objective of this study was to determine if Ohmsett, including the existing filtration system and filter media, is suitable for testing biofuel spill response techniques.

The physical and chemical properties of various biofuels (biodiesels and gasoline/ethanol blends) were reviewed to determine if they pose any handling problems or exposure risks to personnel at Ohmsett. It was quickly determined that **the testing of ethanol/gasoline blends (aka gasohol) at Ohmsett should <u>not</u> be contemplated** because:

1. The release of these products on the tank would pose a significant fire and vapor hazard; and,
2. The ethanol would rapidly and completely dissolve in the tank water and pose a significant cleanup problem.

Only biodiesels should be considered for testing at Ohmsett. The various pure biodiesels (aka B100) are relatively benign, pose no acute risk to humans if used at ambient temperatures, can be considered non-combustible and require no hazard warning labels. **No special PPE is required for handling pure biodiesels under normal operating conditions.** Biodiesel blends (up to 20% by volume, or B2, B6, B20, etc.) with petroleum-derived diesel fuel are considered a flammable liquid. The petroleum diesel component of the blends imparts inhalation, ingestion and possible carcinogenic risks. The handling and PPE requirements for these blends are the same as for the pure petroleum component.

The compatibility of the Ohmsett oil storage and distribution system with the chemical constituents of various biofuels and blends was assessed. **Of prime concern are elastomeric components (such as hoses and gaskets) that may be adversely affected by the pure biodiesels. Of secondary concern are "yellow" or "red" metals (such as brass, bronze, copper, lead, tin and zinc) that will accelerate oxidation of the pure biodiesel and create insoluble sediments or gels and salts in the fuel.** Biodiesel blends of 20% or less (i.e., B6-20) have shown a much smaller effect on these materials. Improper or lengthy storage of pure biodiesel or biodiesel blends can result in oxidation and the formation of corrosive materials (including organic acids, water, and methanol) that can adversely affect vulnerable materials. **Unless they are used within a few months, biodiesel and biodiesel blends should be stabilized with antioxidants.**

Biodiesels are mild surfactants. **B100 on the tank water at Ohmsett will naturally disperse much more easily than petroleum diesels.** This may result in much more contamination of tank water requiring remediation by filtration than is normal during skimmer tests with the usual Ohmsett test oils or crude oils. Biodiesel blended with diesel can cause dispersion of diesel into the water column in blends as low as B10 to B20. **This characteristic of biodiesels may also necessitate careful handling when moving surface biodiesel slicks to the sluice gate with fire hoses and processing it in the oil refurbishing systems.**

Biodiesel, particularly blends with higher concentrations than B20 is hygroscopic (picks up water) and can hold between 1200 and 2500 ppm water in solution. **Recovered biodiesel from tests on the Ohmsett tank will contain water that will dramatically increase the**

biodegradation rate of the biodiesel and acidification. The presence of a water-biodiesel interface in a slops or waste storage tank can produce very acidic conditions, with commensurate increases in metal corrosion rates, and result in rapid microbial growth in the tank. Internal corrosion in biodiesel storage tanks due to the presence of water and microbial growth is not prevented using corrosion mitigation tools such as cathodic protection.

Biodiesel degrades about four times faster than petroleum diesel. Within 28 days, pure biodiesel degrades 85 to 88 percent in water. Dextrose degrades at the same rate. Blending biodiesel with diesel fuel accelerates its biodegradability. **Long-term storage of recovered biodiesel is not recommended and prompt disposal of the slops will be necessary. Disposal of pure biodiesel waste products can be considered non-hazardous.**

Laboratory filtration tests with pure Canola, Soy and Tallow biodiesels showed that the 50:50 **mix of Diatomite and cellulose normally used on the leaf filter to clean the tank after dispersant testing was effective in removing both biodiesel droplets and chemically dispersed biodiesel droplets.**

Further laboratory tests showed that **powdered activated carbon treatment of the tank water will effectively remove dissolved Corexit 9500 from the water** in the presence of 3 ppm each of the Canola, Soy and Tallow biodiesels.

1 Introduction

The use of biofuels (gasoline blended with ethanol and biodiesels) is being actively encouraged by government and industry to diversify energy sources for the transportation sector. While the potential benefits of biofuels are great, the best way to respond to spills of these fuels and blends is unclear. The introduction of biofuel blends into petroleum fuels changes their physical properties and chemical makeup and thus may change the effectiveness of current spill mitigation and cleanup procedures (Hollebone *et al.* 2008). Well-researched spill response techniques will be crucial to support the development and promotion of the biofuel industry.

Recently, research has begun at the laboratory and bench scale on countermeasures for biofuel spills on water (Cooper *et al.* 2008, Hollebone and Yang 2009). The next logical step is to continue this research at larger scales at Ohmsett; however, before doing this it is prudent to confirm that the various systems at Ohmsett will be compatible with biofuel physical and chemical properties and that the tank remediation systems will work with biofuels.

1.1 Background

Biofuels (bio-diesels and gasoline/ethanol blends) are becoming more prevalent in the marketplace. For example, presently there are 179 plants that can produce a combined 2.69 billion gallons of biodiesels annually in the continental U.S. (http://www.biodiesel.org). Since biofuels have physical and chemical properties different than the petroleum products that they are replacing, it is inevitable that interested parties will request testing of potential countermeasures for spills of biofuels at Ohmsett. At present, the implications of testing biofuel spill response techniques for the facilities and personnel conducting tests at Ohmsett are unknown.

1.2 Objective

The objective of this study was to determine if Ohmsett, including the existing filtration system and filter media, is suitable for testing biofuel spill response techniques.

1.3 Goals

More specifically, the goals of the study were to:

1. Research the physical and chemical properties of various biofuels to see if they pose any handling problems or exposure risks to personnel during use at Ohmsett, and what procedural changes and/or PPE would be appropriate to minimize the risks.

2. Ascertain if the oil storage and distribution systems are compatible with various unweathered biofuels and their chemical constituents.

3. Determine if the tank cleaning and vacuum system are capable of safely removing biofuel from the surface and bottom of the tank.

4. Verify, through small-scale testing, whether the existing leaf filter coated with the blend of cellulose and diatomaceous earth filter aids presently used for dispersant testing, can effectively remove dispersed biofuel droplets from the tank water. Also, determine whether dispersed/dissolved biofuel will interfere with the removal of dissolved dispersant by the powdered activated carbon system.

2 Physical and Chemical Properties of Biofuels

The published physical and chemical properties of various biofuels (biodiesels and gasoline/ethanol blends) were compiled and reviewed to determine if they pose any handling problems or exposure risks to personnel during use at Ohmsett. It was quickly determined that **the testing of ethanol/gasoline blends (aka gasohol) at Ohmsett should <u>not</u> be contemplated** because:

3. The release of these products on the tank would pose a significant fire and vapor hazard; and,
4. The ethanol would rapidly and completely dissolve in the tank water and pose a significant cleanup problem.

Only biodiesels should be considered for testing at Ohmsett.

The properties of typical biodiesels and biodiesel/petroleum diesel (petrodiesel) blends are given in Table 1.

Representative MSDS sheets are provided as reference material for Ohmsett safety review purposes.

MSDS for B100

MSDS for B6-20

To summarize, the various pure biodiesels (aka B100) are relatively benign, pose no acute risk to humans if used at ambient temperatures, can be considered non-combustible and require no hazard warning labels. Overheated pure biodiesels (above ~ 130°C [266 °F]) may pose a vapor inhalation risk. No special PPE is required for handling pure biodiesels under normal operating conditions. Where splashing of the product is possible, safety glasses with side shields are recommended. Breathing apparatus is required only when aerosol or mist is formed.

Biodiesel blends (up to 20% by volume, or B2, B6, B20, etc.) with petroleum-derived diesel fuel are considered a flammable liquid. The petroleum diesel component of the blends imparts inhalation, ingestion and possible carcinogenic risks. The product must carry the following OSHA label "*Aspiration (inadvertent suction) of liquid into the lungs can produce chemical pneumonia or even death. Produces skin irritation upon prolonged or repeated contact*." Respiratory protection is required only when the product produces vapor that exceed permissible levels or excessive vapors are produced. No special protective clothing is normally required. Neoprene, nitrile, polyvinyl alcohol (PVA), polyvinyl chloride and polyurethane gloves should be worn to prevent skin contact. Where splashing of the product is possible, safety glasses with side shields are recommended.

Table 1. Physical properties of typical biodiesels and blends.

