THE INFLUENCE OF PROCESS PARAMETERS ON PROPERTIES OF SAMPLES OBTAINED BY ADDITIVE MANUFACTURING

Goal of the project

The main goal of the project was to establish analytical correlations between the input process parameters and the outcome properties of samples obtained by selective laser sintering.

Short description of the project

The project approaches an exploratory research that fit in additive manufacturing field, particularly on Selective Laser Sintering (SLS). Using SLS technology, samples were manufactured under various conditions. By inspecting and mechanical testing, important findings in process parameter-property relation were identified.

Implementation period

01.02.2020 - 15.06.2020

Budget

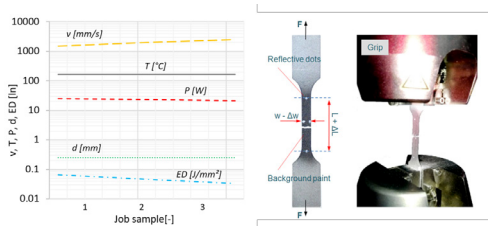
47.600 RON (10000 EUR)

Main activities

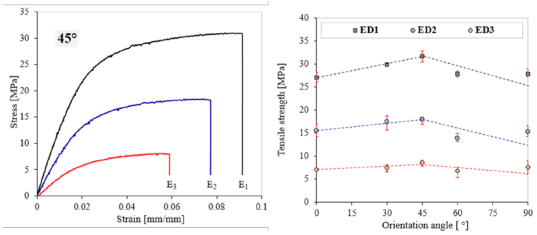
- Geometric model design according to ISO 527-1:2012(en) and ASTM D 5045-14 standards.
- Sample manufacturing by SLS under rational selection of process parameters.
- Inspection of dimensional accuracy of samples and microstructure investigation.
- Mechanical testing: tensile, bending and fracture mechanics.
- Data analysis by statistical tests (Pearson's correlation, Covariance, ANOVA)
- Process parameters – geometric and mechanical properties relation.

Results

- One hundred Polyamide (PA2200) samples were manufactured using two process variables: Orientation angle (OA) and Energy density (ED).



- Tensile tests on standard samples reveal the following behavior: energy density produces direct consequences on mechanical properties, an ED<0.06 J/mm2 leading to unacceptable strength values. The proper OA for the best tensile strength is 45° in X-Y plane.



Identic process parameters were used to manufacture rectangular section samples. The 3P-bending tests were conducted on un-notch and notched samples in order to underline the bending strength and fracture toughness.

The geometrical results on these samples reveal a high dimensional error (up to 9%) on vertical direction (Z axis). Also, on this direction of growing the best density was recorded.

Pearson's correlation reveals strong positive relationship of density and KIC with ED and OA. The best fracture toughness value was determined for vertical orientation (Y-Z plane) and for highest ED, as the above diagrams indicates.

Applicability and transferability of the results:

The research results are addressed to manufacturing engineering field and they provide important information on how the process parameters are influencing the mechanical and geometrical properties of the parts. Relying on this information, the SLS process parameters can be set to obtain reliable results. Also, design restrictions for additive manufacturing process and samples virtual arrangement in the building envelope can be specified based on research data.

Research team

STOIA Dan Ioan, ȘTEFAN Călin, RUSU Lucian
MARȘAVINA Liviu, VIGARU Cosmina,

Contact information

Assoc. Prof. Dan Ioan STOIA, PhD
Faculty of Mechanical Engineering
Mechanics and Strength of Materials Department
Address: Str. Mihai Viteazul, No. 1, 300222, Timisoara
Phone: (+40) 256 403633
Mobile: (+40) 722512247
E-mail: dan.stoia@upt.ro