**A Mobile CO2 Capture Pilot Plant at ULiège, Belgium**

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As the European Union accelerates its push toward decarbonizing society, industrial stakeholders are actively exploring the most effective pathways to reduce greenhouse gas emissions. Pilot installations have become critical in de-risking both novel and established technologies in the field of carbon capture, utilization, and storage (CCUS).

At the University of Liège (ULiège) in Belgium, researchers are working towards creating a "smart campus" that provides students and researchers alike with access to cutting-edge CCUS installations. With funding from the European Union's Resilience Plan, the *Products, Environment, and Processes* (PEPs) group at ULiège is spearheading the construction of a $CO_2$ capture pilot plant, a $CO_2$-to-kerosene conversion pilot, and a direct air capture test bench.

The $CO_2$ capture pilot plant has a processing capacity of 1 ton of $CO_2$ per day. Utilizing a well-established chemical absorption process, the plant can employ either amines or carbonate solvents to capture $CO_2$ from a variety of emission sources. Fully automated and designed for remote operation, the plant is ideal for long-term experimental campaigns, including overnight and weekend operations. This extended operation allows for the collection of large datasets, which are critical for process model validation and testing advanced control strategies, including intelligent control systems. Long-duration experiments also offer valuable insights into solvent stability and corrosion behavior.

The pilot plant is fully electrified, requiring electricity as its main utility. A heat pump is integrated into the system, recovering heat from the condenser and upgrading it to the higher temperatures needed by the reboiler. The commissioning and initial tests of the pilot plant are planned to take place at the central heating station on the Sart Tilman campus of ULiège, where the plant will capture $CO_2$ from the exhaust gases of a biomass boiler.

The installation is compact, housed within three 20-foot shipping containers. Two containers hold the main equipment, while the third serves as the control room, facilitating easy transportation and deployment across different industrial sites.

A key feature of the installation is its flexibility-oriented design. The pilot includes a gas pretreatment section equipped with bag filters, selective catalytic reduction for NOx removal, and a two-stage scrubbing column for SOx removal and gas cooling. This pretreatment enables the unit to process flue gases with a wide range of impurities. The absorption and desorption columns are designed to integrate intercooling and interheating, optimizing process efficiency. The flexible design allows the solvent to be fed at different heights within the columns, enabling the evaluation of column height effects on $CO_2$ separation without requiring physical modifications. If necessary, the columns can be easily dismantled, as they are constructed from flanged pipe segments.

Overall, this pilot plant serves both scientific and educational purposes, offering crucial insights into $CO_2$ capture technologies while facilitating the de-risking of these processes in hard-to-abate sectors. This is an essential strategy for advancing industrial decarbonization efforts.

