Pressure Optimisation

Estelle Baumann

December 11, 2024

1 EPFL Carbon Team

We are a MAKE Project, building a prototype able to perform direct air capture (DAC). Our main prototype, Astérix, can be seen like a big air vent. Air flows from one side to another thanks to a fan in the entrance, and will pass through structures containing adsorbents. This is where the capture process happens, those adsorbents are small chemical structures on which the CO_2 sticks when passing through. Using temperature swings, the machine captures CO_2 at ambient temperatures and releases it in a highly concentrated form when heated, making it ready for storage

You will join a dynamic team of 60 members coming from various sections. Joining a MAKE Project means you will be surrounded by students available to help you, and give you advice if needed. On top of that, working in the SPOT gives you access to every tool or machinery you might find useful, and highly competent coaches here to help as well.
Every semester, we have mechanical engineering students joining us for semesters project. We always received good feedback, and some of them chose to remain involved with the team afterward.

Do not hesitate to check our website, and if you have any questions or are interested in joining the project, you can contact us at `presidentcarbonteam@epfl.ch`

2 Description of the project

2.1 Context

We want to optimize the pressure drop inside the prototype. The biggest issue we encounter happens when the air must go through the structure holding the adsorbents. Considering they are in quite dense configuration, we must find the geometry that allows the easiest path for air flux. Currently, we use columns to hold the adsorbents (Figure 1), there are 9 of them in parallel inside Astérix, and 1 inside the smaller version of the prototype ("Casing" on Figure 2). This smaller version, which we like to call Mini-Astérix, has been built last year as a semesters project like this one. Because the outer structure is made out of wood (Figure 3), we cannot test capture with temperature swing, but it was made to analyze general air flux performance.

Figure 1

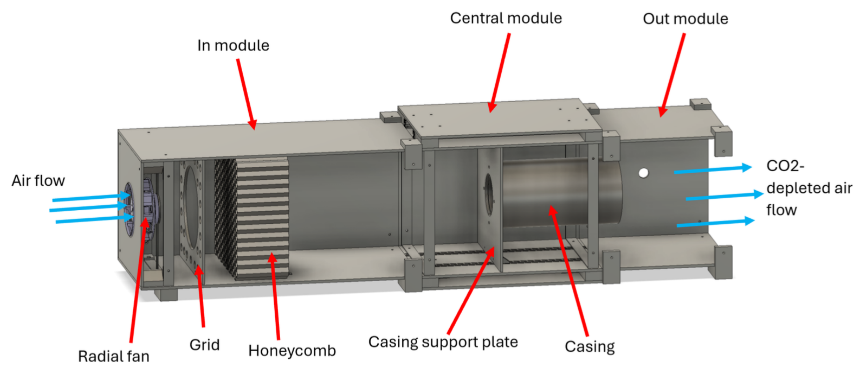


Figure 2: CAD of the Mini-Astérix prototype

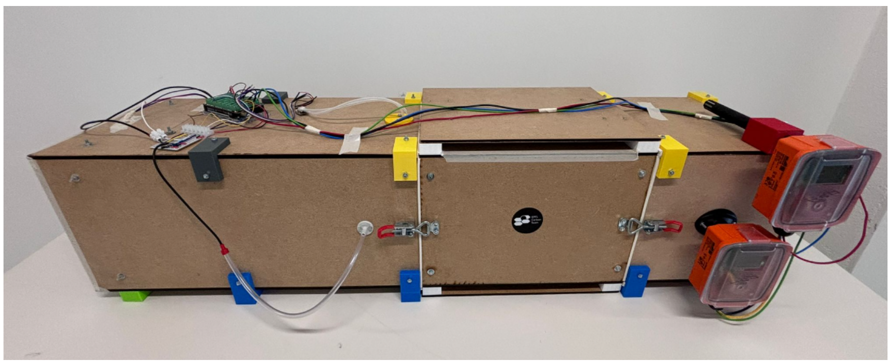
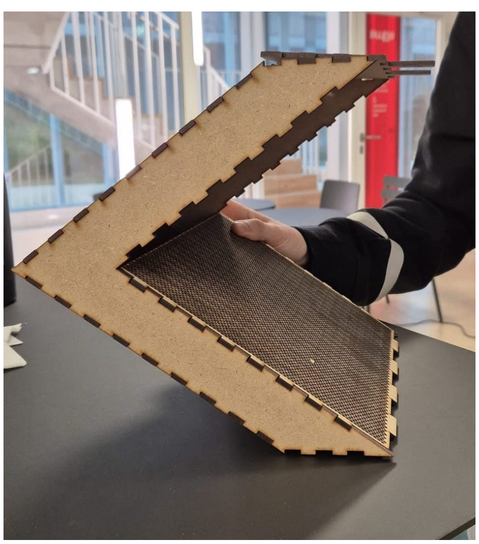


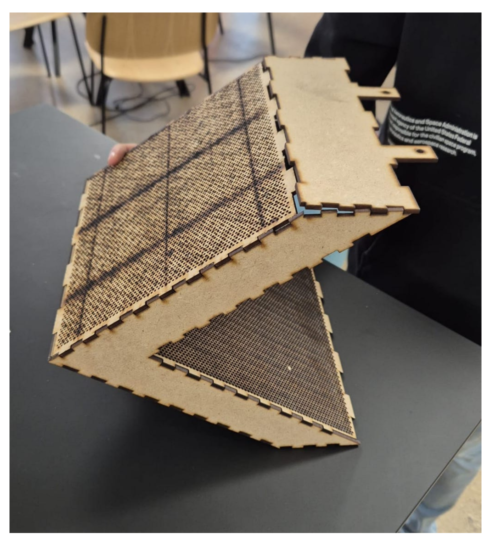
Figure 3: Photo of the Mini-Astérix prototype

2.2 Your task

Like said before, we currently use columns to contain the adsorbents, but we already have the possibility to try a triangular shape instead (Figure 4). The goal of this project is to find the optimal structure for adsorbent housing, using the Mini-Astérix prototype.



(a)



(b)

Figure 4: Triangle version of adsorbent structure

The main tasks of this project are:

- Improving the prototype by adding the necessary components to be able to analyze pressure drop
- Comparing the results for different structures of adsorbent holders (columns/triangle)
- Researching other geometries for the structure and, if time allows, designing and testing them as well.

This task will require CAD designs of your new ideas of structure, building of these structures using rapid prototyping methods available at the SPOT (laser cutting, 3D printing, etc), and most importantly, the reading of sensors values to determine the most optimized solution.

If this project resonates with you, we would love to welcome you in the team !

2.3 Number of people required

For this project we expect 2 to 3 students.