Sinking Oils – A Brief Summary
By Jim Jeansonne, NOAA, September 11, 2008

A **Group V Oil,** or **Low API (gravity) Oil (LAPIO),** will sink if its density is greater than the receiving water.

About Density - Most liquid density is given as specific gravity (spGv), which uses pure water as the standard with a value of 1.0, and it is a ratio. So most fresh water has SpGv near 1.0. The American Petroleum Institute (API) uses a special density measure called API gravity:

API gravity (°F) = (141.5 ÷ s) – 131.5, where "s" is the SpGv at 60°F.

It is important to remember that API gravity has **an inverse relationship to SpGv**, so **higher numbers are lighter, not heavier**.

Below is a table with some typical and specific API Gravity values.

Substance	Typical API Gravity	Specific Gravity
Water (Fresh)	10	1.000
Gulf seawater off Tampa 2Apr08	6.2	1.0275
Asphalts	5 -10	1.037 – 1.000
Gasoline	55	0.7587
Low API gravity crude oil	< 25 (yields high % asphalt)	> 0.9042
High API gravity crude oil	> 25 (yields low % asphalt)	< 0.9042
#6 Fuel in DBL151 2Apr08	-0.2	1.078
#6 Fuel in DBL 152 Nov05	4.439	1.041

Seawater in the Gulf off Tampa during the recent DBL-151 grounding off Egmont Key on April 2nd had a spGv of 1.0275 (at 38 ppt salinity, which is slightly saltier and heavier than standard seawater).

The **heavy fuel oil in the DBL-151 on April 2nd, 2008 had an API gravity of -0.2.** This is the heaviest fuel oil potential spill incident that NOAA Hazmat has ever worked with. This converts to a SpGv of 1.078, which is heavier than seawater.

By comparison, the oil from the DBL-152 spill off the coast of Louisiana in November 2005 had an API gravity of 4.439. After some initial sheening, the bulk of that oil sank to bottom. Very little of the 3 million gallons spilled was recovered.

Heavy fuel oils are the residual "bottoms" left after the lighter fractions of crude oils are refined and separated. **Over the last few decades**, refining processes use more catalytic cracking methods to break more of the big oil molecules (heavy oil) into smaller ones (the light parts, like gasoline), so that **the residual (from which heavy fuel oil is made) has become much heavier.**

Heavy fuel oil customers, such as electric generating plants, specify the characteristics of the oil they want. This usually requires them to blend lighter oils with the heavier residual oils. This blending from multiple source tanks at the refinery is done in-line during the barge loading operation. The multiple oil types are known to re-separate rather easily during shipping, or especially if spilled into the water. As a result, some of the lighter components of the blend may float and form a sheen, while the heavy parts sinks directly to the sea bottom. Any surface sheen released may evaporate and disperse fairly quickly.

Heavy oils also tend to be very viscous, which describes a fluid's resistance to flowing or spreading, which is very temperature dependent. They are shipped hot so they can be more easily pumped. If these oils cool down, they may become essentially non-flowing, like tar or asphalt.

In any case, once the oil has settled to the bottom, it requires a fair bit of energy to mobilize it. In the coastal region, most of the energy at the bottom is driven by waves. However, tugs and ships working the channels will tend to mobilize oil sunken in the channels. Any oil that is mobilized in the channel will tend to move up and down the channel with the tidal currents.

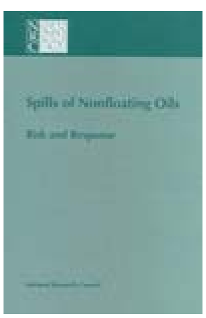
If there is a release, and oil remains on the bottom, it could be mobilized by the waves of large storm events, and possibly move significant distances, depending on the properties of the oil.

The heavy oil that sinks to the bottom will be very persistent, remaining for a long time. Following the 1993 Tampa Bay heavy oil spill, in which some of the oil sank (after a few days weathering and grounding on shorelines), that oil has persisted in the environment for decades and re-oiling of beaches occurred for years following intense storm events. Over time, submerged oil may break up and stick to sediments, resulting in an increase in oil density. Once broken up, the smaller particles will move similarly to sediments in the region. Large patches that do not get broken up could remain in place as a "pavement" for a long time, behaving similarly to local sediments in terms of episodes of burial and re-exposure. How much remains intact, and how much is broken up, is highly dependent of the specific oil properties and environmental conditions.

Lastly, the long-term weathering of sunken oil depends on the availability of oxygen in the sediments where the oil ends up. If the sediments are aerobic (well oxygenated and usually light colored) the oil may be degraded by aerobic microbes. If the oil becomes buried in the anoxic (no oxygen) layers, which are usually dark and smell like rotten eggs due to the hydrogen sulfide, then sunken oil may persist essentially unchanged for decades. That is because anaerobic microbes cannot degrade hydrocarbons.

Additional information:

NOAA-UNH Coastal Response Research Center – Submerged Oil Workshop Report: http://www.crrc.unh.edu/workshops/submerged_oil_workshop_report.pdf.



Spills of Nonfloating Oils: Risk and Response Committee on Marine Transportation of Heavy Oils, National Research Council

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