	B100	**B6-20**
Appearance	Amber Liquid	Clear to Amber Liquid
Physical state	Liquid	Liquid
Substance type	Mixture	Mixture
Color	Amber	Clear or Amber
Odor	Slight	Slight Hydrocarbon
Molecular weight	290	180
pH	Neutral	Neutral
Boiling Point, ºC (ºF)	315–350 (599–662)	180–340 (356–644)
Flash Point, ºC (ºF)	100–170 (212–338)	60–80 (140–176)
Pour Point, ºC (ºF)	-5 to 10 (23 to 50)	-35 to -15 (-31 to 5)
Specific gravity	0.87 @ 25 °C	Approx. 0.8 @ 25 °C
Density	7.35 lbs/gal	6.76 lbs/gal
Vapor density	No data available.	4-5
Vapor pressure	<1 mm Hg @ 72 °C	1-10 mm Hg @ 100 °F
Solubility (equilibrium)	20–100 ppm	20–40 ppm
Viscosity	4.0–6.0 @ 40 °C	1.9-3.4 @ 40 °C

3 Compatibility of Oil Storage and Distribution Systems

The compatibility of the Ohmsett oil storage and distribution system with the chemical constituents of various biofuels and blends was assessed. Of prime concern are elastomeric components (such as hoses and gaskets) that may be adversely affected by the biofuels. Of secondary concern are “yellow” or “red” metals (such as brass, bronze, copper, lead, tin and zinc) that will accelerate oxidation of the biodiesel and create insoluble sediments or gels and salts in the fuel.

With prolonged exposure, B100 can degrade; soften; or, seep through filter media, hoses, gaskets seals, elastomers, adhesives and plastics. Binders used in cellulose (paper) filters, polypropylene, Buna or Nitrile rubber, polyvinyl and Tygon materials are particularly vulnerable to B100. Materials such as Teflon, Viton, fluorinated plastics and Nylon are compatible with B100. Table 2 (from the National Renewable Energy Board Report NREL/TP-540-43672) gives specific materials compatibility for B100 (whose chemical name is methyl oleate).

Most tanks designed to store diesel fuel will be adequate for storing B100. Acceptable storage tank materials include aluminum, steel, fluorinated polyethylene, fluorinated polypropylene, Teflon, and most fiberglass. Lead solders and zinc linings should be avoided, as should copper pipes, brass regulators, and copper, brass or bronze fittings. The fuel or the fittings will tend to change color and the insolubles generated on contact with these metals may plug filters. Potentially affected equipment should be replaced with stainless steel, carbon steel, or aluminum.

Biodiesel blends of 20% or less (i.e., B6-20) have shown a much smaller effect on these materials. The effects are virtually non-existent in low-level blends such as B2. When handling blends of B20 or less normal monitoring of hoses and gaskets for leaks is sufficient. Blends of B20 and lower reduce the impact of metal compatibility issues.

Table 2. B100 materials compatibility.

Material	Compatibility with Fresh, Unoxidized Methyl Oleate Unless Noted	Reference
Buna-N	Not Recommended	3,4
Butadiene	Not Recommended	2
Butyl	Mild Effect	2,4
Chemraz	Satisfactory	4
Ethylene propylene (EPDM)	Moderate Effect	2,4
Fluorocarbon	Satisfactory	2,4,5
Fluorosilicon	Mild Effect; increase swelling	1
Fluorosilicone	Mild Effect	2,4
Hifluour	Satisfactory	2
Hypalon	Not Recommended	2,4
Natural Rubber	Not Recommended	2,4
Neoprene	Not Recommended	3,4
Neoprene/Chloroprene	Not Recommended	2
Nitrile	Not Recommended	1,2
Nitrile, high aceto-nitrile	Mild Effect with B20, swelling and break strength affected	5
Nitrile, hydrogenated	Not Recommended	2,4
Nitrile, peroxide-cured	Mild Effect with B20, swelling and break strength affected	5
Nordel	Moderate to Severe Effect	3
Nylon	Satisfactory	1
Perfluoroelastomer	Satisfactory	2
Polypropylene	Moderate Effect; increased swelling, hardness reduced	1
Polyurethane	Mild Effect; increased swelling	1
Styrene-butadiene	Not Recommended	2,4
Teflon	Satisfactory	1,3,4
Viton	Satisfactory; type of cure affects compatibility with oxidized biodiesel see specific types of Viton below	1,3
Viton A-401C	Satisfactory with fresh RME; not recommended for oxidized blends B20 and above	6
Viton F-605C	Satisfactory with fresh RME; not recommended for oxidized blends B20 and above	6
Viton GBL-S	Satisfactory with RME and with all oxidized blends	6
Viton GF-S	Satisfactory with RME and with all oxidized blends	6
Wil-Flex	Moderate to Severe Effect	3

[1]Bessee, G.B. and J.P. Fey. Compatibility of Elastomers and Metals in Biodiesel Fuel Blends. SAE 971690. 1997.
[2]Parker O-Ring Handbook, Parker Hannilin Corporation, O-Ring Division, Lexington, KY, 2007.
[3]Chemical Resisitance Guide, Wilden Pump & Engineering Co., Grand Terrace, CA, 2005.
[4]O-Ring Chemical Compatibility Guide, *www.efunda.com* accessed July 12, 2008.
[5]Terry, B., R.L. McCormick, M. Natarajan. Impact of Biodiesel Blends on Fuel System Component Durability. SAE 2006-01-3279, 2006.
[6]Thomas, E., R.E. Fuller, K. Terauchi. Fluoroelastomer Compatibility with Biodiesel Fuels, SAE 2007-01-4061, 2007.

In some cases the storage of crude or other test oils used at Ohmsett leaves a deposit in the bottom of fuel lines, tanks, and delivery systems over years of time. Biodiesel acts as a cleaning agent and can dissolve these sediments and result in fluid contamination until the whole system has been cleaned of the sediments left by the previous fuel. This phenomenon has not been observed with B5 and lower blends, and may occur when first using B20 or higher. The cleaning effect of B20 and lower blends occurs only with systems that have significant amounts of sediment. Although experience is limited, with higher blend levels than B20 if any sediment is present it is picked up almost immediately by the biodiesel.

When biodiesel made from soybean oil is blended at 2% by volume with average No. 2 petrodiesel, the cold flow properties of the finished B2 blend are similar to those of the petrodiesel alone. With B20, the cold flow properties of the blend can be 3-10 °F higher than average No. 2. There can be more biodiesel impact when using biodiesel from different feedstock (Table 3) or with lower gelling diesel fuel. In some cases, the increased gel temperature of B20 is within the variability seen with petrodiesel from supplier to supplier and no further precautions are needed in cold weather but it is always good to measure the cold flow properties of a biodiesel blend. As biodiesel components greater than B20 are added, the cold flow properties become more like the B100. Table 3 lists the cloud and pour points of various B100 biodiesels. Care must be taken to be sure a biodiesel or blend will not gel in cold conditions while in storage at Ohmsett.

Improper or lengthy storage of biodiesel or biodiesel blends can result in oxidation and the formation of corrosive materials (including organic acids, water, and methanol) that can adversely affect vulnerable materials. Although only limited research has been done on this issue, tests indicate the degree of oxidation may be more important than the concentration of biodiesel. Unless they are used within a few months, biodiesel and biodiesel blends should be stabilized with antioxidants to reduce compatibility issues.

Table 3. Cloud and Pour Points of Various Types of B100 Biodiesels

Test Method for B100 Fuel	Cloud Point (ASTM D2500)		Pour Point (ASTM D97)	
	(°F)	(°C)	(°F)	(°C)
Soy Methyl Ester	32	0	25	-4
Canola Methyl Ester	26	-3	25	-4
Lard Methyl Ester	56	13	55	13
Edible Tallow Methyl Ester	66	19	60	16
Inedible Tallow Methyl Ester	61	16	59	15
Yellow Grease 1 Methyl Ester	–	–	48	9
Yellow Grease 2 Methyl Ester	46	8	43	6

Finally, biodiesel is generally more susceptible than petroleum to microbial degradation. In the case of spills in the environment, this is a positive attribute because they biodegrade more rapidly. However, microbial contamination of fuel storage tanks can plug dispensers and filters. This is not unheard of for petroleum diesel, but anecdotal evidence suggests it is a greater problem for biodiesel blends. The best way to deal with this issue (for both petroleum diesel and biodiesel) is adequate fuel storage tank housekeeping and monitoring, especially eliminating water in contact with the fuel. Water bottoms must be removed from tanks, and standing tanks should be sampled and tested for microbial contamination.

