Research into how to create self-cleaning surfaces via 3-D printing

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Juan Manuel Barrios and Pablo Romero, investigators of the study. Credit: Universidad de Córdoba (Spain)

It is becoming more and more obvious that 3-D printing is more than

just an interesting toy to be used at tech fairs. Based on the 4.0 industry principles, several startups and small businesses are currently incorporating it into their manufacturing processes in order to directly create customized end products. In this context, the Manufacturing Processes Engineering group at the University of Cordoba studied how to optimize the features of surfaces made from 3-D printing with a very speficic goal: that they clean themselves.

The concept of a self-cleaning surface is not new. For instance, in the construction and car industries, coatings of this kind have been used for some time now on glass surfaces. "This coating helps drops of water roll easily down the surface and take dirt particles with them as they go," explains Pablo Romero, author of the study along with Juan Manuel Barrios.

There are other sectors in which it is also important to use self-cleaning surfaces. One of them is traffic signals, a sector in which 3-D printing is already in use to print bulbs for traffic lights. Road safety on highways depends a great deal upon these signals being clean and visible to drivers, making it interesting to use elements that clean themselves on their own with help from the rain or morning dew.

This research study analyzed characteristics of roughness from 3-D printed surfaces. The idea is to make surfaces with very few raised parts and a good finish in order to avoid getting dust embedded and to facilitate getting dirt particles off easily. The study also looked into hydrophobic features, that is to say, the ability to repel water. Hence, the water would roll easier down the surface, taking with it dirt particles, which would have a hard time sticking to the surface.

With the aim of implementing this research in a practical way within companies, the research team created easy to manage models that can predict the surface properties of the pieces even before they are printed.

3-D printers have several operational parameters that can be used to modify surface characteristics of the printed component. To create these models, by means of data mining techniques, they analyzed the printing parameters that most influence self-cleaning features on surfaces. According to the researchers, "thanks to these models, workers that manage this printing equipment can easily be aware of the values they need to adjust on the printer in order to obtain a piece with the desired self-cleaning characteristics."

The study was carried out in partnership with the Cordoban business called Estampaciones Casado ("Casado Stamping"), a company that manufactures and does maintenance on traffic signals, and that recently incorporated 3-D printing to produce certain components of signals equipped with LED lights. "This is about our research work solving real world problems and having a positive impact on companies in our area," points out Pablo Romero. In the study, Smart Materials 3-D, a manufacturing company from Jaen, also participated. Smart Materials 3-D manufactures thermoplastic filaments that are used as a raw material in 3-D printers.

Henceforth, the group will work on a project that is part of the FDM-Sur National Plan called "Development of new industrial uses for pieces printed in 3-D based on improving their surface properties." Through the project, they will attempt to optimize features of surfaces printed in 3-D in order to solve real problems that companies in the region are facing.

In addition to delving deeper into self-cleaning characteristics of pieces printed in 3-D, this project will improve surface properties of molds printed in 3-D used to manufacture polyurethane foam pieces, such as seats for cars, mattresses and pillows. What is more, they will work on reducing ice attaching itself to communication antennas and other parts of airframes on drones and unmanned aerial vehicles that nowadays are manufactured with 3-D printing.

More information: Juan M. Barrios et al, Improvement of Surface Roughness and Hydrophobicity in PETG Parts Manufactured via Fused Deposition Modeling (FDM): An Application in 3D Printed Self–Cleaning Parts, *Materials* (2019). DOI: 10.3390/ma12152499

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