Description of the process

Ceramic Injection molding

When flawless injection moulding products are required...

Ceramic-Injection Molding (CIM) by Kläger:
High reproducibility within narrow tolerances

Kläger is one of the pioneers in the field of ceramic injection moulding. Since the middle of the 1990's we have employed us with this production method. Numerous key components for the most diverse applications are manufactured in our company today.

- Complex components
- A shaping step
- Reproducible
- Suitable for large series production

The production process of powder injection moulding is a multi-stage process consisting of the preparation of a plastic highly filled with ceramic particles ("binder"), its injection moulding ("green part"), the debinding ("brown part") as well as the sintering process and a possible product refinement.

While the ceramic powders in many cases have the same origin or at least comparable quality the feedstock systems developed in-house or on the market differ mainly in the carrier materials used. Depending on the type of the so-called binder (carrier material = waxes, POM, PP, PA, PE ...) is the debinding method (thermal with or without separate pre-debinding, catalytic, solvent) required.

In addition to its own material formulations, the plaintiff processes all the materials currently on the market commercially available feedstock systems and offers through their interchangeability a high manufacturing redundancy in the production of the individual products.

Port-Folio	Engineering Mold making Injection molding Systemintegration
Materials	**Oxidkeramiken** ▪ Al2O3 (R 96 – 99,8%) ▪ ZrO2 (Y-stab.) – different colours ▪ Individually adapted mixed oxide ceramics (ZTA, ATZ) ▪ Material development
CIM Injection molding machines	> 10 (25—220 Mp)
Debinding	Thermal Catalytic Solvent
Sintering units	> 20 (8, 50, 250 Ltr.); Selection according to material, geometry and quantity

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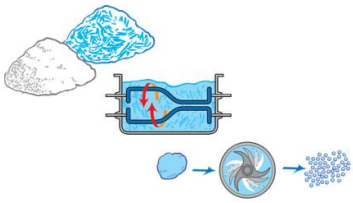
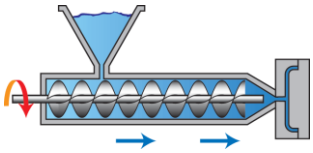
The process



From powder to **feedstock** (selection / preparation / compounding)

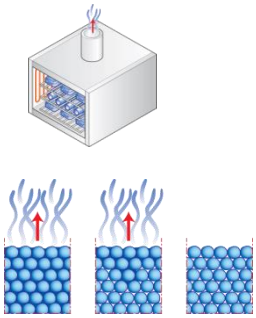
The ceramic powder is selected according to the functional requirements of the finished component. By mixing different ceramic powders, it is also possible to change the material-specific property profile and adapt it to the application. The ceramic powder or powder mixture is then mixed with wax or thermoplastic-based components (binder systems), homogenised and granulated.

This feedstock can be plasticised by means of a binder system and can therefore be used in an injection moulding machine. The necessary melt temperature is determined by the binder system.



Injection Molding, the shaping step.

The plasticized feedstock is injected under pressure into the injection mould. In the mould, the material is cooled down to a solid state and is removed as a finished part after opening the mould. The hollow space (cavity) of the mould determines the shape and surface structure of the finished part. By means of appropriate mould technology, 3-dimensional geometries can be reproduced in one process step.

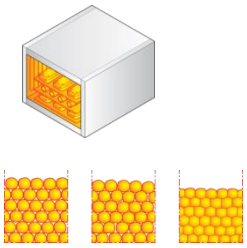


Debinding

The aim of debinding is a complete removal of the organic binder without influencing the geometry of the component and the chemical purity of the material.
Depending on the feedstock, different debinding strategies are required.

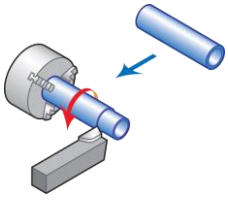
- Thermal
- Catalytic
- Solvents

Kläger has all debinding methods in-house and is therefore able to process different feedstock systems with the identical ceramic powder.



Sintering

The debound parts are sintered at the material-specific temperature (e.g.: Al2O3 - approx. 1,650°C; ZrO2 approx. 1,400°C). The ceramic grains grow together, close the pores created by debinding and form a closed, dense structure. The shrinkage that occurs (depending on the material, between 16 - 28%) is taken into account in the tool design in advance. An adapted temperature control and suitable sintering supports or sintering aids determine a high dimensional stability and component quality.



Optional **Mechanical preparation**

Ideally the components are used "as fired". However, functional (e.g. polished surface; extreme edge sharpness ...) or for dimensional reasons, mechanical reworking may be necessary. In principle, all mechanical processing methods such as surface or cylindrical grinding, vibratory grinding, drilling, lapping, honing, etc. are possible.

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