3D Printing Object Using Recycled Disposable Masks Filament

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Abstract. 3D printing filament is the main asset in the development and manufacture of 3D objects. However, not all filament materials can be made easily. The difficulty level of 3D printing lies in the materials that are not commonly used. ABS and PLA are the easiest filaments to use, currently we are researching 3D printing filaments made from recycled disposable mask where machine specs are needed to enable 3D object fabrication. Recycled Disposable masks becomes an important research object when mask waste is widely used during the Covid-19 pandemic and currently it can be an alternative when these materials can be recycled into 3D printing filament. In this research also requires techniques to analyze typical filament materials that are adjusted for ambient temperature, filament thickness, nozzle temperature, and print bed temperature. In the design process, it is also necessary to set printing quality standards on the software used, such as the configuration of the raft printing support, the enable of the retraction. This study also analyzes the results of different objects for each filament diameter, filaments smaller than 1.75 mm will have a high vacancy rate on the object, while filament diameters with sizes larger than 1.75 mm will have high vacancy rates on the object. difficulties when entering the filament into the head print on 3D printing machine. It is also hoped that in this research, the 3D printing objects can be printed correctly and can be used as a reference to determine which is better than other filament material schemes and adjustments to different techniques.

Keywords: *3D Printing, Filament, Masks Object, Nozzle*

1 Introduction

3d printing is a hastily growing era withinside the last years. This business revolution has packages withinside the fields of engineering, remedy and lots of more. These include introduction of mass-custom designed merchandise, prototypes, alternative elements or even clinical and dental implants. The pace and simplicity of designing and enhancing merchandise has made them the primary fast prototyping technique [1]. 3D printing era is a surely modern and has emerged as a flexible era stage. It opens new possibilities and offers wish to many opportunities for businesses trying to enhance production efficiency [2].

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In the Covid-19 Pandemic situation, masks are the main protective equipment from potential exposure to the virus. Surgical masks and N95 masks have a better ability to protect users than other masks, but they are both disposable masks that contribute to the accumulation of waste and are potentially the next threat. Data from the Indonesian Institute of Sciences shows that the amount of waste of personal protective equipment, especially masks, was recorded at 1,662.75 tons in the first 6 months of the pandemic from March-September 2020 [3]. The masks are generally made of synthetic fabric made of Polypropylene which cannot be biodegradable. Disposable mask waste has a similar impact to other plastics if disposed of in the environment, including causing water pollution, being ingested by animals, to potential sources of microplastics). Therefore, efforts to develop technology that can overcome the problem of disposable mask waste are important and needs special attention.

An alternative solution to avoid plastic contamination due to the use of masks during a pandemic is the technology of recycling mask waste into plastic ore as raw material for thermoplastic products. In general, the process of recycling disposable masks goes through four stages, namely disinfection, removal of ear rubber and nasal clamps, grinding, extrusion and injection [4]. Plastic ore recycled from masks can be molded into various types of products according to needs, one of which is 3D Printing filament products.

3D printing filaments are thermoplastic materials in the form of spools of yarn which are generally available in two standard diameters, namely 1.75 mm and 2.85 mm. Acrylonitrile butadiene styrene (ABS) and Polylactic acid (PLA) are the most widely used thermoplastic materials in 3D Printing applications. The use of mask recycling materials both as a whole and mixing with thermoplastics that are commonly used in 3D printing applications is expected to be a more environmentally friendly alternative material. In addition to reducing the amount of waste, the use of this recycled material is expected to reduce the use of new plastics, especially in 3D Printing products.

2 Methods

The main obstacle when still using the previous 3D machine (Shilouette Alta 3D Machine) belonging to the Polymedia laboratory is when the basic material Filament Mask cannot be absorbed through the filament hose of the 3D (Shilouette Alta Machine). So that the need for a new machine is immediately functioned. The second obstacle is related to the shape of the diameter that is less than the standard Filament of each 3D Printing machine, which is 1.75 mm. This causes a lack of leveling heating pressure during the printing process that occurs at the beginning in the print head of the 3D machine and causes the print output to be imperfect.

The methodology used in this study is the systematic literature analysis. The systematic literature review was conducted in five stages: formulating the research problems, identifying relevant work, assessing the quality of studies, summarizing the evidence, and interpreting the findings. [5]. The reuse of unsuccessful prints, used parts, disposable prototypes, and waste materials not necessarily originally used for 3D printing, pivot artistict source of materials for filament production is beneficial both economically and for the environmental [6].

