

Description

ZNT-EpTM is a polymer modified multi-wall carbon nanotube additive that can be used for reinforcing rubbers and elastomers that are peroxide cured. The polymer modification on these multi-wall carbon nanotubes makes them easy to disperse and crosslink into the host matrix, resulting in improved mechanical properties for a wide range of applications including gaskets, o-rings, seals, and shock absorption. Electrical conductivity can also be achieved with the proper loadings of ZNT-Ep.

ZNT-Ep can be mixed into a variety of elastomeric resins such as ethylene propylene rubber (EPDM/EPM), nitrile rubber (NBR), natural rubber (NR), styrene-butadiene rubber (SBR), chloroprene rubber (CR), Acrylic rubber (ACM), hydrogenated nitrile butadiene rubber (HNBR), and fluoroelastomers (FKM) that are cured using peroxide and amine chemistries. Depending on the formulation characteristics, the typical final ZNT-Ep loadings in the formulation range from 1 -10 phr for mechanical property improvements. ZNT-Ep can be readily dispersed into rubber formulations using an open mill and/or internal mixers. ZNT-Ep loadings of 5 -10 phr provide for electrical surface resistivity of 10^8 - 10^9 ohm/square or lower values. Thermal conductivities improvements may also be achieved using ZNT-Ep. ZNT-Ep has methacrylic ester groups and can be further post functionalized with other chemical moieties to modify the surface functionalities of MWNTs. Typical mechanical improvements include increases in tear strength, tensile modulus, rapid gas decompression, and shear strength.

Mixing Procedure

ZNT-Es is a polymer modified multi-wall carbon nanotube powder that is easily integrated into a wide range of peroxide-cured elastomers. The following mixing procedures typically produce the best results:

Dispersion into elastomer compounds:

Solvents are generally not required to achieve uniform dispersion of ZNT-Ep in rubber compounds. No special mixing processes are required to disperse ZNT-Ep into elastomer compounds. Conventional process equipment such as open mills and internal mixers are adequate for achieving uniform dispersions. As a general rule, fillers such as carbon black or silica should be added after dispersing the ZNT-Ep into the rubber compounds. Plasticizers such as castor oil, paraffin oil and others can be used as carriers for incorporating ZNT-Ep into rubber formulations.

For applications that need to solvate rubber, ZNT-Ep can be easily introduced using mechanical mixing followed by evaporation of the solvent at ambient or low pressures. High-shear mixing or sonication process can also be used in lieu of mechanical mixing. Solvent dispersions are particularly advantageous for introducing the ZNT-Ep into the pre-polymer latex for rubber compounds.

Solvent dispersions:

Accurately weigh 100-400 mg ZNT-Ep into 100 ml solvent and process the materials using water bath sonicator or probe sonicator at 50-60 watts of power. Alternatively, high-shear mixing can also be used in

making solvent dispersions. When high-shear mixing, typically 4000 -6000 RPM is needed to disperse ZNT-Ep into solvents. Both sonication and high-shear mixing processes result in generation of heat, therefore keeping the contents at temperatures below 10°C will reduce the processing time and improve the quality of dispersions. ZNT-Ep is associated with a slight excess of a proprietary polymer (non-covalent functionalization agent). The excess polymer aids in the dispersion of the MWNTs into solvents. During the first few minutes of the sonication or high-shear mixing process, the ZNT-Ep suspension may have a slight fluorescence color. With additional processing time, the suspension will gradually become black. Applications that need a high dispersive state of ZNT-Ep in solvents may need to include ultra-centrifugation process. ZNT-Ep solvent suspension can be centrifuged (depending on the specific centrifuge) at 3000- 4000 RPM for 30 minutes to remove larger agglomerates as needed.

Safety Handling

Zyvex Technologies provides its customers with a product-specific Material Safety Data Sheet (MSDS) to cover potential health effects, safe handling and use information.

Zyvex encourages its customers to review all relevant MSDS prior to use.

Disclaimer

Zyvex Technologies believes that the technical data provided is accurate as of the published date. Performance values and the material specifications are considered representative but are not intended as a specification and may vary slightly from lot to lot of product.

