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Content:

Development of plastic properties

Adding very small amounts of natural clays to plastics changes some of their physical properties," says Dr. Evangelos Manias, assistant professor of materials science and engineering. "While we can tune the chemical interactions between the clays and some polymers, it is the general changes due to the nanometer fillers in all plastics that may be the most interesting."
Addition of clay can make plastics less permeable to liquids and gases, more flame retardant and tougher. Lower permeability can make plastics like PET, 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.
An inexpensive, more environmentally clean method of producing flame retardant plastics could eventually save lives. Because the addition of clay into plastics reduces flammability in a wide range of plastics, it may have universal application as a general flame retardant additive.
"Currently, chemicals used to make plastics flame retardant contain bromine, which produces poisonous combustion gases when burned," says Manias. "Using clay is a green alternative to current practices and reduces flammability in a wide range of plastics."
When polymers with clay incorporated in their structures burn, the clay forms a char layer on the outside of the plastic that insulates the material beneath.
"Natural clays are currently the most used because they are the same clays already used in many products," says Mania. "However, synthetic clays, because of their tailored properties, may prove essential for high added value products, such as in biomedical devices and space applications."

The natural clays Manias refers to are bentonites and montmorillonites that are already in use in paints to prevent dripping, cosmetics to prevent shine and in pharmaceuticals. Because the U.S. Food and Drug Administration already approve them for use, there is no problem incorporating them into plastics that come in contact with foods, medicines, beverages or plastics used in

biomedical devices.
The polymer clay blends, while containing only 1 to 5 percent clay, are actually nanocomposites. The addition of clay into the polymer blend, does not alter the normal production and processing of the clayless polymer.

"The clay can be added at the final stages of polymer processing without any change in the current industrial practices," says Manias. "The thermodynamics drive the nanometer dispersion of the clay through the polymer and the small amounts of clay do not cause any wear in the equipment. Manufacturers can use the same equipment, timing and settings as in their normal process."
While natural and synthetic clays provide a broad possibility of enhances plastics, Manias is also looking at polymer nanocomposites that contain platelets of metal and ceramic nanoparticles instead of clay.
These ultra-small fillers require different surfactants and offer much more flexibility in property tailoring, where cost can be slightly increased.

The Penn State researcher has reported on his work in a variety of journals including Advances in Polymer Science, Chemistry of Materials and Macromolecules.

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