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## **Technology News**

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# **Wetted clay does not make bricks - or plastics on its own\***

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Near the little desert town of North Edwards - itself a suburb of Boron, Calif. - is a dusty track called Clay Mine Road. Years ago, I explored it and found what, indeed, appeared to be clay mines.

They were mostly large, shallow pits and still contained some clay deposits. At that time there were light red, pink, and a very fine light gray that may have been koalin.

The local old-timers said that a "Back East" company had started the digs looking for porcelain and cosmetic grade koalin. What they found was better suited for pottery and ceramics, so they lost interest.

Perhaps they should renew that interest.

Dr. Evangelos Manias, assistant professor of materials science and engineering at Pennsylvania State University has found that small amounts of well-dispersed natural clay can lead to environmentally friendly and inexpensive plastic composites with improved specialized properties.

This process can make plastics less permeable to liquids and gases, more flame retardant and tougher. Lower permeability can make plastics like PET (polyethyl terephthalate), the standard plastic used in soft drink bottling, suitable for bottling beer or wine. The clay-enhanced product would protect the beverages from the effects of oxygen. At the same time, the addition of small amounts of clay does not affect the transparency of plastics.

Adding clay to polymer blends is not a simple process as polymers and clays mix about as

well as oil and water. However, if the clay is treated with an organic surfactant, a compound that allows the inert clay to mix with the polymers, much as soap allows oil and water to mix, the clays can be incorporated into the final product.

This inexpensive, more environmentally clean method of producing flame retardant plastics could eventually save lives. Current flame-retardant additives produce poisonous gases when the plastic is burned. Clay avoids that and reduces flammability as well. Finally, because the U.S. Food and Drug Administration already approves natural clays for use, there is no problem incorporating them into plastics that come in contact with foods, medicines, beverages or plastics used in biomedical devices.

They must have a lot of clay in Pennsylvania. Penn State has a professor of clay mineralogy. Sridhar Komarneni, a colleague of Manias', worked with Penn State's Department of Agronomy to develop a clay-based method to remove environmentally harmful materials from waste streams and drinking water.

Komarneni's team demonstrated that a synthetic clay known as a swelling mica has the ability to separate ions of radium, a radioactive metal, from water. The results were reported in the April 12 issue of Nature.

The finding could have implications for radioactive and hazardous waste disposal, particularly in the cleanup of mill tailings left over from the processing of uranium for the nation's nuclear industry. The tailings contain radium and heavy metals that can leach into groundwater and contaminate drinking water supplies.

Natural mica is a mineral containing a combination of aluminum, silica, magnesium and potassium. The mineral is found in sheets and has a structure like the pages of a book. The sheets are bonded to each other to form a solid, layered mass. Natural mica has a closed structure with all the spaces between layers filled and is not a good ion exchange media. The swelling mica tested by Komarneni's team is one of a group of clays not found in the natural environment. Created specifically for water treatment purposes, swelling micas expand as they absorb metal ions and then, reaching their capacity, collapse and seal the contaminants inside.

The swelling micas are being explored for potential use in separating ions of heavy metals such as lead, zinc and copper as well as other radioactive materials, including strontium, from waste streams. Because they trap the ions, the micas can permanently immobilize the pollutants. They could prove useful for the recovery and recycling of valuable metals as well.

Komarneni has used x-ray diffraction and nuclear magnetic resonance spectroscopy to evaluate the chemical properties of this new class of materials. One of his goals is to determine whether they have a larger capacity for metal uptake than currently available materials.

Not exactly natural clay, but anything that filters heavy metals out of my water gets my vote.

It's not exactly clay or even mica, but it's a waste product looking for a beneficial application.

It's fly ash and it's what found at the bottom of those electric bug zappers.

No, seriously, fly ash is a waste by-product of burning coal to generate electricity. It's cheap because power companies don't have much use for it other than as landfill.

Each year, 110 million tons of fly ash is generated in the United States, approximately 1,000 pounds per person. Less than 30 percent of the fly ash is reused in industrial processes or recycled.

What better use for something that is an environmental problem but to use it to solve another environmental problem?

Here's how. Researchers from Temple and Philadelphia universities are using fly ash to remove heavy metals from contaminated water. They have been successful in using fly ash, sand, and activating chemicals to create reactive barriers, which can either change or destroy contaminants.

Heavy metal pollution of groundwater is an extremely serious problem and costly to remediate. There are more than 200,000 contaminated sites in the United States, with the groundwater being contaminated at over 70 percent of those sites, and more than half with heavy metal contaminants.

Many companies cannot afford to clean contaminated water because the available processes are very expensive, labor intensive and time consuming. With reactive barriers, 80-90 percent of the heavy metals can be removed. What's left is a lot less damaging and can be cleaned at much less cost.

Thus far, the researchers have been successful at removing nearly 99 percent of cadmium (Cd) and chromium (Cr) from contaminated water, and are still testing the removal of lead (Pb) and mercury (Hg).

I hope they're comparing notes with their colleges at Penn State. They appear to have synergistic products.

\* "No man ever wetted clay and then left it, as if there would be bricks by chance and fortune." Plutarch, about 110 AD

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