Abstract

Kansai Electric Power Co., Inc. (KEPCO) and Mitsubishi Heavy Industries, Ltd. (MHI) developed the high-efficiency post-combustion CO\textsubscript{2} capture technology known as the KM CDR Process\textsuperscript{TM}. Thirteen (13) commercial plants with CO\textsubscript{2} capacities ranging from 200 ton per day to 4,776 ton per day have been delivered around the world, and one (1) plant is under construction, as of January 2022. This process can efficiently capture CO\textsubscript{2} from flue gas from power plants and other various facilities and is one of the effective measures to combat global warming.

Increasing CO\textsubscript{2} capture efficiency in carbon capture facilities is crucial to help mitigate global warming. In GHGT-14, MHI reported on CO\textsubscript{2} capture cost and technical features at 99.5\% CO\textsubscript{2} capture from a 650 MW coal-fired power plant using this process and compared the higher capture ratio design to the conventional CO\textsubscript{2} capture ratio of 90\%.

Negative emission is achieved when the CO\textsubscript{2} concentration of the treated gas released into the atmosphere from the CO\textsubscript{2} capture plant becomes lower than the atmospheric CO\textsubscript{2} concentration of 400 ppm. This can be achieved if the CO\textsubscript{2} capture ratio is 99.96\% or higher for typical boiler flue gases having 10\% CO\textsubscript{2} concentration.

MHI studied whether such a high capture ratio could be achieved with the KM CDR Process\textsuperscript{TM}. The driving force for CO\textsubscript{2} absorption is extremely diminished at the high CO\textsubscript{2} capture ratio, but the simulation results indicate that increasing both the solvent circulation rate and the steam amount for regeneration can result in CO\textsubscript{2} capture of 99.96\% or higher.

Campaigns aimed at extremely high CO\textsubscript{2} capture rates were carried out at the MHI / KEPCO pilot plant and Mongstad demonstration plant in Norway in 2021.

As calculated in the simulation, a very high CO\textsubscript{2} capture rate of 99.8\% were achieved or GT flue gas in both the MHI/KEPCO pilot plant and the Norwegian Mongstad plant using KS-21\textsuperscript{TM} solvent. The CO\textsubscript{2} concentration at the Absorber outlet was much lower than 400 ppm in air.

MHI confirmed based on these testing results that increasing the packing height of the absorber and regenerator
helps reduce solvent circulation and reboiler steam. This suggests that the overall CO₂ capture cost can be optimized by trading operating cost with capital cost.

Our study indicates that the CO₂ capture cost would not increase much even compared to the conventional 90-95% CO₂ capture case in a typical CO₂ capture plant, when the CO₂ capture ratio increases to negative emission level. It seems more economical than using DAC technology and high CO₂ capturing can be some role of DAC after the KM CDR Process™ is well optimized for very high CO₂ capture rate.

In this presentation, the test results of 99.8% CO₂ capture in our pilot and Mongstad plant will be announced. The economics of CO₂ capture plants that achieve such high CO₂ capture, which can be a very important tool in the world of zero emissions, will be also discussed.

*Keywords:* KM CDR Process™