SCIENCE

FANTASTIC PLASTIC

In the immortal words of pop group Aqua: *"Life in plastic, it's fantastic"*... Whether or not we like it, the plasticising of the world has, and will, continue to occur. Nothing is sacred, not even the exalted wine bottle. Until now the properties of polymers have meant they were not conducive to housing a fine wine or brew of beer. That has changed.

Researchers at US Penn State University are mixing clay with polymers to create a stable plastic with durable qualities. "Adding very small amounts of natural clays to plastics change 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 plastics that may be the most interesting."

Clay fillers could become a popular "green" alternative to current flame-retardant additives for polymers. They can greatly boost the flame-retardant properties of plastics, while retaining the polymers' low weight and eliminating the formation of toxic fumes upon burning.

The benefits of adding the earth to plastics also include making it less permeable to liquids and gases. This lower permeability can make plastics like PET, the standard plastic used for soft drink bottling, suitable for bottling beer and wine. The clay-enhanced product would protect the beverages from the effects of oxygen. Conversely, the addition of clay in such small amounts does not

affect the transparent quality of the plastic.

Contrary clay

The problem in the process is that it is quite complicated as polymers and clay mix together as well as oil and water do, say the researchers. The clay must be treated with an organic surfactant, which is a compound that allows it to mix with the polymers, in the same way that soap allows oil and water to mix.

The resulting flame-retardant qualities imparted to the plastic by the clay mean it could one day be widely used to reduce flammability in a wide range of plastics. "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 the added clay burn, the clay forms a char layer on the outside that insulates the material beneath.

"Natural clays are currently the most used because they are the same clays already used in many products," explains Manias. "However, synthetic clays, because of their tailored properties, may prove essential for high added value products, such as in biomedical devices and space applications."

Retardant earth

These natural clays are currently in use to prevent paint from dripping, cosmetics shining and also in some pharmaceuticals. As they are already approved by the Food and Drug Administration, there will be no delays in incorporating them into plastic.

"The clay can be added at the final stages of polymer processing without any changes to current industrial

practices," says Manias. "The thermodynamics drive the manometer 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."

Despite the possibilities that clay holds for plastics, Manias continues to look for other alternatives to add. He 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, especially where cost can be increased.

So keep an eye out for your favourite tipple arriving encased in plastic at a store near you...

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