CARBON CAPTURE, UTILIZATION & STORAGE

DMX™ Process

A Breakthrough Demixing Solvent for Post Combustion CO_2 Capture

The Key Role of CCS in Emissions Reductions

The capture and further use or storage of CO_2 present in industrial gases, such as process gas streams or flue gases, is one of the major tool to limit the global warming by reducing the level of CO_2 emissions to the atmosphere. In their World Energy Outlook from October 2020, the International Energy Agency (IEA), estimates that CCS (Carbon Capture & Storage) can contribute significantly to the overall efforts required to keep global warming below 2°C. CCS could avoid an estimated amount of 5 Gt CO_2/year from energy-related and industrial process CO_2 emissions by 2050 in their Sustainable Development Scenario (SDS). Apart from the transport sector, the biggest CO_2 emitters remain power generation plants (especially coal and gas plants) and industries like cement, steel plants and refining among many others, where CCS solutions are key to reduce hard-to-abate emissions.

Building on 60 years of Experience and Continuous Innovation, Axens Provides CO_2 Capture Solutions

CO_2 removal with amine scrubbing is a well-known process used since 1920 in Natural Gas Treatment. Axens and IFPEN have acquired an over 60 years' experience in CO_2 removal on natural gas through the licensing of the Advamine™ Process.

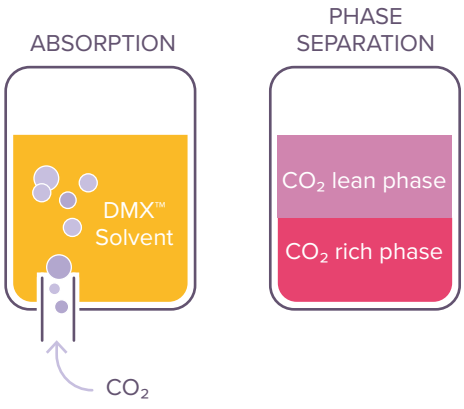
Although CO_2 can be easily recovered from pressurized gases with currently available absorption technologies, its recovery from low pressure gases or flue gases, leads to a significant energy penalty. Furthermore, most solvents currently used in the Oil and Gas or Chemical Industries will be severely degraded by the oxygen present in flue gases for instance. More suited technologies are therefore required for most CCS applications.

BENEFITS

- Low steam energy consumption
- Thermally stable solvent with low degradation rate
- CO_2 produced readily under pressure up to 5 barg for significant compression cost savings
- High capture rate achievable (>90%) and high purity of produced CO_2 (>99%)
- -30% of CO_2 capture costs

DMX™: Minimize CO_2 Capture Costs with a Breakthrough Absorption Process

To address these challenges, Axens and IFPEN have been involved in several R&D programs over the past years to develop enhanced CO_2 capture technologies. An outcome of those developments, the DMX™ process is a breakthrough CO_2 post combustion capture process based on absorption by a proprietary demixing solvent. The DMX™ solvent consists of a mixture of CO_2 absorbing compounds in aqueous solution which is demixing under certain conditions of temperature and CO_2 partial pressure (cf. Figure 1).



↑ Figure 1: The demixing principle

Axens SOLUTIONS

DMX™, a Cost Effective Process

The DMX™ solvent is **regenerable** with a much **higher capacity** than available solvents and only the CO_2 rich phase needs to be regenerated. As it is very stable, it can be regenerated at higher temperature than amine solvents such as MEA which allows to produce the CO_2 directly under pressure up to 5 barg. This ability is a major cost saving factor when the CO_2 needs to be compressed and reinjected underground for instance.

Thanks to these properties of the solvent, the DMX™ process allows a **30 % reduction on the energy penalty and on the total CO_2 capture cost,** compared to the first generation absorption process using 30 wt.% MEA. DMX™ solvent is also **less corrosive** and Carbon Steel may be used as principal material which reduces also the CAPEX compared to other first generation solvents.

DMX™ Applications

The DMX™ process has been developed for CO_2 capture on coal power stations flue gases and steel mill gas but it could also be used for capturing CO_2 from other type of emitters such as refinery FCC unit, Steam Methane Reformer (SMR), waste incinerator, cement plant, district heating and also production of electricity from biomass.

The DMX™ process is well adapted to CO_2 capture on industrial smoke or industrial gas when the CO_2 partial pressures are low to medium, typically below 1 bara.

DMX™ Process Concept

The DMX™ solvent removes CO_2 from the flue gas in the absorber to achieve a CO_2 recovery from 90% to 99% depending on the needs. The CO_2 rich solvent is preheated in the lean/rich solvent exchanger to reach conditions at which the solvent forms two phases: one CO_2 rich phase and one CO_2 lean phase. The CO_2 lean phase is separated in the decanter and directly routed back to the absorber. Only the CO_2 rich phase is regenerated. The required reboiler steam consumption is greatly reduced thanks to this feature, associated to the solvent high capacity (cf. Figure 2).

This CO_2 rich phase regeneration is performed under pressure, up to 5 barg, thanks to its thermal stability. It enables to reach significant CO_2 compression cost savings in view of its sequestration or liquefaction.

