Methane Production through Combined Depressurization + Hydrate Swapping method in the Sandy Porous Medium under Permafrost Temperature Conditions

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Abstract. Methane Production through Combined Depressurization + Hydrate Swapping method in the Sandy Porous Medium under Permafrost Temperature Conditions.

Methane gas production recovery rate from the natural gas reservoir depends on the characteristic of porous media as well as production techniques. 70% of discovered hydrate reservoirs are in a sandy porous medium in the permafrost region. In this work, instant partial depressurization followed by Hydrate swapping combined method is applied for recovery of methane from gas hydrate reservoir by improving diffusion channels and by applying in-situ swapping of trapped methane with CO_2 or Mixture of CO_2/N_2. The aim of the study is to investigate the dependence of methane production on the nature of the porous medium using combined method in the permafrost region.

We quantitatively investigated the methane recovery from the combined method in 3 different artificial methane hydrate-bearing sand samples in parallel in the same timeline by the use of specially designed core flooding experimental apparatus. A total of 12 experiments run are performed and effect of the combined method on methane recovery from 3 different sand medium having particle sizes (0.25mm-0.3mm, 0.33-0.4mm, 0.32-0.7mm) in the permafrost temperature conditions 269.15 -274.15K and in 20-40 bar pressure range is investigated.

The experiments result demonstrated methane recovery in permafrost region is dependent on temperature and particle sizes. Combined method generate higher methane recovery as particle size increases. Use of CO_2+N_2 gas mixture results into higher methane recovery compared to pure CO_2. Results suggest that combined approach, is a better choice using CO_2+N_2 gas mixture as minimum 30% of methane has been found to be replaced from hydrate phase in most of the experiments after 120 hours from the initial exchange reaction. Gas chromatography analysis and numerical calculations show the presence of N_2 allow additional recovery of methane even though driving force behind recovery reduce. High CO_2% with N_2 allowed further methane recovery due to an increase in driving force.