

## Risk Assessment of Microbial Associated CO<sub>2</sub> Geological Storage and CH<sub>4</sub> Production

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Among in-situ microbes within depleted oil-gas reservoir, there are special species those produce much more methane gas in CO<sub>2</sub> rich environment than in CO<sub>2</sub> poor environment. CO<sub>2</sub> acts as a catalyst in the reaction. If we maintain preferable conditions for methanogenesis archaea during geological CCS, we will be able to abate greenhouse gas emission and produce natural gas as one of natural energy resources at the same time.

We named the technological concept as 'Microbial associated Geological CCS'. In Microbial associated Geological CCS, CO<sub>2</sub> will be injected from a well for two purposes: to abate greenhouse gas emission and to cultivate methanogenic geo-microbes. CH<sub>4</sub> gas will be produced later using other wells. The procedure is similar to the Enhanced Oil/Gas Recovery (EOR/EGR) operation, but in Microbial associated Geological CCS, the target is production of methane out of depleted oil/gas reservoir during CO<sub>2</sub> abatement.

When we consider feasibility of Microbial associated Geological CCS technology concept, the most essential information is CH<sub>4</sub> produce potential. To estimate production rate, we set a developed a basic geological model of Microbial associated Geological CCS process on CHEM-TOUGH simulator, and implemented microbial activities and CCS process into it. For mineralogical composition of rock matrix and formation water in depleted reservoir, we applied measured value in Nagaoka and Yabase. We assumed a fluid flow model; residual oil is a part of matrix and it will not move; fluid will flow in the rest, 0.1 real pore space. Then we obtained preliminary results of CH<sub>4</sub> production and other masses' distributions (2).

We analyzed accident statistics of ground surface industrial facilities and oil/gas wells especially accidental leakage of CO<sub>2</sub> and methane leak. We estimated distribution of accident probabilities and accidental leak volume for 105 ton/year CO<sub>2</sub> injection. These accidental leak scenarios were offered for environmental impact studies. As regard with risks of produced methane gas, it will vary on the quantities of the production from the well. Timescale of biological methanogenesis is different from that of CO<sub>2</sub> injection rate. To assist basic site evaluation and help understanding of Microbial associated Geological CCS technology concept, we are preparing a prototype of Bio-CCS site evaluation system.

Keywords: CCS, microbial, peripheral risk, methane production, environmental impact