Print like an Egyptian

A ceramics engineer and former visual arts graduate are developing a 3D printable self-glazing ceramic inspired by Egyptian faience – an old non-clay technique used in jewellery making. While 3D technical ceramics (usually fired at more than1,300°C) exist, 3D is a relatively new field in terms of domestic ceramics. 'The first patents were filed in the early 1990s but good results have only recently been obtained,' says Professor Stephen Hoskins of the Centre for Fine Print Research at the University of the West of England, Bristol.

The manufacturing process involves dry mixing ceramic materials with up to 25% organic binder to produce a 3D printable ceramic body mix. This is put into the 3D printer and bound together using ZCorp (a proprietary powder deposition printing system) with liquid inkjet binders, which are printed onto the surface of the clay body one layer at a time. Hoskins explains, 'Instead of using a plaster powder in the printer, we added our patented ceramic mix. The printer works by having two boxes of powder – one full and one almost empty. To create a print, a virtual 3D CAD file is first created and then vertically sliced into many parts. These slices are then sent one at a time to the printer.'

So far, the method has been successfully used to fabricate porcelain, earthenware, stoneware and terracotta-type bodies, although the physical properties are not yet exactly comparable to conventional formed clay ware. The ultimate goal is to replicate the types used in the tableware, architectural and tile ceramic sectors, notes Hoskins.

The main advantage of a 3D ceramic material is that any shape can be created, including those impossible to form using a conventional ceramic process. Additionally, there is no need for tooling or moulds, so a designer or engineer can go straight from a 3D CAD file directly to printing a ceramic object with no interim stages.

Another benefit of printing ceramic materials is cost. 'As printing takes away the need for moulds or casting equipment, the costs necessary for extrusion processes are far less than conventional industrial machinery. A basic 3D extrusion kit can be bought for £1,000 and modified to requirements.'

To scale up the process, Hoskins says all that is needed is either multiple print heads, larger scale printing beds or multiple extrusion heads.

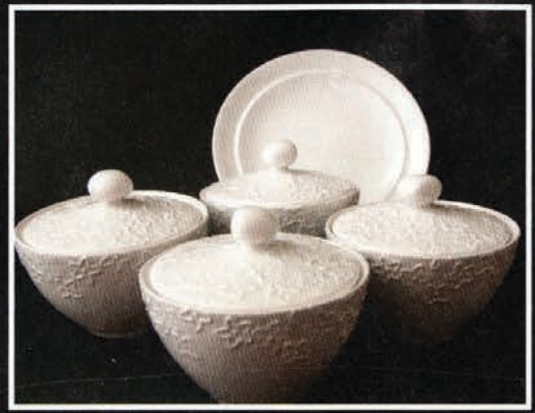
'The process also uses less energy to make the powdered body mix, as instead of spray drying, this is a ceramic dry powder that is essentially glued together,' adds Hoskins. However, once the artefact is printed, it follows standard ceramic processing, such as firing and glazing.

Giving an indication of the method's potential versatility and speed, he explains that, 'a 3D printer can build a bed of objects or a single object at a rate of about 2.5cm in an hour. The time saving comes because you can build a unique object without any tooling. On our previous research project with Denby, it took two to three weeks to create a set of moulds for a prototype, which a 3D printer can do in a matter of hours.'

Hoskins notes that the work is intended as research at the moment. The project is funded by the Arts and Humanities Research Council, so its primary aim will be to assist the art and design sector. However, the implications of a 3D printable self-glazing ceramic material that can be taken straight from the printer, placed in the kiln, vitrified and glazed in one firing could be far reaching.

At present, the duo hold a patent and licensing agreement for a 3D printable ceramic material that is based upon a porcelain type body. The work in collaboration with Denby Potteries can be viewed at www.ahrc.ac.uk/News-and-Events/News/Pages/3D-Printing-in-Ceramics.aspx

The research programme, which started in September 2012, will run for three years. All papers on its progress can be accessed at www.uwe.ac.uk/sca/research/cfpr/



Above: A lattice tea bowl designed by Peter Ting, printed and fired at the Centre for Fine Print Research. **Right:** Denby sugar bowl prototypes and a Denby plate, printed, fired and glazed at the Centre of Fine Print Research.