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Impact of impurities on formation of carbon-dioxide hydrates

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The continued rise of CO_2 emissions threatens life on Earth, through warming the planet. Carbon Capture and Storage (CCS) is an effective method in reducing CO_2 emissions, thus over time, inhibiting the effect of global warming. One of the major challenges that face the transportation process, an intermediate stage between capture and storage, is potential flow assurance issues, especially hydrate formation due to the presence of impurities such as N_2 and H_2O. If the conditions within the pipeline are at a high pressure and low temperature, hydrates could form. Hydrate formation, which is the physical combination between a gas molecule and water molecules, could cause pipe blockage and therefore, stop the high-CO_2 mixture being transported to its storage location. This study aimed at investigating the impact of impurities on the formation of CO_2 hydrates, whilst simultaneously, considering the vapour-liquid equilibrium (VLE) phase envelope. Initially, a sensitivity analysis on binary and tertiary systems was conducted, based on the impurities most commonly encountered in CCS. Where from here, investigation into two case studies (Cortez and Sheep Mountain Pipeline) was conducted. The results from the binary analysis showed H_2S caused a significant expansion of the hydrate stability zone (HSZ). The presence of the impurities, COS, SO_2 and NH_3, caused the opposite effect to what was found with H_2S. Each impurity caused an effect on the VLE phase envelope with H_2 and N_2 causing the most significant expansion. The tertiary system sensitivity analysis showed there was a clear interaction between H_2S with Ar, O_2 and CH_4. Analysis into the case studies showed the presence of H_2S reduced the hydrate formation pressure thus increasing the likelihood of hydrate formation. This was proven to be counteracted with the presence of either COS, SO_2 or NH_3, where they increased the hydrate formation pressure.

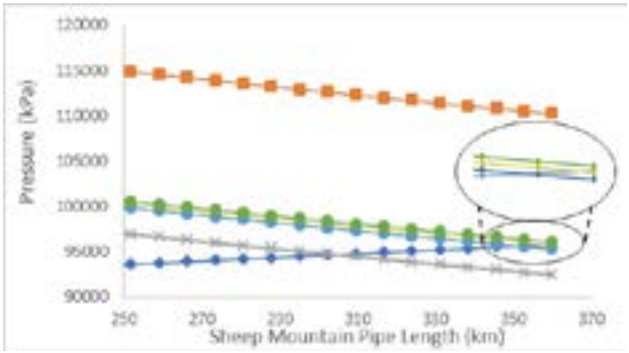

Figure : Results from the simulation of the Sheep Mountain Pipeline

Biography

Prakash Kumar Nair is currently a MEng student studying Chemical Engineering at the University of Bradford. Residing in Doncaster, Prakash has an extensive interest in the oil and gas industry and CO_2 capture and storage. The interest in the latter lead to Prakash taking on the Masters project entitled 'Impact of Impurities on Formation of Carbon-Dioxide Hydrates'. During the course of this project, Prakash has had his work accepted for a poster presentation at the annual conference 'ChemEngDayUK 2017' and an oral presentation at the 6th International Conference on Petroleum Engineering

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