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Evaluation of CO2 capture from gas engine using a mobile CO2 capture testing unit

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Abstract

Capturing CO2 from various sources of flue gas, such as industrial facilities and power plants, is a very effective method of reducing CO2 emissions and will become a major source of CO2 for the carbon capture and storage (CCS) process.
Mitsubishi Heavy Industries, Ltd. (MHI) developed the high-efficiency post-combustion CO2 capture technology known as the KM CDR Process™ with Kansai Electric Power Co., Inc. (KEPCO).
Eighteen (18) commercial plants with CO2 capacities ranging from 0.3 to 4,776 tons per day have been delivered around the world as of March 2025. The process efficiently captures CO2 from flue gases from numerous industrial facilities, including power plants with a variety of fuels, such as gas, heavy oil, coal, and biomass, refineries, steel mills, and others. The captured CO2 is commercially used in EOR, urea, methanol, beverages, dry ice, and others. The previously used proprietary KS-1 solvent™ was upgraded to KS-21 solvent™, which demonstrated very high CO2 capture rates (>99%) in 2021 during long-term test campaigns at the KEPCO/MHI pilot plant and at Technology Centre Mongstad (TCM) in Norway [1], [2].

The amine solvent technology for CO2 capture is key to the long-term stable operation. It frequently uses gas sources containing "dirty" components as feedstock, such as cement flue gas, steel blast furnace gas, and others. Many gases are highly contaminated with impurities that are detrimental to the amine solvent process. When planning to install a CO2 capture unit, all harmful impurities produced during every operating mode of the facility should be considered. In addition, plant equipment and its material should be carefully selected to avoid any potential problems coming from such harmful impurities. Unfortunately, it is very difficult to sample and quantitatively analyse all these impurities accurately for every operating mode. More realistically, a portable CO2 mobile testing unit demonstrating CO2 capture performance from actual flue gas is a suitable way to manage the issue.

Before constructing full-scale units, MHI frequently conducts many pilot tests with portable CO2 mobile testing unit for evaluation purposes in many locations worldwide including, amongst others, Canada, the UK, the EU and Japan. Pilot test flue gas sources include biomass, cement, blast furnaces, gas engines, papermaking mill and incinerators. These tests not only capture CO2, but also demonstrate the operation of the pretreatment unit against harmful impurities.

This presentation will present examples of these pilot tests conducted by MHI, as well as examples of the deployment study of the Advanced KM CDR Process™ into commercial units.

References

[1] Takuya Hirata, Tatsuya Tsujiuchi, Takashi Kamijo, "Near-zero emission coal-fired power plant using advanced KM CDR process™", International Journal of Greenhouse Gas Control, Volume 92, January 2020

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