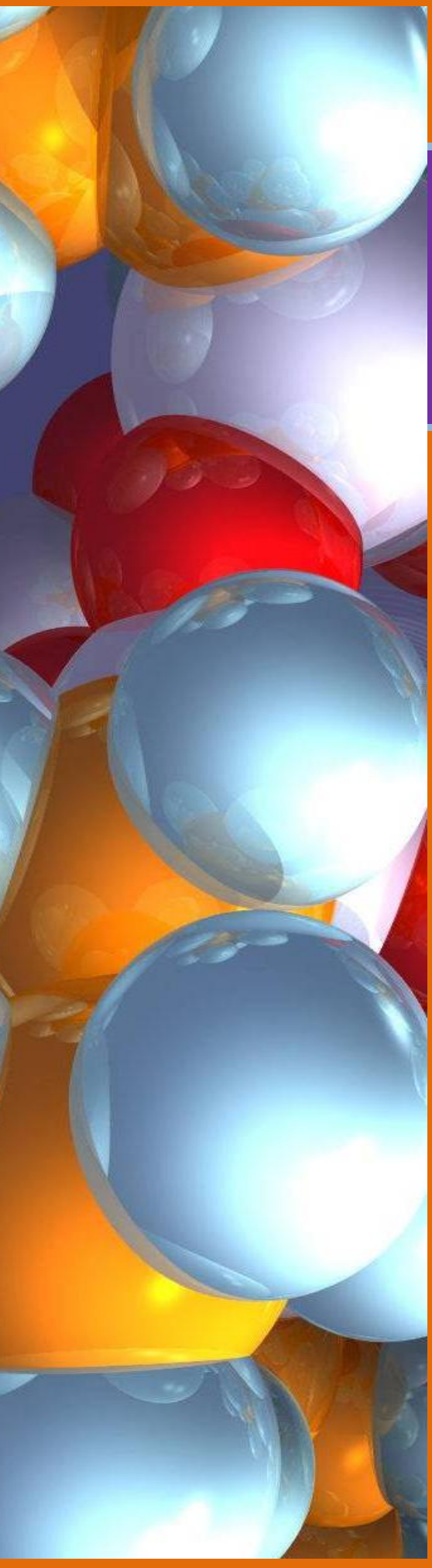


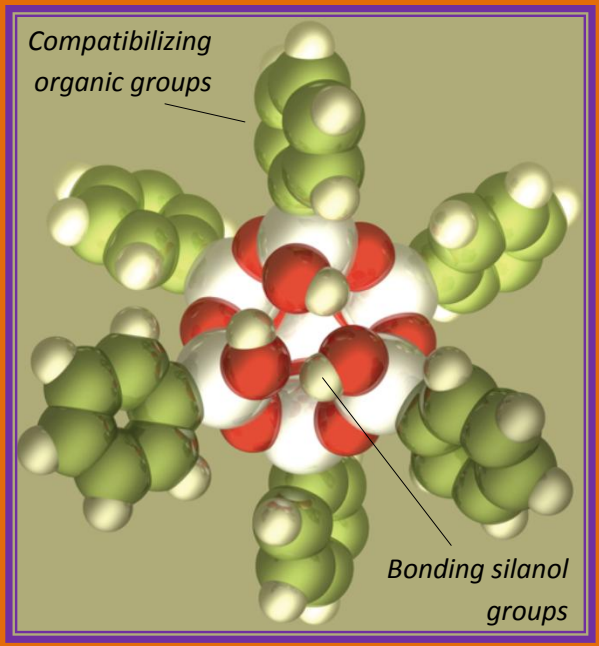
POSS® Dispersants

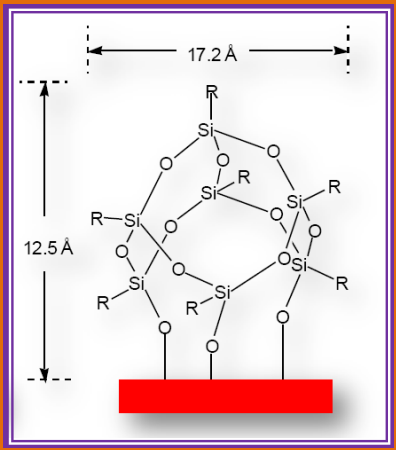
POSS® Dispersants

- High temperature performance
- Better mechanical properties
- Easier processing
- Superior aesthetics
- Effective on all filler types

