What is Nano or Ultrafine Precipitated Calcium Carbonate?

Precipitated Calcium Carbonates (PCCs) are manufactured or synthesized calcium carbonates, which can be prepared in many different crystal sizes and shapes. For an introduction to what PCCs are and how they are made, click here.

A special category of PCC is the ultrafine PCC, or as it is now more commonly known, the nano PCC. Nano particles are those which are less than 100 nanometers or 0.1 microns in size. To help judge what this means: a human hair is between 40 to 120 microns thick. To give you an idea of how small this is you would have to line up 400 ultrafine PCC particles, side by side, to make a line of particles the width of the finest human hair. Very small, indeed!

Nano Precipitated Calcium Carbonates

While the field of nano particle research has exploded in recent years, nano PCCs have been in commercial use for much longer. Specialty Minerals Inc. (SMI) has manufactured nano PCCs for more than 25 years. They have been widely used to make automotive and construction sealants and PVC window profiles.

SMI’s ultrafine PCCs range in particle size from 0.06 microns or 60 nanometers to 0.15 microns or 150 nanometers in median particle size. This is an order of magnitude smaller than the so-called ultrafine ground calcium carbonates, which are typically 0.7 microns. SMI’s PCC tightly controlled precipitation process results in ultrafines that are uniform in shape, size and particle size distribution.

Nano PCCs For Sealant Rheology and Reinforcement

With these extremely small particles, true thixotropic structure can be built in a sealant or other moderately to highly filled product in which control of viscosity, sag, slump and other rheological properties is needed. These ultrafine PCC particles also act as a semi-reinforcing filler, for strong physical performance. PVC plastisols, urethanes, silicones, polysulfides, and silylated polyethers are some of the types of high performance, long-lived automotive and construction sealants that use nano PCCs.

Nano PCCs For Rigid PVCs

In rigid polyvinyl chloride, nano PCCs can act as impact modifiers, providing the impact strength, even at very low temperatures, needed for PVC window profiles (which are used to form the frame of vinyl windows). When formulating with a nano PCC, replacing a larger sized ground calcium carbonate (GCC), the amount of expensive acrylic or chlorinated polyethylene (CPE) impact modifier used can be substantially reduced, saving money. Nano PCCs also give the highest gloss and best surface finish to PVC window profile extrusions.

Other Uses For Nano PCCs

Nano PCCs are also used in lithographic or offset inks. In highly filled litho inks, they can serve as the main rheological additive and cost-reducing filler. In lightly filled offset inks, they can extend other more expensive thickeners, as well as replace oils and varnishes. Nano PCCs thicken PVC plastisol silk screen inks. Gravure inks need very low abrasion fillers. Small particle-sized PCC is excellent here.

Rheology and filling are also the reasons to use ultrafine PCCs in epoxy and other adhesives, as well as in unsaturated polyester gel coats.

Other uses include:

- High strength reinforcement of rubber
- Detackification and mold release for thin gauge surgical and other medical gloves
- Nucleating agent in emulsion polymerization
- Carrier for catalysts, peroxides, fragrances
- Powder flow control additive for acrylic modifiers and other sticky products.
The uncoated nano PCC products can be used for fortifying beverages such as cow’s milk and soy milk. By using a calcium carbonate with a very small particle size, the calcium fortifier stays suspended much longer, making a better tasting and appearing product.

Why Are Some PCCs Coated?
Ultrafine PCCs are often coated with a low percentage (1-3 percent) of a fatty acid, such as stearic acid, or other organic material, for use in non-aqueous systems like plastics, rubber and sealants. These coatings increase the dispersibility of the PCC in the system's polymer and its compatibility with the polymer, which maximizes the rheological and / or reinforcing efficiency of the PCC.

The choice of coating depends on the type of polymer the ultrafine PCC will be used in and the type of rheology desired. As polymers vary widely in polarity and solubility constants, different organics are chosen to give the best compatibility and/or the best balance of rheological and physical properties. Two ultrafine PCCs coated with the same amount of different organic materials can produce very different viscosities, degrees of shear thinning, and controls of sag and slump.

SMI’s Nano PCCs
The Calofort® nano PCCs made at the SMI Birmingham plant in the United Kingdom include uncoated Calofort® U nano PCC and the stearic acid coated Calofort® S, SV and SM nano PCC.

In the United States, stearic acid coated Ultra-Pflex® nano PCC is manufactured at Adams, Massachusetts. Coated Thixo-Carb® 300, 500 and HP PCCs come from Adams. The uncoated nano PCC sold in the U.S. is Multifex-MM® PCC, manufactured by us in the U.K.

Learn more:
- What is Precipitated Calcium Carbonate (PCC)?
- Specialty applications for Specialty Minerals nano Precipitated Calcium Carbonate (PCCs)
- SMI products for adhesives and sealants
- SMI products for food fortification
- SMI products for inks
- SMI products for plastic
- SMI Performance Minerals plant locations and plant profiles