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Influence of 3D Printing Parameters by FDM Method on the Mechanical Properties of Manufactured Parts

Jarosław Zubrzycki[1*], Estrada Quirino[2], Michał Staniszewski[3], Magdalena Marchewka[4]

[1] Mechanical Engineering Faculty, Lublin University of Technology, ul. Nadbystrzycka 38D, 20-618 Lublin, Poland

[2] Universidad Autónoma de Ciudad Juárez, Instituto de Ingeniería y Tecnología, Ciudad Juárez, Chihuahua, México

[3] Fundamentals of Science Faculty, Lublin University of Technology, ul. Nadbystrzycka 38D, 20–618 Lublin, Poland

[4] Mechanical Engineering Faculty, Lublin University of Technology, ul. Nadbystrzycka 38D, 20–618 Lublin, Poland

* Corresponding authors' email: j.zubrzycki@pollub.pl

ABSTRACT

The manufacturing of machine parts with additive methods (AM) is of significant importance in modern industry. The development of 3D printers and all 3D printing technology is impressive. The ability to make parts quickly and relatively cheaply with AM gives excellent opportunities in terms of e.g., shortening the production preparation time. Proper selection of printing parameters allows for a significant reduction of printing time and production costs. Unfortunately, this has different consequences. Due to the course of the printing process and the parameters that can be set, the same product produced with different parameters has different mechanical properties – mainly different strength. This paper presents the impact of 3D printing parameters on the strength of manufactured parts. Strength tests were carried out on samples made in accordance with DIN EN ISO 527-1:2019. The samples were printed in technology FDM from three different materials, i.e. PLA (completely biodegradable), PETG (recycled material) and Smart ABS (material with minimal shrinkage). The tested samples were made in three levels of print filling – 10, 30 and 60% and with different types of filling – line, mesh and honeycomb. A series of static tensile tests were carried out to determine the strength of the samples produced with different printing parameters. Thanks to the obtained test results, it is possible to select the optimal printing parameters depending on the forecast load of the manufactured parts.

Keywords: 3D printing, line, honeycomb, PLA, ABS, PETG, 3D printing strength, additive methods.

INTRODUCTION

From the beginning of the existence of human civilization, man strove to simplify everyday activities as much as possible. The motives could be different, as the proverb says: "Necessity is the mother of invention". Often you can also come across a similar and quite funny term, replacing the word "need" with "laziness". While creating new inventions, Homo sapiens often needed to create new tools. More durable, more precise with a more complicated shape [1, 2]. At some stage in human history and development, the burden of production was shifted onto computers. Precisely programmed systems that control complex apparatus, making movements so precise and fast that the production of products in this way has become more attractive and more profitable. Machines controlled in this way are now called CNC machines (Computerized Numerical Control). Constructed by Joseph Marie Jacquemart in 1805, the tying machine became the basis for the future automation of production in many industries, as well as part of the industrial revolution [1, 3, 4].