IEAGHG 8th Post Combustion Capture Conference

16th to 18th September 2025 Marseille, France

Update of MHI KM CDR process™ - Recent technical improvements and commercial achievements

Takashi Kamijo[a], Daigo Inakazu[a]

[a]*Mitsubishi Heavy Industries, Ltd.3-3-1 Minatomirai, Nishi-ku, Yokohama 220-8401 Japan*

Abstract

Mitsubishi Heavy Industries, Ltd. (MHI) developed the high-efficiency post-combustion CO2 capture technology known as the KM CDR Process (TM) 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].

ExxonMobil and MHI have entered a CO2 capture technology partnership in 2022. Leveraging the strengths of both companies to meet customer needs, MHI and ExxonMobil will provide each strength in CO2 capture technology and CO2 transportation/storage, respectively. In addition, both works together to develop next generation amine solvent technology for CO2 capture.
This joint effort will ensure that all customers have a comprehensive end-to-end solution to drive a low-carbon future.
Not satisfied with operating numerous commercial plants, KM CDR process (TM) continues to improve to reduce energy consumption and CO2 capture cost through further development of proprietary solvent and optimization of process system.
Below are the recent notable updates:

1. Conducted pilot tests on various facilities such as biomass, waste, gas engines, ships, cement plants, blast furnace, wood pellet plants, paper mills. Based on these results, an appropriate design approach was established for each flue gas considering the effects of impurities in flue gas and its countermeasures.

2. Conducted many integration studies with cement plants, FPSO, ships, CCGT and others. These integration studies include optimization of the heat recovery system between host unit and CO2 capture, and flue gas impurity removal treatment. A closer study of a heat pump using low-temperature waste heat sources both inside and outside the CO2 capture plant was also conducted.

3. A CAPEX reduction study was carried out for the CO2 capture unit, which accounts for a large cost in a CCS project. This includes a wide range of efforts such as standardization of the unit, modularization to reduce direct and indirect costs for on-site construction, adoption of advanced equipment and others.

4. An automated operation system has been being developed to simplify the operation of CO2 capture plant and reduce the burden on operators. Effort is also being made to quickly identify the operating status of CO2 capture plant using a remote monitoring system and for MHI to provide advice. The aim is to improve the operational availability and reliability of CO2 capture plants. These efforts can reduce the barriers to introducing CO2 capture plants for owners who have difficulty securing skilled operators and want to maximize plant availability.

5. A new commercial plant started up in Bangladesh in 2024. KS-1 solvent™ was used during the commissioning and start-up periods. The solvent was changed from KS-1 to KS-21 solvent™ after initial start-up and has continued stable commercial operation without any issues. This demonstrates the superior characteristics of KS-21 solvent™, which is less prone to degradation by high temperatures and oxygen than KS-1 as MHI expects.

6. A CO2 capture pilot plant with a capacity at approximately 5 tons/day was installed and started operation at Himeji No.2 power plant of KEPCO in Japan. The new plant accelerates and demonstrate activities towards next generation CO2 capture technology under the agreement with ExxonMobil, as a substitution of the previous pilot plant installed at Nanko power station in 1991.

This presentation will focus on providing an update on the various MHI passionate activities mentioned above regarding the Advanced KM CDR process™.

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

[2] Osamu Miyamoto, Cole Maas, Tatsuya Tsujiuchi, Takashi Kamijo, "KM CDR Process TM Project Update and the New Novel Solvent Development", Energy Procedia, 114:5616-5623, July 2017

Keywords: Amine; CO2 capture; KM CDR process , KS-1 solvent™, KS-21 solvent™