ADAPTATION OF REPRAP 3D PRINTERS FOR PRINTING CERAMIC COMPOSITIONS BY EXTRUSION

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1. ABSTRACT

Additive manufacturing (AM) is a manufacturing technique in which layer upon layer of a given material is joined to form a three-dimensional object. Different materials, such as plastic, metals, resins, and plaster are used in this technique, and forming takes place according to different physical principles by means of a 3D printer.

A 3D printer is thus a machine that is able to make 3D "prints" of designs, creating volumetric pieces or scale models from a computer design. It is being increasingly used in die making and the prefabrication of pieces or components in sectors such as architecture and industrial design, as well as more recently in making prostheses, as 3D printing allows each piece to be personalised to the particular characteristics of a given patient.

The technique has extended itself at a dizzying pace among consumers thanks to RepRap printers. These printers are free 3D printers that run at a very low cost and are capable of printing plastic objects. As many of the parts are made of plastic and RepRap prints those parts, RepRap can replicate itself, hence its name. The most attractive feature of 3D printers is that they allow industrial manufacturing processes to be transferred – on a smaller scale – to the laboratory, as well as to the home or the office.

This presentation describes the results of a successful adaptation of this type of printer to the extrusion of ceramic compositions, with a view to studying the printing of different designs with ceramic materials, using this 3D technology, on a laboratory level.

Items with different designs were printed using monoporosa and stoneware tile compositions, which were subsequently subjected to drying and firing processes. This required equipping the printer with a device that enabled slurries to be extruded through nozzles of different diameters by means of pressurised air in a controlled way.

The resolution of the final finish of the piece, as it is a manufacturing technique in which layer upon layer is added, was determined by extruder diameter. Objects were printed with extruders having diameters between 1.5 and 2.5 mm. This meant, for each diameter, optimising suspension moisture content and pressure, in order to obtain the targeted resolution without any subsequent crack defects forming in drying owing to excess moisture content in forming.

This development contributes to determining, on a laboratory level, the different variables involved in the 3D printing of inorganic materials by extrusion, in order then to be able to extrapolate the technology to industry.

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