U of T researchers turn waste cooking oil from McDonald's into high-resolution, biodegradable printing resin

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Researchers convert used deep fryer oil from McDonald's into high-end 3D printing resin

U of T Scarborough scientists find a way to turn fryer oil into 3D printing material

Researchers at U of T Scarborough have for the first time turned waste cooking oil from a deep fryer into a high-resolution, biodegradable resin for 3D printing.

Using waste cooking has significant potential — it's cheaper to make and the plastics made from it can break down naturally compared to conventional 3D printing resins.

"The reasons plastics are a problem is because nature hasn't evolved to handle human-made chemicals," says Professor Andre Simpson, who developed the resin in his lab at U of T Scarborough.

"Because we're using what is essentially a natural product – fats from cooking oil – nature can deal with it much better."

Simpson first became interested in the idea when he first got a 3D printer about three years ago. After realizing the molecules used in commercial resins were similar to fats found in cooking oils, he wondered whether one could be created using waste cooking oil.

One challenge was getting waste cooking oil from a restaurant to test in the lab. After contacting all major national fast food chains, the only one to respond was McDonald's. The oil used in the research was from a local outlet in Scarborough.

Simpson and his team used a straightforward one-step chemical process in the lab, using about 1 litre of used cooking oil to make 420ml of resin. The resin was able to print a plastic butterfly that showed features down to 100 micrometres, and was structurally and thermally stable, meaning it wouldn't crumble or melt above room temperature.

"We found that turning McDonald's waste cooking oil has excellent potential as a 3D printing resin," says Simpson, an environmental chemist and director of the Environmental NMR Centre at U of T Scarborough.

The results of the research are published in the journal *ACS Sustainable Chemistry & Engineering*. Simpson received funding from the Natural Sciences and Engineering Research Council of Canada (NSERC), the Canada Foundation for Innovation (CFI), Government of Ontario, and the Krembil Foundation.

Used cooking oil is a major global environmental problem, with commercial and household waste causing serious environmental issues, including clogged sewage lines caused by the build-up of fats.

While there are commercial uses for waste cooking oil, Simpson says there's a lack of ways to recycle it into a high value commodity such as a 3D printing resin. He adds that creating a high commodity product could remove some of the financial barriers with recycling waste cooking oil since many restaurants pay to dispose it.

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Conventional high-resolution resins can also cost upwards of $525 USD per litre to make because they're derived from fossil fuel oils and require several steps. They also aren't biodegradable.

All but one of the chemicals used to make the resin can be recycled meaning it could be manufactured for as low as $300 USD per tonne making it cheaper than most plastics. In addition, it cures solid in sunlight, opening up the possibility pouring it as liquid and forming structure on a work site, and is biodegradable. They found that after burying a 3D plastic object made with their resin in soil, it lost 20 per cent of its weight in about two weeks, but does not degrade without contact with soil microbes.

Deleted: The resin made in Simpson's lab on the other hand has the double benefit of costing about **$$$ to make** and is biodegradable.

"If you bury it in soil microbes will start to break it down because essentially it's just fat," says Simpson.

"It's something that microbes actually like to eat and they do a good job at breaking it down."