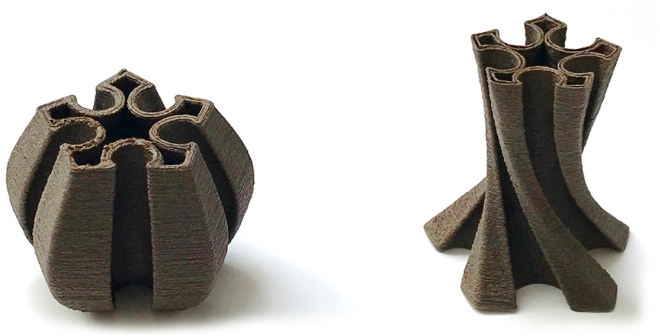
Circular & Sustainable 3D Printing

Masters graduation or research project



The problem: 3D printed plastic parts often cause much higher environmental impacts per part than traditional injection molding at scale. This is because 3D printing requires much more energy per part than injection molding. However, new materials can enable 3D printing that is actually an environmental improvement instead. Replacing the melting of plastic with the extrusion of pastes that bond chemically at room temperature can use up to 75% less energy than standard ABS extrusion. Furthermore, the embodied impacts of good materials can be 80% lower than ABS plastic, by choosing materials with low toxicity and a circular life cycle (compostable biomaterials, even sourced from agricultural waste like sawdust or the shells of cacao, pecans, or oysters). Such materials can even be half the cost of standard ABS printing filament. However, their material strength and print quality need improvement.

Project goal: Invent new material recipes that bring the quality of 3D paste extrusion up to match ABS extrusion, perhaps even match its strength, or find viable commercial markets for materials with current performance. Quality may be measured by dimensional accuracy, surface finish, and ease of printing. This includes printer setup, and could include the invention of better hardware to modify Ultimakers for paste printing, a possible commercial product. Project variations could include life cycle assessment and/or material toxicity assessment of 3D printed parts versus standard plastic printing.

Company partner: No industry partner is guaranteed, but connections exist to a Dutch 3D printer manufacturer, a German furniture manufacturer using 3D printing in production, and a Canadian producer of printer modification kits. Students are also welcome to recruit other companies.

Skills required: Applicants must have strong hands-on experience with desktop extrusion printing, ideally with some knowledge of G-code. Experience with materials design also desired, especially chemistry knowledge. Time commitment required is a graduation project or a research project of 9 ECTS.

Contact: Assistant professor Jeremy Faludi, j.faludi@tudelft.nl.