CO_2 Impurities
Joint Industry Project (JIP)

Impact of impurities on CO_2 Capture, Transportation & Storage

CO_2 originating from capture processes is generally not pure and can contain impurities such as N_2, H_2, CO, water, SO_2, NO_2, Ar. The presence of these impurities leads to challenging engineering, flow assurance issues, as well as an increase in the significant processing costs. The presence of water may result in ice and/or gas hydrate formation and cause blockage. Furthermore, the gaseous CO_2-rich stream is generally compressed to be transported as liquid in order to avoid two-phase flow and increase the density of the system. The presence of the above impurities will also change the physical properties of the stream, i.e., the system's bubble point pressure and viscosity, hence affecting the compression requirement. Furthermore in the majority of feasibility studies of CO_2 injection, the effects of these impurities have been overlooked or completely ignored.

A preliminary study showed that there is limited or no experimental data on the above systems. Therefore, using conventional thermodynamic models can lead to unexpected problems, e.g., two-phase flow when only one phase was expected, higher dehydration requirements to avoid hydrate/ice problems. Recent work carried out at Heriot-Watt has revealed that using conventional phase behaviour models could result in serious errors with respect to the level of compression requirements to ensure single-phase flow.

The aim of this Joint Industry Project (JIP) is to investigate the phase behaviour of carbon dioxide in the presence of impurities such as N_2, O_2, H_2, CH_4, SO_2, SO_3, NO, NO_2, N_2O, CO, H_2O and H_2S as well as developing a general phase behaviour/equilibrium predictive model. The work programme will be an integrated experimental and modelling study focusing on the effect impurities have on the phase behaviour (VLE, solubility in saline water, hydrate, solid formation) and fluid properties (density, viscosity, IFT, heat capacity, thermal conductivity) of CO_2-rich mixtures.

The following impurities/components are included in the project: H_2O, CH_4, C_2H_6, C_3H_8, Ar, CO, N_2, O_2, H_2, H_2S, SO_2 and N_yO_x (NO, NO_2, N_2O)
Properties to be investigated during the course are: VLE, hydrate (saturated and "dry"), CO_2 solid formation, density, viscosity, interfacial tension, solubility in brine, and calorific properties
Modeling will include: classical EoS (PR and SRK) and transport models (LBC, corresponding state, SUPERTRAP)
Funding partners so far: Chevron, Petex, OMV, UK National Grid, Statoil and Total

For further information contact: Dr Antonin Chapoy, Heriot-Watt University
Telephone: + 44 (0) 131 451 3797
Email: Antonin.Chapoy@pet.hw.ac.uk