

CIM-Pro Prototypes in Ceramic Injection Moulding: Fast, Near-Series, Low-Cost

Near-series small or pilot series of CIM components in four weeks – Kläger/DE fabricates prototypes in injection moulding from rapid tools in the target material.



*Fig. 1
CIM-Pro sleeve: can only be fabricated with the CIM-Pro process;
filigree sleeve for testing materials and geometry in medical technology*

Introduction

Alongside technological know-how, product quality, and business data, time to market, that is the speed with which products and services can be brought to market, is a crucial element for the overall entrepreneurial success of an idea or a product. This empirical management formula applies irrespective of the product or the branch. The hype about additive manufacturing of prototypes has now arrived in technical ceramics, too. To make injection moulding components made of technical ceramics quickly available for their customers, Kläger Spritzguss GmbH & Co. KG based in

Keywords

CIM, prototyping, alumina

Dornstetten is now pursuing an interesting alternative approach.

Technical ceramics are still not established as materials in industrial application, and ceramic injection moulding remains an exotic process for many designers and developers, too. Even if the properties of ceramic materials offer perfect conditions to meet very high requirements, the limited experience with high-tech material necessitates that this should be verified in tests very close to series production in respect of the specific application. Up to now, the samples needed for this could be produced as mechanically fabricated components from semi-finished products or produced by means of the different additive manufacturing processes. The results: feasible based

on geometry or not, cost intensive, not necessarily in the intended series material and definitely not comparable with injection moulding as the later fabrication process. Reason enough to look for an alternative method as close as possible to injection moulding, and then to verify and establish this method. Prototypes made of technical ceramics can be injection-moulded within a few working days close to series production and then sent to the downstream processes of “debinding” and “sintering”. As part of its corporate philosophy as a full-service partner, Kläger therefore offers its customers an almost unbeatable advantage: rapid “time to market” with just four to six weeks gross fabrication time for prototypes made of technical ceramics.

Near-series prototypes for functional testing

Small prototype batches close to series production are fabricated because the customers need real ceramic parts quickly for their respective application for near-series tests. Accordingly, tests are conducted, for example, to determine whether there is any interference between the respective target material, the production process and the application. The verification of material, geometry and process can be performed fast and simply – but also the more complex combination of these three components can be analysed. The high

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degree of design freedom with injection moulding makes it possible in the optimum case to fabricate ceramic components in the scope of Ceramic Injection Mouldings (CIM) to produce load-optimised structures and free-form surfaces as well as complex structures such as undercuts, threads and boreholes so that material consumption, costs and weight are minimised and the product properties improved. The intelligent combination of injection moulding and the time-optimised fabrication of the necessary tools make up the added value of this co-operation.

Faster prototypes nearer to series production

Being able to use series materials already at the development stage and to test these constitutes an unbeatable advantage for many applications. The realisation that the material selection and its properties were severely limited in 3D-printing led to the development of a refined injection moulding process. The first tests brought rapid success and therefore the fully automatic injection moulding system was steadily further developed.

“Additive tooling” and injection moulding

In additive tooling, no complete tools are fabricated, but only dedicated mould inserts in 3D-printing. These consist of surface-hard and heat-resistant thermosetting plastic and are combined with other components to a complete hybrid form. The rap-



Fig. 2
CIM-Pro insulation sleeve: thin-walled and filigree, sleeve fabricated from Al_2O_3 in the CIM-Pro process (material ATZ)

id realisation of the 3D-data in real, shaping mould inserts and the consequently possible fast fabrication of CIM components on small-scale injection moulding machines with clamping forces up to 10 t results in an unparalleled speed of the entire manufacturing process.

Small series in the injection moulding process

The injection moulding process with the existing standard mould units is suitable for small series or for verification of material and process providing the principle is fol-

lowed that only the shaping insert has to be fabricated specific to the component rather than an entire tool. The same equipment, same process, same material as in the later series are crucial advantages. The big plus: the components are fabricated from the identical feedstock that is used in actual series manufacture. All types of ceramic and all ceramic injection moulding feedstocks can be used and be injected identically in series processes. Subsequently, the green components are debinded and sintered, also in series conditions. Pure materials like Al_2O_3 or ZrO_2 can be used as well as



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Fig. 3
CIM-Pro setter: relatively large, thick-walled components made of different materials can also be fabricated; for example, D 65 mm, 30 g (material Al_2O_3 and ZrO_2)

Alumina-Toughened Zirconia ceramic (ATZ) or Zirconia-Toughened Alumina ceramic (ZTA). Kläger is therefore capable of working with all CIM materials available on the market for prototypes, in pilot series or in series – irrespective of whether materials with POM-, PP- or PA binders, materials on wax basis and chemically or catalytically debinded feedstocks are involved.

Cost-efficient manufacture of small lot sizes

The lot sizes that can be manufactured in an economic viable process range between one and a few hundred units, the component weights between 0,1–60 g. Kläger's objective with this interesting prospect: to keep the customers' threshold for testing product and fabrication alternatives as low as possible, to minimise the costs of prototypes, to improve the usefulness for the customers and make the customers much faster on their way to the market.

Kläger – value creation partners in the best sense

Founded 60 years ago for the production of plastic switch boxes, Kläger Spritzguss GmbH & Co. KG has been one of the leading manufacturers of complex injection moulding components for more than two decades: on the one hand, from technical ceramics and on the other from a range of high-grade plastics.

Kläger has utilised its many years of know-how in sophisticated ceramic production and plastic component fabrication, tooling and processing of specific materials as a long-standing value creation partner – whether for its customers' production or on contract as an external tool engineer. Today, Kläger is a competent full-service provider and partner for numerous high-tech companies: as a development partner and reliable manufacturer of high-quality injection moulding tools and as a producer of high-grade series components in injection moulding processes.

Why technical ceramics?

Ceramic injection moulding components have enormous advantages: hardness, impermeability, temperature and corrosion resistance, electrical insulation, chemical resistance, taste and odour neutrality and biocompatibility – all these can be decision-relevant advantages. Products from ceramic injection moulding can replace conventionally manufactured products in two respects: first metal or plastic components on material and process level; second traditionally produced products made of technical ceramics on process level. Of course, the decision on the production technology to be applied must always be taken in respect of the product requirements and the performance of the product. The substitution decision can be made in response to higher application requirements for an existing product, with a view to the potential reduction of manufacturing costs or to create a new product for a novel application.

Immense advantages

Both technical ceramics as a design material as well as CIM processing as a process are still relatively unknown in industry and still lead a niche existence.

Low-cost prototypes should help to lower the threshold for initiating developments. The CIM-Pro process is ideal for realising and using the CIM injection moulding process close to application in practice.

Accordingly, it offers the possibility to transfer prototypes to series production.

A time and cost benefit, the low-cost and fast trialling of new product qualities and an alternative production technology can offer the customer a considerable advantage on the market.