EvoCera – as Strong as Ceramic and as Safe as Steel

DOCERAM GmbH/DE, a specialist in high-quality industrial ceramic products, has introduced EvoCera, a completely new ceramic material. It combines the properties of the latest high-performance ceramics with the ductility of steel. Its great advantage is that the strength of EvoCera can be calculated and so the workpiece can be designed based on the Finite Element Method (FEM).

Fig. 1
Design of ceramic components by FEM method

The best of two (material) worlds

High-performance ceramics are characterised by many special properties – such as heat resistance, mechanical stability and dimensional stability. While conventional industrial ceramics are not malleable and break suddenly and unpredictably when subjected to overcritical loads, the new EvoCera permits plastic deformation of up to 1 %, which is therefore comparable to that of steel. The plastic behaviour in response to elastic elongation means that mechanical stresses in the material can be reduced. As a result, EvoCera workpieces retain their high strength even under continuous cyclical loads. The dimensional stability and strength can also be calculated. This makes it possible to produce safety-relevant components in ceramic quality for the first time.

Keywords
ductile ceramic, FEM

Calculable based on the finite element method

The plasticity and strength of EvoCera allow the simulation and design of components based on the FEM, which was only possible up until now with other materials, such as steel and special plastics.

While the strength of conventional industrial ceramics usually scatters over a large range, analyses conducted by DOCERAM show a significantly lower scatter rate in terms of material strength (Weibull module >50). The unintentional failure of an optimally designed component made of EvoCera can be practically ruled out and component calculations can be made based on the FEM.

Many advantages combined in one material

The new material combines many advantages, making it significantly superior to many other materials. EvoCera is highly abrasion, corrosion and temperature resistant, non-magnetisable and electrically insulating. In addition, it has good chemical resistance as well as having great strength and being not thermally conductive. This leads to a long service life and extended maintenance intervals and also avoids unplanned machine downtime, resulting in high process reliability and process quality for general mechanical engineering applications.

Testing with a gripper construction

These properties open up a wide range of applications for the new material.

Components made of EvoCera are, for example, ideal for gripping in automation technology: gripping, moving, setting down, regripping – over and over again. The new material can realise its full potential with these continuous cyclical loads. Its final strength can be predicted even after millions of mechanical loads, as documented in a recent test report.

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In this test report a gripper construction was produced in two variants. The first version of the gripper construction was made based on a maximum strength of 600 MPa determined in standard tests (4-point bending strength). In the subsequent test, the component was fixed to the base and the gripping surface was loaded with 260 N. The FEM calculations yielded load values of 600 ± 13 MPa. The calculated maximum values were attained and could even be exceeded. The scatter rate was also below 2 %, a very low value for ceramic materials. In the second version, the component was optimised for higher loads of up to 310 N. Here too, the calculated values relative to strength could be exceeded and the rupture point could be predicted.

This test proves that components made of EvoCera can be designed in the same way as components made of metallic materials. However the new material offers significant advantages in terms of wear resistance, chemical resistance and its influence on electrical and magnetic fields.

A wide range of possible applications

Whether in chemical plants, sensors/measuring systems, gripping devices for joining processes or inductive heating, EvoCera can impress and fully exploit its advantages. The same applies for pumps, valves and fittings, metering systems, isolators, grinding systems, positioning systems and much more.

Fig. 2
EvoCera component designed for a gripper