INTEGRATION OF CALCIUM LOOPING TECHNOLOGY IN EXISTING CEMENT PLANT FOR CO₂ CAPTURE: PROCESS SIMULATION AND ECONOMIC PERSPECTIVES

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Abstract:

Cement sector is currently responsible for approximately 5% of the global CO₂ emissions. CO₂ originates principally from the raw meal calcination stage and conventional fuel (e.g. coal) combustion for the thermal needs of the process. Carbon capture and storage (CCS) is among the examined technologies for mitigating CO₂ emissions generated in a cement plant.

A very competitive technology for CO₂ capture from flue gases is Calcium looping (CaL). According to this, CO₂ is absorbed by CaO in the first reactor (carbonator), and the produced CaCO₃ is regenerated in the second oxy – fired reactor (calciner). During the calcination, the CO₂ is released from the sorbents, purified, compressed and sent to storage. Among the advantages of CaL for CO₂ capture in comparison with other technologies that could be employed in the cement industry, is the familiarity with the management (extraction, storage, feeding, etc.) of CaO-bearing materials and the possibility of reusing purge CaO in cement making as it is chemically compatible with the raw meal used in the clinker making process.

This study describes the process modeling using ASPEN Plus for the CaL implementation on a typical (no by-pass) precalciner five-stage preheater cement plant as a retrofit option, in order to capture the CO₂ produced through the clinker production. A detailed description of the process configuration of the CO₂ capture unit and the basic parameters for the clinker production line is presented. An economic evaluation is also performed, estimating the basic cost parameters and the cost for CO₂ avoidance. In order to assess the results, the CaL process is compared with the corresponding economic analysis of amine scrubbing technology, which is the alternative option for post-combustion capture. Finally, the present work intends to identify the perspectives of the utilization of the released heat from the CaL unit, either for electricity production or for distinct heating.

Keywords: cement sector, calcium looping, CO₂ capture, process modeling

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