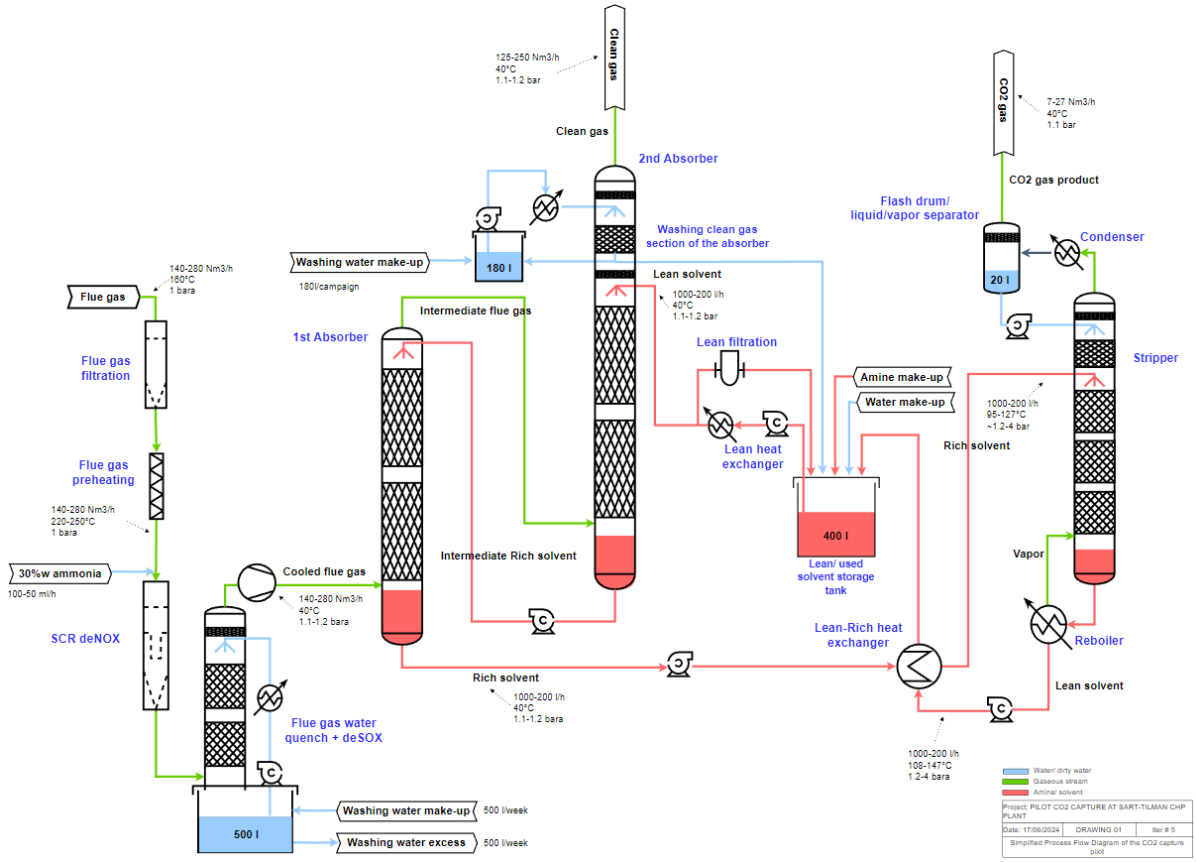


Figure 1. Process flow diagram of the $CO_2$ capture pilot.

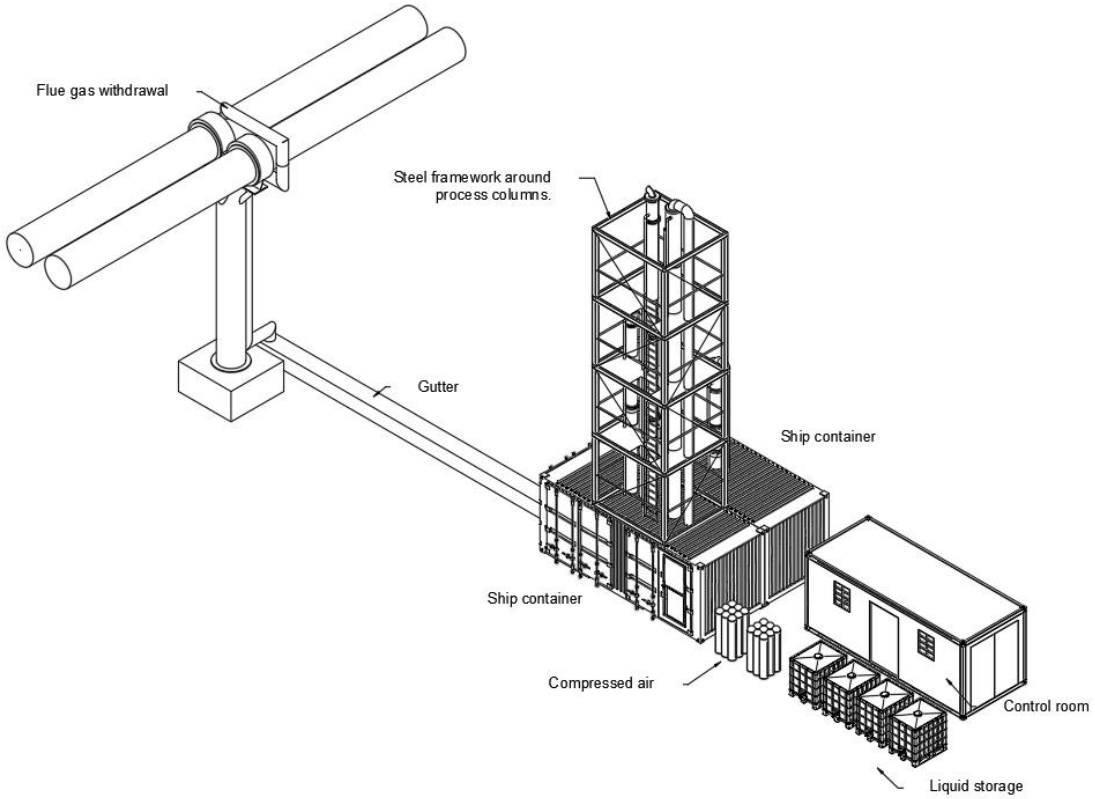


Figure 2. 3D plan of $CO_2$ capture pilot and its connection to the biomass boiler gas ducts.