

## Cenospheres as an industrial filler

### Introduction

Cenospheres are unique free flowing powders composed of hard shelled, hollow, minute spheres. A small proportion of the pulverised fuel ash (PFA) produced from the combustion of coal in power stations is formed as cenospheres. The main characteristics are:

- Hollow spheres with spherical morphology.
- Particle sizes ranging from 5 to 500µm in size.
- Ultra low density.
- Low thermal conductivity.
- High particle strength.
- Resistant to acids.
- Low water absorption.

### Applications

The main application is that of an inert filler. With a density lower than water (typically 0.6 – 0.8) cenospheres provide up to four times the bulking capacity of normal weight fillers. The microspherical shape dramatically improves the rheology of fillers, whether in wet or dry applications. It is an extremely stable material. It does not absorb water and is resistant to most acids. As it is a refractory material it can resist high temperatures.

Cenospheres can be used in plastics, GRP, light weight panels, refractory tiles and almost anywhere traditional fillers can be used. As a result of their flexibility they are used in many high technology and traditional industries. Aerospace, hovercraft, carpet backing, window glazing putty, concrete repair materials, horticultural use, brake and clutch linings, intumescent coatings, insulating and refractory products and off shore oil and gas production industries are just some of the applications for these unique fillers.



### Physical Properties

**Particle size** - In their raw form cenospheres have a continuous particle size distribution from sub-micron to around 500µm. Cenospheres can be classified to particular particle size distributions.

**Hardness** - Mohs scale 5.

**Thermal conductivity** – As cenospheres are hollow they have a relatively low coefficient of thermal conductivity, 0.11 W/m.K.

**Dielectric Properties** - Cenospheres conduct very little electricity and are ideal for use in insulators.

**Melting Temperature** – Cenospheres are extremely resistant to heat and typically have a melting point ranging between 1200 to 1350C.



**Density** - The average particle density is around 0.6 to 0.8g/cm<sup>3</sup> but varies depending on the size fraction. By selecting various size fractions densities as low as 0.3g/cm<sup>3</sup> can be achieved. In general the smaller the size fraction the lower the density. Bulk density ranges from 0.35 to 0.45g/cm<sup>3</sup>. The density of the shell material varies between 2.0 to 2.4g/cm<sup>3</sup> with an average wall thickness of 5 to 10% of the sphere diameter.

**Chemical Composition** - The cenosphere shell contains typically:

- 55 to 65% of SiO<sub>2</sub>
- 25 to 35% of Al<sub>2</sub>O<sub>3</sub>
- 1 to 5% of Fe<sub>2</sub>O<sub>3</sub>
- The central voids contains typically 70% CO<sub>2</sub> and 30% N<sub>2</sub> in gaseous form.

**Water absorption** - Cenospheres have virtually no water absorbing properties. The typical moisture content of processed cenospheres is 0.3%.

**Chemical Resistance** - The alumino-silicate shell is particularly resistant to acidic environments. However, like most glasses, cenospheres are not resistant to strong alkalis.

