



Facts About Agglomerates and Platelets

The growing trends of increased power packed in small electrical and electronic devices poses the challenge of achieving a long and reliable service life by efficiently dissipating heat from the device assembly.

The importance of a good thermal management system is forcing the mechanical designers to evaluate various alternatives and optimize the system-level design from a thermal standpoint prior to the prototype phase. Some of the ways manufacturers are addressing this challenge are improved heat sink designs, high efficiency circuit boards, high thermal conductivity enclosures and other advanced thermal design techniques.

CarboTherm™ thermal management fillers offer a proven heat management solution utilizing the unique thermal, mechanical and electrical properties of Boron Nitride. With its low dielectric constant, high thermal conductivity, and non-abrading properties, CarboTherm enables the most efficient heat management tool for the demanding thermal management challenges of today.

CARBOTHERM PARTICLE MORPHOLOGY

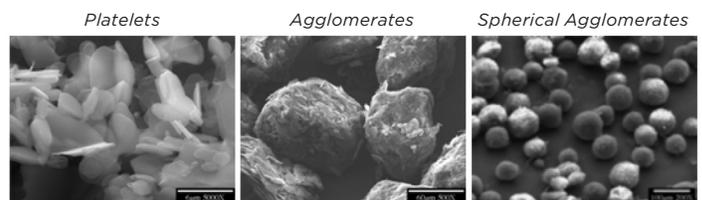
The individual crystals of hexagonal Boron Nitride are inherently platy, similar to graphite.

CarboTherm fillers are produced in many particle sizes and distributions for product thicknesses that are <3 mils to over >20 mils, including a wide range of standard commercial grades as well as customized specifications, as single crystal platelets and polycrystalline agglomerates.

CarboTherm Platelets are fine platy particles with an average particle size from 0.5 to 30 microns. Because of their small particle size, high thermal conductivity and low impact on viscosity due to the particle morphology,

CarboTherm platelets are ideal for thin, heat-spreading thermoplastics that use high shear processing, commonly used for high-volume, cost-efficient applications.

CarboTherm low-density and high-density agglomerates on the other hand, due to their granular morphology, coarse low density grains and isotropic thermal conductivity allow for more efficient particle packing, less interfacial resistance with the polymer resins and improved thermal path through the plane. These properties make CarboTherm agglomerates an ideal candidate for thermosets and thermoplastics utilizing low to medium shear processing, for applications over 4 mil that require through plane thermal dissipation.



CarboTherm spherical agglomerates, specially processed to allow a precise control of surface area, tap density and crystal chemistry, offer the maximum particle loading for low shear processing applications where the highest thermal performance is required.

CARBOTHERM VS. OTHER COMMON FILLERS

CarboTherm Boron Nitride leads the thermal filler applications with its highest thermal conductivity and low dielectric constant. Besides, low density compared to competitive fillers enables high loading volumes and reduced total filler cost.

Filler	CarboTherm	AlN	Al ₂ O ₃
Thermal Conductivity (W/mK)	30-150	100-250	20-30
Theoretical Density (g/cc)	2.2	3.3	3.9
Agglomerate Porosity (%)	40-70	0	0
Dielectric Constant	4	9	9

Thermal Management Fillers

EFFECT OF THERMAL CONDUCTIVITY

The first factor to consider in thermal design of a system is the inherent thermal conductivity of the thermal interface material (TIM) being used. For a given material, the number of particle-to-particle interfacial contacts between the two heat-transfer surfaces and the material composition controls the overall thermal conductivity of the system.

For example, a typical polymer composite with Boron Nitride filler will yield thermal conductivity of 10W/m-K, even though the thermal conductivity of a single-crystal Boron Nitride is up to 300 W/m-K.

The filler plays an extremely important role in improving the thermal conductivity of the polymer composite. Equally important properties are its density, non-abrading properties and ability for customization for a given application.

EFFECT OF PARTICLE LOADING

Fine, platy CarboTherm platelets are easily dispersed in resins to increase their thermal conductivity, and provide excellent spread thermal conductivity high-volume, cost sensitive thermoplastic applications using high-shear processing. Platelet particles, however, align in processing and are surrounded by a sea of resin resulting in few contact points through the plane (in TIM's) or through the bulk (injection molded compounds).

CarboTherm™ agglomerates, on the other hand, due to their granular structure and isotropic thermal conductivity, allow for excellent through plane thermal conductivity at low filler loading.

Overall, filler loading specific to an application is a function of many variables - resin systems, viscosity, processing conditions, target thermal conductivity, as well as other desirable properties of the end product.

EFFECT OF PARTICLE SIZE ON A SPECIFIC APPLICATION

As a general guideline, the maximum filler diameter should roughly equal 1/2 the film thickness, bond line, or cross section of the part. Besides particle size, other factors such as surface area, particle size-distribution and density all play an equally important role in determining the fit for a specific application.

Saint-Gobain has 50+ years of experience in synthesizing and refining Boron Nitride powders to specific process parameters.

For further information on CarboTherm boron nitride solutions, contact us at bnsales@saint-gobain.com.



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