Focus on: Environmental Harm from Oil Spills

Oil spills harm organisms and their habitats. Here, a large biodiesel fuel spill is coating debris and shoreline.

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Accommodations

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The Department of Ecology responds to oil or hazardous material spills that pose an imminent threat to life, public health, or the environment. If we know the type of oil spilled, we can select the right response equipment and estimate the potential long-term impacts.

Impact of oil on the environment

When oil spills into the environment, plants, animals, and their habitats are injured. Organisms such as plankton, plants, invertebrates, fish, birds, and mammals live in habitats that include water, sediments, beaches, wetlands, and forests. The level of impact the oil has depends on many things, including the life stage of the organism (egg, larvae, juvenile, adult), the time of year (wet or dry season), and other disturbances, such as the presence of invasive species and the chronic effects of the oil spilled. Although we do not know the total effects of oil on the environment, we can make some generalities.

The following information is a guide to the potential harm that an oil spill can cause.

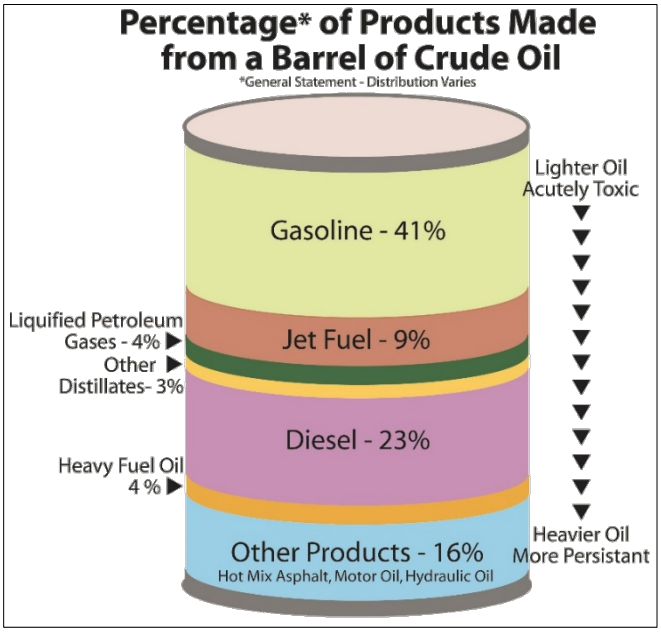
Acute toxicity, mechanical injury, and persistence

Oil has three main environmental impacts:

- Acute (immediate) toxicity — A measure of the amount of volatile compounds in the oil that readily dissolve into water and are capable of killing plants and animals by poisoning. (*Volatility* is a measure of how readily a substance vaporizes.) Inhalation of the volatile compounds in the air may also kill by poisoning.

- Mechanical injury — A measure of how much harm oil causes to organisms and habitats due to its physical impact (coating, smothering).
- Persistence — A measure of how long oil will stay in the environment before it breaks down.

The specific effects of oil on the environment differ depending on environmental conditions and the type of oil spilled. The history of the oil can also play a role. Used oils, waste oils, and mixtures of oils may have different effects than fresh products.



Crude oil is processed to create refined products with varying properties. Lighter, more refined oils have higher concentrations of toxic components. Heavier oils tend to have lower concentrations of toxic components, but are more persistent in the environment.

Environmental conditions play a role in harm caused by oil. Higher temperatures and/or winds create conditions resulting in faster evaporation of volatile products. Higher wind and wave conditions can mix water into some oils, creating a mousse that is more viscous (thick, sticky).

Bigger waves will also mix more of the oil into the water column, increasing toxic effects, making it important to know both the type of oil spilled as well as the current environmental conditions, such as air and water temperature, wind speed, wave height, salinity, humidity, and direct sunlight.

Acute toxicity

Acute toxicity is a measure of the ability of a substance to cause severe biological harm or death by poisoning soon after a single exposure. Volatile compounds in the oil can readily dissolve into the water and kill plants and animals on contact. They evaporate quickly, adversely affecting organisms that breathe air, such as birds and mammals.

The following are relative acute toxicity characteristics of various oils in order of most to least toxic:

Gasoline, aviation fuel (AvGas), and naphtha contain high levels of volatile compounds (essentially 100% will evaporate) and are the most acutely toxic (lethal) petroleum products to organisms.

Jet fuel, kerosene, and No.1 fuel oil are intermediate in acute toxicity, between gasoline and diesel (80% to 90% will evaporate). The Navy uses JP-5 (a type of jet fuel) for all shipboard fuel requirements, including equipment that normally uses diesel.

Diesel fuel, home heating oil, and No.2 fuel oil contain some volatile compounds that are acutely toxic to organisms (50% to 70% will evaporate).

