# Engineers hit pay dirt with clay mixture

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A watery, mud-like substance has hit pay dirt for Case Western Reserve University engineering professor David Schiraldi and his research group.

The researchers have created a line of patented foam-like and environmentally friendly polymers, called clay aerogel composites that can take on the shape and size of any container that can hold water—from ice cube trays to rubber ducky molds to clam-shell packaging molds that hold and ship electronics.
"This is cool stuff," says the associate professor and associate chair of the university's Department of Macromolecular Science and Engineering.

When fired in a muffle furnace (a kiln) to 800 degrees centigrade, this material undergoes a chemical transformation. It can become a hard, lightweight ceramic. When mixed with latex, it becomes a bendable material like rubber. If magnetic materials are included in the clay concoction, it becomes a super-lightweight magnet. Combined with the right materials, it can even be an electrical conductor or a catalyst for chemical reactions.

"The flexibility of the clay aerogel composites is amazing," says Schiraldi.

The clay aerogel composites are inexpensive to produce and involve the same kind of freeze-drying process used to make banana chips and coffee.

Schiraldi says almost anyone can make the composites if they have pure clay in a form that resembles cat litter pellets, a blender and a $50,000 freeze dryer.

The researcher bought his equipment with $75,000 he won in the 2005 North Coast Nanotechnology Business Idea Competition that encouraged ideas to create new start-up companies. Schiraldi's used his winnings to establish Aeroclay Inc., and to obtain the AeroClay® trademark for the range of possible products.

After Schiraldi came to the university in 2002 and had a graduate student trained and ready by 2004 to take on an "extra unfunded project," Schiraldi's lab began making these new kinds of polymer-based materials.

Graduate student Matt Gawryla has since received a President's Opportunity Grant to expand clay aerogel composite experiments.

"We have put together an army of graduate and undergraduate researchers on a shoestring budget and produced a gold mine of papers and patents," said Schiraldi.

Aeoroclay materials feel and act like foam, without the injection of gas bubbles or the use of environmentally unfriendly CFC blowing agents.

Recently, the group went even greener by combining clay, water and the milk protein, casein, found in waste water left over from making cheese. This milk protein is the same substance farmers once used to produce durable white milk paint for their barns.

What has resulted with the milk protein is a bio-based polyamide (a high temperature polymer) with insulating properties to withstand heat at temperatures of 300 degrees centigrade. Currently, oil-based polymer

foam insulation degrades at high temperatures, says Schiraldi. Clay aerogel composites have the potential to insulate hundreds of miles of noninsulated piping carrying high-temperature materials throughout refineries.

But milk is not the only bio-based substance the group has used. He has also experimented with the seaweed protein alginate used to thicken ice creams and materials from corn like corn starch, but overall casein continues to produce a better product.

## THE DEVELOPMENT OF AEROCLAY

Before joining the university faculty, Schiraldi spent 20 years as a research scientist at Hoechst Celanese, one of the world's largest chemical companies. The original aeroclay was made when a graduate student working with Schiraldi mixed clay and water in a blender and then freeze-dried the substance. The technique produced a layered, cotton-like substance.

Initially the two researchers thought a mistake had been made, so Schiraldi sent the grad student back to the lab. When he didn't hear from the student after a week, Schiraldi called and asked what had happened.

He says the graduate student replied: "The same thing seven days in a row."

While he thought he had made a new discovery, a 1-inch column of copy in an old journal article from the 1940s described a similar substance made with a different kind of clay.

Schiraldi knew he was on to something, but at that time the industry wasn't ready to pursue this new material.

Now we have this amazing green product, says Schiraldi.

Source: Case Western Reserve University (news : web)