FHS
UNIVERSITY OF APPLIED SCIENCES
ST.GALLEN

INSTITUTE FOR RAPID PRODUCT DEVELOPMENT RPD

Product Design with less restrictions dictated by production processes

A cooperative project between TECAN Group Ltd Switzerland and the Institute for Rapid Product Development RPD at the FHS University of Applied Sciences St.Gallen

TECAN holds a leading position in the rapidly expanding life-science market. Recently, in the field of pipettes a 384-conduit pipette system has been developed by TECAN.

The Starting Position

The newly developed pipette head exerts includes the functions of a high-precision liquid-filling system (200nl - 50µl) and that of an efficient cleaning system. In this cleaning system, washing blocks are used into which the pipette heads are dipped and washed. Each single pipette needle is washed in a dedicated channel before pipetting the next sample.

Therefore, the washing block needed to be adjusted to the new requirements. This led to a very complex washing block geometry. The cost for a corresponding injection casting tool was estimated to be around CHF 200,000.-. Since approximately 100 washing block units would be required each year, amortizing the investment represented a problem.

Picture 1: washing bloc in use (pict:. TECAN)

Due to these considerable tool costs (not taking into account any possible tool modifications), either the geometry had to be simplified or another manufacturing technique had to be chosen.

The solution

A meeting with the RPD Institute of the FHS St.Gallen concerning a solution with the Selective Laser Sintering (SLS) process brought up the final idea to produce the series directly by using DuraForm™ (PA12) on the SLS machine.

The following criteria were defined to stipulate the process:

- Resistance to DMSO and Isopropanol
- Sufficient strength of materials
- Surface quality
- Admissible position tolerances of the pipes laser-sintered in PA12

In order to test the DuraForm™ resistance, it was put into DMSO and an Isopropanol fluid – with great success: DuraForm shows excellent resistance.

Picture 2: production procedure (laser sintering, unpacking of parts, assambling, end product (pict:. FHS)

Properties of DuraForm™ (PA 12)		
Tensile strength	[MPa]	44
Tensile Modulus	[MPa]	1‘600
Tensile Elongation at Break	%	9
DTUL, 1.45 Mpa	°C	177
Chemical Resistance	Alkalines, hydrocarbons, fuels & solvents	

Picture 3: material properties of DuraForm™

The conduit geometry of the washing block is largely designed for taking up the detergents and letting them flow through freely. The tensile strength of 44 N/mm² will fit these requirements. Several important DuraForm™ material specifications are reported in picture 3. Each piece that is produced by the SLS technique has a typical slice structure on the surface (based on the layer wise production method). Due to the fact that the geometry does not have any visible surfaces and the fine “eroding structure” does not impair a free flow, the surface could be neglected.

With the SLS technique, the tolerance field is 0,1 to 0.2mm, which is alright for this application. Considering these requirements, it was easy to decide that TECAN would manufacture the washing blocks using the SLS process. Thus, TECAN was now free to design the washing blocks adapted to their function rather than to the method of their production.

The procedure

The 3D STL data e-mailed by TECAN to the FHS (with IGES or STEP also being possible) was used to build the washing blocks in respective 8, 16 or 32 batch units. After cooling down, the pieces were dug out, the loose powder onto the part surface was removed by glass blasting and prepared for assembling the small pieces. The conduit inserts could be screwed directly into the sintered threads and the washing blocks were ready to use.

For the second project phase, some improvement was decided on. It was agreed to design the washing blocks as two-piece elements. The case was to be milled in polypropylene (PP) making low demand on cost and the complex inside was to be laser-sintered.

This strategy showed the following advantages: simplified assembly, more accurately produced laser sintered pieces. Furthermore, the production step of colouring the “visible surfaces” could be eliminated.

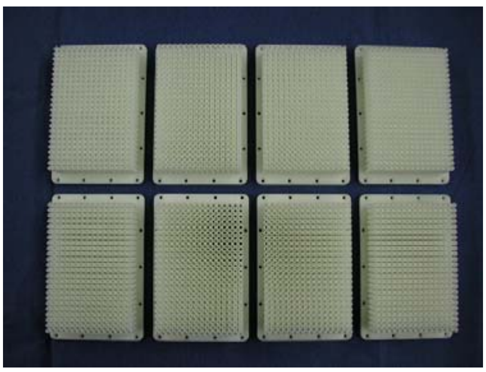
What TECAN appreciated:

- During the production phase of a part the design and the geometry can be adapted to the requirements at any time with no additional cost
- Reduced “time-to-market" as no tools are required
- Much lower starting costs and considerable reduction of risk

