DMX™ Demonstrator for CO_2 Capture: First Results of Experimental Campaign

Claire Barbot (TotalEnergies, Pau, France)
David Albarracin-Zaidiza, Vincent Carlier, Vania Santos-Moreau and Pierre Bachaud (IFP Energies Nouvelles, Solaize, France)
Clément Salais (clement.salais@axens.net) (Axens, Rueil-Malmaison, France)
Bernard Petetin (ArcelorMittal, Dunkerque, France)

Background/Objectives. Carbon capture is due to play a fundamental role in achieving a Net Zero Emissions scenario in 2050. Amine scrubbing is considered a suitable technology for the sectors with large-fixed CO_2 emissions due to its robustness, adaptability, and capability of producing a highly concentrated CO_2 stream that is suitable for transport. Four main challenges need to be addressed for the industrial deployment of this technology: process footprint reduction, process energy penalty reduction, solvent and VOC emission limitation and long-term process stability. Some challenges can be addressed through solvent formulation and process configuration. IFPEN has developed a novel solvent and process configuration, the DMX™ process, showing promising energy consumption and process stability results. This work aims at the demonstration of the DMX™ process by means of a set of experimental campaigns with a demonstration plant treating real gases in the frame of H2020 funded project called 3D (grant agreement n° 838031). The demonstration plant is installed in the Steel Mill of ArcelorMittal Dunkirk and will absorb CO_2 present in the blast furnaces gases. The design and construction of the unit are realized under the supervision of Axens. The demonstration plant is operated by a mixed team from IFPEN and TotalEnergies.

Approach/Activities. The DMX™ technology is a CO_2 chemical absorption process involving a demixing solvent. This process consists of the continuous operation of two sections: 1) the absorption section, in which the CO_2 is captured by the lean solvent, and 2) the regeneration section, in which the rich solvent is thermally stripped from the CO_2 and recirculated to the absorption section. The particularity of this process is the solvent demixing in the regeneration section. Only the CO2-rich aqueous stream is thermally stripped. In addition, since the regeneration of the solvent can be performed at a relatively high temperature (150-160 °C), the DMX process produces a relatively high-pressure CO_2 effluent (5-6 bara). Hence, energy and investment cost savings are expected to be obtained.

Results/Lessons Learned. The demonstration plant operation started in October 2022. A total of 14 months (60 weeks) of operation have been considered, excluding the commissioning, starting-up and dismantling steps. The pilot unit's operating time is divided into two different types of tests: 8 months dedicated to a set of parametric studies and 6 months invested to perform a long-term test. Several operating conditions, such as the quality of the solvent regeneration, the solvent and raw gas temperatures or the absorption and regeneration pressure will be studied to optimize the energy consumption of the DMX™ process for different CO_2 capture applications. A specific set of tests will be performed to optimize the operating parameters allowing to limit solvent emissions. A preliminary set of results of these experimental campaigns will be presented and some lessons learned from the start-up and operation of the unit will be discussed.

3D Project, standing for DMX™ Demonstration Dunkirk, is a European-funded project to demonstrate an innovative CO_2 capture process at a semi-industrial scale: DMX™. The 11 partners of this project gathered their forces to demonstrate the capture process and to study the CCS chain (capture, transport and Storage) allowing to decrease the CO_2 emissions from industries (steel mills, refineries, waste-to-energy plants etc).