

Diluted Bitumen Spills

Definition

Diluted bitumen (Dilbit) products are unconventional crude oils created by mixing bitumen, which is a highly viscous form of petroleum with a density close to 1 g/cm³, with a lighter hydrocarbon (diluent) to meet the minimum requirements for transport in pipelines (viscosity <350 cSt and density <0.94 g/cm³).

Properties

- The final oil is a true mixture; the diluent will not separate out as a liquid, though it will be lost by normal volatilization processes (see ADIOS® oil weathering plots on the next page). Table 1 lists the different types of bitumen products and diluents used to make them.
- Diluted bitumen has greater density, viscosity and adhesion properties, and higher resin and asphaltene content (~50%) than most conventional crude oils.

Environmental Behavior

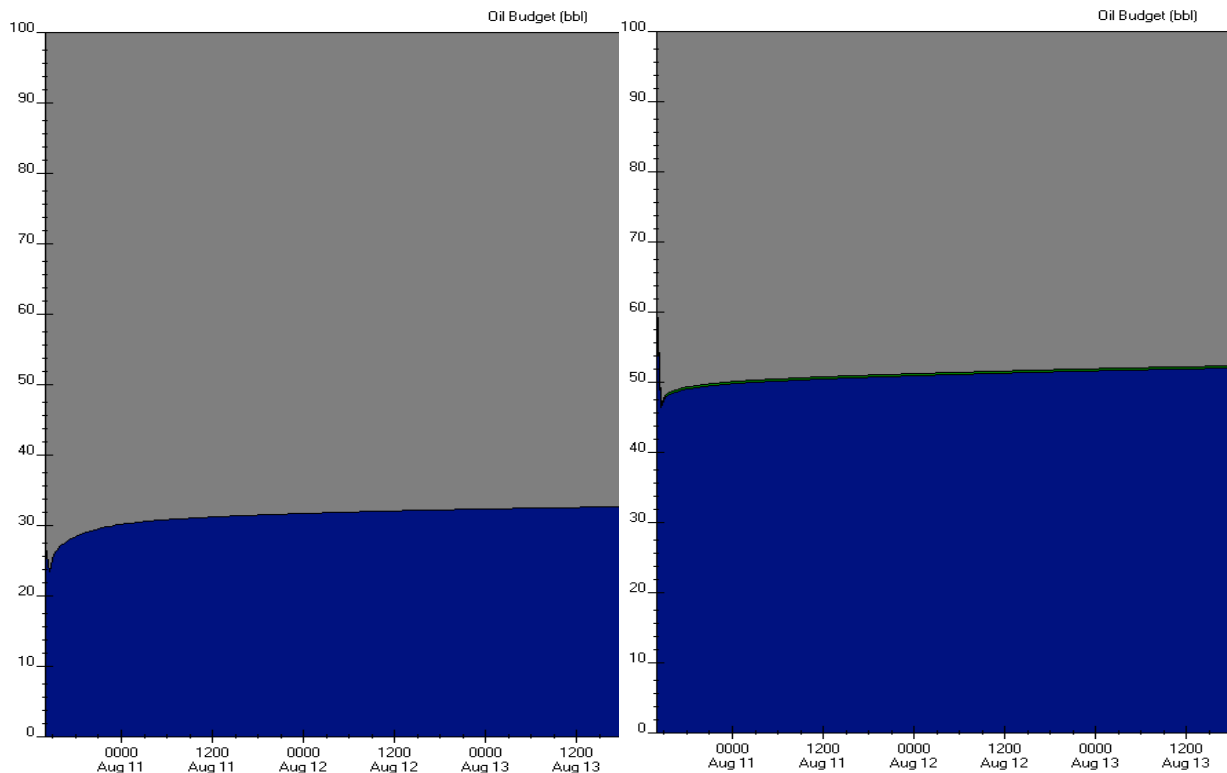
- In the early part of a spill (several days), the environmental behavior of diluted bitumen will be similar to medium crude oil. The oil will float and spread relatively quickly, thus booming and recovery tactics will be the same as for medium crude oil.
- Diluted bitumen spills are expected to pose air quality concerns similar to medium crude oil spills. However, BTEX concentrations (average of 0.84% by volume) and hydrogen sulfide concentrations (<25 ppm) are lower than many conventional crude oils.
- Diluted bitumen weathers faster than conventional oils due to the rapid loss of low molecular weight hydrocarbons associated with the diluents. As the oil weathers, it becomes very viscous (more viscous than peanut butter) and very sticky, so it can thickly coat and adhere to solid surfaces, vegetation, debris, wildlife, etc. Expect response equipment, Personal Protective Equipment, etc. to become coated with oil that will be difficult to remove.
- The bitumen component of diluted bitumen behaves like a highly weathered oil and undergoes very slow natural degradation, making it persist in the environment. Thus, under certain conditions there may be a need for more aggressive removal of stranded or submerged oil.
- After loss of the light fractions, diluted bitumen has a greater potential to submerge and form aggregates with suspended particulates, especially in freshwater environments with turbulent flow and suspended sediments.
- These oil-particulate aggregates can be heavier than water and sink in low-flow areas, which can be many miles downstream of the release site. Therefore, it may be necessary to develop a sunken oil detection plan to confirm the presence or absence of sunken oil.
- Oil droplets and oil-particulate aggregates that sink can be spontaneously released from the bottom of a waterbody by a process known as ebullition, where anaerobic degradation of organic-rich sediments generates bubbles of methane that carry oil with them as they rise to the surface. This process can increase during warmer water temperatures. Thus, chronic sheening can be a concern in low-flow areas where oil has accumulated on the bottom.
- For spills in rivers, sunken oil-particulate aggregates can become re-suspended during higher flow conditions, migrate downstream, and again accumulate in low-flow areas.

Environmental Effects

- The greatest hazard of diluted bitumen spills to biological resources is smothering.
- The aquatic toxicity of diluted bitumen varies widely due to variations in the chemical composition of the source bitumen oil and the products used as diluents. However, the aquatic toxicity of diluted bitumen oils is generally similar to that of conventional crude. Chronic toxicity due to residual oil associated with sediments may be of greater concern.
- Early containment and recovery is key to reducing the risks of the oil submerging or sinking in freshwater, as it will lose the diluent by evaporation over time and can then adhere to particulates in the water under turbulent conditions.

Table 1. Different types of bitumen products.

Product	Description
Bitumen, Neatbit	Undiluted extremely heavy oil extracted from oil sands. Must be heated to be shipped.
Diluent	Any light petroleum used to dilute bitumen for transportation by pipeline or rail; can be a condensate, ultralight crude oil, or a light refinery cut such as naphtha.
Synthetic crude	An oil made by partial upgrading or refining of bitumen; used as a diluent in synbit.
Dilbit	Bitumen diluted with ~30% diluent, such as condensate or naphtha, for transportation.
Synbit	Bitumen diluted ~50% with synthetic crude.
Dilsynbit	Bitumen diluted with synthetic crude plus ~15% diluent, usually a condensate.



ADIOS model output for a Cold Lake Blend spill of 100 bbl; winds of 5 knots (left) and 20 knots (right). **Blue = evaporated**; **green = dispersed**; **grey = remaining**. Note the very slight amount of dispersion at 20 knots.

ADIOS (Automated Data Inquiry for Oil Spills) web link: <https://response.restoration.noaa.gov/adios>

