

EXPERIMENTAL DETERMINATION OF MATERIAL MODEL OF MACHINE PARTS PRODUCED BY SLS TECHNOLOGY

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1. Introduction

The role and importance of additive production technologies became increasingly important in several fields of our life. Due to the development of materials and technologies the applicability of the procedure is expansive. We can state, that in case of additive production technologies used earlier the material properties of the parts show orientation features [1]. The fact mentioned above in case of the design procedure of different elements, medical implants have great importance. The production technology with its parameters play important role in the material properties on the basis of our earlier experiences [2], [3]. In our paper the SLS technology – as the most reliable one - was investigated in order to compare the results with other parameters of different additive technologies.

2. Methodology

In case of SLS technology the previously developed method has been followed. [4]. Despite some references [5] it has been assumed, - similarly to Polyjet [4] and FDM [2] technologies – that the material properties could be described by orthotropic theory. The behavior of the material – in this case – depends on the load direction. The material behavior could be described by the orthotropic Hook's Law. Concerning the behavior to determine the orthotropic material law nine independent material parameters must be determined. In that case, when the properties are independent of the direction we can speak about isotropic material. This is the case of reduced Hook's Law for isotropic materials.

In case of an isotropic material the behavior can be described by two independent parameters.

The comparison of the material parameters in different production directions seems to be important. The specimens printed in different directions (x, y, z) can be seen in Fig.1.

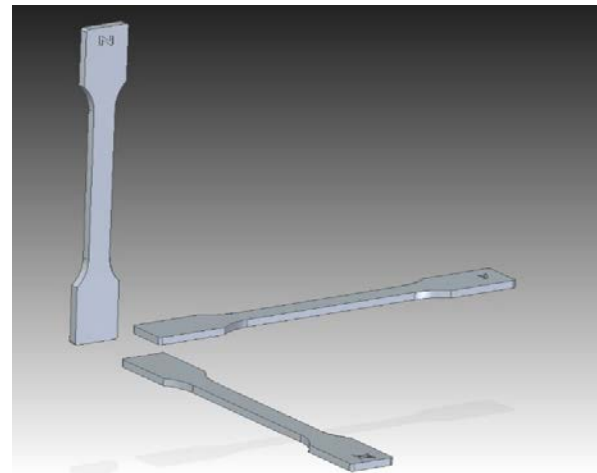


Fig. 1. Tensile specimen printed in different position.

When the tensile test has been realized we can draw conclusions what type of material law can describe the investigated specimen.

3. Experimental Results

The test results of the investigation can be seen in Fig. 2. and Fig. 3. In the linear section of the diagrams the homogeneity of the material can be realized. In this part of the tensile test diagrams the behavior of the specimens from practical point of view is the same.

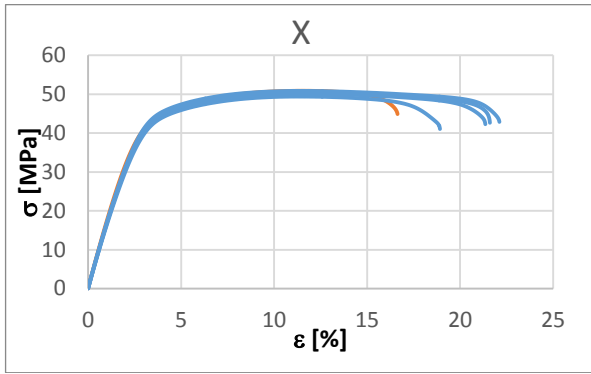


Fig. 2. Tensile test diagram in x-direction.

The test results in y direction correspond with the results measured in x direction in characteristic and in extent values as well. Based on our results and our estimation the material can be considered as an isotropic one in a given plane.

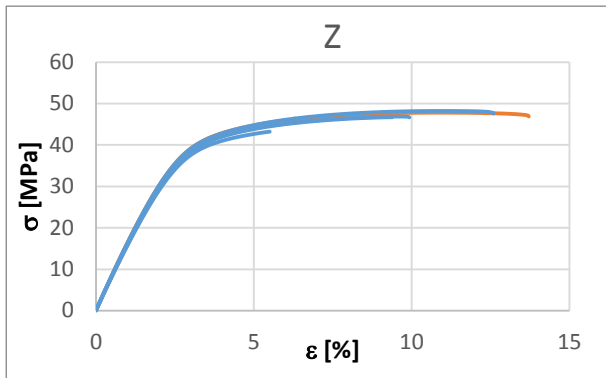


Fig. 3. Tensile test diagram in z-direction.

As in Fig. 4 the test results can be seen in z direction similarly as determined in direction x and y. The difference can be seen in the feature of the ultimate elongation in characteristic and extent values as well.

The evaluated results are summarized in Table. 1.

	Ultimate strength R_m [MPa]	Young modulus E [MPa]
Laying (x-y)	49.93615 ± 0.9	1713.48 ± 40
Standing (z)	47.4045 ± 0.8	1661.039 ± 30

Table. 1. Tensile test results of SLS material

4. Analysis

Investigating our results we can state the following things: in case of SLS production technology there is no essential difference in the material parameters in a function of the production direction (printing in laying and in standing direction). Remember: the direction dependence is

strong in case of Polyjet and FDM technologies. Another conclusion is that the characteristics of the plastic zone in case of printing direction z show different behavior. Some difference is observable in the ultimate elongation (elongation at rupture).

5. Summary

Based on our investigation of SLS production technology it could be stated that the material properties of the technology are independent of the printing direction. One important final conclusion is that the behavior of the material produced by SLS technology can be described by isotropic material law.

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