Microalgae as SLA 3D printing material

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B: Design Flagship Proof of principles

Objective

To use microalgae oil as a renewable material for the production of SLA 3D printing resin, aiming to phase out fossil fuel feedstock.

Main (Key) Result

Microalgae oil is suitable feedstock for 3D printing resin

We successfully used microalgae oil as a renewable material for SLA 3D printing. Microalgae oil is rich in fatty acids bearing double bonds which can be utilised to insert functional groups. In our case, the fatty acid double bonds were transformed to epoxide groups through an epoxidation reaction. On a next step, methacrylate groups were inserted on the locations of the highly reactive epoxidation groups, yielding a potentially photopolymerisable product. Using the final product of the methacrylation reaction, we formulated a resin which cures under UV light.

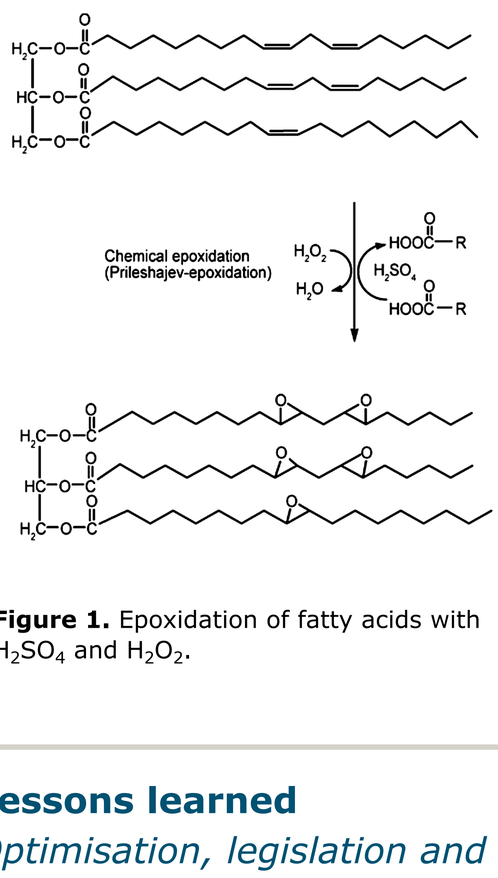

Figure 1. Epoxidation of fatty acids with H_2SO_4 and H_2O_2.

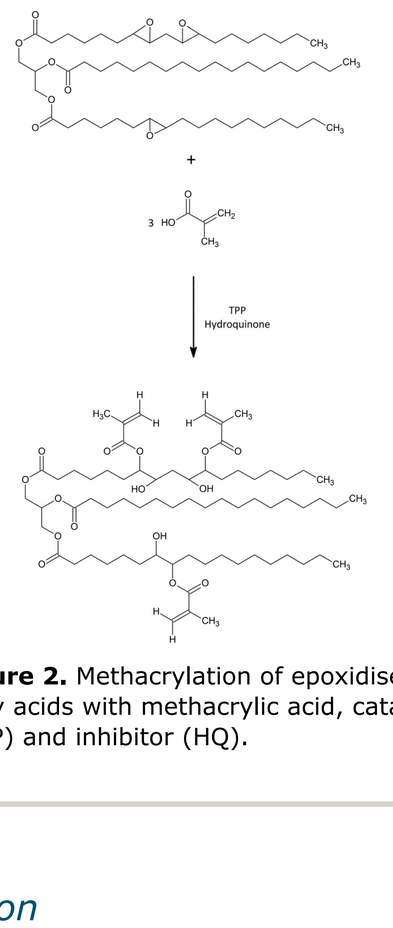

Figure 2. Methacrylation of epoxidised fatty acids with methacrylic acid, catalyst (TPP) and inhibitor (HQ).

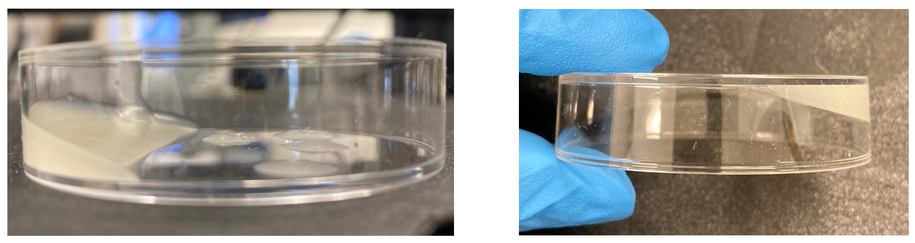

Figure 3. UV-cured microalgae-based resin.

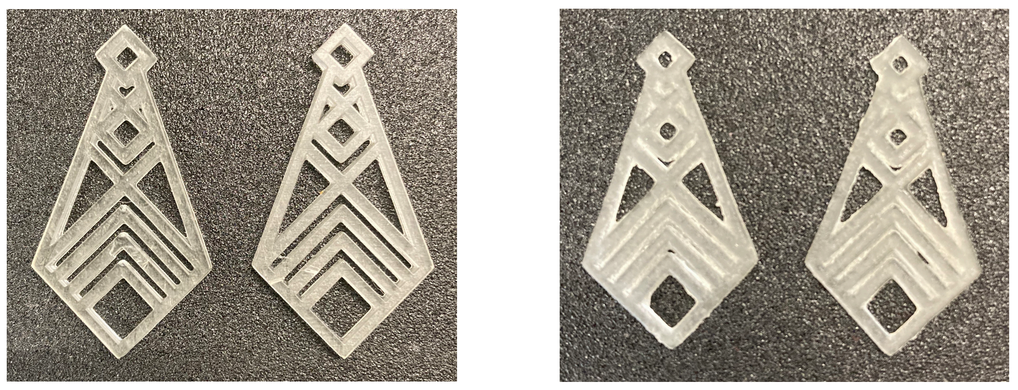

Figure 4. 3D printed earrings using (left) commercially available 3D printing resin and (right) microalgae-based resin.

Readiness

Laboratory tests completed & proof of concept

The research project is on **TRL Level 3 / 4.** A photocurable resin from microalgae oil was successfully formulated, proving that microalgae oil can used as an alternative feedstock to fossil fuels, for resin formulation.

Lessons learned

Optimisation, legislation and promotion

Microalgae oil can be used as a **printing material**, but:

- further studies are needed for **optimising the printability** & mechanical characteristics of the printing material
- analysis of the **legal framework** within which a **biobased product** can be introduced

3D printing may seem counterintuitive in terms of "green" materials and waste, but it allows for:

- printing only the needed accessory, at location, **eliminating shipping emissions**
- **customising** particular objects or garments, that could **potentially reduce waste**

Next steps

Testing the final material & applications

Further developing the research product includes:

- analysing the **microalgae oil resin in comparison to the commercially available resins** (PCC)
- **reviewing the legislation** for making such product available on the market
- **analysing the market** before introducing the product (pricing, promotion etc)
- Using the microalgae resin to print microfluidics device for microalgae separation - **From microalgae, to microlagae** (BPE)

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