3D Printing Of Renewable Materials

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3D Printing

3D printing is inexpensive prosthetics, creating spare crucial parts, rapid prototyping, creating personalized items and manufacturing with minimum waste. The technology is very useful and widely available almost everywhere. However, its application is yet limited and need many research and trials to make it more easy and flexible to use and produce any model with different material as well as more biodegradable away from plastic filament that is mostly used. If renewable material could be used same as the normal plastic filament, it will be a leap in 3D printing industry.

Literature Review

According to Central Agency for Capital Mobilization And Statistics (CAPMAS) Egypt in 2015 have a rice agriculture of 1,100,000 feddans which is nearly 7.3 million tons of rice per year. In addition, about 16 million tons of sugar cane per year is being produced in Egypt [1 & 2]. To conclude, rice and sugar cane grains are produced in vast amount in Egypt. However, many waste is being thrown without any benefit. Waste of agricultural product (rice, sugar cane, wheat and date palm) will be used in this project. Every fiber from the mentioned above there are 4 different grain sizes (250, 180, 106, 53) micrometer every size has its unique feature whether from viscosity, strength, density perspective. In addition, Methylcellulose (MC) will also be added as it has special property which is thermo gelation. It claims that MC can reverse its property upon temperature change whereas at high temperature MC tend to become more soluble and return back to its original state which is gel like substance [3]. The strength of the paste increase when left to the open air for days.

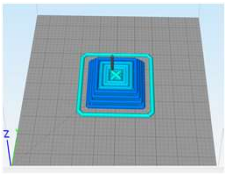
All of the above is the biodegradable material that will be used to make models using 3D printing. The software that will be used is divided into 3 parts.

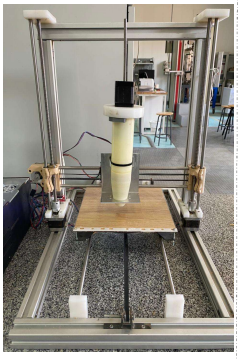
- First, drawing the model with the appropriate dimensions that suits the nozzle diameter and that part Solid Work will be used.
- Second, marlin and the reason why marlin is used is because the 3D printer that is used in this paper is a home-made printer so marlin is the connection between the Ardunio Mega 2560 and PC, also it sends all crucial information used in printing like Steps per Unit, Feed Rate, Jerk, etc.
- Third, slicer application that translate model To G-code that is understood by the printer and command the movement and flow rate order.

Combining the material and appropriate parameters (as every fiber and every grain size has its unique parameters) in software results in desired model that is made from biodegradable material as well as has strength same as plastic filament. As for results, bending samples was printed with every fiber and with every grain size. In addition, an infinity table was printed.

Methodology

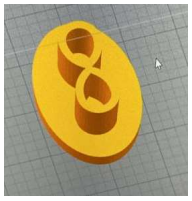
- First, paste set ready by adding 5.4 grams of fibers to 1 gram of Methylcellulose to 20 grams of water and mixing it very well till achieving the paste.
- Second, adjust all parameters that suits our grain size on marlin whether the Feed Rate or Steps per Unit or Acceleration then recheck on all movements setting parameters.
- Third, also set the slicer parameters (in this paper we used simplify3D) so first step is removing temperature control as we don't have the normal extruder, second set nozzle diameter to syringe nozzle diameter (6 mm in our case), third set the default printing speed, finally there are many other options that suits every model and printer like skirts, support, extrusion multiplier, etc.
- Finally, prepare our bed and sensors to the desired home position.





Photos of powder preparation, slicer application (software) & 3D printer.

Results



Infinity table using wheat 180.

Samples for bending test

Pyramid model using wheat 180.

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