SAMPLE PREPARATION MODULE

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Problem

Users of the modular experiment box might have to prepare samples for their experiment off-grid. Without fume hood, this can cause contamination of the sample and release of toxic fumes. Because of the corona virus, limited labs are available and installing a fume hood in your house is very expensive and the size is not practical. Also, a fume hood is not portable which limits the places where you can work.

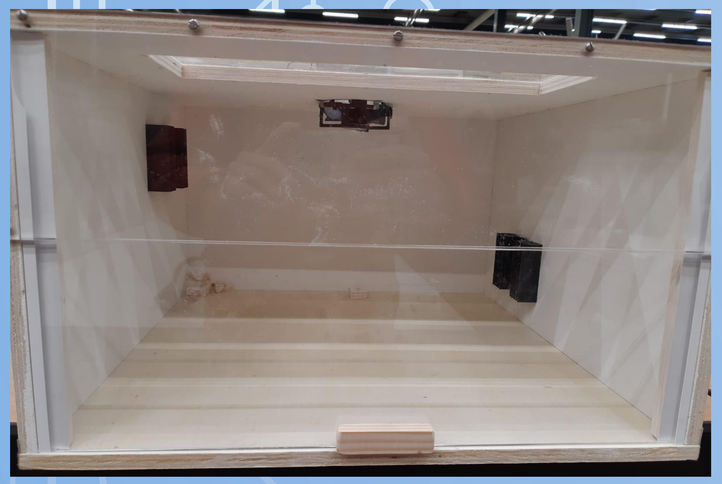

Figure 1: Inside view of the sample preparation module with heat sinks at the sides and the fan at the top.

Solution

We created a sample preparation module that provides a ventilated, clean, and chemical resistant workspace for samples to be prepared in. The sample preparation module is lightweight, which make it easy to carry around. It can be integrated in and powered by the modular experiment box.

Figure 2: Sample preparation module

Specifications

- Ventilation to carry away fumes
- Chemical resistant worksurface
- Light and portable
- Can be stored in and powered by The Box.
- Incorporated temperature control

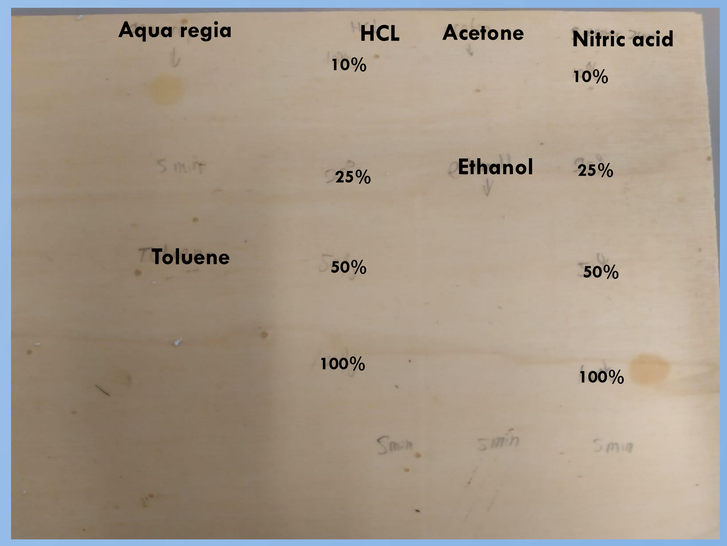

Figure 4: Coated test wood after testing the chemical resistance. Visible discolouration at 100% nitric acid and aqua regia spots.

Building process

Building time: 2 weeks
Total cost: €61.75
Materials (widely available):

- Wood
- Fan recycled from old computer
- Plexiglass
- Polyurethane coating
- White paint
- Rail + slat for sliding plexiglass
- Duct tape
- Retractable pipe + pvc pipe
- Construction glue
- Screws

Two Peltier elements (cooling and warming) have been added to the sides to control the temperature, see figure 3.

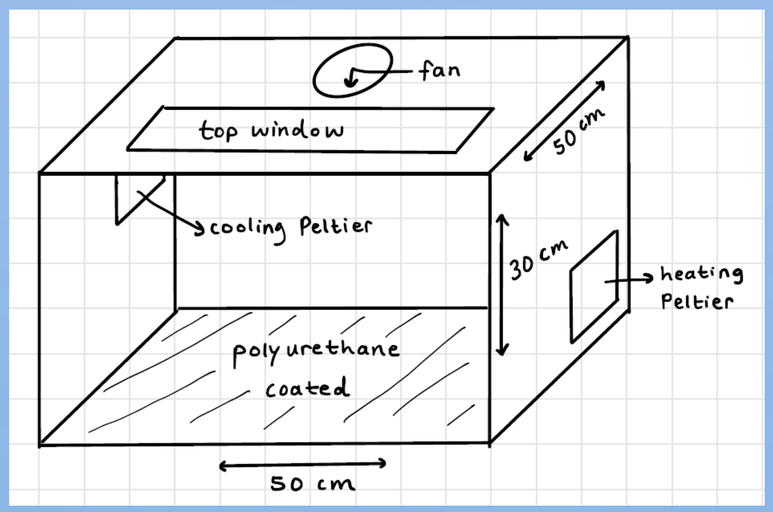

Figure 3: Schematic representation including dimensions

Testing

Ventilation:

- Used anemometer to measure the airflow
- Measured face velocity of 0.2 m/s
- The guideline for a professional, full-sized fume hood is that the face velocity should be between 0.3 and 0.5 m/s [1]
- We concluded that 0.2 m/s is enough for the purpose of the sample preparation module.
- No flow was measured through the sides of the box

Chemical resistance:

- Drops of approximately 0.5-1 mL chemical were left for 5 minutes on a coated test piece of wood.
- Concentration series of hydrochloric and nitric acid: 10% 25%, 50% and 100%
- Aquaregia and 100% nitric acid damage surface (see figure 4)
- Feel test after 24 hours indicates that Acetone might also damage coating (not an exact measure)

References:
[1] A guide to Laboratory Fume Hoods, ESCO, http://www.escoglobal.com/products/download/1334055898.pdf