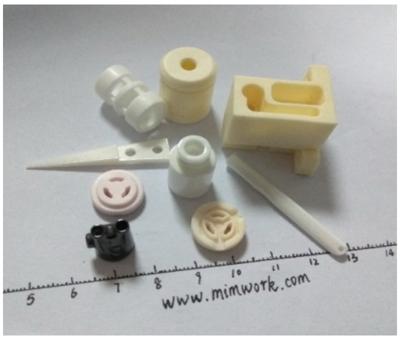
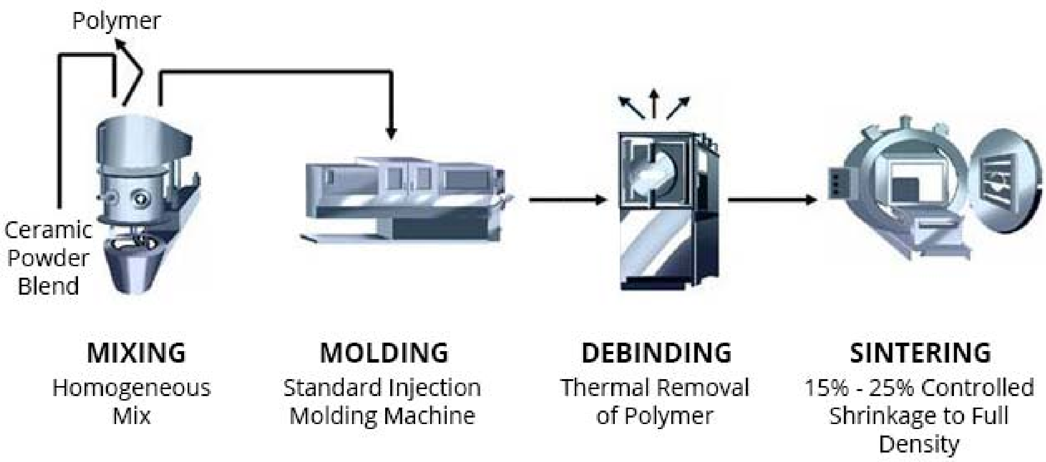
Ceramic Injection Molding (CIM)



Ceramics provide a hard, wear-and corrosion-resistant solution for many engineering challenges that other materials are rarely able to meet. The injection molding of ceramics allows for complex shapes to be created in a process that borrows a great deal from the injection molding of plastics. The technique is suitable for scales of production from one-off research prototypes to mass-produced components for commercial products. Ceramic injection molding (CIM) has been especially effective within the medical field, to make components for pacemakers and surgical instruments that need to be micro-miniature, with exceptional tolerances, as well as being biocompatible.

The most suitable type of ceramic powder is chosen and mixed with a binder that allows the mixture to flow and become moldable. The binder is a key aspect of the molding process and is used because it has a lower melting point than the ceramic powder, which enables the two materials to be separated at a later stage. A specially made machine with greater corrosion strength than the traditional injection molding machines is used to feed the ceramic and binder mix into the mold cavity. The corrosion strength is required because of the abrasiveness of the ceramic that is being molded.

Once the component has cooled the mold is heated until it is just high enough to melt the binder material (but not the ceramic), causing it to evaporate and leave behind just the ceramic material. The finished part can be sintered or undergo hot isostatic pressing (HIP) in order to remove any stresses caused during molding and provide further strengthening.



Quick Guide

Volumes of production

The process allows for complex ceramic parts to be produced in tens of thousands.

Unit price vs. capital investment

Producing molds means the initial setup cost is very high. Unit price is reduced when the scale of production is increased.

Speed

Multiple components are produced in the same production run to optimize the timescale: it can take many days for a part to go through the various stages.

Surface

The nature of ceramic materials results in a fine, stone matte surface.

Types/complexity of shape

The types of shape have similar restrictions to those of injection molded plastics, where the main considerations should be undercuts and the removal of components from the mold.

Scale

The component featured here from Small Precision Tools illustrates the tiny scale that this process is capable of. Components produced with this process are typically measured in 1/25 or 1/12 inch, but components can be produced that would fit through the eye of a needle.

Tolerances

These vary depending on the type of material but ±0.5% can be obtained.

Relevant materials

A range of ceramics, including aluminum oxide (Alumina), zirconium oxide (Zirconia), and silicon carbide.

Typical products

CIM is particularly suited to small engineering components as ceramics have exceptional resistance to wear and corrosion, and chemicals, and are biologically inert. This makes the process suitable for a range of parts, including dental implants.

Similar methods

Injection molded plastics.

Sustainability

The main consideration in this multistage process is the use of heat during sintering and the removal of the binder.

Further information: www.ceramic-parts.com

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