Lit. T-11 (10/04) Epoxy Nanocomposites Using Nanomer® I.30E Nanoclay

General Information:

Nanomer® I.30E nanoclay is a surface modified montmorillonite mineral which will disperse to nanoscale in epoxy resin systems. The dispersion creates a near-molecular blend commonly known as a nanocomposite. This new type of composite exhibits enhanced strength, thermal and barrier properties. I.30E is supplied as a white powder which disperses to particles so thin they are nearly transparent in the resin matrix.

Loading Levels:

Unlike conventional mineral fillers, Nanomers enhance performance at low loading, generally 10-25 phr. This unique feature allows for improved performance at minimal added weight. Figure 1 plots relative flexural modulus versus loading levels at different temperatures for high Tg matrix.

Flexural Modulus:

Epoxy nanocomposites exhibit improved modulus across the effective temperature spectrum, regardless of Tg. Generally, the magnitude of improvement is greater in the region above resin Tg. Figures 2-4 give DMA's for three widely used epoxies containing 7% wt./wt Nanomer I.30E nanoclay. Depending upon the resin, Tg will increase 30-45%, indicating improved thermal stability.

Chemical Resistance:

Chemical resistance, as measured by the solvent uptake/sample weight increase method, improves across a wide range of solvent types. Table 1 presents data for three resins.

TABLE 1 – Relative Uptake (ASTM D543-87)

EPOXY	H_20 23^{0}C	H_20 50^{0}C	H_2SO4 23^{0}C	H_2SO4 50^{0}C	Toluene	MEK
DER® 331-230	0.68	0.72	0.75	0.89	0.85	-
DER® 331-400	0.76	0.68	0.50	0.75	0.34	0.31
EPON® 828-3164	0.21	0.15	0.32	0.11	0.85	0.68

Note: Unfilled resin = 1.0

Impact Resistance:

For low Tg resins (-40^{0}C) impact may improve by many multiples of the pristine system. Nanocomposites of medium Tg epoxy (25^{0}C) have impact about equal to pristine polymer. High Tg systems (70^{0}C) suffer impact loss and require modifiers to achieve desired levels.

PHYSICAL PROPERTIES

Appearance	White Powder
Mean Dry Particle Size (microns)	8-10
+ 325 Mesh Residue (%)	0.1
Specific Gravity	1.71
Bulk Density (pounds/ft^3) (gm/cc)	25 0.41
Moisture (%)	3 max
Mineral Purity (% min)	98.5

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Nanoclay Incorporation:

Nanomer nanoclays are easily dispersed in liquid epoxy resins using medium shear (Cowles®, paddle or turbo mixer). For best results the resin should be preheated to 75-90^{0}C. Nanomers are then dosed slowly into resin while mixing. After 5-10 minutes a smooth, uniform dispersion will result. Curing agents can then be added. Cured material is degassed and molded under normal conditions.

Limitations:

Because Nanomer nanoclay disperse to very small particles with high surface area, resin viscosity will increase. Sufficient mixing energy must be used to compensate for the increased viscosity. Minute particles have some catalytic effect. Do not exceed 100^0 C or self-polymerization may occur. Gel time for any particular resin may be shortened with Nanomer addition. Curing cycle will not be altered.

Product Availability:

Nanomer I.30E nanoclay is available in 20 kg (44 lb.) polylined bags or fiber drums.

