



Courtesy The Mineralogical Society

# Halloysite nanotubes

After three years in development, NaturalNano Inc. is ready to introduce halloysite nanotube based products. It has the potential to revolutionise a host of industries from agriculture to coatings

SINCE ITS FOUNDATION in 2004, NaturalNano Inc. has been developing a unique process to refine naturally occurring halloysite nanotubes (HNT) for a host of applications.

Mined at the Atlas Mining Dragon Mine in Utah, halloysite is readily available in large quantities and does not require the fabrication infrastructure normally associated with manufacturing of other types of nanotubes. NaturalNano claim HNT are 1,000 times less expensive than carbon nanotubes.

HNT's formation: Millions of years of weathering breaks apart the surface of the halloysite mineral, this natural process causes nanotubes to form with a diameter ranging 40nm-200nm, and length between 500nm-1.2µm. NaturalNano exploits HNT by separating them from the mineral for use in a composite.

The Rochester, New York based company recently announced a breakthrough in which it plans to commercially use HNT in its new product, Pleximer - a nanocomposite additive enabling stronger, lighter, and less expensive materials for the multi-billion dollar polymer composite industry.

For the last three years, NaturalNano's aim has been make commercial quantities of high quality naturally occurring nanotubes,

along with licenses based on the company's proprietary technologies, available for a wide variety of uses. It has already obtained 20 patents to which NaturalNano is looking to add to with two recently filed patents covering HNT coating compositions and processes, citing claims for adhesives and functional coatings.

## Pleximer

Pleximer is a ready to use, nanocomposite additive incorporating HNT that operates with standard conventional equipment. It takes the form of pellets that can be incorporated into the extruder by the end manufacturer, eliminating three out of four basic nanoclay production steps: the treatment reactor, polymer synthesis reactor, and first extruder.

Pleximer will serve the same functions as the current "platy nanoclays" in the plastics industry. However it does not require the relatively expensive processing before hand, and still gives a similar performance in dispersion.

Platy nanoclay has a structure that is two sheets held together by an intermediary layer. For the clay to function as a nanofiller and be dispersed in the polymer matrix the sheets must be separated. This will require chemical separation or physical exfoliation which adds to cost, both in time and investment.

The table shows a comparison between the conventional fillers, platy nanoclay's, and HNT.

## Ready-to-go

Pleximer can potentially solve a problem that nanocomposites have had in the market: they do not require additional investment to use, and is essentially ready-to-go. The market is limited by a small number of manufacturers who have invested significantly in expertise and the equipment needed to incorporate platy manacles.

NaturalNano said: "We believe that the Pleximer technology will have a rapid industry acceptance because it enables manufacturers to produce nanocomposites with existing equipment. NaturalNano is currently focused on leveraging this new drop-in, turnkey advantage to a select number of industrial compounders who supply major industries."

NaturalNano plans to commercially offer Pleximer in the fourth quarter of 2007.

USA based market research company, BCC Research, estimates clay-based nanocomposites will represent 47% of the plastics market in 2010. The market value is expected to rise from of just under \$400m. (£197.8m.) to around 850m. (£418m.) in 2011.

Aiming for a significant share of this value, NaturalNano has highlighted the short term target industries: automotive, military, and plastic packaging.

NaturalNano explained future opportunities with HNT: "The nanotube structure makes possible extended release over long periods of time and under harsh conditions... this will revolutionise the agricultural industry through extended and controlled release of herbicides and pesticides, and the cosmetic and household industry [amongst others that include UV protectants, antifungal agents, and colouring agents]."

## Nanocomposite comparison

	Conventional filler	Nanoclay (Kaolin)	HNT
Features:	High strength	High strength	High strength
	Brittle	Not brittle	Not brittle
	Higher weight	Lower weight	Lower weight
Processing requirements:	Standard equipment	Specialised equipment	Standard equipment
		Specialised chemistry	Lower processing costs
		Limited compatibility	Broader compatibility

Source: NaturalNano