Nanoshel Nanoclays for Nanocomposite

*We help you add a new value to your plastics*

Nanoshel Nanoclays are derived from naturally occurring clay mineral especially purified and processed in order to obtain nanoclay suitable for the production of a nanocomposite material. Polymer-clay nanocomposite represents one of the most interesting classes of materials developed in recent years.

Nanocomposite provide dramatic improvements if compared with virgin polymers. Moreover the content of nanoclay is often included in the following range: 2-5% weight. Some of the most important improved properties are the following:
- Flame retardancy and thermal stability
- Mechanical properties: stiffness, melt fracture reduction, tension, compression and bending
- Barrier properties to oxygen, CO2, vapor barrier and solvent resistance

**Synthesis of Nanoclay**

*NANOCLAY PRODUCTS: THE SYNTHESIS*

It is important to stress the fact that in order to prepare good nanoclay you need to eliminate all the impurities that are commonly contained in the natural bentonite, and to remain with the presence of the only montmorillonite. Doing this, the first step is to prepare a very diluted suspension of bentonite in water, and then eliminate all heavier particles through screening, sedimentation and centrifugation, remaining with the presence of the only montmorillonite platelets homogeneously dispersed in water.

When the platelets are dispersed in water, the negative surface charge is balanced by the sodium ions forming an electric double layer surrounding the montmorillonite platelets. These sodium ions can be easily replaced by organic ions, like for example long chain alkylammonium ions: the reaction is instantaneous, the product flocculates and can be filtered, dried and grind to the desired particle size. The organic ions act as compatibilising agent between the polymer matrix and the montmorillonite platelets, allowing the polymer to completely interact with silicate layers, improving lot of its mechanical, thermal and structural characteristics.

*packets before suspending in water  single platelets after purification*
Mechanical properties in automotive
The customer produces polypropylene automotive parts. He is interested in improving mechanical properties without weight increase.
Details and Results
The addition of low percentage of Nanoshel Nanoclay has been sufficient to reach an about 50% improvement in polypropylene Flexural Modulus without decreasing the impact characteristics. No weight increasing has been registered.

Flame Retardants Capability
The customer produces PP automotive parts. The flame retardant property of the polymer is fulfilled by the use of a traditional flame retardant system. The high portion of FR required (about 30% weight) causes the following disadvantages: high density and lack of flexibility of the end products, low mechanical properties and problematic compounding and extrusion steps. The goal is to maintain the thermal stability the flame retardancy improving the mechanical properties.
Details and results
To maintain a sufficient peak heat release level, the weight content of FR can be decreased of about 20% by the presence of 5% Nanoshel Modified Nanoclay in the PP polymer matrix.
The FR reduction results in improved mechanical and rheological properties for typical PP-based automotive parts.

High barrier food packaging material
The customer produces biodegradable food packaging plastics. The object is to reduce the water vapor permeability of the starch based products manufactured by the customer without modifying both the process and the production costs.
Details and Results
Addition of 5% of Nanoshel Nanoclay has been enough to improve the barrier properties of about 50% if compared to the pristine polymer.
Most formulators seem to think that nanomaterials are in the embryonic stage or even still laboratory curiosities. Actually these materials are now commercially used in several adhesive systems. They provide properties never before realized and promise huge opportunities for the near future.

Adhesives and sealants look to be an early pioneer in the nanomaterials area. The added value that these materials provide could be a significant benefit. Nanomaterials look especially promising when it comes to electrical or thermal conductivity improvements or for "engineered" permeability materials. However, recent developments indicate that there may be many more opportunities for nanomaterials in the adhesives and sealants industry.

Some of the opportunities for Adhesives and Sealants are following:

- **Rheology control** - nanomaterials maintain low viscosity even at very high levels of loading. Nanoparticles have been noticed to achieve 40-60% loadings without adverse effect on rheology.
- **Mechanical properties** - high filler loadings and the unique aspect ratios of Nanoparticles make them ideal reinforcing fillers.
- **Anti-microbial properties** - active elements are far more available and effective in nano-form.
- **Coating thickness reduction** - coating thickness can be reduced by virtue of the high solids content at low viscosity; thus, thinner coatings can be produced with better coating uniformity.
- **Tagging security applications** - nanomaterials can be tagged for tractability with various elements. They also can be made magnetically or optically active.
- **Ceramic adhesives** – Nano ceramic powders can be made to have properties and application characteristics similar to organic adhesives. Thus, one could have a very high temperature and chemical resistant adhesive that is as easy to apply as an epoxy.

**Fields of Applications**

**Packaging**
Nanocomposite if compared to usual plastic barrier materials provide a lower weight and a greater barrier to gases (oxygen, carbon dioxide and water), to chemicals and to odour migration.
An improved barrier effect allows: longer product shelf life, lower absorption of flavors and vitamins by the polymer matrix
A lower weight allows: costs saving

**Automotive**
Lower weight with the same mechanical and flame resistant properties and an improved barrier to fuel vapor make nanocomposite an interesting opportunity in the transportation sector.
They provide: costs saving, greater resistance to common corrosive agents, reduction in gas emission because of the lighter vehicles and so a more environmental friendly impact
Up to now Nanoclays have not been able to substitute completely the usual flame retardant but very important results have been obtained by the combination of traditional flame retardant products and Nanoclays.

Traditional flame retardant systems require high portion of the filler within the polymer matrix to achieve suitable flame retardancy. Clear disadvantages are the high density and the lack of flexibility of the end products, the low mechanical properties and the problematic compounding and extrusion step. On the contrary the presence of only very low percentage of nanoclay allows to decrease the weight content of flame retardant systems up to 30%.

Reduction in total amount of these fillers also results in: Improved mechanical and rheological properties, strong reduction of rate of heat release measured with a cone calorimeter

Industrial and general items
Nowadays plastics have replaced almost completely metal items not only in everyday life but also in business and industrial fields.

The advantages of nanocomposite technology are generically listed below:

- Thermal stability
- Flame resistance
- Chemical resistance
- Reduced weight

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