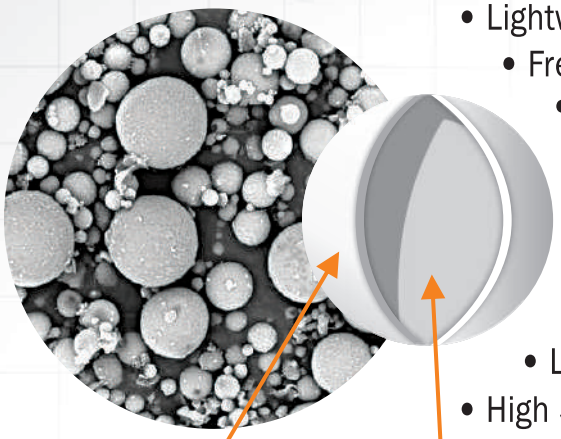
NANOVISION
Special Fillers

Hollow Ceramic Microspheres - Cenospheres



- Lightweight
- Free-Flowing
- Spherical Shape
- High Melting Point
- Bulk Filler for Grout
- Improved Workability
- Solid Shell (non-porous)
- Low Water or Resin Demand
- High Strength-to-Weight Ratio

Surface Strength 3000 psi

Nitrogen or Carbon Dioxide negative pressurized

Granule sizes : 100-125-150-300-500μm

Hollow Ceramic Microspheres (HCM) or "Cenospheres" are inert, hollow microparticles made largely of silica and alumina, filled with gas negatively pressurised (mostly carbon dioxide and/or nitrogen). They are extremely resistant to high temperatures, as high melting points are required to achieve their strong ceramic surface. So the final material resulted, makes hollow drops come from a rapid cooling process. They are ideal particles providing lowest surface area to volume ratio of any shape. This fact results in a lower resin and binder demand, permitting formulations with high filler loadings, lower viscosities and reduced VOC's, compared to irregular shaped fillers.

Typical Physical Properties (Not for specification purposes)

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O eqv	LOI (950 °C)
> 55	> 31	< 3	> 2	< 1	> 1	≤ 2.0%

Softening point approx. °C	1550
Water absorption by mass %	16-18
Thermal conductivity W/mk	0.11
True Density gr/cm^3	0,80-0,92
Crush Strength psi	1600 -3000
Hardness Mohs Scale	5 – 6
Water content (100 °C)	0,5

High Melting Point

Cenospheres are formed at approx 1400 - 1500 degrees centigrade, resulting in an inert and durable material, ideally suited for high temperature resistant applications where excellent thermal insulation, fire resistance and high strength to weight ratio are required.

Lightweight

The light weight of Cenospheres contributes to low transport costs and therefore benefits our planet as well as the humanity's future. Formulating low density products with Cenospheres makes the use of materials easier during production and improves safety. Cenospheres are used in a wide variety of materials, from paints and finishes to plastics and caulking. Even though they are very successful in cementitious applications, their use is not widely known. Cenospheres have a couple of uses in concrete applications, such as mortars, due to their ability as:

- Workability enhancer and extra-fine aggregate, and
- Bulk filler and shrinkage reducer in cement grouts.

The advantage of Cenospheres over lightweight aggregates is that they are essentially "invisible" in the concrete, even when it is ground and polished.

Densities of Common Fillers

Barium Sulfate	4.50 g/cc
Titanium Dioxide	4.17 g/cc
Wollastonite	2.99 g/cc
Talc	2.80 g/cc
Calcium Carbonate	2.71 g/cc
Feldspar	2.65 g/cc
Sand	2.6 g/cc
Alumina Trihydrate	2.42 g/cc
Clay	2.20 g/cc
Fumed Silica	2.10 g/cc
Cenospheres	**0.80 – 0.92 g/cc**
Perlite	0.15 g/cc

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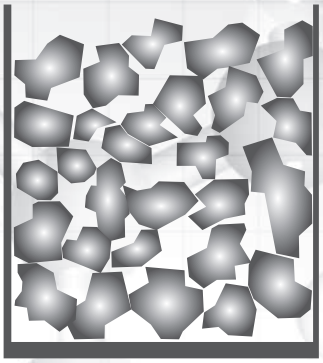
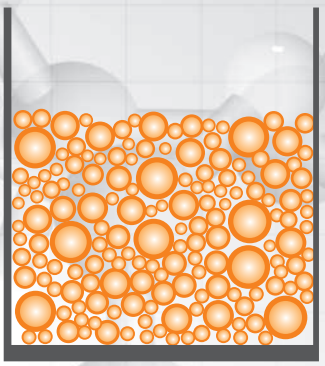
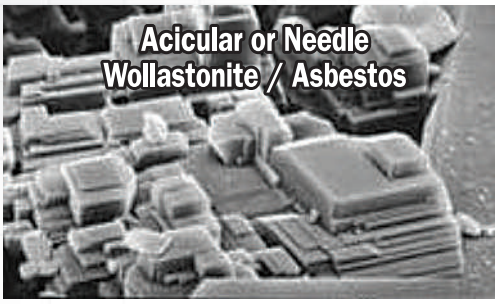
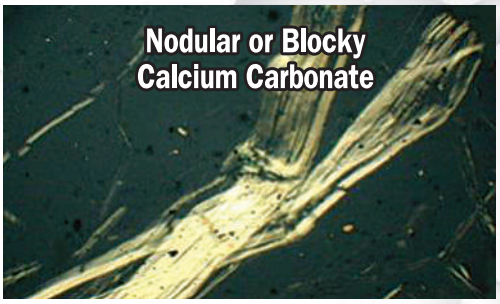
Spherical shape and Workability

