Avoiding Eddy Current in Magnetic Drive Pumps

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A look at new ceramic spacer cans that are non-magnetic with elasticity similar to steel.

Ceramic materials are often associated with commodities for domestic use; the porcelain and stoneware used to make cups, plates, tiles and bowls are regarded as useful but brittle. The other type of ceramics, "engineered ceramics" such as Alumina (Al_2O_3), Zirconium dioxide (ZrO_2) or Silicon Carbide (SiC), are classified by their nonmetallic and inorganic structure.

These engineered ceramics have clearly defined technical properties with a wide application range.

Zirconium dioxide (ZrO_2) is an outstanding engineered ceramic with elasticity similar to steel after its microstructure is chemically stabilized. In combination with modern tools and special machining designed to handle materials with special properties, new products can be developed that can replace steel or high alloys in some applications.

FRIATEC has developed and supplied spacer cans or containment shells made from Magnesia stabilised Zirconium dioxide (FZM®) with proven reliability and performance in more than 1,500 pumps worldwide.

FZM® is a ceramic material with a high bending strength of 500-MPa combined with a young's modulus (E-module) of 200-GPa. This gives the spacer can the necessary reserve in elasticity similar to steel.

Due to a beneficial thermal expansion coefficient of 10 (10^{-6}/K), this material can be combined with steel or grey cast iron without any fear of thermal stress.

This material is also non-magnetic, so it will not be affected by a rotating magnetic field.

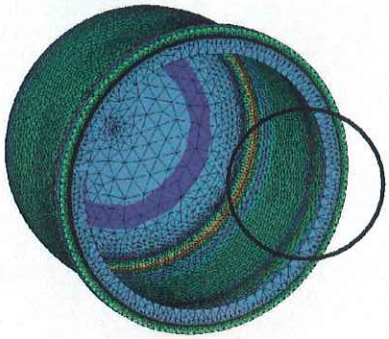

Figure 1. FEM – Calculation

With metallic materials inside a rotating magnetic field, eddy current will be automatically created, resulting in higher temperatures and heating of metal components. Without cooling, a metallic spacer will easily reach a temperature of 300-deg C (572-deg F) within a few minutes.

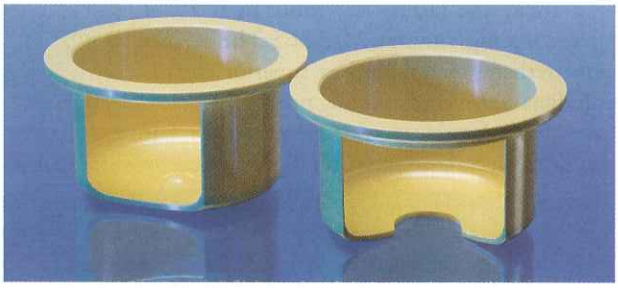

Figure 2. Ceramic spacer cans with 1.8 mm wall thickness

Eddy current can have a tremendous negative impact on the liquid if pumped close to the boiling point. If the liquid starts boiling in a mag-drive pump during operation, the bearings will loose lubrication and the whole pump will suffer serious damage. Ceramic spacer cans are completely unaffected by magnetic fields since they are nonmetallic. No critical heating will occur. Even under normal conditions the non-magnetic properties of this material help save energy that otherwise would be wasted by eddy current in the metal.

The chemical and thermal resistance of is comparable to other ceramics—a great range of liquids including organics and acids, except boiling concentrated sulphuric acid or fluoride-containing media, can be pumped without any corrosion.

Spacer cans made of this material have a wall thickness of 1.8-mm, a maximum outer diameter of 180-mm and a maximum length of 250-mm.

Tests have been successfully performed under critical conditions such as 100-bar (1,450-psi) pressure in water at 25-deg C (77-deg F) and 30-bar (435-psi) in hot oil at 200-deg C (392-deg F).

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