HYDRAULIC -, PNEUMATIC COMPONENTS

Additive Manufacturing (AM) is a technology enabling the engineers to increase the function and efficiency of designs. The idea of this project is to develop generic design studies that are relevant to the members´ application needs, run analysis, collect performance data and report the benefits. Thus, the project idea is adapted year by year with facing new challenges or harnessing further potentials of AM. This year the project considers hydraulic- and pneumatic powder bed AM parts and assemblies. General feasibility and limitations in design and manufacturing for hydraulic or pneumatic parts shall be analyzed for Polymer Laser Sintering and Selective Laser Melting as well.

PROJECT OVERVIEW

DURATION

01/2020 – 12/2020

PARTNER

Industrial Consortium of DMRC

FUNDED BY

Industrial Consortium of DMRC

RESEACHER

Research Leader
Prof. Dr.-Ing. Hans-Joachim Schmid (PVT)
Prof. Dr. Thomas Tröster (LiA)
Research Assistant
Christina Kummert, M. Sc.
Jan Gierse, M. Sc.,
Ivo Kletetzka, M.Sc.
Dennis Lehnert, M.Sc.

DMRC DIRECT MANUFACTURING RESEARCH CENTER RESEARCH INNOVATION EDUCATION

Introduction

Limits of applications should be clarified for the adaptation and utilization of additive manufacturing technologies for hydraulic or pneumatic components. AM can be used for pressurized, storage and distributing applications. The use of metal AM technologies is hereby most prominent for pressurized applications, whereby polymer parts show promising performance and cost benefits for storage and distributing use cases. Especially for polymers the influences of environmental interaction as media exposure has to be analyzed in more detail. Thus, for the implementation of polymer laser sinter parts in fluid contact applications, the material behavior in the given environment need to be analyzed in more detail. The here obtained information will be used for a case study part, which shall demonstrate the benefit of additive manufacturing and utilize the obtained information of the investigated material properties and post processing methods.

Experimental approach

First of all, information on general requirements from conventional manufacturing should be analyzed in order to incorporate these into the development of AM hydraulic components. Further, suitable test procedures are selected.

As all laser sintering materials are well known from conventional manufacturing methods, the chemical resistance and stress crack resistance is known as well. However, laser sinter parts have a higher crystallinity, rougher surfaces and some porosity. Therefore, the knowledge of conventional chemical material resistance should be validated. For the validation different LS materials are exposed to different substances and changes in especially the physical properties (mechanical, thermal, optical, etc.) immediately after immersion storage for different dwell times and temperatures are investigated. In addition, the effect on the manufacturing specific part structure is examined more in detail in dependence of different manufacturing parameters and design aspects.
These might be the microstructure or the part surface as well and will be compared to injection molding parts. Ideally, some processing guidelines for improved stability can be derived.

Design guidelines

Although the great design freedom of AM manufacturing offers new potential and some design rules already exist for the processes under investigation, certain limitations must be taken into account. For helping designers, some guidance for fluid transmitting parts shall be developed. For laser sintering, at a minimum the minimal wall thickness at fluid tightness are analyzed and determined. Furthermore, post processing methods for powder cleaning are considered for those investigations. For selective laser melting, samples are manufactured in different diameters and orientations to test the component in a destroying pipe test by internal pressure, as well as to identify the minimal thickness for fluid tightness.

Case study

The information of the previous investigations will be evaluated and shall be used for a case study part. Hereby, the material restrictions as well as the new and general design guidelines for polymer LS parts will be applied and utilized in a laser sintering technology part, e.g. fluid distribution, transfer or storage. For the SLM technology a pressurized part will be developed, as well emphazising the benefits of AM design for hydraulic parts. Thus, the case study part will be a fictive part combining multiple benefits of the AM technology for the given application.

Overall aim

The overall aim, is to find limitations of additive manufacturing in hydraulic or pneumatic components and to create processing and design guidelines for these applications.

FIGURE 1 Storage test on the functional behaviour towards different media