Construction of a recycled plastic filament winder for 3D printing

Francisco-de-Paula Luque-del-Castillo[1], M.Carmen Ladrón-de-Guevara-Muñoz[1*], Óscar-D. de-Cózar-Macías[1], Francisca-J. Castillo-Rueda[1], Jorge Pérez-García[1], José-Luis Martínez-Torres[1]

[1] Universidad de Málaga. Escuela de Ingenierías Industriales. Departamento de Expresión Gráfica, Diseño y Proyectos. C/ Doctor Ortiz Ramos, s/n. 29071 Málaga.

* Corresponding author: clguevara@uma.es; Tel.: +34-951952274

Abstract The work presented here exposes the development and design of a new machine: the recycled plastic filament winder understood as an innovative DIY tool that enables and provides new solutions for the recycling and reuse of plastic, creating customized filaments that can be used in 3D printing, for instance. It is a cost-effective and sustainable solution that helps reduce waste and environmental pollution.

The construction of this machine makes possible to create 3D printing filament from discarded plastic. It can be understood as one more option among the existing solutions that, in a profitable and sustainable way, contribute to reduce waste and environmental pollution. Thus, the construction of this winder joins the set of machines that allow to extend the useful life of plastic materials, trying to prevent them from ending up in landfills or seas and oceans; in short, to reduce the amount of plastic waste that every year pollute the ecosystem and the environment.

The winder works by taking plastic from disposed containers such as bottles, caps, jerry cans, etc. These containers need to be previously shredded into small plastic shavings or flakes, which are then fed into an extruder machine, where they are melted and, through the winder, this molten mass of plastic is transformed into a thread or filament that can be used in 3D printing. In addition, this winder design also gives users the opportunity to create customized filament since the color, texture and thickness of the filament can be controlled.

Keywords: Plastic recycling; winder; 3D printing; filament; thickness control.

The experiment consists in converting a larger diameter filament of 2.85mm, formerly used in older 3D printers, into a standardized diameter of 1.75mm. To do this, the filament was heated with a torch at minimum power. Then, the filament was fed into the winder starting with the cooling stage and proceeding through the remaining two stages.
During the development of this tests, some calibrations were made on the PID controllers. Consequently, once the extruder machine is in operation, they will need to be further adjusted during the subsequent experiments.
After the due PID calibration, the 2.85mm filament was successfully transformed into 1.75mm filament obtaining a good precision. The measurements made on the filament show that an accuracy of ±0.07mm is achieved since the maximum and minimum thickness are within the range of 1.82 - 1.73mm. In addition, the commercial spools average error is found at ±0.05mm, which supports that the winder presented here obtains good and accurate results after proper calibration.

5 Conclusions

After deep research to approach each design stage, a functional prototype is given as a result. However, it still needs further testing especially regarding its joint operation with the extrusion machine that is currently being optimized by the MAREA Plastic team.

Up to date, the recycled plastic winder for 3D printing filament has achieved the following:

- Adequate filament cooling system by air through the use of one, two or three fans simultaneously depending on the desired temperature.
- Accurate thickness control by means of the non-linear thickness control system in charge of applying tension to the filament according to the diameter needed an measured by a DIY sensor, obtaining an accuracy of ±0.07mm.
- Customized 3D printed gears and support for filament coils.

In addition, it should be noted that most of the materials employed for the winder construction were recycled or reused promoting once again the circular economy concept. As future work, further experiments need to be conducted to improve and refine the interaction and codependence between the extruder and the winder machine.
As part of the social movement Precious Plastic, all the improvements and designs developed by the MAREA Plastic team will be published on the web in open source, so as to contribute to this international community by offering the possibility that anyone can reproduce it, in order to promote the philosophy of a circular economy and a sustainable development of society.

Acknowledgments The research work reported here has been carried out within the MAREA Plastic project, financed by the II Own Plan of the Vice-Rectorate for Smart Campus of the University of Malaga.

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