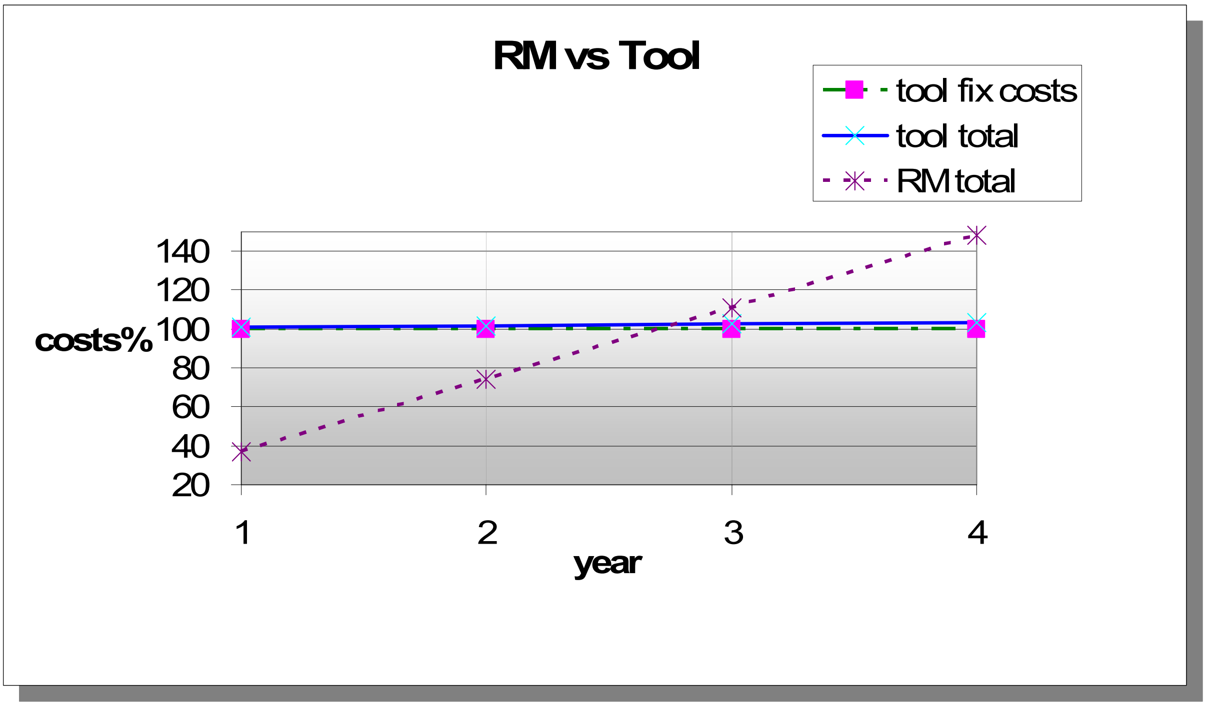
The Benefit of RAPID MANUFACTURING

Under the condition that the material properties and the tolerances required fulfil the performance specification of the components, Rapid Manufacturing shows many advantages:

- First batches very quickly available (within 2 to 4 workdays)
- Part design is free of any limits given by the production technique – the geometry can be optimized to attain perfect functioning of the component
- No storage, production on demand
- Geometry modifications possible at any time, even during production
- No expensive tool modifications
- The individual pieces of a series may show different geometries (piece No., etc.)
- Great individualization, different variants can be produced in one batch
- Undercuts and hollow spaces are producible
- Even the direct production of interlocked pieces (sub-assemblies) possible with no need of assembly work



Picture 4: end geometry of SLS parts (pict:. FHS)



Picture 5: comparison RM vs tool; break even after 2,8 years, tool costs 100%, series of 130 pcs. the year
This figure excludes the changing of the tool geometry after half a year (break even after 5,6 years)

The example for the RM application with TECAN has impressively shown the amazing potential of generative processes, particularly the Selective Laser Sintering procedure, in the manufacturing process.

Ralf Schindel, University of Applied Sciences St.Gallen

Profil

The institutes key competences are the Layer Manufacturing Technologies, especially:

- Selective Laser Sintering (SLS)
- 3D-Printing (3DP)
- Stereolithography (SLA)
- new: LaserCUSING® (SLM)

Additional fields of the institutes activities are:

- 3D-Scanning of physical objects, data acquisition and the transfer to CAD
- preparation of medical data taken directly from the CT or MRI
- fabrication of models for the presurgical planning
- production of custom made implants

RPD develops in close cooperation with industrial companies powder materials for the SLS process and SLS process chains.

Out of these activities resulted already four SLS powder materials, which are used worldwide today.

The applications of the Layer Manufacturing technologies start with the additive fabrication of prototypes or functional models in plastic or metal and lead over the fabrication of complex tool insert (Rapid Tooling) to the Rapid Manufacturing: the direct production of small series.

Contact

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