

GRAPHISTRENGTH® C S1-25

EPOXY MASTERBATCH

TECHNICAL DATA SHEET

Description:

Graphistrength® C S1-25 is a Multi Wall carbon Nanotubes (MWNT) masterbatch for thermoset composites that contains perfectly dispersed MWNT at a concentration of 25% by weight.

Graphistrength® C S1-25 is suited for the production of high performance thermoset composites, it is based on DGEBA monomer, bis-phenol A grade, that makes it compatible with most of epoxy based thermoset formulations. This masterbatch can also be used with other thermoset bases such as ester and acrylics. Graphistrength® C S1-25 refines intended for use in electrostatic discharge (ESD) protection or mechanical reinforcement of composite structures.

Key features:

Graphistrength® C S1-25 is provided in pellet form with the following key characteristics:

Property	Method	Unit	Typical value ⁽¹⁾
MWNT content	TGA	wt%	25 ⁽²⁾
Moisture content	Karl-Fisher	wt%	0.05 -0.10
Epoxy value	ISO 3000	Eq/Kg	3.95 – 4.08
Flash point	ISO 2719	°C	>200

(1) Data not intended for specification purposes

(2) Graphistrength® CS1-25 contains Graphistrength® MWNT with purity > 90 %

Benefits and applications:

Graphistrength® C S1-25 is generally diluted in various liquid bases of thermoset formulations. Typical final MWNT loadings in the final compounds are in the range 0.1 to 2 wt% depending on the host matrix characteristics, the targeted performances, processing methods and conditions.

The typical electrical resistivity that can be achieved is in the range of 10 – 10⁸ ohm.cm. The ESD properties obtained with Graphistrength® C S1-25 are outstandingly consistent and uniform.

Graphistrength® C S1-25 offers particular advantages for the formulation control due to high concentration of MWNT. It also offers a process advantage, with the possibility to efficiently introduce MWNT using conventional mixing equipment.

Graphistrength® C S1-25 is particularly suited for epoxy coatings and epoxy composites applications.

Example of mechanical properties in composites:

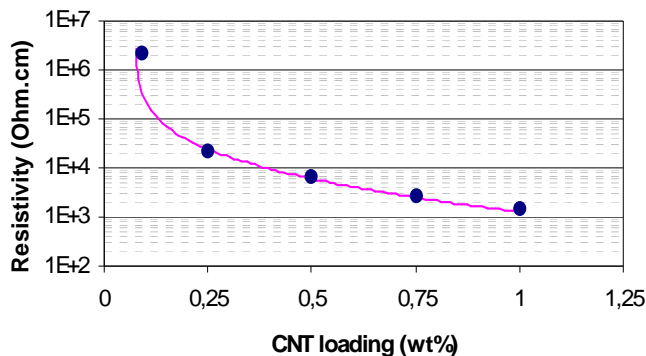
Carbon fabric impregnated with	Tensile modulus (GPa)	Stress (compression) (MPa)	ILSS* (MPa)	G1c (J/m ²)
Neat epoxy	54.7	495	59.3	600
Epoxy + C S1-25	58.0	575	67.1	850
Improvement	+6%	+16%	+13%	+42%

Results obtained on composites containing 50 vol% of fibers, impregnated with a 1 wt% MWNT DGEBA epoxy. * Interlaminar Shear Strength.

Example of electrical properties obtained in epoxy:

Percolation curve obtained by dilution of CS1-25 in classical DGEBA resin cured with DDS.*

*Dilution performed according to dilution and processing guide below. Mixing was done on a Silverson LR4T high shear mixer for 30 min at 5,000 rpm.



Dilution and processing:

For optimal dispersion, the masterbatch granules have to be softened. This is achieved by immersing the granules overnight in the base resin used in the final formulation. The liquid should cover completely the masterbatch granules. It is recommended to heat the resin + CS1-25 mixture at about 80°C to accelerate the CS1-25 granules softening. The weight of the liquid components used for the impregnation should be taken into account in final formulation.

- Dilution, step by step:
 - 1. Immerse CS1-25 granules in base resin overnight.
 - 2. Dilute further the resulting slurry in the base resin with a dilution factor corresponding to the desired CNT concentration.
 - 3. Apply high-shear mixing to the mixture. Typically, a Silverson LR4T should be used at 5,000 rpm for 30 min. Three-roll mills also give optimal dispersion qualities. It is important to note that any thickening agent (thermoplastic, rubber, nano/micro particles,...) should be added AFTER CNT dispersion is completed.
 - 4. Add the remaining components of the final formulation, e.g. hardener, accelerator, fillers.
- MWNT even in small quantities may lead to increased viscosity of the formulation. Viscosity regulating additives may be needed.
- The presence of MWNT in formulation may lead to variations in curing times. Adjustment of reactive components may be needed.

Safety and Handling:

Graphistrength® C S1-25 is provided in pellet form where MWNT are strongly embedded.

Graphistrength® C S1-25 does not present any specific health risk when using in thermoset processing.

Graphistrength® C S1-25 is provided in metal vessels of 2.5 kg and kraft drum of 25 kg net. The preliminary impregnation of the masterbatch with base resin can be done in original packaging.

Graphistrength® C S1-25 should be stored in dry place, preferably in its sealed original container, at temperatures between 0 and 40°C. In these storage conditions, shelf life is more than one year.

Consult the product's MSDS for additional information on properties, hazards and handling.

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