POSS® Dispersants

Dispersants are widely used on pigments and fillers. Effective dispersants not only reduce formulation viscosity, enabling better processing and higher filler loadings, but they also improve mechanical properties and aesthetics. POSS® Dispersants excel where other dispersants falter, namely at high temperatures. POSS® dispersants are tightly bound to the particle surface and outperform regular dispersants, which desorb and degrade at high temperature.

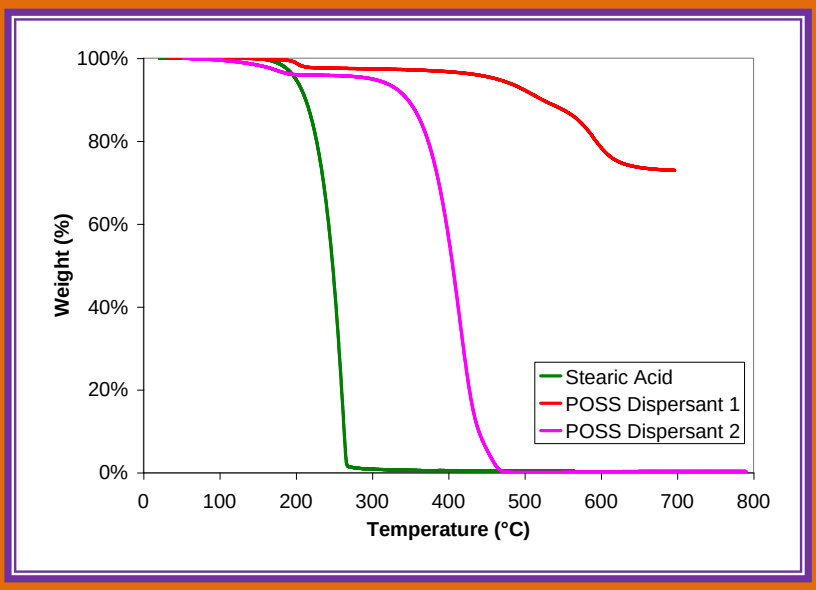




Each POSS® dispersant molecule has three groups to bind it to the particle. This chelate / tridentate action boosts the strength of the bond over conventional monofunctional dispersants that can easily debond. The organic groups on the POSS® are chosen to match the polarity of the matrix polymer or coating for maximum dispersant efficiency.

