

Case Study

Glass-Lined High Pressure Reactors for the Process Industry



**Additive Manufacturing for Process
Engineering at THALETEC GmbH**

3D-Printing Success Story

MANUFACTURED IN ONE PIECE
with a temperature control channel



INCREASED PRESSURE HOLDING CAPACITY
despite lower wall thicknesses and lighter weight

Part Data

Designation:	Glass-lined high pressure reactors
Industry:	Chemical Industry
Layer Thickness:	60 μm
Build Time:	3d 3h 1min (full load, 5 pieces)
Machine:	SLM [®] 280 Twin



SLM[®]280

Current Situation

High pressure reactors in process engineering

Additive manufacturing (AM) is regarded as „game changer“ for many industries. How large that potential in equipment and plant construction for the process industry and what challenges lie ahead is shown by the example of a high-pressure reactor developed by THALETEC.

High pressure reactors are used in process engineering for carrying out chemical reactions under pressures up to 200 bar. Traditionally these reactors are machined from materials such as stainless steel or Hastelloy. For use with highly-aggressive chemical products, high pressure reactors are also equipped with a liner made of PTFE.

In order to use high-pressure reactors, they must be designed and constructed according to Pressure

Equipment Directive 97/23 (PED) and for a valid set of rules, for example AD 2000. Additively manufactured high-pressure reactors from THALETEC can be produced according to the approved pressure equipment standards. THALETEC has a tested and proven approach to certify pressure equipment additively manufactured according to PED.

The prototype of the additively manufactured high-pressure reactor was developed in close cooperation between THALETEC and the engineering office JUREC, who specializes in supporting small and medium enterprises exploit the potential of additive manufacturing. JUREC advises these companies in the development and design of additively manufactured parts in mechanical and chemical engineering.

Innovations with Selective Laser Melting

Glass-lined high pressure reactor with integrated temperature control channel

The new-solution prototype glass-lined high-pressure reactor was prepared using the selective laser melting metal-based additive manufacturing process. The use of the SLM® process opens the possibility build the high-pressure reactor with an integrated temperature control channel for the heating or cooling of the reactor's interior.

The combination of enameling the interior surface and integrated temperature control channels in the reactor's walls provides significantly improved heat transfer than



Fig. 1:
Prototype, glass-lined high-pressure reactor

previous solutions. The design enabled the opportunity to better influence the product and the temperature control fluid, thus the opportunity to better influence the heat effect of the process.

Moreover, the ability to hold higher pressures is possible, despite a lower wall thicknesses of the additive design. A guaranteed diffusion-proof and chemically highly-resistant coating in the wetted interior was also achieved. Further, the weight of the high-pressure reactor was reduced, an important factor for laboratory handling.

Through the use of the SLM® process it is possible to produce inner structures such as ducts and voids in complex parts that cannot be produced by conventional manufacturing processes such as turning, milling and drilling. When using the SLM® process, the part is developed in a 3D CAD system and geometrically optimized, processed digitally and then supplied to the SLM® machine. Built in layers within the SLM®280 selective laser melting machine, the metal powder used by THALETEC was then glass-lined.



Fig. 2:
Dr. Jürgen Reinemuth, Managing Director of Thaletec with the component

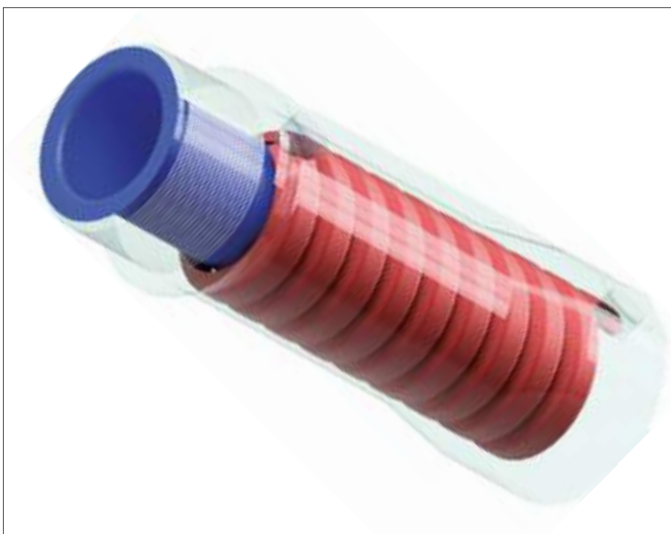


Fig. 3:
Integrated internal temperature control channel built into the reactor wall

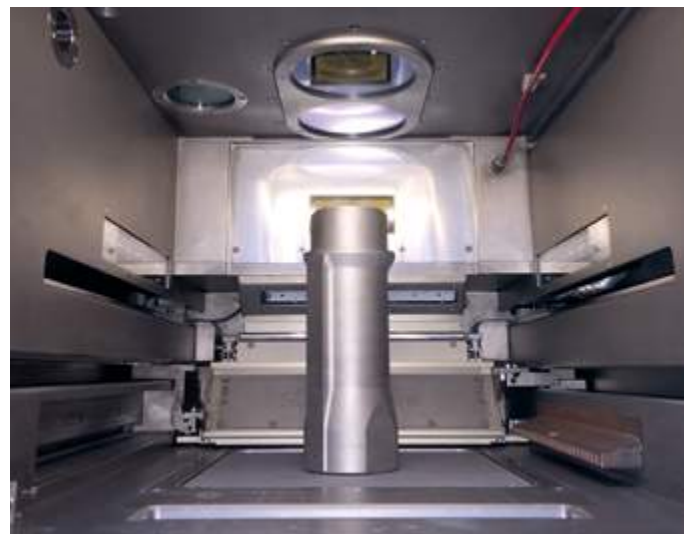


Fig. 4:
Reactor built in the SLM®280 selective laser melting machine

Summary

Glass-lined high pressure reactors for the process industry

- Glass-lined high pressure reactor with temperature control channel additively manufactured in one piece with the SLM® process
- Significantly improved heat transfer between the product and temperature control fluid
- Increased pressure holding capacity despite lower wall thicknesses
- Achievement of a guaranteed non-diffusive and chemically highly resistant coating in the wetted interior
- Weight savings for better handling of the reactors in the laboratory



Fig. 5:
High pressure reactor before and after enameling

THALETEC GmbH

THALETEC is the company with the world's greatest experience and the longest tradition in processing the glass-steel compound material. The first developments in glass lining technology started as early as 170 years ago. Today, our more than 190 employees produce apparatus and products coated with technical glass for the chemical and pharmaceutical industry.

The company places great importance to quality. All of our products are „Made in Germany“. This has been certified, and documented to DIN ISO 9001 and proven on a regular basis. The vast majority of our materials and external parts also are of German origin, enabling us to most efficiently fulfill our high claim to quality and reliability of our products.

SLM Solutions - Technology Pioneers, Innovation Leaders

SLM Solutions helped invent the laser powder bed fusion process, was the first to offer multi-laser systems and all selective laser melting machines offer patented quality, safety and productivity features. Taking a vested interest in customers' long-term success in metal additive manufacturing, SLM Solutions' experts work with customers at each stage of the process to provide support and knowledge-sharing that elevate use of the technology and ensure customers' return on investment is maximized. Optimal paired with SLM Solutions' software, powder and quality assurance products, the SLM® technology opens new geometric freedoms that can enable lightweight construction, integrate internal cooling channels or decrease time to market.

A publicly traded company, SLM Solutions Group AG focuses exclusively on metal additive manufacturing and is headquartered in Germany with offices in China, France, India, Italy, Russia, Singapore and the United States and a network of global sales partners.



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