A Dilbit Primer: How It's Different from Conventional Oil

Bitumen extracted from tar sands has the consistency of peanut butter and must be diluted to flow through pipelines. And that's just the beginning.

BY LISA SONG, INSIDECLIMATE NEWS

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A handful of Canadian oil sands/Source: Suncor

When emergency responders rushed to Marshall, Mich. on July 26, 2010, they found that the Kalamazoo River had been blackened by more than one million gallons of oil. They didn't discover until more than a week later that the ruptured pipeline had been carrying diluted bitumen, also known as dilbit, from Canada's tar sands region. Cleaning it up would challenge them in ways they had never imagined. Instead of taking a couple of months, as they originally expected, nearly two years later the job still isn't complete.

Dilbit is harder to remove from waterways than the typical light crude oil—often called conventional crude—that has historically been used as an energy source.

While most conventional oils float on water, much of the dilbit sank beneath the surface. Submerged oil is significantly harder to clean up than floating oil: A large amount of oil remains in the riverbed near Marshall, and the cleanup is expected to continue through the end of 2012.

InsideClimate News spent seven months investigating what made the Marshall spill different from conventional oil spills. Part of the challenge was that there has been little scientific research on dilbit; most of the studies that have been done were conducted


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by industry and considered proprietary information.

The information we did find comes from government records and publicly available industry studies, plus dozens of interviews with industry analysts, federal and state officials, and several university researchers who've worked with the oil industry. We also interviewed watchdog groups that have focused on increasing dilbit regulations, including the **Pipeline Safety Trust**, the **Natural Resources Defense Council** and the **Pembina Institute**, a well-respected Canadian think tank that supports sustainable energy.

Experts at the **University of Alberta** and the **University of Calgary**, where tar sands research has been done, did not return requests for comment. InsideClimate asked the **American Petroleum Institute** and the **Canadian Association of Petroleum Producers** to put us in contact with their experts, but neither organization provided scientists or engineers for interviews.

What is dilbit?

Dilbit stands for diluted bitumen.

Bitumen is a kind of crude oil found in natural oil sands deposits—it's the heaviest crude oil used today. The oil sands, also known as tar sands, contain a mixture of sand, water and oily bitumen. The tar sands region of Alberta, Canada is the third largest petroleum reserve in the world.

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What makes bitumen different from regular or conventional oil?

Conventional crude oil is a liquid that can be pumped from underground deposits. It is then shipped by pipeline to refineries where it's processed into gasoline, diesel and other fuels.

Bitumen is too thick to be pumped from the ground or through pipelines. Instead, the heavy tar-like substance must be mined or extracted by injecting steam into the ground. The extracted bitumen has the consistency of peanut butter and requires extra processing before it can be delivered to a refinery.

There are two ways to process the bitumen.

Some tar sands producers use on-site upgrading facilities to turn the bitumen into synthetic crude, which is similar to conventional crude oil. Other producers dilute the bitumen using either conventional light crude or a cocktail of natural gas liquids.

The resulting diluted bitumen, or dilbit, has the consistency of conventional crude and can be pumped through pipelines.

What chemicals are added to dilute the bitumen?

The exact composition of these chemicals, collectively called diluents, is considered a trade secret. The diluents vary depending on the particular type of dilbit being produced. The mixture often includes benzene, a known human carcinogen.

If dilbit has the consistency of regular crude, why did it sink during the Marshall spill?

The dilbit that spilled in Marshall was composed of 70 percent bitumen and 30 percent diluents. Although the dilbit initially floated on water after pipeline 6B split open, it soon began separating into its different components.

Most of the diluents evaporated into the atmosphere, leaving behind the heavy bitumen, which sank under water.

According to documents released by the National Transportation Safety Board—a federal agency that is investigating the spill—it took nine days for most of the diluents to evaporate or dissolve into the water.

Can conventional crude oil also sink in water?

Yes, but to a much smaller extent.

Every type of crude oil is made up of hundreds of different chemicals, ranging from light, volatile compounds that easily evaporate to heavy compounds that will sink.

The vast majority of the chemicals found in conventional oil are in the middle of the pack—light enough to float but too heavy to gas off into the atmosphere.

Dilbit has very few of these mid-range compounds: instead, the chemicals tend to

be either very light (the diluents) or very heavy (the bitumen).

Because bitumen makes up 50 to 70 percent of the composition of dilbit, at least 50 percent of the compounds in dilbit are likely to sink in water, compared with less than 10 percent for most conventional crude oils.

How do you know whether a particular type of crude oil will sink or float?

The industry classifies different crude oils as light, medium or heavy, based on their densities. There is debate over the cutoffs for these categories, but bitumen falls into the "extra heavy" category because it is more dense than water. The diluted bitumen that spilled from 6B was lighter than water and considered heavy crude oil.

But density alone doesn't determine whether a particular type of crude oil will sink or float, said **Nancy Kinner**, a professor of civil and environmental engineering at the University of New Hampshire who studies submerged oil. Weather and other conditions can change the buoyancy of crude oils: for example, crudes that are lighter than water can sink if they mix with sediment.

That's exactly what happened with the bitumen from 6B. In general, the density of bitumen ranges from slightly heavier than water to barely lighter than water. The bitumen that spilled in Marshall was at the lighter end of the scale. **Marc Huot**, a technical and policy analyst at the Pembina Institute's Oilsands Program, said the bitumen's density was so close to that of

water that it was in "a gray area. It may or may not float depending on [conditions]...think of a log—it floats, but not very well."

