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The impact of the mechanical properties of 3D prints Produced by the Fused Deposition Modelling technique on the selection of raw materials for their applications

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Abstract:

3D printing technology; It is a technique that uses computer-aided design (CAD) and is one of the most modern manufacturing methods recently due to its capabilities in manufacturing different models without being restricted to a specific form of design, as well as printing models that have the required mechanical properties with lighter weight and less consumption of raw materials as well as the diversity of raw materials used, which made it invade most important industries In proportion to its applications, and to achieve this, it is necessary to take into account the mechanical properties most appropriate for the purpose of use in order to achieve the highest printing quality, as well as saving time, effort, and replacement costs through the appropriate selection of the appropriate material for each application separately.

Research problem: - Printing 3D prints using the Fused deposition modeling technique with polymeric materials that are not chosen in proportion to the mechanical stresses to which the 3D print is exposed in various applications. - The short service life of the 3D prints produced with this technology due to its inability to withstand the mechanical stresses of use, such as the tensile and corrosion resistance that arises from friction.

Objective: - Printing three-dimensional prints with mechanical properties that meet the purpose of their use.
- Make maximum use of the mechanical properties of each raw material.
- Determine the suitable material (polymer) for the production of 3D prints using the Fused deposition modeling technique, in proportion to the mechanical stresses of the application.

Significance: - The importance of determining the optimal raw materials for printing products with mechanical properties suitable for use is an important indicator of the effectiveness of 3D printing in the functional performance entrusted to it, which achieves better efficiency and higher suitability to withstand pressure and thus achieve high quality. - Increasing the operational life of the 3D print due to its ability to withstand tensile and corrosion stresses for longer periods, and thus the length of its operation or consumption, and thus saving replacement costs and printing a new print to replace it.

Research sample: Printing five samples of 3D prints from different materials (the most common in the Egyptian market) and measuring them with force measuring devices.

Methodology: The research followed the experimental descriptive approach, where the theoretical study follows a comprehensive presentation of 3D printing techniques in general and the Fused deposition modeling technique in particular, and the most common raw materials in use in Egypt in this technique and a review of the basic mechanical properties and an experiment by printing 3D prints and measuring them and deducing the purpose of using both Of which .

Experimental work: Practical experiments to measure the tensile and corrosion resistance separately for five samples of 3D prints printed with different polymeric (resin) materials separately (the most widely used in the Egyptian market), which are used in 3D printing by the Fused deposition modeling technique; And to reach the most appropriate applications for each material by monitoring the tensile and corrosion resistance values of the prints produced from these resin materials.

Results :

1- 3D prints printed with PLA are characterized by: Higher tensile strength than ABS , Higher modulus of bending than BETG, ABS, PLA Wood, Higher in flexural strength and tensile modulus than PC-ABS, PLA Wood, ABS), Highest fracture stress of PC- ABS, PLA Wood, More abrasion resistant than PLA Wood, ABS,

2- 3D prints printed with BETG material are characterized as: The highest tensile strength, flexural strength and corrosion resistance of all materials, Higher tensile strength than PC-ABS, ABS, PLA., Higher in fracture stress than PLA Wood, PC-ABS, PLA Wood, Higher modulus of bending than (PLA Wood, PC-ABS)

3- 3D prints printed with ABS material are characterized by: The highest stress fracture and bending coefficient ever , Lowest corrosion resistance, tensile strength and tensile modulus ever , Higher in flexural strength than (PLA Wood, PC-ABS).

4- The 3D prints printed with PC-ABS material are characterized as: The highest tensile strength of ABS, PLA, Highest tensile modulus of ABS, • The least ever in bending strength, Higher wear resistance than PLA

Wood, ABS, Higher in fracture stress and flexural modulus than PLA Wood

5- The 3D prints printed with PLA Wood are characterized by: - Highest tensile strength ever. - Higher tensile modulus than PC-ABS, ABS, Higher in bending strength than PC-ABS. - Higher corrosion resistance than ABS, The least ever in stress fracture and bending modulus.

Keywords:

Abrasion resistance Fused deposition modeling , tensile strength

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