

Oxide Ceramics: Their Potential and Typical Applications

FRIATEC stands for customer-oriented special solutions up to large product series based on oxide ceramics.



Fig. 1
Positioning pins with wear protection made of ceramic for automotive industry.
(source: FRIATEC AG)

A growing number of innovative machine engineering components

Oxide ceramics present an alternative material for a considerable number of exclusive machine components. Their unique combination of material properties widens design freedom. Material properties, with allowance for economic manufacturing processes, combined with application-relevant engineering deliver successful solutions.

Physical material data must be interpreted in combination with requirement specifications aligned to finding a solution. Know-

Keywords

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ledge of the characteristic strengths and weaknesses of ceramic materials is crucial. Generally, successful design helps the material used overcome any weaknesses in order to optimally utilize its strengths. Application-oriented component design is therefore essential if ceramics are to be introduced. Merely changing the material of a component while keeping the metallic or plastics-based design does not bring the desired success. Collaboration and interaction between user, designer and ceramics manufacturer is a precondition for the success of ventures in ceramics.

The following typical examples show a small selection of the innumerable typical applications of high-performance ceramics. For many problems, ceramics offer the optimum solution both in technical and economic terms.

Pistons/cylinder units

Conveying, pumping and metering of liquids present the manufacturers of filling plants with high requirements. Metering accuracy, purity of the product and aseptic cleaning of the entire plant must be reproducible and managed reliably. Especially in the foodstuffs and pharmaceuticals industry, these aspects have key importance.

For piston fillers in a metallic design, elastomer sealing elements similar to the piston rings in combustion engines are essential for sealing and function. It is difficult to reliably remove dirt and bacteria from such seals. Cleaning cycles are both complex and costly. For designs with sealing elements made of rubber and plastic, sterilisation is always difficult and unsafe.

This is where the seal-less solution approach comes in: ceramic pistons glide almost clearance-free (clearance <math><10 \mu\text{m}</math>) in ceramic cylinders. Wear is extremely low and in addition biocompatible. The undesirable sealing elements can be eliminated. Cleaning and sterilization of the system is simplified and much safer with the use of ceramics.

In the manufacture of medical equipment, careful conveying of liquids in combination with reliable sterilization is a demanding application. For the safe function of dialysis equipment, the ceramics-based solution has already proven effective thousands of times over. For filling foodstuffs too, the machine manufacturer relies on the use of pistons and cylinders made of ceramic, which are fitted seal-less thanks to precision grinding technology.

The demanding automotive industry too is looking for materials that meet the extraordinary requirements. The exact positioning of metal parts for automated welding processes is possible with wear-resistant positioning and welding pins. Satisfactory accuracy of welding groups can only be maintained at a constantly high level providing the positioning pins exhibit high abrasion resistance.

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On account of malfunctions during start-up of a plant or occasionally during operation, ceramic pins can be exposed to impact or bending stresses. For this load, the metallic toughness of the pin is desirable. With the high-performance ceramic rod version from FRIALIT-DEGUSSIT, the advantages of metal and ceramics are combined with toughness and wear resistance in one component. Especially for small centring diameters, this design principle has proven optimal.

A host of automotive manufacturers worldwide have convinced themselves of the reliable performance of this design and profit from the low tool costs and higher productivity thanks to reduced downtime.

Flow metering

Pipelines in plant engineering convey considerable quantities of liquid products that have to be precisely metered and recorded. For filling foodstuffs, accurate determination of flow rates is of essential importance.

With magnetic-inductive flow metering, a high-accuracy electromagnetic measurement principle is available to the industry. The electric conductivity of almost all liquids is used for magnetic-inductive flow metering. In the pipeline, the extremely accurate measurement process does not cause any additional flow resistance, as known from impellers or floats.

For the sleeves of the magnetic inductive flowmeter an electrically insulating non-magnetic material is needed, which can withstand high pressures with sufficient mechanical strength and does not suffer any chemical decomposition on contact with aggressive acids and lyes. For the measurement, a pipe made of electrically insulating material is needed.

These wide-ranging material requirements are optimally met with the properties profile of FRIALIT oxide ceramic. A patented electrode system enables the reliable recording of the measurement signal. High accuracy in universal use is the recipe for success for this technology.

Pipes with a wide array of profiles are available to the user in lengths to 2 m and more. The outstanding material properties give these sections a wide range of application. The material DEGUSSIT AL23 has proven particularly effective in exposure to high temperatures and corrosion by liquids

and gases. Without the precision components made of oxide ceramics, dilatometry for characterization of materials based on temperature-dependent dimensional changes would not be feasible at this level of sensitivity. In thermogravimetry, marginal weight changes are recorded under temperature influence and evaluated as measurement variables for materials analysis. Components made of DEGUSSIT AL23 protect the sensitive scale against the corrosive reaction atmosphere.

Changing technology profits from the combination and interaction of newly developed high-performance materials, science and design. Interdisciplinary communication is the formula for profitable product development and innovation.



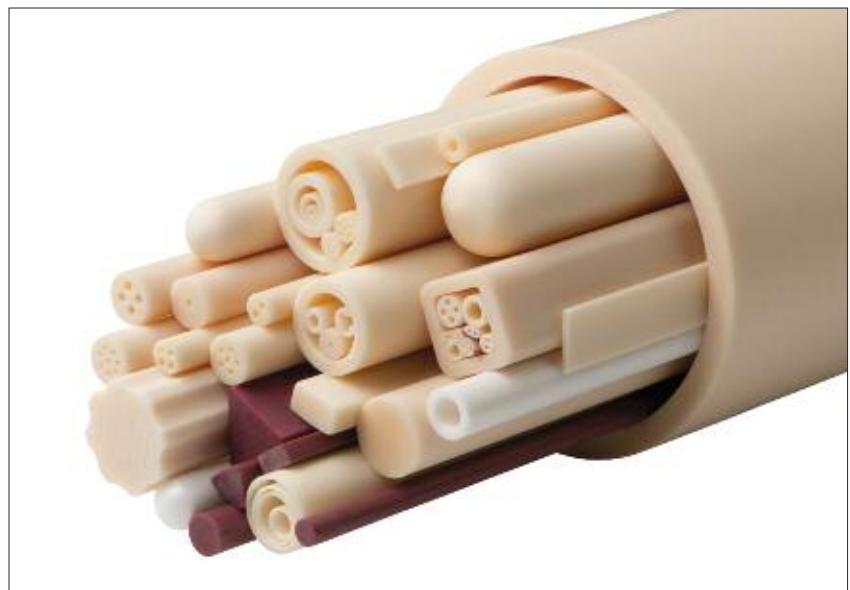
*Fig. 2
Piston cylinder unit; seal-less; sterilisable and therefore extremely low maintenance (source: FRIATEC AG)*



*Fig. 3
Flow meter for level measuring (source: FRIATEC AG)*



*Fig. 4
X-Ray tube for radiology*



*Fig. 5
Pipes made of DEGUSSIT AL23 for high-temperature applications (source: FRIATEC AG)*