4 Suitability of Tank Cleaning and Vacuum System

In this task, the compatibility and operability of the tank cleaning systems (tank sweeping booms, sluice gate system, oil refurbishing system and bottom vacuum system) with biofuels was evaluated. The purpose was to determine if the physical and chemical properties of biofuels and their blends with petroleum products could pose any problems with the effective operation of the systems.

The same materials compatibility issues noted above for the oil storage and distribution systems will apply to the tank cleaning and vacuuming equipment as well.

In terms of sorbent use with biodiesels, biodiesel pick-up is very similar to that of petroleum of same viscosity for most sorbent types.

Biodiesels are mild surfactants. B100 on the tank water at Ohmsett will naturally disperse much more easily than petroleum diesels and form a white, milky emulsion. This may result in much more contamination of tank water requiring remediation by filtration than is normal during skimmer tests with the usual Ohmsett test oils or crude oils. Biodiesel blended with diesel can cause dispersion of diesel into the water column in blends as low as B10 to B20. This characteristic of biodiesels may also necessitate careful handling when moving surface biodiesel slicks to the sluice gate with fire hoses and processing it in the oil refurbishing systems.

Biodiesel, particularly blends with higher concentrations than B20 is hygroscopic (picks up water) and can hold between 1200 and 2500 ppm water in solution. Recovered biodiesel from tests on the Ohmsett tank will contain water that will dramatically increase the biodegradation rate of the biodiesel and acidification. The presence of a water-biodiesel interface in a slops or waste storage tank can produce very acidic conditions, with commensurate increases in metal corrosion rates, and result in rapid microbial growth in the tank. Internal corrosion in biodiesel storage tanks due to the presence of water and microbial growth is not prevented using corrosion mitigation tools such as cathodic protection.

Biodiesel degrades about four times faster than petroleum diesel. Within 28 days, pure biodiesel degrades 85 to 88 percent in water. Dextrose (a test sugar used as the positive control when testing biodegradability) degrades at the same rate. Blending biodiesel with diesel fuel accelerates its biodegradability. For example, blends of 20 percent biodiesel and 80 percent diesel fuel degrade twice as fast as #2 diesel alone. As such, long-term storage of recovered biodiesel is not recommended and prompt disposal of the slops will be necessary.

Disposal of pure biodiesel waste products can be considered non-hazardous.

5 Filtration and Powdered Activated Carbon Systems

The effectiveness of the leaf filter system for removing dispersed oil droplets and suspended solids from the tank water, and the powdered activated carbon system for removing dissolved dispersant from the tank water, after biofuel testing was assessed. This was accomplished by small-scale laboratory testing with three types of pure biodiesel: Canola, Soy and Tallow. The samples were obtained from Environment Canada's Environmental Science and Technology Service in Ottawa. Vacuum flask tests (Figure 1) to emulate the existing leaf filter coated with a 50:50 blend of Diatomite FW-60 (a diatomaceous earth filter aid) and the cellulose filter aid presently used to clean the tank of dispersed oil droplets after dispersant testing, were conducted to determine if these can effectively remove dispersed biofuel droplets from the tank water. In addition, laboratory testing was conducted to see whether biofuel test residues will interfere with the removal of dissolved dispersant by the Ohmsett powdered activated carbon system. The test procedures used were based on those employed to develop the present dispersant effectiveness testing and tank cleanup protocols (SL Ross 2000, 2002 and 2003).

Figure 1. Laboratory test setup.

5.1 Filter Aid Tests

The analytical instrument used to measure dispersed oil and dispersant in water was a Horiba OCMA-350 non-dispersive infrared oil content analyzer. This instrument measures the absorption of IR light by a sample in the 3.4 to 3.5 µm wavelength range. This is the wavelength of light absorbed by the C-H bond. In order to measure the oil content of a sample of water, it is shaken with a solvent that extracts the hydrocarbons. The solvent used was IR-spectroscopy grade perchlorethylene (also known as tetrachloroethylene).

The tests were intended to simulate the operation of the Ohmsett leaf filter, but the loadings of filter aid (both the pre-coat and the body-coat) used were higher than those that are used at Ohmsett. The purpose of this was to ensure that any beneficial effects of the filter aids would be easily detected. The tests involved filtering samples of distilled water contaminated with about 50mg/L of each the three biodiesels, and each of the biodiesels pre-mixed with1:20 Corexit 9500. All samples were stirred with a magnetic stirrer to ensure thorough dispersion of the oil/dispersant into the water prior to extraction and/or filtering. The filter used was a ceramic-type Buchner funnel fitted with medium-to-fine Fisher brand P8 filter paper (5.5 cm diameter) and placed on a 1-L glass Kimax filter flask. A water-tap aspirator provided vacuum. Prior to a filter test, a “pre-coat” of filter aid was placed on the filter paper. This involved mixing a slurry of 6 g of Diatomite and 6 g of cellulose in 200 mL of tap water and filtering the slurry (as a comparison, this is about four-times as much pre-coat as would be normally used on the Ohmsett leaf filter). For a test, 6 g of Diatomite and 6 g of cellulose was mixed with 500 mL of the contaminated water and filtered (this is about a 50-times greater concentration of filter aid in the body-coat slurry than would be used with the Ohmsett leaf filter).

The measurement with the Horiba OCMA-350 of the concentration of biofuel and/or dispersant in the samples proved particularly vexing. In the end it proved necessary to record the absolute absorbance of the samples, as the “zero” setting for the analyzer with each individual biodiesel and biodiesel with Corexit 9500 combination was different for pre-filtered and post filtering samples. Figure 2 shows the results for the filtering tests.

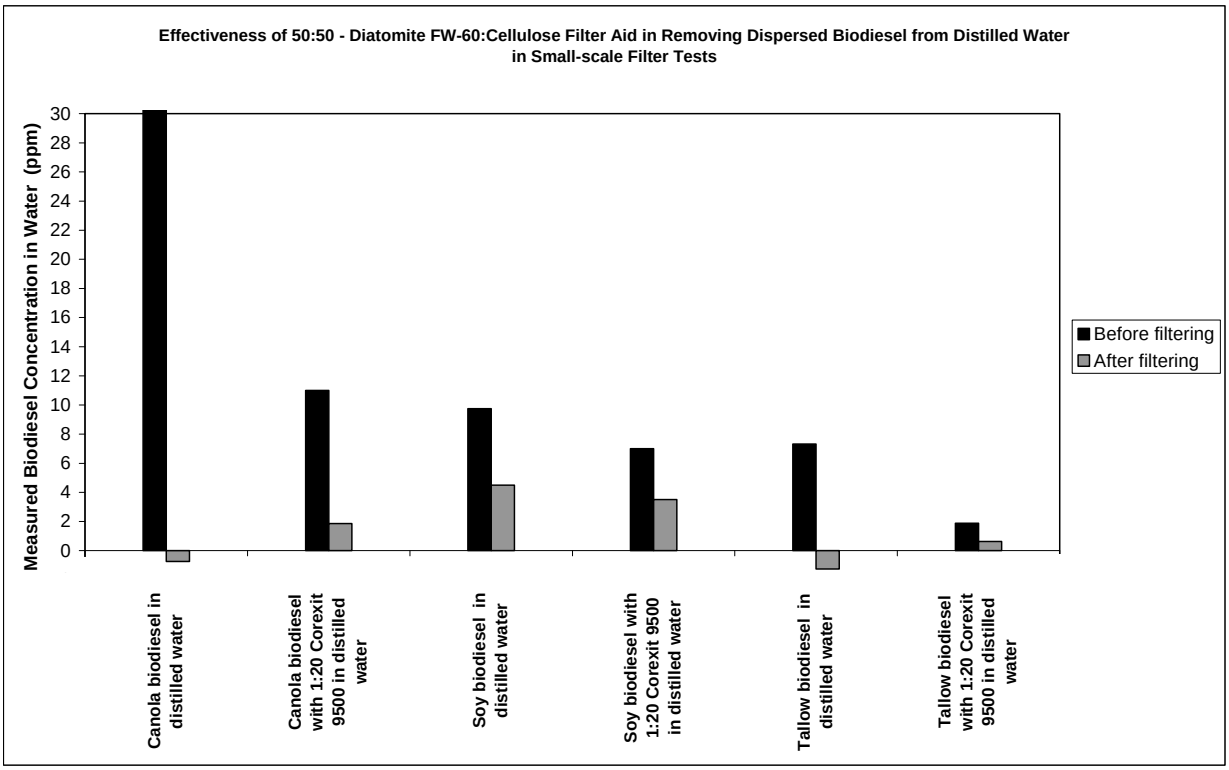

Figure 2. Filter aid test results for each biodiesel with and without dispersant.