Material Specifications

Table 1: ZNT-Ep Specification

Characteristic	Unit of Measure	Value	Method of Evaluation
Carbon content	wt%	90	Elemental analysis
Functional chemistry	wt%	10 -13	TGA
CNT outer diameter	Nanometer	10-15	Arkema *
CNT length	Microns	0.1-10	Arkema*

*Properties established by the MWNT supplier

*Other CNT manufacturers may be used upon request or at Zyvex Technologies' discretion

Table 2: Material Characteristics

Characteristic	ZNT-Ep
Color	Black
Nanomaterial	Multi-wall carbon nanotubes
Appearance	Powder
Total Solids, weight %	100%
Shelf Life	12 months
Typical loading level by weight %	0.1% - 10%

Table 3: Particle Size Analysis Verification and Surface Area Inspection

Characteristic	ZNT-Ep
Single Point Surface Area	114.5 m ² /g
BET Surface Area	124.4 m ² /g
Langmuir Surface Area	200.7 m ² /g
BJH Adsorption Surface Area	185.6 m ² /g
Single Point Adsorption Pore Volume, less than 40 nm in Diameter	0.375 cm ³ /g
BJH Adsorption Cumulative Pore Volume of pores between 1.7 and 300 nm	0.369 cm ³ /g
Adsorption Average Pore Diameter	12.1 nm

Figure 1: Particle Size Analysis: Dynamic Light Scattering of ZNT-Ep in DI Water

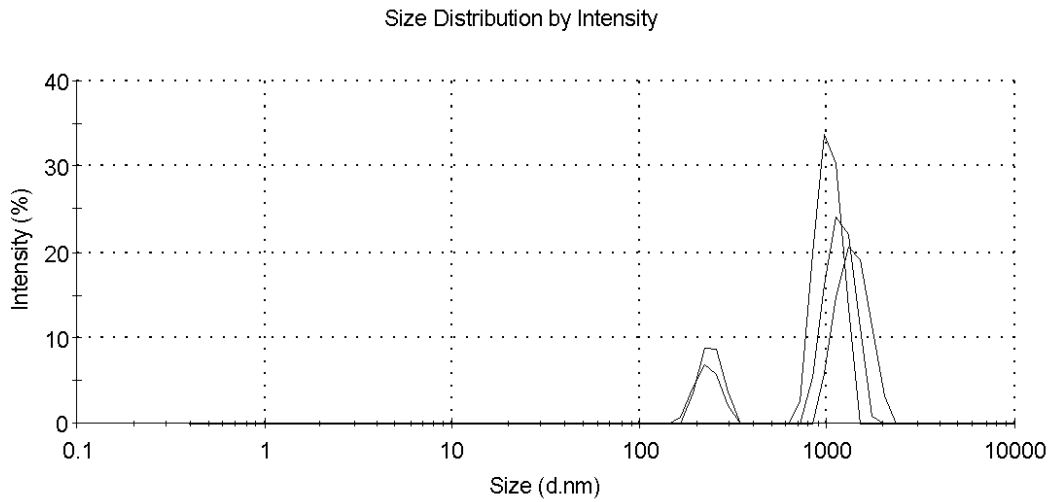


Figure 2: SDT of ZNT-Ep in argon at 10°C/min

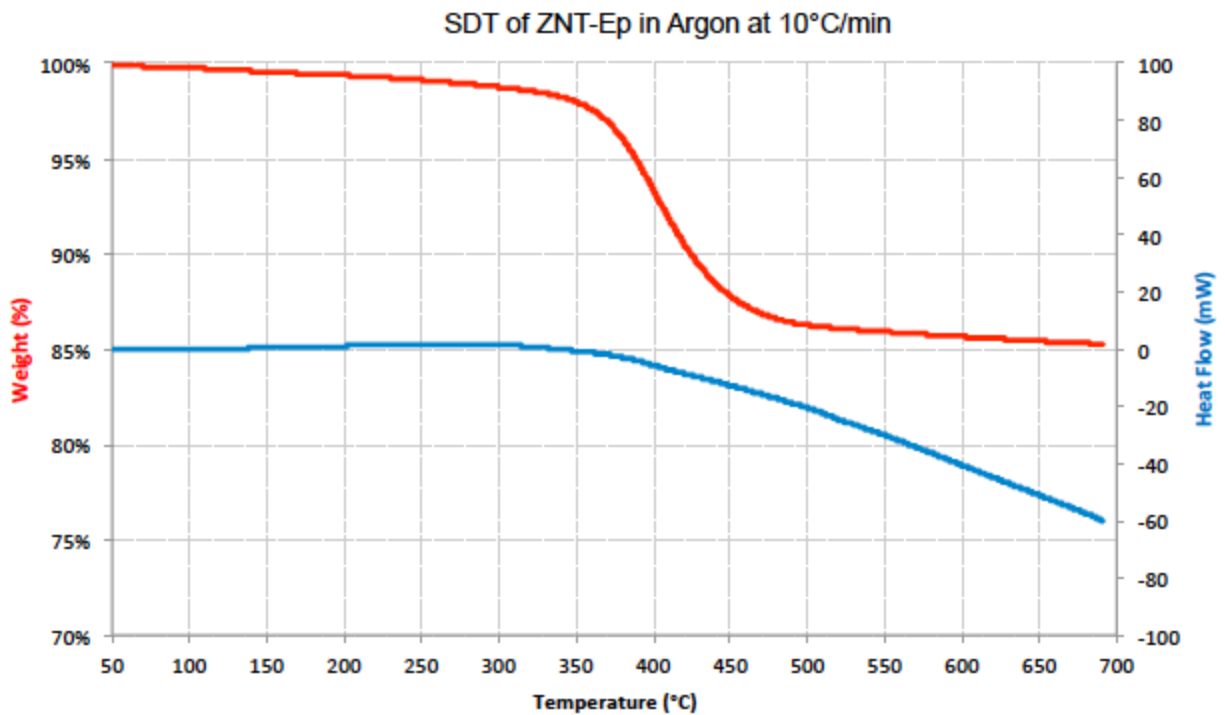
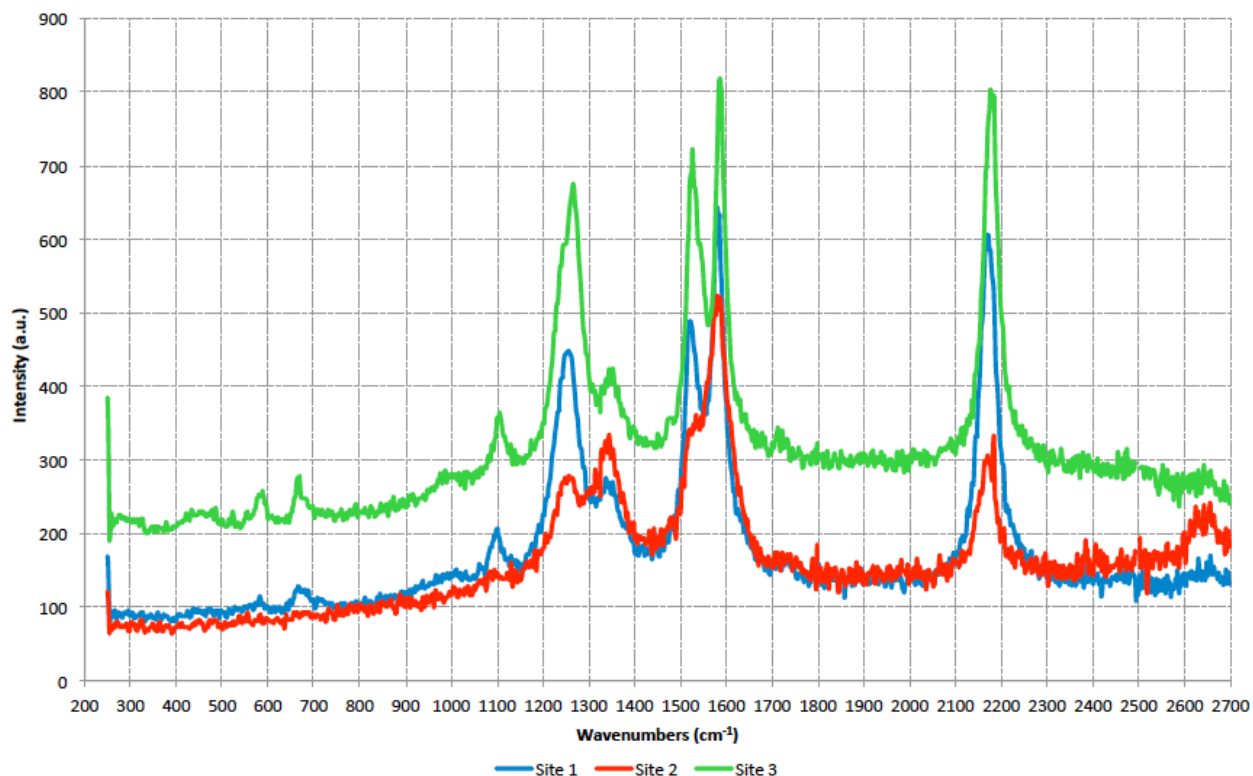


Figure 3: Raman spectrogram of ZNT-Ep



Contact Zyvex

For United States quotes, orders and product information call toll free 877.Go.Zyvex (877.469.9839).

For international quotes, orders and product information call 614.481.2209.

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