Bunker fuel (intermediate fuel oil [IFO]-380, fuel oil #6) contains no volatile compounds and is generally not acutely toxic. However, adding diesel or other solvents to most bunker fuel makes it burn better. This increases the acute toxicity. Some IFOs have shown acute toxicity when combined with sunlight (phototoxicity).

Crude oil contains all components of refined petroleum products (except additives), including volatile compounds. It is acutely toxic to organisms during the early stages of a spill incident (30% to 40% will evaporate).

Biological oils (lard, butter, fish oil, and vegetable oil) are not petroleum-based, do not contain volatile compounds, and are not generally considered toxic. Some biological oils have petroleum additives that increase their toxicity.

Lubricating oils (grease, gear oil, motor oil, hydraulic oil, mineral oil) contain no volatiles and have low acute toxicity.

Dead fish and worms from a gasoline spill in Whatcom Creek.

Mechanical injury

Mechanical injury is a measure of how much harm oil causes due to its physical characteristics. This is sometimes called the "coating" effect because oils which are thick and sticky (viscous) tend to coat plants and animals to a level that causes physical injury. For example, loss of insulation, mobility, possible smothering, etc., may occur. These oils can also plug up crevices in habitat. The following are relative mechanical injury characteristics of various oils in order of most to least injurious:

Bunker fuel (IFO-380, fuel oil #6) is extremely viscous and sticky and presents a major mechanical injury threat.

Crude oils and the mousse they can produce are viscous and present a serious mechanical injury threat.

Lubricating oils (grease, gear oil, motor oil, hydraulic oil, mineral oil) are somewhat viscous and present a moderate mechanical injury threat.

Biological oils are somewhat viscous and present a mechanical injury threat similar to lubrication oils.

Diesel fuel, home heating oil, and No. 2 fuel oils are not viscous and present a minimal mechanical injury threat, but loss of insulation can be a significant concern for large spills.

Jet fuel, kerosene, and No. 1 fuel oils are not viscous and present little mechanical injury threat. Large quantities could cause loss of insulation.

Gasoline, AvGas, and naphthas are not viscous and present practically no mechanical injury threat. Large quantities could cause loss of insulation, but toxicity would likely result in death before hypothermia.

Birds coated in canola oil from the White Center Pond spill, November 2015.

Persistence

Persistence is a measure of how long oil stays in the environment before breaking down. Oils with high persistence tend to foul habitats for longer periods and pose ongoing threats to organisms that rely on these habitats. Persistence is also a rough measure of chronic (long term) toxicity. Certain compounds in oil can persist in the environment for months or years following a spill.

Many oils have components called polycyclic aromatic hydrocarbons (PAH). Recent research indicates that some types of PAHs cause long term, sublethal, chronic effects to organism growth, reproduction, and survival. This can result in harmful effects to populations over time. The following are relative persistence characteristics of various oils from most to least persistent:

Bunker fuel (IFO-380, fuel oil #6) is extremely persistent, lasting five to ten years or more in the environment.

Crude oil is extremely persistent, lasting five to ten years or more in the environment.

Lubricating oils (grease, gear oil, motor oil, hydraulic oil, mineral oil) are moderately persistent, lasting one to two years in the environment.

Biological oils may be somewhat persistent, lasting one month to a year in the environment.

Diesel fuel, home heating oil, and No. 2 fuel oil is somewhat persistent, lasting one month to a year in the environment.

Jet fuel, kerosene, and No. 1 fuel oil breaks down quickly, usually lasting only days to weeks in the environment.

Gasoline, AvGas, and naphtha breaks down very quickly, usually lasting only days to weeks in the environment.

Oil classes listed by acute toxicity, mechanical injury, and persistence

Oil class	Acute toxicity	Mechanical injury	Persistence
Gasoline, AvGas, naphtha	High	Low	Low
Kerosene, jet fuel, fuel oil (FO) #1	Medium	Medium low	Low
Diesel, FO-#2, heating oil	Medium	Medium	Medium low
Bunker fuel, FO-#6, intermediate fuel oil (IFO)-380	Medium	High	High
Alaska North Slope (ANS) crude	Medium low	Medium high	High
Biological oil	Low	Medium high	Medium low
Motor oil, hydraulic oil	Low	Medium	Medium
Hot mix asphalt	Low	High	High

More information

- Chapter 173-183 WAC (see the compensation schedule)[1]
- Ecology's *Guidelines for Determining Oil Spill Volume in the Field – Terminology, Ranges, Estimates and Experts (Publication 96-250)*[2]

[1] https://apps.leg.wa.gov/WAC/default.aspx?cite=173-183
[2] https://fortress.wa.gov/ecy/publications/summarypages/96250.html