Figure 1 – Effect of Nanomer Loading

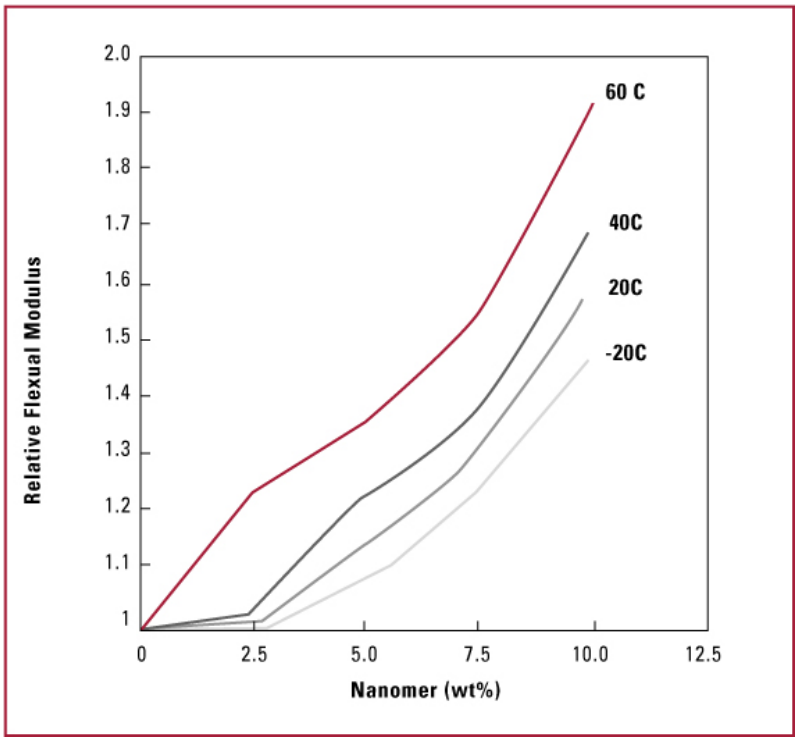

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Figure 2 – Storage Madulus Low Tg Epoxy Matrix

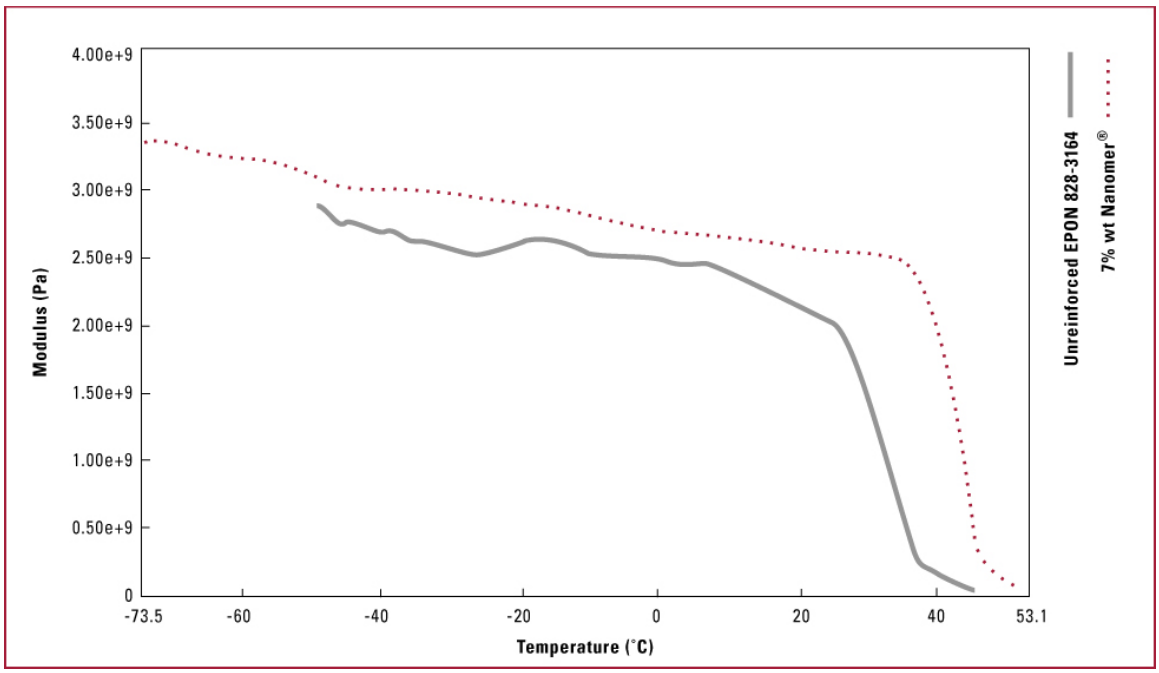

Figure 3 – Storage Modulus Medium Tg Epoxy Matrix

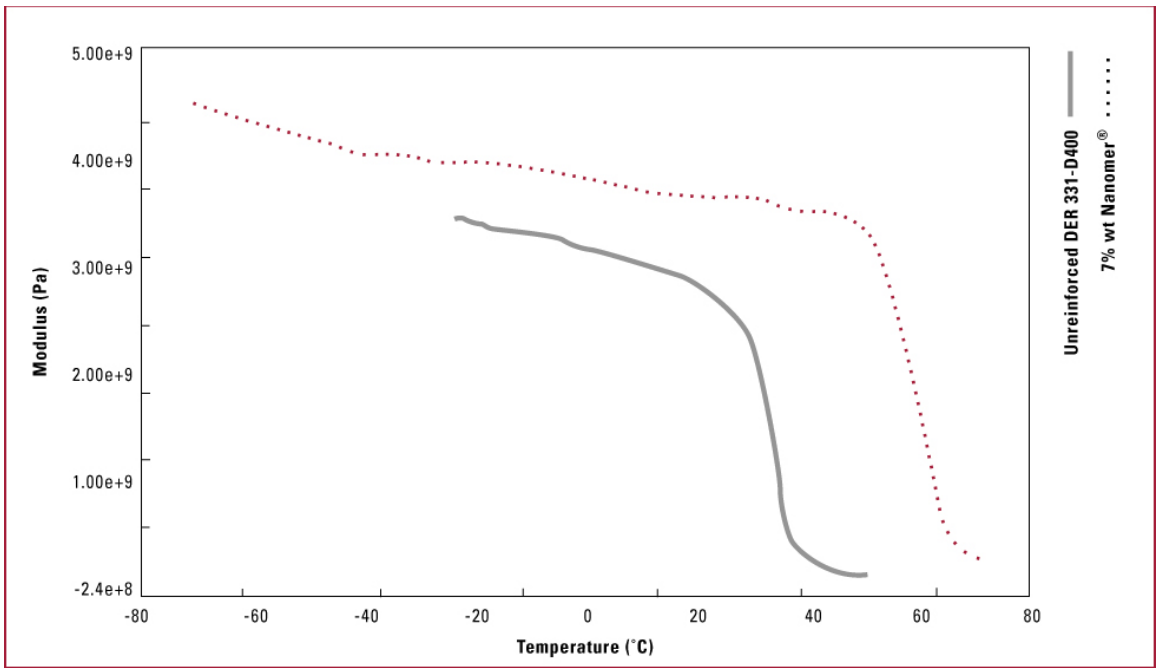

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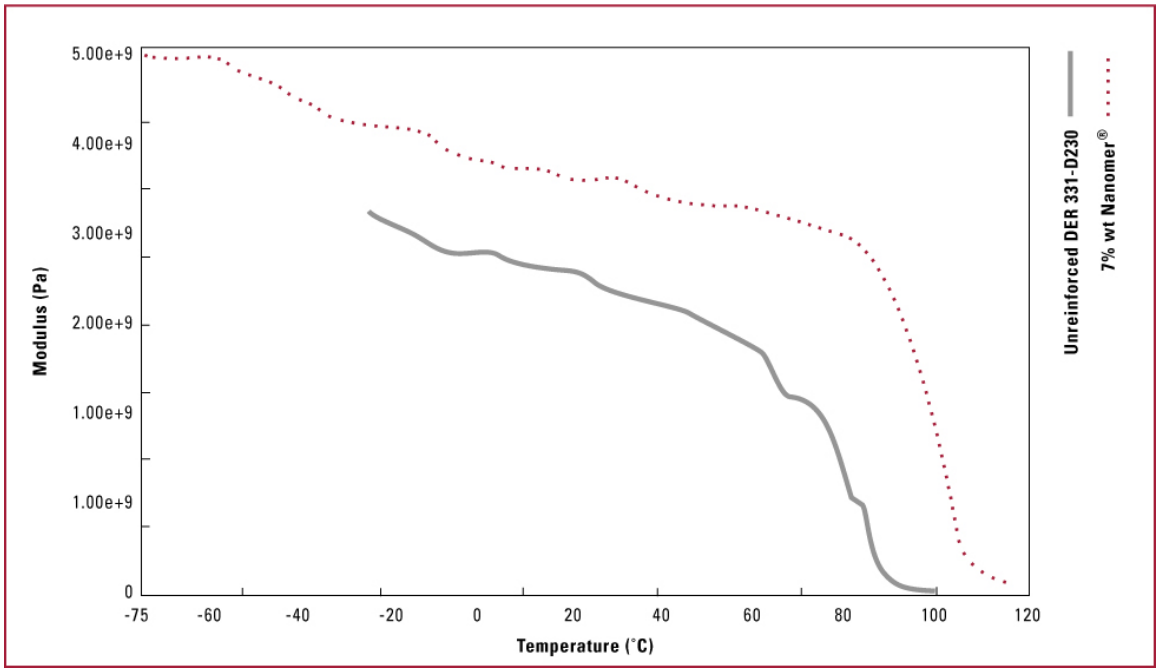
Figure 4 – Storage Modulus High Tg Epoxy Matrix



* Heat rates for Figure 2-4 were 2.00^{0}C/min.

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

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