But as the bitumen mixed with grains of sand and other particles in the river, the weight of the sediment pulled the bitumen underwater.

Why has it been so hard to clean up submerged oil in the Kalamazoo?

Existing cleanup procedures and equipment are designed to capture floating oil. Because the Marshall accident was the first major spill of dilbit in U.S. waters, cleanup experts at the scene were unprepared for the challenge of submerged oil.

The EPA has supervised the cleanup of nearly 8,400 spills since 1970, but in multiple interviews with InsideClimate News, agency officials said the Marshall spill cleanup was unlike anything they'd ever faced.

"[It's] not something a lot of people have dealt with," said Kinner. "When you can't see [the oil], you don't know where it is, so it's very hard to clean it up."

Once cleanup crews locate submerged oil, it's hard to remove it without destroying the riverbed. Cleanup workers in Marshall were forced to improvise less invasive procedures that balanced oil cleanup with protecting the ecosystem.

On July 16, 2010, just nine days before the Marshall accident, the EPA warned that the

proprietary nature of the diluents found in dilbit could complicate cleanup efforts. **The agency was commenting** on the State Department's Draft Environmental Impact Statement (EIS) of the Keystone XL, a proposed pipeline that would carry Canadian dilbit across six U.S. states and the critically-important Ogallala aquifer.

"First, we note that in order for the bitumen to be transported by the pipeline, it will be either 'diluted with cutter stock (the specific composition of which is proprietary information to each shipper) or an upgrading technology is applied to convert the bitumen to synthetic crude oil,'" the EPA wrote. "...Without more information on the chemical characteristics of the diluent or the synthetic crude, it is difficult to determine the fate and transport of any spilled oil in the aquatic environment.

"For example, the chemical nature of dilutent may have significant implications for response as it may negatively impact the efficacy of traditional floating oil spill response equipment or response strategies. In addition, the Draft EIS addresses oil in general and as explained earlier, it may not be appropriate to assume this bitumen crude/synthetic crude shares the same characteristics as other oils."

How does dilbit affect pipeline safety?

Some watchdog groups contend that dilbit is more corrosive than conventional oil and causes more pipeline leaks. The industry disputes that theory, and there are no independent studies to support either side.

In late 2011, Congress passed a bill that ordered the Pipeline and Hazardous Materials Safety Administration (PHMSA) **to study** if dilbit increases the risk of spills. Results are expected in 2013.

The industry says that Canadian tar sands oil is very similar to conventional heavy crudes from places such as Venezuela, Mexico and Bakersfield, California. Those crude oils, however, aren't transported through the nation's pipelines. The Bakersfield oil is processed at on-site refineries, while the Venezuelan and Mexican imports are shipped via tankers to refineries on the U.S. Gulf Coast.

The same watchdogs that criticize dilbit say that synthetic crude—which is also made from bitumen—poses no additional threats to pipeline safety. The U.S. currently imports more than 1.2 million barrels of Canadian dilbit and synthetic crude per day, and that figure is expected to grow dramatically in next decade. Most of the increased production will come from dilbit—because Canada's synthetic crude upgraders have reached capacity, and because it's more financially lucrative for U.S. refineries to process dilbit.

Does the government regulate dilbit differently from conventional crude oil?

For the most part, no.

Dilbit is not subject to any additional safety regulations, and PHMSA doesn't track the specific kind of crude oil that flows through each pipeline. This is one of the reasons why

it's hard to compare dilbit's safety record with that of conventional crude.

But oil from the tar sands is regulated differently when it comes to taxes. The oil industry pays an 8-cent-per-barrel tax on crude oil produced and imported to the U.S. The tax goes into the **Oil Spill Liability Trust Fund**, which provides emergency funds for oil spill cleanup and claims. Both the Marshall and BP Gulf Coast spills have tapped that fund.

In early 2011, five months after the Marshall spill, the IRS ruled to exempt dilbit and synthetic crude from paying this tax. The energy and environment news service E&E Publishing reported that **the exemption was made** "at the request of a company whose identity was kept secret."

Some say the oil from Canada's tar sands is so different based on its chemistry, behavior and how it's produced, that it should not be considered crude oil.

"One would not consider tar sands typical crude," said Kinner, the University of New Hampshire professor. "It's not considered crude oil by most people who deal with oil and oil spills."

Kinner co-directs the **Coastal Response Research Center**, a collaboration between the university and the National Oceanic and Atmospheric Administration. The center conducts research on innovations in spill response and recently launched a **Submerged Oil Working Group**.

The tar sands boom is part of a larger industry trend of producing heavier crude oils, whether that's bitumen or conventional heavy crudes, Kinner said. "All the lighter stuff has been used up...we wouldn't be taking tar sands if it wasn't economically viable...and with time, there will be more [spills with] submerged oil."

Anthony Swift, an attorney at the Natural Resources Defense Council who has spent years studying the tar sands industry, said the Marshall spill points to the need for more stringent dilbit regulations.

The Marshall spill is not the largest oil spill in U.S. history, but it is by far the most costly. Using figures from PHMSA's pipeline incident database, Swift calculated that the average cleanup cost of every crude oil spill from the past 10 years was $2,000 per barrel. The Marshall spill has cost upwards of $29,000 per barrel.

"When you have something that isn't the biggest spill we've had, but turns out to be far more damaging and difficult to deal with, that raises the question, what about this spill was different?" Swift said. "And what was different is what spilled."

Researcher Lisa Schwartz contributed to this report.

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