The 50:50 mix of Diatomite and cellulose was effective in removing both biodiesel droplets and chemically dispersed biodiesel droplets. One interesting observation was that the concentration of chemically dispersed biodiesel was consistently less than the concentration of naturally dispersed biodiesel, in the same level of mixing energy.

5.2 Powdered Activated Carbon Tests

Simple tests were undertaken to determine whether or not the presence of dispersed biofuel droplets in the water would prevent the Ohmsett powdered activated carbon (PAC) system for removing dissolved dispersant from functioning. This laboratory-scale test involved treating a volume of water premixed with 10 ppm of Corexit 9500 and containing 3 ppm each of the Canola, Soy and Tallow biodiesel with 50 ppm Nuchar SN PAC. The presence of dispersant was determined by measuring the interfacial tension of the water and USP grade mineral oil (see SL

Ross 2003 for an explanation of this technique). Figure 3 presents the results. It is clear that the PAC treatment does effectively remove dissolved Corexit 9500 from the water in the presence of 3 ppm each of the Canola, Soy and Tallow biodiesels.

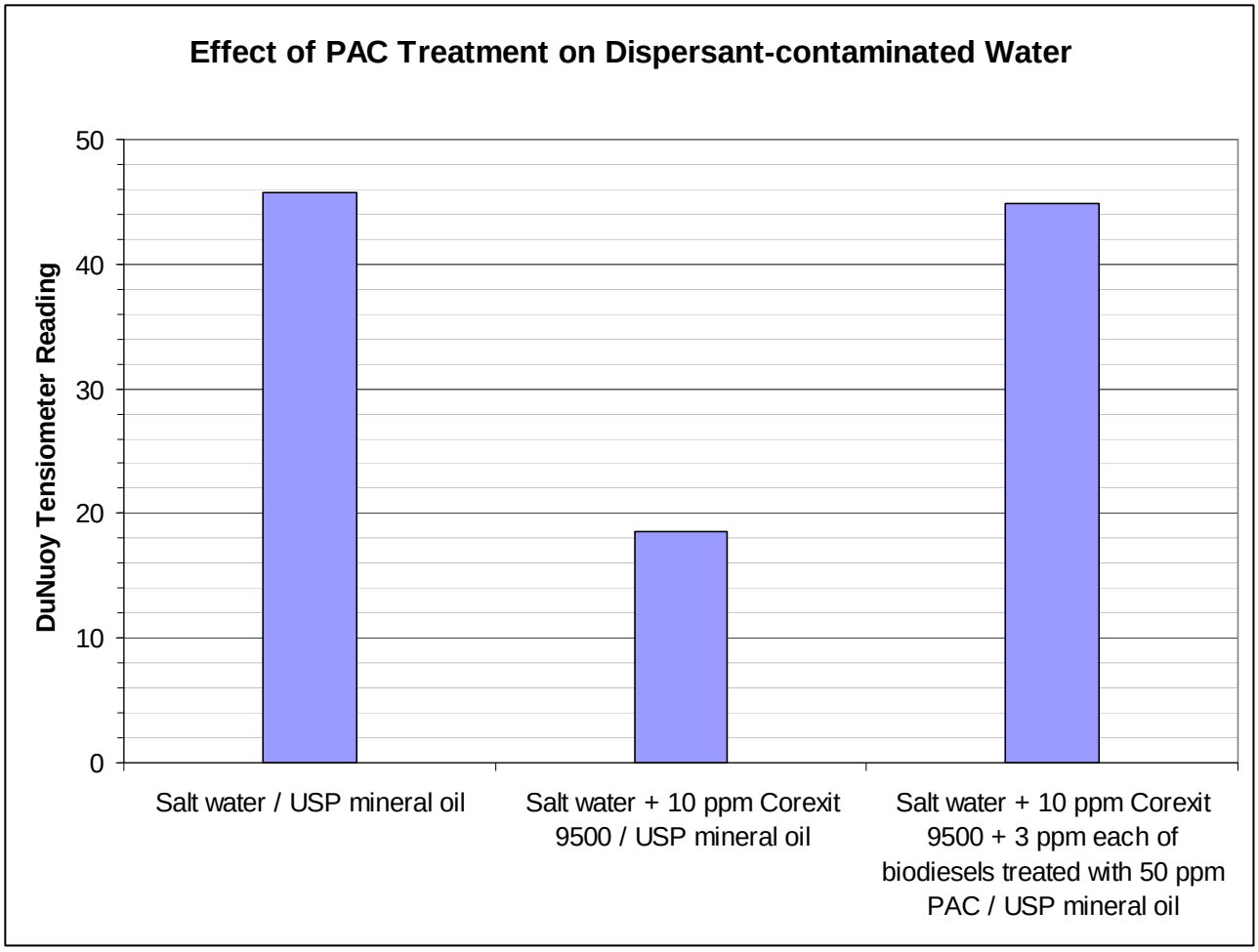

Figure 3. Effect of biodiesels on PAC treatment of dispersant-contaminated water.

References

Cooper, D., D. Velicogna, A. Obenauf and C. Brown. 2008. Biodiesel Spill Response. *Proceedings of the 31st Arctic and Marine Oilspill Program Technical Seminar*. Environment Canada, Ottawa, ON. pp 351-360.

Hollebone, B., B. Fieldhouse, M. Landriault, K. Doe and P. Jackman. 2008. Aqueous Solubility, Dispersibility and Toxicity of Biodiesels. *Proceedings of the International Oil Spill Conference 2008.* API, Washington, DC. pp 929-936.

Hollebone, B. and Z. Yang. 2009. Biofuels in the Environment: A Review of Behaviours, Fates, Effects and Possible Remediation Techniques. *Proceedings of the 32nd Arctic and Marine Oilspill Program Technical Seminar.* Environment Canada, Ottawa, ON. pp 127-139.

SL Ross Environmental Research. 2000. *Feasibility of Using Ohmsett for Dispersant Testing and Research.* Project #375 Report to MMS. Herndon, VA.

SL Ross Environmental Research. 2002. *Ohmsett Dispersant Test Protocol Development.* Project #427 Report to MMS. Herndon, VA.

SL Ross Environmental Research. 2003. *Research on Powdered Activated Carbon to Remove Dissolved Oil Spill Dispersant from Ohmsett Basin Water*. Project # 456 Report to MMS. Herndon, VA.

APPENDIX A - MSDS for B100

Material Safety Data Sheet

MSDS ID NO.: 0282MAR019
Revision date: 08/06/2009

1. CHEMICAL PRODUCT AND COMPANY INFORMATION

Product name: Marathon Biodiesel B100
Synonym: B100 Biodiesel; Virgin Biodiesel; Soy Biodiesel; Rapeseed Biodiesel; Tallow Biodiesel; Canola Biodiesel
Chemical Family: Fatty acid alkyl esters
Formula: Mixture

Manufacturer:
Marathon Petroleum Company LLC
539 South Main Street
Findlay OH 45840

Other information: 419-421-3070
Emergency telephone number: 877-627-5463

2. COMPOSITION/INFORMATION ON INGREDIENTS

Biodiesel is a complex mixture of C16-C18 methyl esters derived from the processing of soybean oil. This product is intended for use as a blending component in diesel fuel at a level of 0-5%.

Product information:

Name	CAS Number	Weight %	ACGIH Exposure Limits:	OSHA - Vacated PELs - Time Weighted Ave	Other:
Marathon Biodiesel B100	67784-80-9	100			

Component Information:

Name	CAS Number	Weight %	ACGIH Exposure Limits:	OSHA - Vacated PELs - Time Weighted Ave	Other:
Biodiesel (Canola derived)	129828-16-6	0-100			
Biodiesel (Tallow derived)	61788-61-2	0-100			
Biodiesel (Soybean derived)	67784-80-9	0-100			
Biodiesel (Fatty Acid, Methyl Ester)	68937-84-8	0-100			
Biodiesel (Rapeseed derived)	73891-99-3	0-100			

Notes: The manufacturer has voluntarily elected to reflect exposure limits contained in OSHA's 1989 air contaminants standard in its MSDS's, even though certain of those exposure limits were vacated in 1992.

