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1. INTRODUCTION

One important factor for the creation of new and innovative products in the fast growing markets is prototyping. Points of interest are especially flexibility and cost-efficiency. Using a closed process chain consisting of a high precision CAD/CAM design tool combined with a cost-efficient fabrication via plastics engineering gives us the ability to produce even small amounts of specialized products in an economical way. Typical lot sizes in the field of plastics engineering range around several thousand pieces. For a lot of small and medium sized companies and especially in case of rapid prototyping much smaller amounts are needed. Unfortunately is an economic production of such small amounts a serious problem. The price per piece is much higher than in bigger amounts and not every manufacture is willing to work for such a low lot. To realise a low-cost fabrication for injection moulding of micro plastic parts we needed to implement a universal moulding tool. The idea was to create an inlay made of brass and place it into a prepared steel attachment. Brazen can easily be processed and is therefore an economic alternative compared to tool out of steel.

2. TECHNOLOGIES

2.1 DESIGN

First step is the design and simualtion of each prototype in CAD. Using the CAD/CAM software from CIMATRON a high-performance construction even in the micrometer range is availiable. The CAD/CAM created can easily be transfered to the micro-milling-machine via a post-processor [1]. Additionally this tool provides us also with the ability to simulate the milling process itself prior to manufacturing. In figure 1 some examples out of this design process are shown.

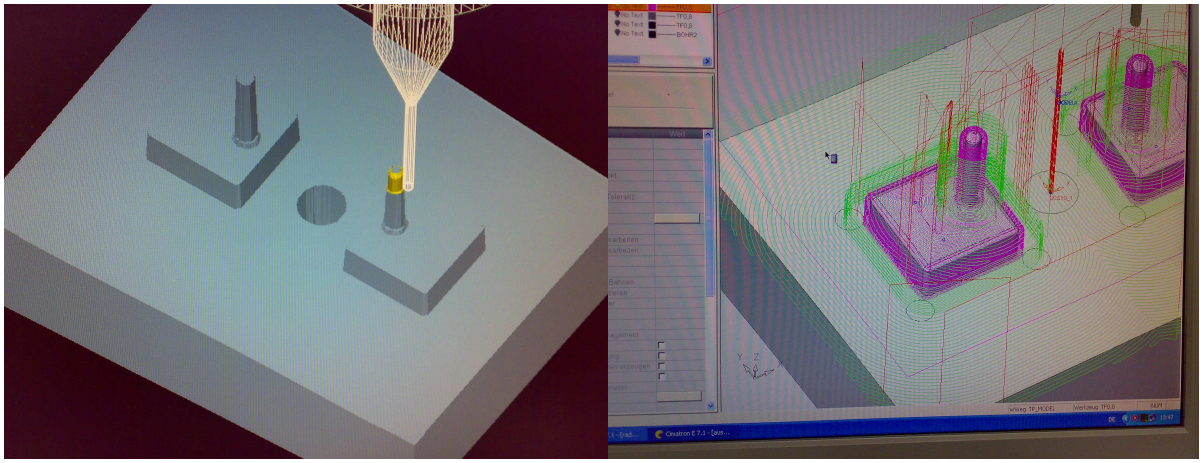

Figure 1: CAD-Simulation, simulated milling process (left) and complete visualisation of the cutter path during milling process

2.2 Milling

In a first step all editing parameters were optimised to ensure that an expensive post processing is not necessary. Figure 1 shows the processing of brazen by using a micro milling machine. Most important is that the inlay is free of burrs and has a low surface roughness.

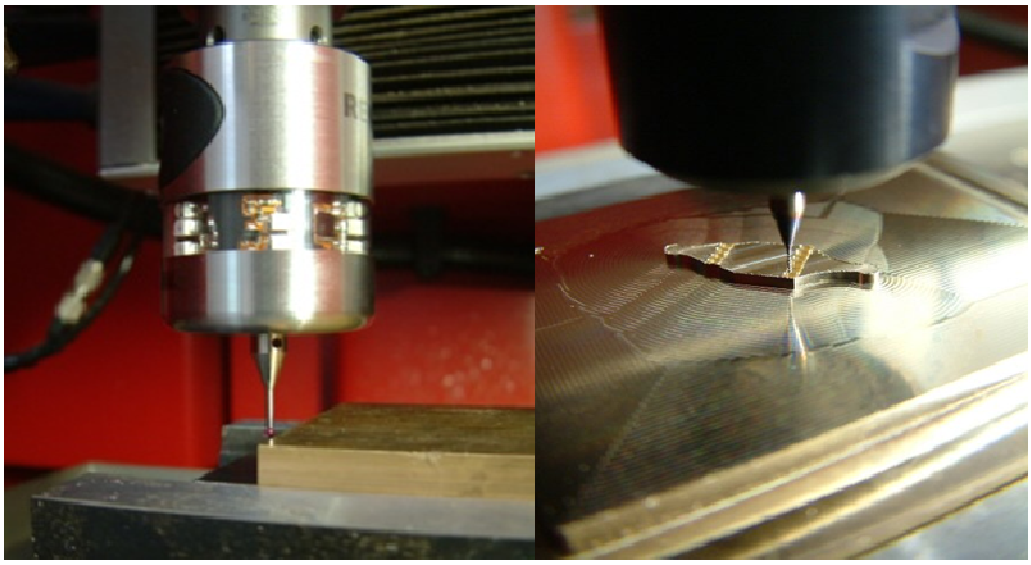

Figure 2: micro milling machine processing a workpiece out of brazen

All used parts or tools are manufactured using the high-precision CNC constructionstation Kern MMP 2522 micro milling machine. It operates with a lateral resolution of approx. 0,1 µm. Milling- and positioning precision are each in the range of 2 µm. The machine can be modified to operate in 3- or 5-axis mode. A wide range of materials like steel, NE-metals, plastics and ceramics can be milled. Due to the high-precision construction geometries can also be realized in a micro-level. In figure 2 the milled inlays and steel attachments are shown.

