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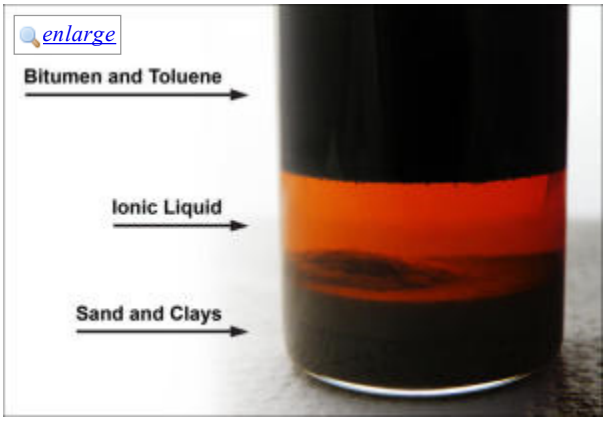
New Process Cleanly Extracts Oil from Tar Sands and Fouled Beaches

ScienceDaily (Mar. 20, 2011) — An environmentally friendlier method of separating oil from tar sands has been developed by a team of researchers at Penn State. This method, which utilizes ionic liquids to separate the heavy viscous oil from sand, is also capable of cleaning oil spills from beaches and separating oil from drill cuttings, the solid particles that must be removed from drilling fluids in oil and gas wells.



A middle layer of ionic liquid separates a bottom layer of sand and clays from an upper layer of bitumen and toluene. (Credit: Paul Painter)

Tar sands, also known as bituminous sands or oil sands, represent approximately two-thirds of the world's estimated oil reserves. Canada is the world's major producer of unconventional petroleum from sands, and the U.S. imports more than one million barrels of oil per day from Canada, about twice as much as from Saudi Arabia. Much of this oil is produced from the Alberta tar sands.

However, the production of petroleum from tar sands causes environmental damage. Part of the damage comes from the storage of contaminated wastewater from the separation process in large open air ponds. Wastewater from the ponds can seep into groundwater and pollute lakes and rivers. In addition, the requirement for large amounts of water can deplete the supply of local fresh water resources. The Penn State separation method uses very little energy and water, and all solvents are recycled and reused.

Paul Painter, professor of polymer science in the Department of Materials Science and Engineering at Penn State, and his group have spent the past 18 months developing a technique that uses ionic liquids (salt in a liquid state) to facilitate separation. The separation takes place at room temperature without the generation of waste process water. "Essentially, all of the bitumen is recovered in a very clean form, without any contamination from the ionic liquids," Painter explained. Because the bitumen, solvents and sand/clay mixture separate into three distinct phases, each can be removed separately and the solvent can be reused.

The process can also be used to extract oil and tar from beach sand after oil spills, such as the Exxon Valdez and Deepwater Horizon incidents. Unlike other methods of cleanup, the Penn State process completely removes the hydrocarbons, and the cleaned sand can be returned to the beach instead of being sent to landfills. In an experiment using sand polluted by the BP oil spill, the team was able to separate hydrocarbons from the sand within seconds. A small amount of water was used to clean the remaining ionic liquids from the sand, but that water was also recoverable. "It was so clean you could toss it back on the beach. Plus, the only extra energy you need is enough to stir the mixture," said Aron Lupinsky, a researcher in Painter's group.

The researchers work with a group of ionic liquids based on 1-alkyl-3-methylimidazolium cations, a positively

charged material with high chemical and thermal stability, a low degree of flammability, and almost negligible vapor pressure, which makes recovering the ionic liquid relatively simple. The team has built a functioning bench top model system and is in the process of reducing their discovery to practice for patenting.

In addition to Painter, team members include Bruce Miller, senior research associate in the EMS Energy Institute, and former students Aron Lupinsky and Phil Williams.

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