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

BIODIESEL IS AN NON VOLALTILE, NON COMBUSTIBLE AMBER LIQUID. THIS MATERIAL IS NOT COMBUSTIBLE PER THE OSHA HAZARD COMMUNICATION STANDARD BUT COULD EMIT FUMES OF ELEMENTAL COMPONENTS IF HEATED TO ELEVATED TEMPERATURES. THIS PRODUCT HAS BEEN EVALUATED AND DOES NOT REQUIRE ANY HAZARD WARNING LABEL UNDER THE OSHA HAZARD COMMUNICATION STANDARD.

OSHA WARNING LABEL:

THIS PRODUCT HAS BEEN EVALUATED AND DOES NOT REQUIRE ANY HAZARD WARNING LABEL UNDER THE OSHA HAZARD COMMUNICATION STANDARD.

CONSUMER WARNING LABEL:

A CONSUMER WARNING LABEL IS NOT APPLICABLE FOR THIS PRODUCT.

Inhalation: No acute effects expected from routine operations. Overheating of product may produce vapors which can cause respiratory irritation, dizziness and nausea.

Ingestion: Not likely to be toxic by ingestion.

Skin contact: Prolonged and repeated liquid contact can cause defatting and drying of the skin and can lead to irritation and/or dermatitis.

Eye contact: Produces little or no irritation on direct contact with the eye.

Carcinogenic Evaluation:

Product information:

Name	IARC Carcinogens:	NTP Carcinogens:	ACGIH - Carcinogens:	OSHA - Select Carcinogens:
Marathon Biodiesel B100 67784-80-9	NE			

Notes: The International Agency for Research on Cancer (IARC) has not evaluated this product.

Component Information:

4. FIRST AID MEASURES

Inhalation: If affected, move person to fresh air. If breathing is difficult, administer oxygen. If not breathing or if no heartbeat, give artificial respiration or cardiopulmonary resuscitation (CPR). Immediately call a physician. If symptoms or irritation occur with any exposure, call a physician.

Skin contact: Wash with soap and large amounts of water. Remove contaminated clothing. If symptoms or irritation occur, call a physician.

Ingestion: If swallowed, do not induce vomiting and do not give liquids. Immediately call a physician.

Eye contact: Flush eyes with large amounts of tepid water for at least 15 minutes. If symptoms or irritation occur, call a physician.

Medical conditions aggravated by exposure: No data available.

5. FIRE FIGHTING MEASURES

Suitable extinguishing media: For small fires, Class B fire extinguishing media such as CO2, dry chemical, foam (AFFF/ATC) or water spray can be used. For large fires, water spray, fog or foam (AFFF/ATC) can be used. Fire fighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

Specific hazards: This product is not a combustible liquid per the OSHA Hazard Communication Standard, but will ignite and burn at temperatures exceeding the flash point. For additional fire related information, see NFPA 30 or the North American Emergency Response Guide 128.

Special protective equipment for firefighters: Avoid using straight water streams. Water spray and foam (AFFF/ATC) must be applied carefully to avoid frothing and from as far a distance as possible. Avoid excessive water spray application. Keep surrounding area cool with water spray from a distance and prevent further ignition of combustible material. Keep run-off water out of sewers and water sources.

Flash point: > 300 F (PMCC)
Autoignition temperature: No data available.
Flammable limits in air - lower (%): No data available.
Flammable limits in air - upper (%): No data available.

NFPA rating:
Health: 1
Flammability: 1
Instability: 1
Other: -

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: Keep public away. Isolate and evacuate area. Shut off source if safe to do so. Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate. Contain liquid with sand or soil. Recover and return free product to proper containers. Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids.

7. HANDLING AND STORAGE

Handling:
Comply with all applicable EPA, OSHA, NFPA and consistent state and local requirements. Store in properly closed containers that are appropriately labeled and in a cool well-ventilated area.

Exercise good personal hygiene including removal of soiled clothing and prompt washing with soap and water.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

PERSONAL PROTECTIVE EQUIPMENT

Engineering measures: Local or general exhaust required when using at elevated temperatures that generate vapors or mists.

Respiratory protection:	Breathing apparatus needed only when aerosol or mist is formed. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 1910.134. Self-contained breathing apparatus should be used for fire fighting.
Skin and body protection:	Not required under normal operating conditions.
Eye protection:	No special eye protection is normally required. Where splashing is possible, wear safety glasses with side shields.
Hygiene measures:	No special protective clothing is normally required.

9. PHYSICAL AND CHEMICAL PROPERTIES:

Appearance:	Amber Liquid
Physical state (Solid/Liquid/Gas):	Liquid
Substance type (Pure/Mixture):	Mixture
Color:	Amber
Odor:	Slight
Molecular weight:	Not determined.
pH:	Neutral
Boiling point/range (5-95%):	> 600 F
Melting point/range:	-1 C
Decomposition temperature:	Not applicable.
Specific gravity:	0.87 @ 25 C
Density:	7.35 lbs/gal
Bulk density:	No data available.
Vapor density:	No data available.
Vapor pressure:	<1 mm Hg @ 72 C
Evaporation rate:	No data available.
Solubility:	Negligible
Solubility in other solvents:	No data available.
Partition coefficient (n-octanol/water):	No data available.
VOC content(%):	No data available.
Viscosity:	No data available.

10. STABILITY AND REACTIVITY

Stability:	The material is stable at 70 F, 760 mm pressure.
Polymerization:	Will not occur.
Hazardous decomposition products:	Carbon monoxide and carbon dioxide
Materials to avoid:	Strong oxidizers such as nitrates, chlorates, peroxides.
Conditions to avoid:	Extreme heat.

11. TOXICOLOGICAL INFORMATION

Acute toxicity:

Product information:

Name	CAS Number	Inhalation:	Dermal:	Oral:
Marathon Biodiesel B100	67784-80-9	No data available	No data available	> 17.4 gm/kg [Rat]

Although specific subchronic toxicity studies have not been conducted, soybean oil is considered to have a low order of oral and dermal toxicity.

12. ECOLOGICAL INFORMATION

Ecotoxicity effects: This product does not concentrate or accumulate in the food chain. If released to soil and water, this product is expected to biodegrade under both aerobic and anaerobic conditions.

The 96 hour LC50 for biodiesel in bluegill fish is > 1000 mg/l.

13. DISPOSAL CONSIDERATIONS

Cleanup Considerations: This product as produced is not specifically listed as an EPA RCRA hazardous waste according to federal regulations (40 CFR 261). However, when discarded or disposed of, it may meet the criteria of an "characteristic" hazardous waste. This material could become a hazardous waste if mixed or contaminated with a hazardous waste or other substance(s). It is the responsibility of the user to determine if disposal material is hazardous according to federal, state and local regulations.

14. TRANSPORT INFORMATION

49 CFR 172.101:

DOT:

Transport Information: This material when transported via US commerce is NOT REGULATED by DOT regulations.

Packing group: Not applicable.
DOT reportable quantity (lbs): Not applicable.

TDG (Canada):

Packing group: Not applicable.
Regulated substances: Not applicable.

15. REGULATORY INFORMATION

US Federal Regulatory Information:

US TSCA Chemical Inventory Section 8(b): This product and/or its components are listed on the TSCA Chemical Inventory.

OSHA Hazard Communication Standard: This product has been evaluated and determined not to be hazardous as defined in OSHA's Hazard Communication Standard.

EPA Superfund Amendment & Reauthorization Act (SARA):

SARA Section 302: This product contains the following component(s) that have been listed on EPA's Extremely Hazardous Substance (EHS) List:

Name	CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs
Biodiesel (Canola derived)	NA
Biodiesel (Tallow derived)	NA
Biodiesel (Soybean derived)	NA

Name	CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs
Biodiesel (Fatty Acid, Methyl Ester)	NA
Biodiesel (Rapeseed derived)	NA

SARA Section 304: This product contains the following component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:

Name	CERCLA/SARA - Hazardous Substances and their Reportable Quantities
Biodiesel (Canola derived)	NA
Biodiesel (Tallow derived)	NA
Biodiesel (Soybean derived)	NA
Biodiesel (Fatty Acid, Methyl Ester)	NA
Biodiesel (Rapeseed derived)	NA

SARA Section 311/312 The following EPA hazard categories apply to this product:

None

SARA Section 313: This product contains the following component(s) that may be subject to reporting on the Toxic Release Inventory (TRI) From R:

Name	CERCLA/SARA 313 Emission reporting:
Biodiesel (Canola derived)	None
Biodiesel (Tallow derived)	None
Biodiesel (Soybean derived)	None
Biodiesel (Fatty Acid, Methyl Ester)	None
Biodiesel (Rapeseed derived)	None

State and Community Right-To-Know Regulations:
The following component(s) of this material are identified on the regulatory lists below:

Biodiesel (Canola derived)

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	Not Listed.
Pennsylvania Right-To-Know:	Not Listed.
Massachusetts Right-To Know:	Not Listed.
Florida substance List:	Not Listed.
Rhode Island Right-To-Know:	Not Listed
Michigan critical materials register list:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Biodiesel (Tallow derived)

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	Not Listed.
Pennsylvania Right-To-Know:	Not Listed.
Massachusetts Right-To Know:	Not Listed.