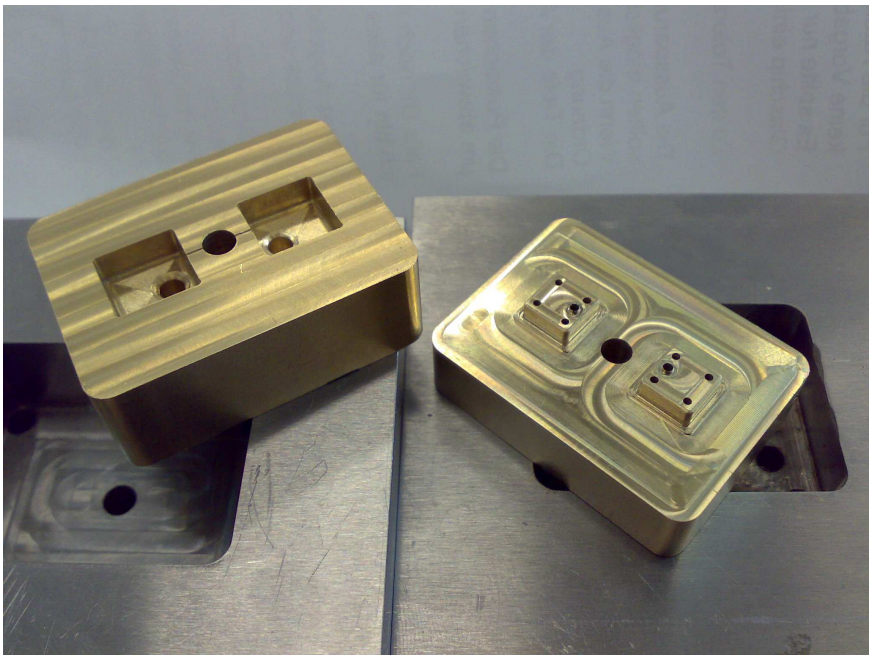

Figure 3: Brass inlay and steel attachment

2.3 TOOL CONSTRUCTION

The micro milling machine is mainly used to manufacture tools for an injection moulding machine. Such inlays made of brass are placed into a prepared steel attachment. Two different injection moulding machines are used, one so called Babyplast (6t clamping force) and a DEMAG Ergotech 100/420-310 (100t clamping force). Faster and more cost-efficient than common technologies in mold construction this method represents an alternative especially for small and medium sized companies. For application in the field of rapid prototyping molding tools and micro-fluidic structures can be fabricated out of PDMS.

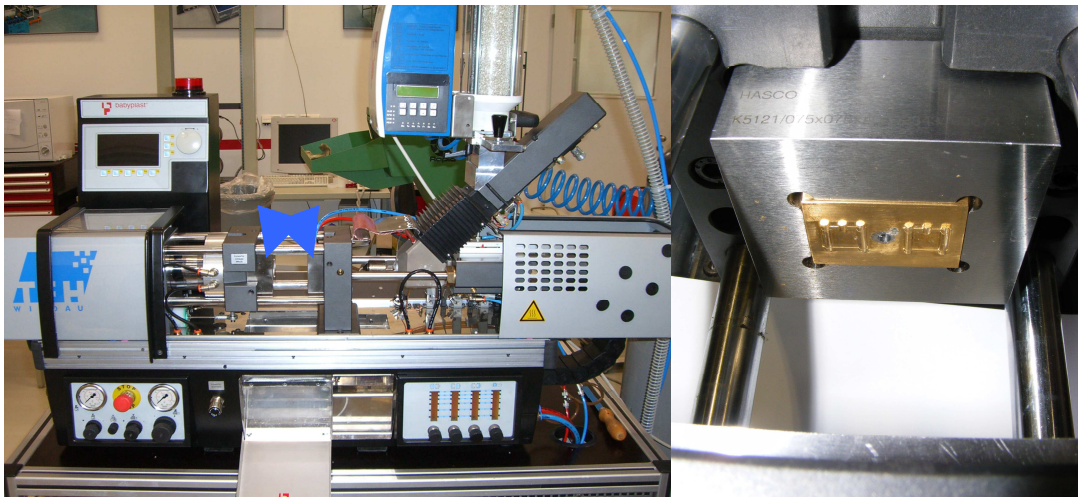

Figure 4: Babyplast (right) and implementet die cast mold with brazen inlay (right)

3. OUTLOOK

The closed process chain starting from CAD design, tool construction via micro milling machine and injection moulding of final prototypes is flexible as well as cost-efficient. Its an ideal method for rapid prototyping or fabrication of small amounts of products.

Reference:

[1] Dr. Johannes Heidenhain GmbH, *Benutzer-Handbuch Heidenhain- Klartext-Dialog für iTNC 530*, S.38-, (7.Auflage 2004)

[2] Dr. Johannes Heidenhain GmbH, *Programmierplatz iTNC 530 (Bedienungsanleitung)*, S.27-33 (11/2003)

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