BRIDGE

Industry Case Study

Ultra-low cost high throughput 3D printed NMR tube cleaner

Background

Used NMR tubes present a common problem in chemistry as they are difficult to clean effectively and can require substantial effort to clean in a time and resource effective way. A common solution is to resort to using disposable NMR tubes, which can have a considerable negative sustainability impact, adding to levels of laboratory waste. There exists, therefore, a need for a time- and cost-effective solution for the cleaning and re-use of NMR tubes in many chemistry laboratories.

Approach

This Case Study describes how fused deposition modelling (commonly known as 3D printing) was used to design a novel NMR tube cleaner that can be manufactured in-house by laboratories for minimal cost.

The design presented is high throughput, allowing six NMR tubes to be cleaned simultaneously. In addition, flexibility is at the heart of the design as the cleaner can be mounted on a typical lab flask (Figure 1A), screwed onto a custom-made flask (Figure 1B) or screwed onto a generic container (Figure 1C). The only equipment then needed to make the device function are a vacuum source and a single length of standard 10 mm laboratory tubing.

NMR tubes are placed on the central supports and a small quantity of solvent placed in the attached receptacle. The action of the vacuum pump then circulates water through each of the tubes, cleaning them in the process.

The Bridge Advanced Materials and Engineering R&D Centre has an industry-leading 3D printer produced by Construct3D1, which enables us to print large, and potentially complex, designs quickly and reliably.

Outcomes

The cleaner allows NMR tubes to be cleaned at high throughput (ca. twelve NMR tubes per minute) and with minimal workload (tubes just need to be placed on supports). It also cleans NMR tubes more effectively than hand-washing and has the potential to significantly reduce NMR glassware waste from the laboratory.

Summary

The low cost and high efficiency make this ideal for laboratory environments that generate large quantities of used NMR tubes that are sensitive to price, e.g. undergraduate chemistry lab classes. The CAD files are available free-of-charge on the Bridge website.

A   B   C

Fig 1.

Low cost high throughput 3D printed NMR tube cleaner in three possible configurations.

A. Installed upon a standard laboratory wide-necked Erlenmeyer flask.
B. Installed upon a custom printed vessel.
C. Installed upon an old grocery container, an insert was required in this configuration to accommodate the wider neck of the jam jar.