Biodiesel (Canola derived)	
Florida substance List:	Not Listed.
Rhode Island Right-To-Know:	Not Listed
Michigan critical materials register list:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed
Biodiesel (Soybean derived)	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	Not Listed.
Pennsylvania Right-To-Know:	Not Listed.
Massachusetts Right-To Know:	Not Listed.
Florida substance List:	Not Listed.
Rhode Island Right-To-Know:	Not Listed
Michigan critical materials register list:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed
Biodiesel (Fatty Acid, Methyl Ester)	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	Not Listed.
Pennsylvania Right-To-Know:	Not Listed.
Massachusetts Right-To Know:	Not Listed.
Florida substance List:	Not Listed.
Rhode Island Right-To-Know:	Not Listed
Michigan critical materials register list:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Biodiesel (Canola derived)
Biodiesel (Rapeseed derived)

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	Not Listed.
Pennsylvania Right-To-Know:	Not Listed.
Massachusetts Right-To Know:	Not Listed.
Florida substance List:	Not Listed.
Rhode Island Right-To-Know:	Not Listed
Michigan critical materials register list:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Canadian Regulatory Information:

Canada DSL/NDSL Inventory: This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.

16. OTHER INFORMATION

Additional Information: No data available.

Prepared by: Mark S. Swanson, Manager, Toxicology and Product Safety

The information and recommendations contained herein are based upon tests believed to be reliable. However, Marathon Petroleum Company LLC (MPC) does not guarantee their accuracy or completeness nor shall any of this information constitute a warranty, whether expressed or implied, as to the safety of the goods, the merchantability of the goods, or the fitness of the goods for a particular purpose. Adjustment to conform to actual conditions of usage maybe required. MPC assumes no responsibility for results obtained or for incidental or consequential damages, including lost profits arising from the use of these data. No warranty against infringement of any patent, copyright or trademark is made or implied.

End of Safety Data Sheet

APPENDIX B - MSDS for B6 to B20

Material Safety Data Sheet

MSDS ID NO.: 0318MAR019
Revision date: 10/23/2009

1. CHEMICAL PRODUCT AND COMPANY INFORMATION

Product name: Marathon No. 2 Ultra Low Sulfur Diesel 15 PPM Sulfur Max with 6-20% Biodiesel
Synonym: Ultra Low Sulfur No. 2 Diesel with B6 Biodiesel; Ultra Low Sulfur No. 2 Diesel with B10; Ultra Low Sulfur No. 2 Diesel with B20 Biodiesel; Ultra Low Sulfur No. 2 Diesel with B10 Biodiesel; No. 2 Diesel with Biodiesel B6 Blend 15 ppm Sulfur Max; No. 2 Diesel with Biodiesel B6 Blend 15 ppm Sulfur Max; No. 2 Diesel with Biodiesel B10 Blend 15 ppm Sulfur Max; No. 2 Diesel with Biodiesel B20 Blend with 15 ppm Sulfur Max
Chemical Family: Petroleum Hydrocarbon
Formula: Mixture

Manufacturer:
Marathon Petroleum Company LLC
539 South Main Street
Findlay OH 45840

Other information: 419-421-3070
Emergency telephone number: 877-627-5463

2. COMPOSITION/INFORMATION ON INGREDIENTS

No. 2 Diesel with Biodiesel is a complex mixture of paraffins, olefins and aromatic hydrocarbons having hydrocarbon chain lengths predominantly in the range of C11 through C20. Contains 6-20% of Biodiesel that does not materially affect the health or safety of this product. May contain a trace amount of benzene (<0.01%). Contains a small amount of a lubricity additive (<0.1%) which is not considered hazardous at the concentration used. Contains a trace amount of sulfur (<0.0015%)

Product information:

Name	CAS Number	Weight %	ACGIH Exposure Limits:	OSHA - Vacated PELs - Time Weighted Ave	Other:
Marathon No. 2 Ultra Low Sulfur Diesel with Biodiesel	Mixture	100			

Component Information:

Name	CAS Number	Weight %	ACGIH Exposure Limits:	OSHA - Vacated PELs - Time Weighted Ave	Other:
No. 2 Diesel	68476-34-6	80-94	= 100 mg/m³ TWA		
Biodiesel (Fatty Acid, Methyl Ester)	68937-84-8	0-20			
Biodiesel (Rapeseed derived)	73891-99-3	0-20			
Biodiesel (Canola derived)	129828-16-8	0-20			
Biodiesel (Tallow derived)	61788-81-2	0-20			
Biodiesel (Soybean derived)	67784-80-9	0-20			
Naphthalene	91-20-3	0.01-0.5	= 10 ppm TWA = 15 ppm STEL	= 10 ppm TWA = 50 mg/m³ TWA = 15 ppm STEL = 75 mg/m³ STEL	

Notes: The manufacturer has voluntarily elected to reflect exposure limits contained in OSHA's 1989 air contaminants standard in its MSDS's, even though certain of those exposure limits were vacated in 1992.

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

NO. 2 DIESEL WITH BIODIESEL IS A COLORLESS LIQUID. THIS PRODUCT IS CONSIDERED TO BE A COMBUSTIBLE LIQUID PER THE OSHA HAZARD COMMUNICATION STANDARD AND SHOULD BE KEPT AWAY FROM HEAT, FLAME AND SOURCES OF IGNITION. NEVER SIPHON THIS PRODUCT BY MOUTH. IF SWALLOWED, THIS PRODUCT MAY GET SUCKED INTO THE LUNGS (ASPIRATED) AND CAUSE LUNG DAMAGE OR EVEN DEATH. PROLONGED OR REPEATED SKIN CONTACT CAN CAUSE DEFATTING AND DRYING OF THE SKIN WHICH MAY PRODUCE SEVERE IRRITATION OR DERMATITIS.

OSHA WARNING LABEL:

WARNING.
COMBUSTIBLE LIQUID.
ASPIRATION (INADVERTENT SUCTION) OF LIQUID INTO THE LUNGS CAN PRODUCE CHEMICAL PNEUMONIA OR EVEN DEATH.
PRODUCES SKIN IRRITATION UPON PROLONGED OR REPEATED CONTACT.

CONSUMER WARNING LABEL:

A CONSUMER WARNING LABEL IS NOT APPLICABLE FOR THIS PRODUCT.

Inhalation: Exposure to high vapor concentrations may produce headache, giddiness, vertigo, and anesthetic stupor.

Ingestion: Ingestion may result in nausea, vomiting, diarrhea and restlessness. Aspiration (inadvertent suction) of liquid into the lungs must be avoided as even small quantities in the lungs can produce chemical pneumonitis, pulmonary edema/hemorrhage and even death.

Skin contact: Prolonged and repeated liquid contact can cause defatting and drying of the skin and can lead to irritation and/or dermatitis.

Eye contact: Produces little or no irritation on direct contact with the eye.

Carcinogenic Evaluation:

Product information:

Name	IARC Carcinogens:	NTP Carcinogens:	ACGIH - Carcinogens:	OSHA - Select Carcinogens:
Marathon No. 2 Ultra Low Sulfur Diesel with Biodiesel Mixture	NE			

Notes: The International Agency for Research on Cancer (IARC) has determined that there is inadequate evidence for the carcinogenicity of diesel fuel/fuel oil in humans. IARC determined that there was limited evidence for the carcinogenicity of marine diesel fuel in animals. Distillate (light) diesel fuels were not classifiable as to their carcinogenicity to humans (Group 3A).

IARC has determined that there is sufficient evidence for the carcinogenicity in experimental animals of diesel engine exhaust and extracts of diesel engine exhaust particles. IARC determined that there is only limited evidence for the carcinogenicity in humans of diesel engine exhaust. However, IARC's overall evaluation has resulted in the IARC designation of diesel engine exhaust as probably carcinogenic to humans (Group 2A) because of the presence of certain engine exhaust components.