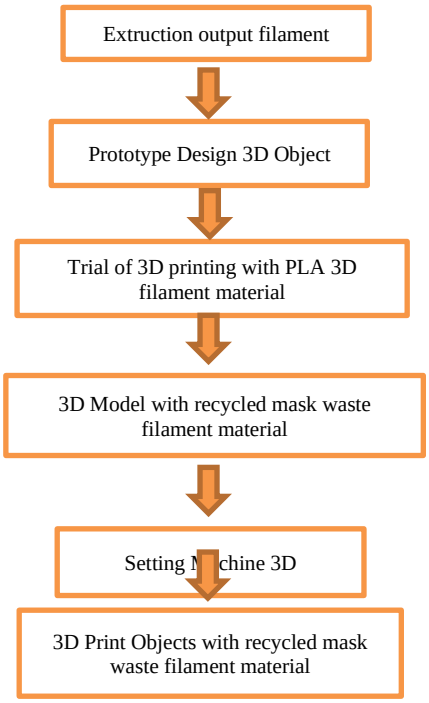

Fig 1. Workflow Method 3D Object Disposable Mask Filament

3 Experiment

3.1 Extrusion Progress

Anderson proposed direct recycling of the applied PLA filament thru its floor up and re-extrusion into 3D printing filament. After extrusion cycles and one 3D printing process, the cloth keeps comparable diameter and surface end because the authentic one, even as its mechanical homes exhibit mild deteriorations [7]. Unexpected discount in viscosity, attributed to chain scission at some stage in recycling, is the primary draw-lower back that prohibits subjection of the applied PLA filament to similarly 3D printing [8]

As the main component of 3D printing materials are filaments that have been extracted from raw materials that can indeed be used as solid objects. In this study, the extrusion process to produce diameters is very difficult. Various process techniques are carried out in order to obtain diameter results with standard filament diameters that are easy to input in the 3D printing head print hole and extrusion properly so as to get quality results. But we tried some filaments that managed to extrud well even though they were only 1 meter long.

3.2 Printing Process

The FDM machine's operating precept is to warmth the filament at the nozzle to attain a semiliquid kingdom after which extruding it on a plate or layer that changed into previously

printed. Thermoplasticity of polymer filaments allows the filaments to fuse at some stage in printing after which solidify at room temperature after printing [9]. Resources Human/Operator very influential in the process printing takes place because Different operator capabilities will produce quality and Different mold quantitiesThe results of the examination that have been carried out by the Research team have produced many Sample Tests that can be used as 3D Printing Filaments, including:

Table 1. Implementation Filament Disposable Mask

No	Filament	Extrusion	Temperature Nozzle	Bed Temperature	Software 3D Modelling / Desain
1	PP 100% + Disposable Mask No	Yes	180°	60°	Creality Slicer
2	PP 50% + Disposable Mask 75%	Yes	180°	60°	Creality Slicer
3	PP 75% + Disposable Mask 25%	Yes	180°	60°	Creality Slicer

Of the three types above, the research team conducted a trial of 3D printing and carried out 3D finishing by expecting output results that could be shaped.

(A) By using PP100% material, it is seen that the machine print process looks active and removes PP100 filaments from the nozzle. However, the shape of the 3D results does not look optimal due to the adjustment of the 3D engine settings that must be determined by the specifications.
(B) At first glance, it looks almost the same as PP100% that the print process results have not looked optimal in terms of filament heating in the nozzle and the shape of the 3D results has not been in the form of a vertical object.
(C) The results of the 3D printing process using a compound of 75% PP + Mask 25%, have begun to form Vertical 3D objects, but it is necessary to adjust the settings on the basic material so that the verticalization of the print can increase and the 3D object begins to be seen.

