From oil spill to toxic waste: The polymer solution

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Hungarian red-mud disaster.

(PhysOrg.com) -- Last October, a containment dam belonging to a Hungarian alumina manufacturer collapsed after heavy rains, releasing 200 million gallons of caustic sludge. Eight people died in the flood of lye-like red mud, which overwhelmed nearby towns and created an environmental catastrophe.

In the aftermath, authorities followed standard practice, neutralizing the red mud with acetic acid. Gerard Caneba, a professor of chemical engineering at Michigan Technological University, believes an unlikely chemical may work even better--and might transform toxic sludge into a

valuable raw material.

Vinyl acetate polymers that are being developed in Caneba's lab have a near-neutral pH when they are dissolved in water, but something intriguing happens if you mix the solution in an alkaline substance like red mud, which has pH levels as high as 13. "When you put it in a base environment, poly(vinyl acetate) converts to poly(vinyl alcohol), and it also kicks out acetic acid within a minute," he said.

Thus, while it is neutralizing the red mud, the poly(vinyl acetate) is also creating a valuable product. A resulting solid material has potential uses in landscaping, insulation and construction. "We did tests and got really nice performance values on simulated alumina tailings," Caneba said. And there's no shortage of potential sites: "They have about 20 alumina repositories in Hungary and could use this method to clean up any contaminated places. Other sources are found in Texas and Louisiana and wherever aluminum is being manufactured from bauxite ore."

This puts a smile on his face. "I like this mechanism," he says. "We're not just cleaning the stuff up with acetic acid. We can neutralize toxic waste and turn it into something benign and useful."

Caneba has been working with the Hungarian Academy of Sciences to further test the process. Promising preliminary results are included in his new book, which details his research on vinyl acetate polymer solutions. He is also working with mining giant Rio Tinto, which is providing him with actual red mud samples.

Caneba is also developing next-generation chemicals from vinyl acetate polymers that could be used to clean up oil spills and disperse spilled oil. With researchers from Gulf Coast universities, he has been working to obtain funds to investigate this family of polymer surfactants.

In particular, the new surfactants could address deep oil plumes like those from last summer's disastrous spill in the Gulf of Mexico. Deep underwater, these eruptions of hot petroleum exploding from beneath the earth are quickly compressed and chilled in the ocean depths. "It's no surprise that you can have lingering plumes, and that they are particularly difficult to break up," said Caneba. "We think our formula will be able to help break down the oil better, so microbes can eat it up."

Lab tests have been promising, yielding emulsions that look "like cream," he said. The surfactants are also relatively benign from an environmental standpoint, which could give them an advantage over present-day oil dispersants.

"We're all really excited about this," said Caneba. Lab work to develop the vinyl acetate-based dispersants will probably begin this fall. And hopefully, those tests will yield new tools for cleaning up and remediating the next big oil spill.

Provided by Michigan Technological University