Component Information:

Name	IARC Carcinogens:	NTP Carcinogens:	ACGIH - Carcinogens:	OSHA - Select Carcinogens:
No. 2 Diesel 68476-34-6			A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans (listed under Diesel Fuel)	
Naphthalene 91-20-3	Monograph 82 [2002]	Reasonably Anticipated To Be A Human Carcinogen male rat-clear evidence; female rat-clear evidence; male mice-no evidence; female mice-some evidence	A4 - Not Classifiable as a Human Carcinogen	Present

Notes: The International Agency for Research on Cancer (IARC) and the Environmental Protection Agency (EPA) have determined that naphthalene could be a possible human carcinogen.

4. FIRST AID MEASURES

Inhalation: If affected, move person to fresh air. If breathing is difficult, administer oxygen. If not breathing or if no heartbeat, give artificial respiration or cardiopulmonary resuscitation (CPR). Immediately call a physician. If symptoms or irritation occur with any exposure, call a physician.

Skin contact: Wash with soap and large amounts of water. Remove contaminated clothing. If symptoms or irritation occur, call a physician.

Ingestion: If swallowed, do not induce vomiting and do not give liquids. Immediately call a physician.

Eye contact: Flush eyes with large amounts of tepid water for at least 15 minutes. If symptoms or irritation occur, call a physician.

Medical conditions aggravated by exposure: Pre-existing skin conditions and respiratory disorders may be aggravated by exposures to components of this product.

5. FIRE FIGHTING MEASURES

Suitable extinguishing media: For small fires, Class B fire extinguishing media such as CO_2, dry chemical, foam (AFFF/ATC) or water spray can be used. For large fires, water spray, fog or foam (AFFF/ATC) can be used. Fire fighting should be attempted only by those who are adequately trained and equipped with proper protective equipment.

Specific hazards: This product has been determined to be a combustible liquid per the OSHA Hazard Communication Standard and should be handled accordingly. For additional fire related information, see NFPA 30 or the North American Emergency Response Guide 128.

Special protective equipment for firefighters: Avoid using straight water streams. Water spray and foam (AFFF/ATC) must be applied carefully to avoid frothing and from as far a distance as possible. Avoid excessive water spray application. Keep surrounding area cool with water spray from a distance and prevent further ignition of combustible material. Keep run-off water out of sewers and water sources.

5. FIRE FIGHTING MEASURES

Flash point:	130-190 F
Autoignition temperature:	637 F
Flammable limits in air - lower (%):	0.7
Flammable limits in air - upper (%):	5.0

NFPA rating:
Health: 1
Flammability: 2
Instability: 0
Other: -

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: Keep public away. Isolate and evacuate area. Shut off source if safe to do so. Eliminate all ignition sources. Advise authorities and National Response Center (800-424-8802) if the product has entered a water course or sewer. Notify local health and pollution control agencies, if appropriate. Contain liquid with sand or soil. Recover and return free product to proper containers. Use suitable absorbent materials such as vermiculite, sand, or clay to clean up residual liquids.

7. HANDLING AND STORAGE

Handling:

Comply with all applicable EPA, OSHA, NFPA and consistent state and local requirements. Use appropriate grounding and bonding practices. Store in properly closed containers that are appropriately labeled and in a cool well-ventilated area. Do not expose to heat, open flames, strong oxidizers or other sources of ignition. Do not cut, drill, grind or weld on empty containers since they may contain explosive residues.

Avoid repeated and prolonged skin contact. Never siphon this product by mouth. Exercise good personal hygiene including removal of soiled clothing and prompt washing with soap and water.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

PERSONAL PROTECTIVE EQUIPMENT

Engineering measures: Local or general exhaust required when using at elevated temperatures that generate vapors or mists.

Respiratory protection: Use approved organic vapor chemical cartridge or supplied air respirators when material produces vapors that exceed permissible limits or excessive vapors are generated. Observe respirator assigned protection factors (APFs) criteria cited in federal OSHA 1910.134. Self-contained breathing apparatus should be used for fire fighting.

Skin and body protection: Neoprene, nitrile, polyvinyl alcohol (PVA), polyvinyl chloride and polyurethane gloves to prevent skin contact.

Eye protection: No special eye protection is normally required. Where splashing is possible, wear safety glasses with side shields.

Hygiene measures: No special protective clothing is normally required. Select protective clothing depending on industrial operations. Use mechanical ventilation equipment that is explosion-proof.

9. PHYSICAL AND CHEMICAL PROPERTIES:

Appearance:	Clear to Amber Liquid
Physical state (Solid/Liquid/Gas):	Liquid
Substance type (Pure/Mixture):	Mixture
Color:	Clear or Amber
Odor:	Slight Hydrocarbon
Molecular weight:	180
pH:	Neutral
Boiling point/range (5-95%):	400-640 F
Melting point/range:	Not determined.
Decomposition temperature:	Not applicable.
Specific gravity:	C.A. 0.8
Density:	6.76 lbs/gal
Bulk density:	No data available.
Vapor density:	4-5
Vapor pressure:	1-10 mm Hg @ 100 F
Evaporation rate:	No data available.
Solubility:	Negligible
Solubility in other solvents:	No data available.
Partition coefficient (n-octanol/water):	No data available.
VOC content(%):	10%
Viscosity:	1.9-3.4 @ 40 C

10. STABILITY AND REACTIVITY

Stability:	The material is stable at 70 F, 760 mm pressure.
Polymerization:	Will not occur.
Hazardous decomposition products:	Combustion produces carbon monoxide, aldehydes, aromatic and other hydrocarbons.
Materials to avoid:	Strong oxidizers such as nitrates, perchlorates, chlorine, fluorine.
Conditions to avoid:	Excessive heat, sources of ignition and open flames.

11. TOXICOLOGICAL INFORMATION

Acute toxicity:

Product information:

Name	CAS Number	Inhalation:	Dermal:	Oral:
Marathon No. 2 Ultra Low Sulfur Diesel with Biodiesel	Mixture	No data available	No data available	No data available

Lifetime skin painting studies in animals with similar distillate fuels have produced weak to moderate carcinogenic activity following prolonged and repeated exposure. Similar middle distillates, when tested at nonirritating dose levels, did not show any significant carcinogenic activity indicating that this tumorigenic response is likely related to chronic irritation and not to dose. Repeated dermal application has produced severe irritation and systemic toxicity in subacute toxicity studies. Some components of this product, have been shown to produce a species specific, sex hormonal dependent kidney lesion in male rats from repeated oral or inhalation exposure. Subsequent research has shown that the kidney damage develops via the formation of a alpha-2µ-globulin, a mechanism unique to the male rat. Humans do not form alpha-2µ-globulin, therefore, the kidney effects resulting from this mechanism are not relevant in humans. Some components of this product were found to be positive in a few mutagenicity tests while negative in the majority of others. The exact relationship between these results and human health is not known.

Summary of health effect data on distillate fuel components:

This product may contain > 1% biodiesel (fatty acid methyl esters) derived from soybeans, canola oil, tallow, rapeseed, or corn oil. Mild liver injury was the only adverse effect observed in rats fed high levels of biodiesel in the diet for exposure periods of 4 weeks.

This product may contain >0.1% naphthalene. Exposure to naphthalene at 30 ppm for two years caused an increased incidence in lung tumors in female mice. Exposure to 30-60 ppm naphthalene for 2 years caused tumors in the tissue lining of the nose and upper respiratory tract in male and female rats. Evidence of inflammation and tissue injury in target tissues (female mouse lung and rat nose) indicated that cytotoxicity played a significant role in the tumor response. Oral administration of 133-267 mg/kg/day of naphthalene in mice for up to 90 days did not produce mortality, systemic toxicity, adversely affect organ or body weight or produce changes in blood. Repeated oral administration of naphthalene produced an anemia in dogs. Repeated intraperitoneal doses of naphthalene produced lung damage in mice. Pregnant rats administered intraperitoneal doses of naphthalene during gestation gave birth to offspring that had delayed heart and bone development. Pregnant mice given near lethal doses of naphthalene showed no significant maternal toxicity and a reduction in the number of pups per litter, but no gross abnormalities in offspring. Suppressed spermatogenesis and progeny development have been reported in mice, rats and guinea pigs after exposure to high concentrations of naphthalene in their drinking water. Repeated high doses of naphthalene has caused the formation of cataracts and retinotoxicity in the eyes of rats and rabbits due to accumulation of 1,2-naphthoquinone, a toxic metabolite. Effects in human eyes is uncertain and not well documented. Certain groups or individuals, i.e., infants, Semites, Arabs, Asians and Blacks, with a certain blood enzyme deficiency (glucose-6-phosphate dehydrogenase) are particularly susceptible to hemolytic agents and can rapidly develop hemolytic anemia and systemic poisoning from ingestion or inhalation of naphthalene.