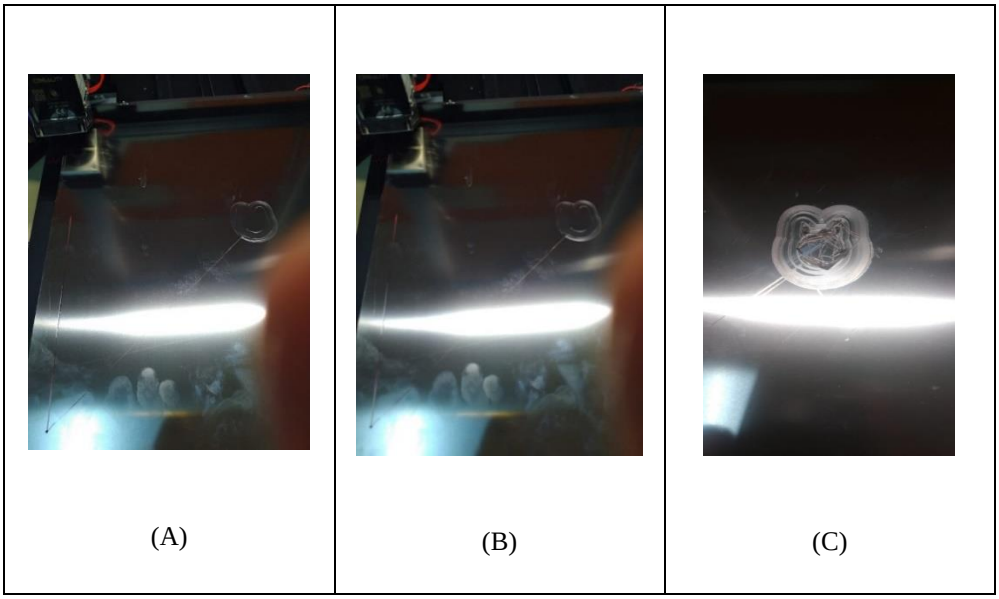

Fig 3. Experiment 3D Object PP – Disposable Mask Filament.

3.3 Design and Temperature Setting

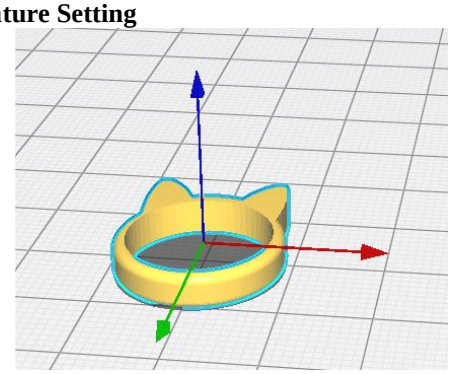

Fig.4 Creation of 3D Object cat ring design using Creality Software

4 Result and Discussion

The process of creating 3D Models and 3D Objects was successfully carried out with several notes, including:
1. Room temperature is very influential for the 3D Printing Creality Smart Pro 10 machine, where the bed temperature has the main factor in printing objects.
2. The diameter thickness of the recycled mask waste filament has a toleration diameter value of 1.85 mm, where the head print hole has a hole size of 1.90 mm.

3. D Printing Machine enclosure is required to maintain the stability of nozzle temperature and bed printing temperature.
4. To avoid the occurrence of warping (non-simestris molding) a dense and stable recycled filament material is needed in diameter so that in the extrusion process in the nozzle runs well and in printing the object is always symmetrical

Table 3. Result 3D Object Disposable Mask

No	Object	Filament	Length	Temperature Nozzle	Bed Temperature	Rafting	Enclosure
1	Dropbolt Lock	PP 75 % + Disposable Mask 25%	0.20 mm	280°	100°	Non Raft	No
2	Cat Ring	PP 75 % + Disposable Mask 25%	0.10 mm	290°	100°	Non Raft	No

Fig 6 . Dropbolt Lock & Cat Ring 3D Object Disposable Mask Filament.

The outer product of 3D Printing based on Mask Waste Filament was successfully applied with an estimated temperature of 280 degrees to 290 degrees Celsius. The 3D printing process takes a bit of a long time, where determining the temperature of the nozzle temperature and bed temperature with the material of the mask waste filament needs more adjustment. Superiority of 3D Printing products made from waste masks, 3D design Objects equivalent to 3D designs of objects made from filaments such as PLA and ABS as well as easy auto levelling optimization When initial installation in the printing process.

5 Conclusion

After conducting several trials of printing 3D Printing Objects with recycled mask waste filament materials, several trial results were found, one of which was successfully printing 3D Printing Objects with excellent results by going through several stages. The temperature of the nozzle that matches the filament material, the temperature of the printing room, the diameter of the filament in the range of 1.60 mm to 1.85 mm and the arrangement of the bed cover of the 3D Printing machine. The additional progress of the component achievements was obtained because the output of good extrusion results from the type of PP material category + Mask Waste can run on the Creality CR-10 Pro machine.

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