



*Enabling Breakthrough Performance Today Through Nano Materials*

## **Carbon Nanotubes Dispersion Guideline**

Carbon nanotubes, as made, often exist as entangled agglomerates. In order to fully utilize the unique properties of this special material, appropriate dispersion procedure has to be applied. Here are a few recommendations that we feel may help to achieve this goal.

### **Carbon Nanotube Dispersion – High Viscosity Material**

There are basically three ways of incorporating carbon nanotubes (CNTs) into high viscosity melts:

- Melt impregnation
- Solvent impregnation.
- In-situ polymerization

Melt impregnation is generally accepted as the easiest approach. In order to achieve even distribution of the carbon nanotubes, the naturally occurring agglomerates of CNTs must be dispersed. This will require high shear forces. However, care must be taken in order to achieve the optimum dispersion of the CNTs while minimizing any potential breakage or degradation of the conductive fillers.

Excellent dispersion results can be achieved by processing the thermoplastic materials in a twin screw extruder. A twin screw extruder can be used for the production of compounds as well as masterbatches. Masterbatches containing a high concentration of CNTs in a polymer matrix can be diluted in either single screw or twin screw extruders.

For rubber materials we recommend the use of standard Banbury equipment, or three roll mill.

### **Carbon Nanotube Dispersion – Medium Viscosity Material**

Carbon nanotubes (CNTs) can be dispersed in medium viscosity media such as polyols or epoxide prepolymers by processing those in a three roll mill or a torus mill. Ultrasonic treatment is also suitable if the viscosity of the matrix is low and

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the concentration of CNTs is not too high (e.g. < 2%). We have found that CNT agglomerates cannot be dispersed by using high speed stirrers or dissolver discs.

### **Carbon Nanotube Dispersion – Low Viscosity Material**

Carbon nanotubes (CNTs) can be dispersed in low viscosity media such as water and organic solvents by using a jet disperser. Ultrasonic treatment is also suitable. Ultra Turrax®, rotor stator or Dispermat® are not effective for dispersing CNTs. Stabilizers (surfactant) need to be added to aqueous dispersions, in particular, to ensure that the nanotubes do not reaggregate. Example of suitable surfactants includes sodium dodecyl sulphate (SDS), dodecylbenzene sulfonate. (NaDDBS), etc.

Please contact CNano Technology if you have any questions or comments.

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