KONINKLIJKE NEDERLANDSE
AKADEMIE VAN WETENSCHAPPEN

Abstracts

Academy symposium: Past, Present and Future of Gas Hydrates

Honouring and celebrating the 95th birthday of Professor J.H. van der Waals

Wednesday, 13 May 2015

Introducing Joan van der Waals

On gas hydrates and beyond

Jakob de Swaan Arons, Professor Emeritus Delft University of Technology & Tsinghua University Beijing

Some fifty years ago before my professional life really got started, I was invited to present my Ph.D. thesis at the laboratories of Shell Research. My host was a tall, athletic-looking man in his mid-forties, who came across as being open-minded, friendly and passionate about science and its applications. This was Joan van der Waals. My first project at Shell as a young staff member in 1965 involved gas hydrates so I was soon learning all about these remarkable compounds: as a scientific marvel and curiosity, as a separating agent, an industrial nuisance and, much later, as a possible blessing for mankind. And since those days I have got to know Joan better as a person, a scientist, a manager, a coach of young scientists and, years later, as a colleague again. This is what this introduction is about: the man beyond "the most beautiful thing" he ever did.

Natural gas hydrates: the effect of embedded minerals and confinement

Geoffrey C Maitland, Imperial College London

Much is known about the structure and thermodynamics of pure gas hydrates, underpinned by the seminal statistical mechanical work of Van der Waals and Platteeuw, published over fifty years ago in 1959. As well as being an interesting class of materials in their own right, hydrates have assumed increasing practical importance over the years, as a source of problems in oil and gas production through their ability to form in production pipelines and cause blockages or flow assurance problems, and more recently as potential routes to gas storage and transport or to gas separation. Over the past few decades there has also been increased interest in natural hydrates as a source of methane gas. These hydrates form naturally in shallow sub-sea sediments or permafrost regions and contain vast reserves of methane, in amounts far greater than all the gas stored in conventional oil and gas reservoirs or available from newer non-conventional sources such as shale gas. However, there are major potential geophysical problems in producing gas safely from such hydrate sediments whose solution depends on knowing more about the phase behaviour of hydrates formed within mineral sediments, as distinct from pure bulk hydrates, and about the kinetics of hydrate decomposition and gas exchange which has been far less well studied than structure and phase behaviour. I will present some recent studies on the effect of dispersed mineral phases on the production, decomposition and gas exchange behaviour of methane hydrates and the effect of mineral pore confinement on their phase behaviour. The aim is to better understand the parameter space available for safe and economic production of methane from natural hydrate sediments.

Exploration and exploitation of natural gas hydrates

Pacelli L.J. Zitha, Delft University of Technology

Natural gas hydrates represent a large clean hydrocarbon resource. After being subject to frequent corrections over three decades, the estimated natural gas hydrates reserves in the USA alone represent about 5.6×10^{15} sm^3 of methane: this is about seven times the estimated reserves of non-hydrate natural gas (0.8×10^{15} sm^3). Large-scale methane recovery from hydrates remained uncertain mainly because conventional gas, and to some extent Shale gas, have much higher economic value at current prices and environmental regulations. One of the reasons for this is that hydrates are dispersed and single large accumulations (of 100 Tcf or more; Tcf = trillion cubic feet) have not been reported. This talk will review the key aspects pertinent to the extraction of natural gas (essentially methane) from gas hydrate locked in marine sediments. A few examples of the field scale pilot tests of the extraction of will be as a way to highlight frontier technological and scientific knowledge and challenges.

Gas hydrates: their potential industrial applications and societal impact

Cor J. Peters, Petroleum Institute, Abu Dhabi / Eindhoven University of Technology

The introduction of the famous Van der Waals – Platteeuw equation in 1959 was the starting point of molecular modelling of gas hydrate phase behaviour. Meanwhile, various improvements have been introduced to make the model more suitable for implementation in industrial process simulators. Some of the new developments will be highlighted briefly.
Furthermore, in this presentation various (potential) industrial gas hydrate applications will be discussed, for example: natural gas storage as hydrate in salt caverns, hydrogen storage by using hydrate promoters and allowing multiple occupancy in hydrate cages, carbon dioxide and hydrogen sulphide capturing, new gas separation processes under study and desalination of seawater and production water from oil reservoirs.