

EPOXY MASTERBATCH

TECHNICAL DATA SHEET

Description

Graphistrength® C S1-25 is a Multi Wall carbon Nanotubes (MWNT) masterbatch that is used as an additive for thermoset-based composites, coatings or adhesives. It contains perfectly dispersed MWNT at a concentration of 25% by weight.

Graphistrength® C S1-25 is designed for the production of high performance epoxy materials. It is based on DGEBA monomer, bis-phenol A grade, that makes it compatible with most of epoxy based thermoset formulations. Graphistrength® C S1-25 is intended for use in electrostatic discharge (ESD) protection or mechanical reinforcement of composites, coatings and adhesives. 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⁾
Epoxy value	ISO 3000	Eq/Kg	3.91 – 4.03
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, targeted performances, processing methods and conditions.

The typical electrical resistivity that can be achieved is in the range of $10 - 10^8$ 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.

Example of mechanical properties in composites

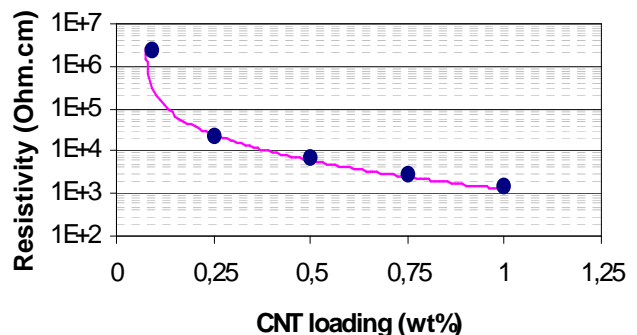
Carbon fabric impregnated with	Tensile modulus (GPa)	Compression strength (MPa)	ILSS* (MPa)	G1c (J/m ²)
Neat epoxy	54.7	495	59.3	600
Epoxy + C S1-25	58.0	575	67.1	850
Improvement	+6%	+16%	+13%	+42%

Results obtained on composites containing 50 vol% of fibers, impregnated with a 1wt% 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 guide

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 softening process. 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. The use of impeller type of mixer, even at high rotation speed, will lead to poor dispersion qualities. For optimal results, a Silverson LR4T should be used at 5,000 rpm for 30 min. Three-roll mills also give excellent 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 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 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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