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Amino Acid based Carbon Capture Technology – from DAC to point sources applications

Ralf Gesthuisen[2], Ulrich Dietz[1], Julien Nottbohm[2], Thomas Bittner[2]
[1]CBL – Carbon Beyond Limits GmbH and Co.KG, [2]INEOS Manufacturing Deutschland GmbH

Abstract

Carbon Capture process technologies are gaining more and more interest in the transformation process of diverse industries. Consequently, existing process technologies are further developed to widen their field of application and increase their efficiency and new process technologies are developing. While in the past carbon capture in industrial applications was focused on processes like methane steam reforming or flue gas treatment of coal fired power plants more new sources of CO_2 are considered for carbon capture application, from biogas treatment with high CO_2 content to Direct Air Capture.

The presented Amino-acid based process is a novel technology for Carbon Capture based on the absorption of CO_2 by an aqueous solution containing the natural amino acid L-Arginine, wherein the aqueous derivates of CO_2 can be bound and stored at atmospheric pressure. A nearly complete removal of CO_2 from a carrier gas can be achieved over the full range of applications, from Direct Air Capture to flue gas treatment to biogas cleaning or respectively from CO_2 concentrations of 400 Vppm to 50 V% or higher. The process is capable to reduce the CO_2 content in the off gas below 20Vppm. The absorption process is either based on a membrane contactor or a typical washing tower which leaves the option to optimize the process setup for the specific application. The bounded aqueous derivates of CO_2 can be selectively separated from the acceptor solution by electrodialysis. CO_2 spontaneously flashes out from the receiving solution at high purity. Results from lab experiments for cleaning a flue gas containing contaminants like NO_2 and SO_2 demonstrate the capability and efficiency of the developed process. Although the types of membranes have not yet been optimized the lab experiments show that the absorption efficiency is close to 100% and that the energy efficiency of a further optimized pilot plant has the potential to be below 0.6 MWh/tCO_2 for point sources which is compared to many other technologies quite low. The developed process allows to absorb CO_2 continuously but to run the power consuming desorption discontinuously. This technological option is a trade-off between the invest and the operating cost.

The used chemicals for absorption and as acceptor solution for desorption are not hazardous. the process can be installed even in non-industrial areas Thus, a novel process can be provided to extract, transport and selectively release CO_2 of high purity. The developed process is environmentally harmless, operated electrically at atmospheric pressure with no thermal heat consumption or production and is easy to operate.