Summary of health effect information on diesel engine exhaust:

Chronic inhalation studies of whole diesel engine exhaust in mice and rats produced a significant increase in lung tumors. Combustion of kerosine and/or diesel fuels produces gases and particulates which include carbon monoxide, carbon dioxide, oxides of nitrogen and/or sulfur and hydrocarbons. Significant exposure to carbon monoxide vapors decreases the oxygen carrying capacity of the blood and may cause tissue hypoxia via formation of carboxyhemoglobin.

12. ECOLOGICAL INFORMATION

Ecotoxicity effects: Product can cause fouling of shoreline and may be harmful to aquatic life in low concentrations. The 96 hour LL50 values for an accomadated fraction (WAF) of fuel oil ranged from 3.2 to 65 mg/l in fish and 2-210 mg/l in invertebrates. EL50 values for inhibition of algal growth ranged from 1.8 to 2.9 mg/l for No. 2 fuel oil and from 10 to 78 mg/l for diesel fuel. This product does not concentrate or accumulate in the food chain. If released to soil and water, this product is expected to biodegrade under both aerobic and anaerobic conditions.

13. DISPOSAL CONSIDERATIONS

13. DISPOSAL CONSIDERATIONS

Cleanup Considerations: This product as produced is not specifically listed as an EPA RCRA hazardous waste according to federal regulations (40 CFR 261). However, when discarded or disposed of, it may meet the criteria of an "characteristic" hazardous waste. This material could become a hazardous waste if mixed or contaminated with a hazardous waste or other substance(s). It is the responsibility of the user to determine if disposal material is hazardous according to federal, state and local regulations.

14. TRANSPORT INFORMATION

49 CFR 172.101:

DOT:

Transport Information: This material when transported via US commerce would be regulated by DOT Regulations.

Proper shipping name:	Fuel Oil, No. 2
UN/Identification No:	NA 1993
Hazard Class:	3
Packing group:	III
DOT reportable quantity (lbs):	Not applicable.

TDG (Canada):

Proper shipping name:	Fuel Oil, No. 2
UN/Identification No:	NA 1993
Hazard Class:	3
Packing group:	III
Regulated substances:	Not applicable.

15. REGULATORY INFORMATION

US Federal Regulatory Information:

US TSCA Chemical Inventory Section 8(b): This product and/or its components are listed on the TSCA Chemical Inventory.

OSHA Hazard Communication Standard: This product has been evaluated and determined to be hazardous as defined in OSHA's Hazard Communication Standard.

EPA Superfund Amendment & Reauthorization Act (SARA):

SARA Section 302: This product contains the following component(s) that have been listed on EPA's Extremely Hazardous Substance (EHS) List:

Name	CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs
No. 2 Diesel	NA
Biodiesel (Fatty Acid, Methyl Ester)	NA
Biodiesel (Rapeseed derived)	NA
Biodiesel (Canola derived)	NA
Biodiesel (Tallow derived)	NA
Biodiesel (Soybean derived)	NA
Naphthalene	NA

SARA Section 304: This product contains the following component(s) identified either as an EHS or a CERCLA Hazardous substance which in case of a spill or release may be subject to SARA reporting requirements:

Name	CERCLA/SARA - Hazardous Substances and their Reportable Quantities
No. 2 Diesel	NA
Biodiesel (Fatty Acid, Methyl Ester)	NA
Biodiesel (Rapeseed derived)	NA
Biodiesel (Canola derived)	NA
Biodiesel (Tallow derived)	NA
Biodiesel (Soybean derived)	NA
Naphthalene	= 100 lb final RQ = 45.4 kg final RQ

SARA Section 311/312 The following EPA hazard categories apply to this product:

Acute Health Hazard
Fire Hazard
Chronic Health Hazard

SARA Section 313: This product contains the following component(s) that may be subject to reporting on the Toxic Release Inventory (TRI) From R:

Name	CERCLA/SARA 313 Emission reporting:
No. 2 Diesel	None
Biodiesel (Fatty Acid, Methyl Ester)	None
Biodiesel (Rapeseed derived)	None
Biodiesel (Canola derived)	None
Biodiesel (Tallow derived)	None
Biodiesel (Soybean derived)	None
Naphthalene	= 0.1 % de minimis concentration

State and Community Right-To-Know Regulations:
The following component(s) of this material are identified on the regulatory lists below:

No. 2 Diesel

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	sn 2444
Pennsylvania Right-To-Know:	Not Listed.
Massachusetts Right-To Know:	Not Listed.
Florida substance List:	Not Listed.
Rhode Island Right-To-Know:	Not Listed
Michigan critical materials register list:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	SN 2444 RQ 10000 lbs
Illinois - Toxic Air Contaminants	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Biodiesel (Fatty Acid, Methyl Ester)

Louisiana Right-To-Know:	Not Listed

No. 2 Diesel

California Proposition 65:	Not Listed
New Jersey Right-To-Know:	Not Listed.
Pennsylvania Right-To-Know:	Not Listed.
Massachusetts Right-To Know:	Not Listed.
Florida substance List:	Not Listed.
Rhode Island Right-To-Know:	Not Listed
Michigan critical materials register list:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Biodiesel (Rapeseed derived)

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	Not Listed.
Pennsylvania Right-To-Know:	Not Listed.
Massachusetts Right-To Know:	Not Listed.
Florida substance List:	Not Listed.
Rhode Island Right-To-Know:	Not Listed
Michigan critical materials register list:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed

Biodiesel (Canola derived)

Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	Not Listed.
Pennsylvania Right-To-Know:	Not Listed.
Massachusetts Right-To Know:	Not Listed.
Florida substance List:	Not Listed.
Rhode Island Right-To-Know:	Not Listed
Michigan critical materials register list:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed

No. 2 Diesel	
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed
Biodiesel (Tallow derived)	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	Not Listed.
Pennsylvania Right-To-Know:	Not Listed.
Massachusetts Right-To Know:	Not Listed.
Florida substance List:	Not Listed.
Rhode Island Right-To-Know:	Not Listed
Michigan critical materials register list:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed
Biodiesel (Soybean derived)	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	Not Listed
New Jersey Right-To-Know:	Not Listed.
Pennsylvania Right-To-Know:	Not Listed.
Massachusetts Right-To Know:	Not Listed.
Florida substance List:	Not Listed.
Rhode Island Right-To-Know:	Not Listed
Michigan critical materials register list:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	Not Listed
New Jersey - Environmental Hazardous Substances List:	Not Listed
Illinois - Toxic Air Contaminants	Not Listed
New York - Reporting of Releases Part 597 - List of Hazardous Substances:	Not Listed
Naphthalene	
Louisiana Right-To-Know:	Not Listed
California Proposition 65:	carcinogen, initial date 4/19/02
New Jersey Right-To-Know:	sn 1322
Pennsylvania Right-To-Know:	Environmental hazard
Massachusetts Right-To Know:	Present

No. 2 Diesel

Florida substance List:	Not Listed.
Rhode Island Right-To-Know:	Toxic; Flammable
Michigan critical materials register list:	Not Listed.
Massachusetts Extraordinarily Hazardous Substances:	Not Listed
California - Regulated Carcinogens:	Not Listed
Pennsylvania RTK - Special Hazardous Substances:	Not Listed
New Jersey - Special Hazardous Substances:	carcinogen
New Jersey - Environmental Hazardous Substances List:	SN 1322 TPQ 500 lb
Illinois - Toxic Air Contaminants	Present
New York - Reporting of Releases Part 597 -	= 1 lb RQ land/water
List of Hazardous Substances:	= 100 lb RQ air

Canadian Regulatory Information:

Canada DSL/NDSL Inventory: This product and/or its components are listed either on the Domestic Substances List (DSL) or are exempt.

Name	Canada - WHMIS: Classifications of Substances:	Canada - WHMIS: Ingredient Disclosure:
Naphthalene	B4, D2A	1 %

16. OTHER INFORMATION

Additional Information: No data available.

Prepared by: Mark S. Swanson, Manager, Toxicology and Product Safety

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End of Safety Data Sheet