

Adsorption of Nitrogen, Carbon Dioxide and Methane at Cryogenic Temperatures and High Pressures. Part 1: Equilibrium and Kinetic Measurements with a Static Cell.

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Natural gas is the most environmentally friendly of the fossil fuels and, in contrast to many other clean fuels, the infrastructure necessary for its widespread use already exists in many parts of the world. However, before a natural gas field can be developed it must be processed to remove impurities, and the cost of the required processing can be critical to the field's economic viability. Conventionally, CO₂ removal requires the use of a water-based amine solution and large absorber and regeneration towers, while N₂ separation requires distillation towers operating at cryogenic temperatures. Furthermore, the conventional CO₂ removal process saturates the gas with water vapour, which can lead to the duplication of expensive gas dehydration equipment. If the feed gas contains CO₂ and N₂ at combined levels in excess of 10 % by mole, then the cost of such processes can make development of the gas field unviable. Many workers are investigating the use of alternative gas separation technologies such as membranes and adsorption to address this general problem. However, very little work has been done studying the efficacy of adsorption processes at cryogenic temperatures and high pressures, and few adsorption equilibria data exist at these conditions even for simple conventional sieves. This presentation will describe the experimental system we have developed for equilibrium adsorption measurements for multi-component mixtures at cryogenic temperatures and high pressures. Adsorption data measured with this system for N₂, CO₂ and CH₄ on various adsorbents at temperatures from 115 to 298 K and pressures to 5 MPa will also be discussed.