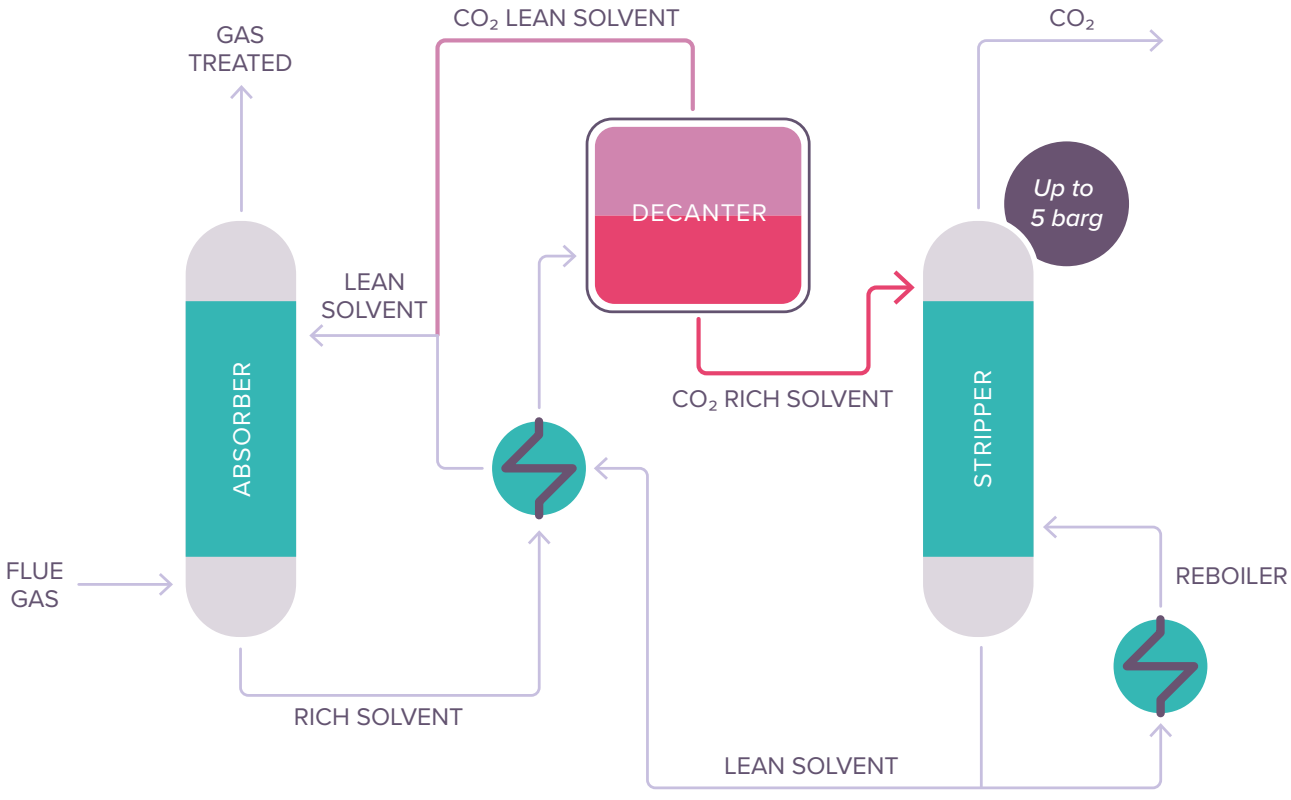


Figure 2: DMX™ Process Concept & PFD

IFP Energies Nouvelles (IFPEN) owns a dedicated pilot testing facility in its premises of Solaize. Dedicated tests can be done upon client's request with a reconstituted gas to confirm the performance of the process for any new application (cf. Figure 3).

Figure 3: IFPEN's Mini-pilot plant in Solaize (France)

3D Project: DMX™ Technology Demonstration

After more than 10 years of development from laboratory scale to global optimization in the power and steel industries, the DMX™ process has passed a new step with its current demonstration at industrial scale, final step before commercialization end of 2023 by Axens. Operational since April 2023 at ArcelorMittal's steel mill in Dunkirk, the unit is capturing the CO_2 from blast furnace gas at a capacity of 0.5t CO_2/h. The first results obtained are in line with the promises of the technology and already attest to the efficiency and energy performance of DMX™ technology. A whole series of operational tests are conducted with 24/7 operation of the unit. The capture rates obtained are greater than 90%. The pilot also produces very pure CO_2 (> 99.5%) while energy consumption remains remarkably low.

The demonstration unit was built and is operated as part of the European H2020 "3D" project bringing together 11 European partners including ArcelorMittal, Axens, IFPEN and TotalEnergies. This project also studies the full-scale CO_2 capture, conditioning, transport and storage of 1 Mtpa CO_2 from blast furnace gas contributing to the development of a CO_2 hub located in Dunkirk and connected with the storage facilities like those foreseen with the Northern Lights (or Longship).

Axens will make CO_2 capture with DMX™ an industrial reality through the design of full-scale industrial units thanks to its industrial know-how of large scale amine units for Oil & Gas applications and to the results from the demonstration on the 3D pilot plant.

› https://3d-ccus.com

Figure 4: Demonstration Plant

CO_2
Catch it ’cause you can!

Axens.net Blog

Axens is a group providing a complete range of solutions for the conversion of oil and biomass to cleaner fuels, the production and purification of major petrochemical intermediates as well as all of natural gas treatment and conversion options. The integrated offer includes technologies, equipment, furnaces, modular units, catalysts, adsorbents and related services, commercialized under “Axens Solutions”, “Heurtey Petrochem Solutions” and “Axens Horizon” brands.

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2023-09_DMX