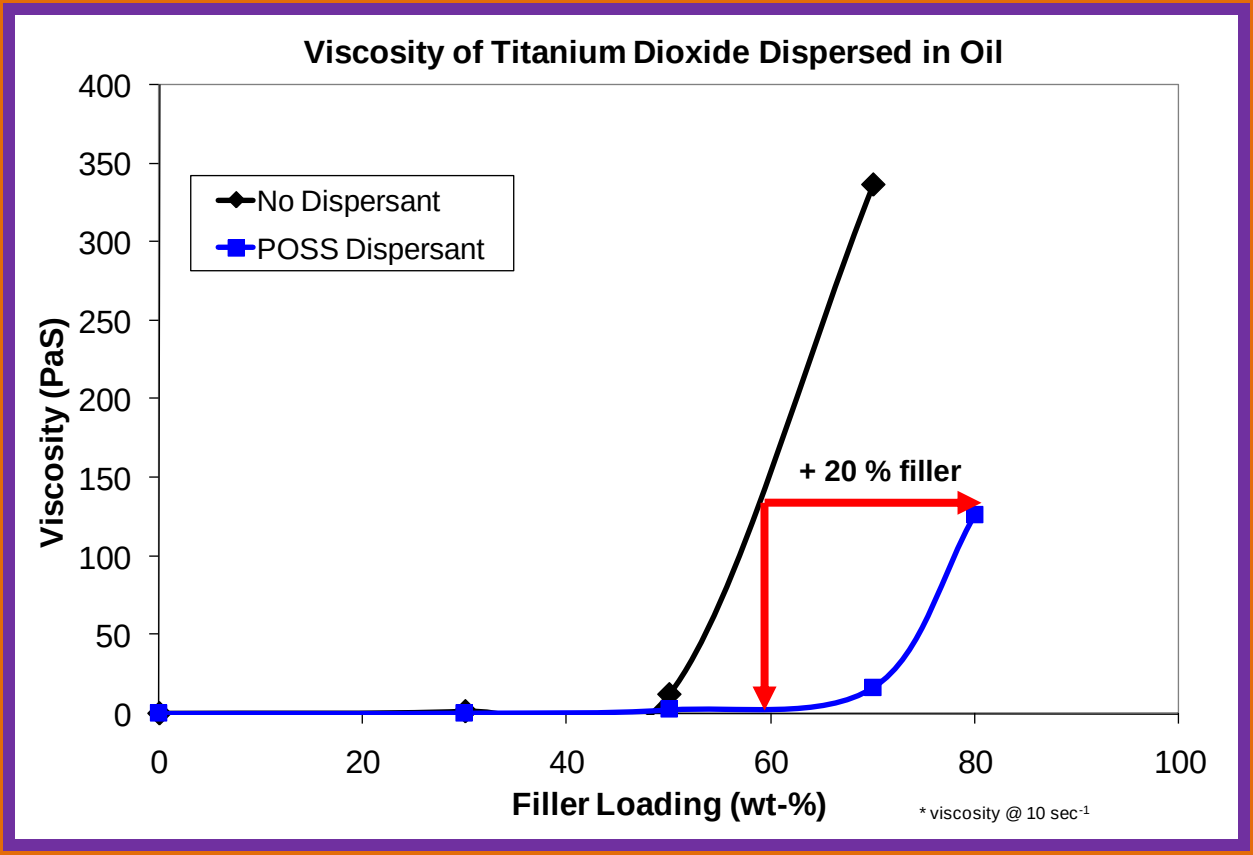
POSS® Dispersants Temperature Stability:

Whereas regular dispersants such as stearic acid degrade around 200°C, POSS® are thermally stable up to over 400°C enabling them to be used in high temperature thermoplastics such as PEEK and PAI or Hybrid Plastics' own ultra high temperature epoxies.



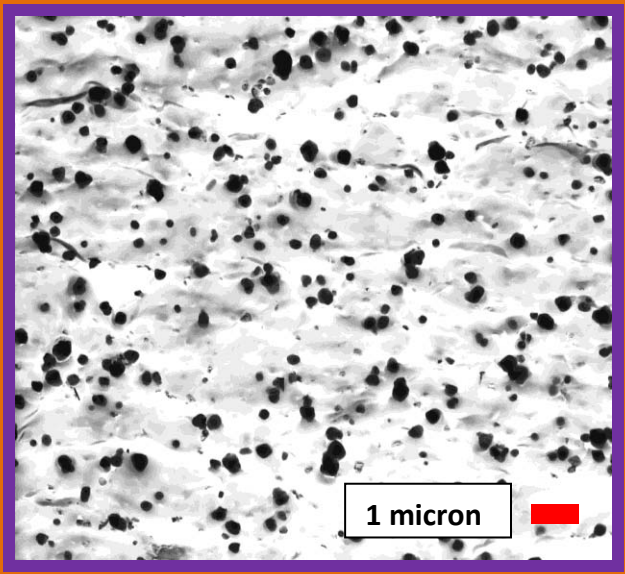
Dispersant Effectiveness: Hybrid Plastics staff has experience developing custom made dispersants for a wide range of different fillers and pigments. Years of development work have led to these new, unique dispersants that not only outperform traditional dispersants at high temperature, but offer other benefits as well. Compared to the industry standard organosilanes, POSS® dispersants offer:

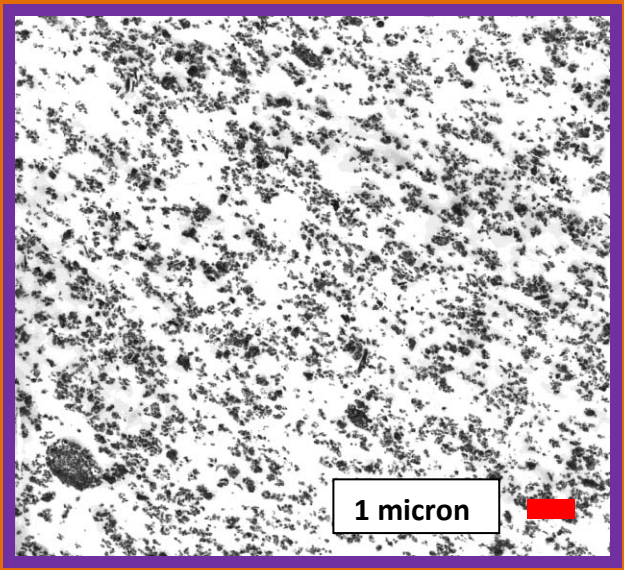
- The dispersant layer is precise, 1-2nm in thickness depending upon the POSS® type chosen (thus ideal for nano-particles and quantum dots)
- No VOCs given off when the dispersant binds, only traces of harmless water
- No pre-hydrolysis needed
- Can be added directly to the resin, coating or extruder



The POSS dispersant allows 20% extra filler to be added with no added viscosity compared to untreated filler. Or, at constant filler level, a large drop in viscosity leads to improved processing.

Effective dispersants reduce viscosity by lessening inter-particle interactions. This is the case for POSS® dispersants. Not only can POSS® dispersants outperform the industry standard additives, they keep on working at high temperatures, for example during extrusion of PEEK. This is especially important when high filler loadings are required, such as for thermally conductive compounds.





TiO_2 in PEEK no dispersant **TiO_2 in PEEK with POSS® Dispersant**

The TEMs tell the story and the same dramatic effect is seen with the other particulates. Extra benefits include protecting the polymer from degradation caused by aggressive fillers such as those with transition metal content, or metallic fillers like copper. The POSS® coating on the particle remains intact and prevents the particles from attacking the polymer. This effect has been repeatedly observed using TGA.

POSS® Dispersant Applicability: It is well-recognized that dispersants are only effective on certain fillers. For example, organosilanes work well on siliceous fillers like silica and mica but do not bind to calcium carbonate. Conversely, stearic acid is well-suited to calcium carbonate, but ineffective on silica. Judging by their chemical structure, one might assume that the POSS® trisilanols would perform like organosilanes. In fact, they are found to be effective on the fillers usually treated with organosilanes and also with other fillers normally not receptive to silanes.

- Silica
- Titanium dioxide (standard and special types)
- Hexagonal boron nitride (thermally conductive and lubriceous)
- Mica
- Micaceous iron oxide
- Wollastonite
- Bismuth subcarbonate (x-ray opaque)
- Magnetite (magnetically susceptible and x-ray opaque)
- Calcium carbonate
- Yttrium oxide
- Titanium carbide
- Gadolinium oxide (radiation shielding against thermal neutrons)
- Many others tested…inquire today!

Hybrid Plastics is one of the top 10 nanotechnology companies in the United States. It is a spin-off of the Air Force Research Laboratory at Edwards Air Force Base in California. POSS® technology is the only major category of nanotechnology which remains controlled by one company. In 2005, the President of the United States designated POSS® technology to be in the strategic national interest of the United States.

The POSS® (Polyhedral Oligomeric Silsesquioxane) compounds are being hailed as the next big leap in plastics and molecular technology, and represent the first new class of chemical feedstocks to be developed in 50 years. They are affordable and cost competitive, and represent an entirely new, recyclable polymer feedstock - one that *marries the beneficial properties of plastics (processability and toughness) with those of ceramics (hardness and stability*). Significantly, POSS® based technology allows substantial redirection to more innocuous and abundant natural resources. *Silicates and sand are the equivalent of crude oil for POSS® Nanostructured® materials.* Finally, the POSS® technology can be incorporated directly into existing formulations without modifying manufacturing processes. The result is immediate turn-key applicability and usability.

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