REMAINING ENVIRONMENTAL CONCERNS ABOUT IN SITU BURNING

Sinking potential for ISB residue

Concerns about the potential for burned oil to sink are commonly expressed by fishermen, resource managers, and others. These concerns are reasonable and understandable, especially since anecdotal accounts from tank studies and isolated tanker incidents suggest that under some conditions, burn residues from source oils that originally floated can indeed sink.

Observers at so-called "meso-scale" in situ burn experiments conducted in Mobile Alabama and on the North Slope of Alaska have reported residue material on the bottom of the respective tanks following a series of test burns. It should also be noted that while this occurrence was observed, it was not common or consistent. Other anecdotal accounts from other burn tests (e.g., at North Bend, Washington) reported no incidents of sinking residue.

There are few published accounts of burned oil residue sinking during a real incident. The best known was the 1991 explosion and burning of the tanker *Haven* off Genoa, Italy (Moller, 1992). Following the fire, very little of the cargo of 141,000 tons of Iranian heavy crude oil remained, and several surveys confirmed the presence of submerged oil offshore and along the coast. The author suggested two possible mechanisms for the oil to have sunk: density increases resulting from the combustion or volatilization of crude oil components with burning points less than about 450°C; and/or, incorporation by wave action of sediment material with the oil.

We believe the *Haven* incident to have represented an unusual set of circumstances, where a relatively heavy crude oil burned intensely and at high temperature for an extended period of time. These conditions would essentially have 'cracked" or distilled the oil into different fractions, including those with a density greater than water.

Moller also reported an incident involving a 2000 ton spill and intentional burn of Arabian heavy crude oil from the tanker Honan Jade. After a two hour burn, residues sank.

During the Newfound Offshore Burn Experiment in 1993, the U.S. EPA deployed a remotely operated vehicle to film conditions beneath the burning oil slick. In the resulting footage, there was no indication of the burn residue sinking.

The evidence from meso-scale experiments and actual spills and in situ burns is, therefore, equivocal. A controlled study of the changes in physical properties resulting from burning of crude and refined oils (Buist and Trudel, 1995) concluded that residues from efficient batch-type burns of thick slicks of heavier crudes can sink in either fresh or salt water. Sinking did not occur with diesel burn residues. The burning apparently concentrated heavier non-volatile crude oil compounds into the residue, resulting in both a denser and more viscous (sometimes semi-solid or solid) material.

We conclude from the sum of this information that burning of some oils, especially heavier crude oils, can result in a residue that will sink. However, we believe that an uncommon series of conditions are necessary to produce this density effect, especially in the "real world" during an actual incident. Residue sinking during meso-scale and

laboratory-scale burns has required "efficient batch-type" burns (using the terminology of Buist and Trudel), in which thick slicks are burned repeatedly and at high temperature. These conditions could occur in the context of a real spill, but would not be considered to be common or ordinary.

How, then, does this impact consideration of in situ burning as a response method? We believe that responders and decisionmakers should be cognizant of the possibility that burned oil residue may sink but should also be aware of the specific conditions under which this is thought to occur. Potentially affected fishery resources and activities obviously must be factored into the consideration. By the same token, the other environmental tradeoffs and potential advantage involved in the rapid removal of an oil slick from the surface of the water should not be overlooked.

In the case of the *New Carissa* incident, the environmental tradeoffs associated with the significant volume reduction that can be expected in a burn and the limited alternatives available under the circumstances would, in our opinion, justify serious consideration of the use of ISB.

ISB residue toxicity

The only studies examining toxicity implications of the use of the ISB technique have been conducted under the auspices of Environment Canada. In conjunction with the 1993 Newfoundland Offhsore Burn Experiment, the toxicity of the water column immediately below burned oil was compared with that beneath unburned oil. No increases in toxicity were noted.

In a followup experiment, the toxicity of the weathered source crude oil used in the Newfoundland study was compared to that of the burn residue collected after the burns. Both freshwater organisms (rainbow trout) and saltwater organisms (three-spine strickleback and white sea urchin) were used to evaluate toxicity. 96-hr lethality was the endpoint for the fish, and the sublethal endpoint of fertilization inhibition was the endpoint for the urchin. A series of oil loadings was prepared (100, 1000, and 10000 mg/L), and rigorous, standardized technique for producing the test water was utilized in all exposures.

None of the exposures were found to be toxic. Only low levels of hydrocarbons could be detected by GC/MS in the water samples.

The results of this experiment were interpreted to indicate that in situ burning of the crude oil used (Alberta Sweet Mixed Blend) did not produce a burn residue more toxic than the oil itself. The authors, however, caution that the data are limited and representative of one oil only, and recommend that other oils should be tested to determine if the same trend exists.

It is important to note that the Environment Canada studies properly compared toxicity implications of unburned and burned oil. This is the relevant comparison, since responders would ostensibly be faced with the choice of either burning or not burning. Because unburned oil contains a number of toxic components, some toxicity would be expected in the presence of a floating oil slick. The question of concern is whether burning of oil would increase that inherent toxicity. To date, the limited information indicates that the answer to that question is "no".

References

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