

P-801 Nanomer® Products for Polyolefin Nanocomposites

General Description:

Nanomer® nanoclays are high purity, surface compatibilized montmorillonites, suitable for use in a wide variety of plastics. This Technical Datasheet describes patented Nanomer grades specifically designed for polyolefin applications.

Incorporation of Nanomer nanoclay into polyolefin improves physical performance properties and flame resistance. The loading level is commonly in the range of 4-6wt% for mechanical improvement, and 1-4 wt% for flame retardation. Nanomers are very effective in flame retardation when combined with traditional flame retardants.

Product Information:

For use in polyolefins Nanomer grades are based on two different clay surface treatment chemistries. The I.30 series utilizes primary amine chemistry and the I.44 series is based on quaternary ammonium chemistry. The I.30 series offers excellent thermal stability as well as high electrochemical stability. The I.44 series offers easy processing and excellent property balance. The I.31PS and I.44PS grades are derivatives containing silane modification. Silane coupling agents enable trouble-free Nanomer dispersion under mild shearing conditions and better silicate layer stability. Processing temperature limits for the I.30 and I.44 series are 540 F (280°C) and 460 F (240°C), respectively. I.44PT features better heat stability than standard I.44P, particularly in long residence time processing.

Table 1. Nanomer® Products for Polyolefin Nanocomposites

Product	Dispersion	Heat Stability	Mechanical	FR	Electrochemical
I.30P	Good	Excellent	Yes	Yes	Excellent
I.31PS	Excellent	Excellent	Yes	Yes	Excellent
I.44P	Excellent	Good	Yes	Yes	Good
I.44PS	Excellent	Good	Yes	Yes	Good
I.44PT	Excellent	Excellent	Yes	Yes	Good

Product Characteristics:

These products are fine free flowing powders. Typically, they have mean particle sizes in the range of 15-20 µm. Each standard package contains 20-kg of the product. Nanocor can also pack products in bulk bags in 400-kg or 600-kg sizes, upon customer request.

Processing Recommendations:

High shear processing equipment is recommended for incorporating Nanomer nanoclays into polyolefin resins. Because polyolefins are hydrophobic, a compatibilizer such as Ma-g-PP or Ma-g-PE is also recommended. Alternatively, Nanomer masterbatch products, available under the nanoMax™ trademark, can be used for easy incorporation. For detailed information on nanoMax refer to Nanocor Technical Data Sheets P-802 and P-804.

Performance Properties:

Low addition levels of Nanomer nanoclays create significant improvements in mechanical properties. Table 2 reports the mechanical performance data on Nanomer I.44P, which was incorporated into PP and TPO matrices.

In the TPO formulation, a reactor grade TPO was used for both control and nano-filled. As the chart indicates, Nanomers increase stiffness and heat stability while maintaining impact strength.

Table 2. Mechanical Properties - Homo-PP and TPO with 6 wt% Nanomer® Loading

Nanomer® Loading Level (wt %)	Resin	Flexural Strength (MPa)	Flexural Modulus (MPa)	Improvement (%)	HDT (C)	Impact Strength (ft-lb/in)
0	TPO	22	820	/	73	9.8
6	TPO	30	1300	60%	93	9.8
0	HPP	35	1180	/	88	0.5
6	HPP	46	1780	50%	109	0.5

Nanomer I.44P was also incorporated into a brominated FR system through compounding. Table 3 lists the performance of this FR combination. Formula 2 provides an example of the mechanical benefit for Nanomer incorporation while improving the FR rating from V-1 to V-0 in UL94 testing. Formulas 3 and 4 provide information on reduction of brominated compounds, while maintaining V-0 and mechanical properties. One will also observe significant reduction in blooming of brominated compounds in the nanocomposite formulation using accelerated heat aging tests.

Table 3. Flame Retardation of Brominated Compounds and Nanomer Combination

Components	Formula 1	Formula 2	Formula 3	Formula 4
DECA (wt%)	25	25	22	22
ATO (wt%)	6	6	6	6
Nanomer I.44P (wt%)	0	6	4	6
UL-94 rating	V1	V-0	V-0	V-0
Flex Strength (MPa)	46	51	52	53
Flex Modulus (MPa)	1810	2570	2490	2740

Nanomer I.44P was incorporated into a non-Hal FR compound using EVA as the matrix resin. In a typical $Mg(OH)_2$ filled system, 65wt% $Mg(OH)_2$ is needed to achieve a V-0 rating. For such a highly filled system, it is difficult to achieve filler dispersion and processing speeds for downstream fabrication are significantly reduced due to surface defects. Formulas 3 and 4 demonstrate the benefit of Nanomer in this FR formulation. With incorporation of just 3% Nanomer I.44P, $Mg(OH)_2$ can be reduced to 60% and 55% respectively while maintaining the fire rating and increasing fabrication speeds.

Table 4. Flame Retardation of $Mg(OH)_2$ and Nanomer Combinations

Components	Formula 1	Formula 2	Formula 3	Formula 4
EVA (wt%)	35	40	37	42
$Mg(OH)_2$ (wt%)	65	60	60	55
Nanomer I.44P (wt%)	0	0	3	3
UL-94 rating (1/8)	V-0	Fail	V-0	V-0

It is believed that Nanomers function as anti-dripping agents in FR systems, thereby improving fire ratings. There are also reports indicating nanoclays function as char forming agents during the combustion process.

* The data reported here was generated with grade Nanomer I.44P product. Based on our experience, all Nanomer grades listed in the datasheet can deliver the comparable results.

For more information on how Nanomer® nanoclays can work for you, contact Nanocor's Technical Service

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