As Cenospheres are very small spherical particles, they behave like tiny bearings into a concrete or any other matrices. Thus adding Cenospheres to the conventional concrete mix can improve workability. Since Cenospheres are also a structural aggregate, they improve concrete density and strength by providing better inert packing density. In addition, the added fine aggregates improve trowelability and finishability of the application. Typically dosages of 1% to 5% by weight of aggregate added to a concrete mix are enough to enhance workability.
Improved flow and workability are desirable features in a range of applications, such as: Oil well Cementing, Refractories & Foundries, Cementitious Construction Products, Joint-Compounds, Bitumen Sound-Dampening, Adhesives, and many more.





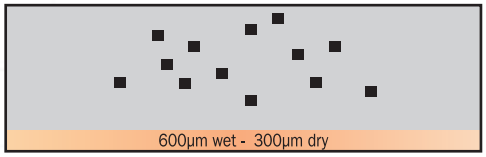




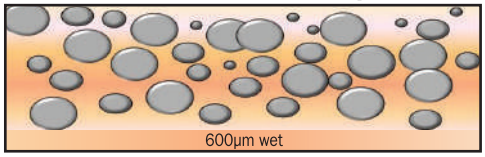
Drying process in paints and coatings

When microspheres are mixed into paint or coating, the painted surface dries to a tightly packed layer of hollow microspheres. The tightly packed film results in a thick thermo-insulating and acoustic dampering surface.

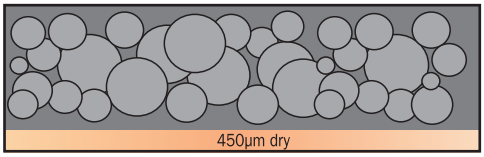
Standard Paint without Cenospheres



Wet Paint film with Cenospheres



Dry Paint film with Cenospheres



Use of Cenospheres

• In Paints and Coatings

The uniformed spherical shape of Cenospheres has a lower surface area than other irregularly shaped fillers and some other pigments, which means lower resin use. Another advantage of their spherical shape is the ability to rotate between them, so there is minimal effect on viscosity when added to a liquid. As coatings end products are manufactured by weight and sold by volume, microspheres increase the solid content of the coating, while decrease the weight, keeping the rest application characteristics and the flow properties constant. Additionally, higher volume solids reduce VOC, shrinkage and drying time. Cenospheres, when used in coatings or other composites, exhibit special mechanical and heat-insulation properties. In many countries, heat insulation by coatings applications is achieved by adding hollow microspheres in acrylic-based matrices. Many coatings are developed with high absorbance in the visible regime (400-700nm, up to 45% total sunlight) or/and very low emissivity in the Near IR regime (700-2500 nm up to 49% hot feeling sunlight) either for architectural paints or industrial coatings.

• As a Thermal Insulation Material

The encapsulated air and inert gas into the cavity of Cenospheres consists a bad conductor of heat, because heat is only transmitted by currents. Cenospheres act as heat insulators and can therefore be used as thermal insulation material in coatings. This feature of Cenospheres allows improved thermal and acoustic properties of coatings or composite materials. Currently, markets that take advantage of these specific properties also produce fire retardants, sensitive acoustic aids and, of course, roof coatings.

• As Bulk Filler for Grout

Since Cenospheres are very fine and generally light in color, they are ideal for use in the cement grout (slurry) used to fill pinholes. Not only does the added bulk from the Cenospheres increase the volume of grout without adding more cement, but also the fine aggregate gradation of the particles helps to reduce shrinkage of the application. Finally, the spherical shapes are more likely to "roll" into small holes better than jagged or angular crushed particles. Typical Cenospheres dosages for grout are around 10% to 30% by weight of cement.

Potential Applications of Cenospheres

- All types of roofs - flat or sloping, made of concrete, metal
- Side walls of houses and buildings, hotels, hospitals, offices
- Roofs and side walls of large halls, control towers, construction sites
- Insulation in air conditioning pipes, steam systems, hot water pipes, boilers
- Outer storage of crude oil, chemicals, solvents, gas, oil, petrochemicals
- Wheat silage, refrigeration chambers, refrigerators
- Exterior roofs of transport vehicles, railway trains and passenger buses

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