Waste plastic yields high-quality fuel oil

Ironically, after all the trouble of reclaiming plastic waste from gooey trash, recycled products often cost more and look worse than virgin plastics — a situation that displeases consumers.

But fuel chemists M. Mehdi Taghiei and his colleagues at the University of Kentucky in Lexington report a new, efficient way of converting plastic waste into high-quality, saturated fuel oil.

"It's good oil, too — much like imported crude oil," Taghiei said this week in Chicago at a meeting of the American Chemical Society. "This oil is even lighter and easier to refine into high-octane fuel than imported oil. It has no sulfur and fewer impurities." Similarly, the chemists found they could liquefy plastic with coal, also producing high-quality fuel.

The researchers mixed various types of plastic with zeolite catalysts, including HZSM-5 and tetralin, in a sand bath, then placed the slurry in a "tubing-bomb" reactor. Pressurizing the mixture with hydrogen and heating it to 420°C for an hour caused high-molecular-weight plastics to break down into smaller compounds, similar to those in crude oil. Furthermore, oil yields proved high: Milk jugs generated 86 percent oil, soda bottles, 93 percent. Polyethylene, another common soft plastic, eked out 88 percent. When liquefied with coal in a roughly half-and-half mixture, the plastics turned into even better oil.

"In terms of the economics of this process, we have done some estimates," says Kentucky chemist Gerald P. Huffman, a coauthor of the report. "To convert coal and plastic simultaneously into oil right now costs about $27 or $28 per barrel, compared with $18 to $20 per barrel for imported oil. But we're quite confident that we can drive the cost of converted oil down to roughly the cost of imported oil. This process may be commercially viable within five to 10 years."

Plastics today account for roughly 40 percent of landfill trash, says Taghiei. However, of the total volume of plastic entering the waste stream, only 3.7 percent gets recycled, he adds. Why so little? The reason lies not only in high cost, he says, but also in contamination and impurities. Thus recycled polyethylene, for example, costs 10 percent more than virgin polyethylene.

Other methods exist for converting plastic to oil, Taghiei says, but usually they produce "unsaturated and unstable oils of low yield and low value." On the basis of the current rate of plastic disposal, he estimates that the United States could produce some 80 million barrels of oil a year.

This work stems from the Consortium for Fossil Fuel Liquefication Science, a five-university project sponsored by the Department of Energy. Overall, the project aims to make oil by liquefying many types of waste hydrocarbons with coal, using such garbage as paper, agricultural waste, sewage sludge, and rubber tires, as well as plastics.

Taghiei and Huffman argue that plastic-to-oil conversion plants could eventually supply the United States with substantial amounts of oil on an ongoing basis. Indeed, says Huffman, Germany has already started building a promising 200-ton-per-day plastic-to-oil reactor in the city of Bottrop. — *R. Lipkin*

Wetlands provide clue to greenhouse gas

Two researchers say they have answered a question that stumped scientists for years: What key factor determines how much methane — a greenhouse gas that warms Earth by trapping heat — the different types of wetlands emit? To find out, the researchers slogged through subarctic peat bogs in Canada and subtropical swamps in Florida, monitoring atmospheric gas levels. Their answer: Methane emissions depend on the total amount of carbon dioxide exchanged between the atmosphere and plants.

Identifying this factor provides a tool to measure methane emissions on a global scale and to pinpoint major sources of emissions, says Gary J. Whiting, a biologist at Christopher Newport University in Newport News, Va., who led the study. These measurements should prove valuable because, although the amount of atmospheric methane has more than doubled in the past 100 years, scientists do not know exactly where it all originates. They do know, however, that too much methane can contribute to global warming.

Whiting and Jeffrey P. Chanton, a chemical oceanographer at Florida State University in Tallahassee, report their findings in the Aug. 26 NATURE.

"They established a quantitative link between the total amount of plant growth and the amount of methane produced," says Robert Harriss, an earth systems scientist at the University of New Hampshire in Durham. Remote-sensing satellites can use this formula to indirectly map methane emissions, he explains. Satellites can directly measure the amount of biomass growing in an ecosystem. Correlating this figure to the amount of carbon dioxide exchanged and will reveal the volume of methane emissions from natural sources.

Methane comes from two major sources: natural, including wetlands, oceans, and termites; and human activities, including coal mining, landfills, rice farming. Natural wetlands, which make up just 5 percent of Earth's land surface, play a disproportionately large role in methane emissions. Bacteria that decompose organic material into methane thrive in such flooded, oxygen-starved soils.

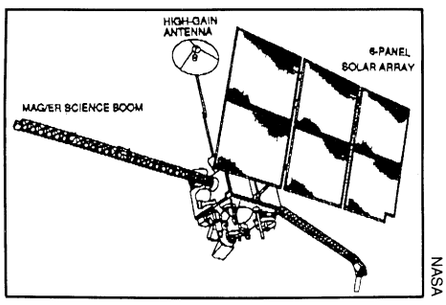
Scientists estimate that wetlands contribute up to one-half the methane emitted into the atmosphere — a total of between 100 and 200 million metric tons a year. "Satellite-generated methane maps can be used to narrow our uncertainty," Harriss says.

The same technique could help analyze rice paddy emissions, Whiting says. As rice became more important in feeding the world, farmers converted more land to these shallow fields of grain, which now emit up to 150 million metric tons of methane each year.

Whiting and Chanton tallied their gas measurements on a daily basis; seasonal and yearly tabulations would provide an even more accurate formula, they say. Harriss adds that measurements of vast, remote wetlands — the Siberian lowlands and the deep-peat swamps of Borneo and Sumatra — would complete the picture. — *B. Wuethrich*

NASA loses contact with Mars Observer

Aug. 21 proved a remarkably bad day for the nation's space program. NASA engineers lost all communication with the Mars Observer shortly before the $980 million spacecraft was to begin orbiting the Red Planet. And NOAA-13, a new weather satellite, fell silent as well.



NASA

Mars Observer: A silent spacecraft.

The reason for the sudden silence from the Mars Observer remains a mystery. Glenn Cunningham, project director for Mars Observer at NASA's Jet Propulsion Laboratory in Pasadena, Calif., says he remains "cautiously optimistic" that the craft has retained a set of critical commands — designed to send it into an elliptical orbit around Mars on Aug. 24 — beamed to the craft the day before communications ceased.