

Direct Air Capture: Construction, Testing and Optimizing of a Prototype

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Purpose The emission of carbon dioxide into the atmosphere increases the greenhouse effect and warms the earth. In addition to reducing CO₂ emissions, it is possible to actively remove the greenhouse gas directly from the atmosphere. This process is called Direct Air Capture (DAC). In the aforementioned process, a fan moves air through a special filter, which separates the CO₂ from the air. The objective of my work was to build a small-scale prototype DAC unit to investigate if measurable amounts of CO₂ can be removed from ambient air. Additionally, I aimed to improve the overall efficiency of the CO₂ capturing process.

Procedure In my project measurements with a self-built DAC unit are carried out and the system is optimized. Designing the apparatus was accomplished with a CAD program. The structural parts then were 3D-printed. The DAC machine and the sensors are controlled by a self-written program running on a microcontroller.

Results With the self-built DAC plant, I demonstrated carbon capture from the ambient air and steadily increased the CO₂ capture rate through improvements to the system. The most efficient setup separates between 2.5 and 3.2 grams of CO₂ within one hour, with an energy consumption of 5,000 to 6,000 joules per gram captured (without regeneration of the filter).

Conclusions With my self-built DAC unit, I was able to actively remove measurable amounts of CO₂ without exceeding material costs of 400\$. Thus, this project provides valuable insights into the subject of DAC and contributes to research on the technology, which can provide a solution for the climate problem.

Awards Won:

