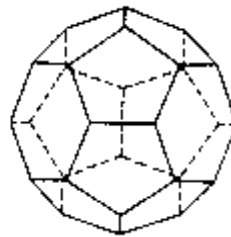
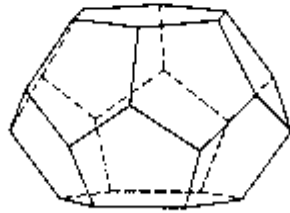
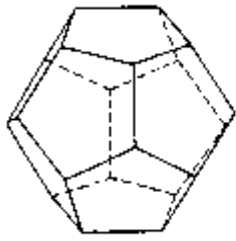


Included in the course are:

- Demonstrations of hydrate formation and inhibition
- Brief videos regarding hydrates
- Effective calculation methods that have practical application in working with hydrates
- Discussions about various software calculation programs and the efficiency of their calculation methods
- A comprehensive manual that includes practical working examples, current reference data, and details of calculation methods



About the instructor...

John Carroll, the instructor for the course and author of the manual, obtained his Ph.D. in Chemical Engineering in 1990 at the University of Alberta in Edmonton, Alberta, Canada. Until 1993, he was a Research Associate and Sessional Lecturer at the university, teaching heat transfer and numerical analysis. In addition he worked on several research projects relevant to the natural gas industry. He has authored or co-authored more than 30 papers in refereed journals, 10 articles in technical magazines, and approximately 25 conference presentations.

He is a registered professional engineer in the Province of Alberta and is associated with several chemical and engineering associations including The Canadian Society for Chemical Engineering (CSChE) and The Canadian Gas Processors Supply Association (CGPSA). He is also on the publication committee of the CSChE.

Dr. Carroll is the Manager of Simulation Services and Technology Development at Gas Liquids Engineering in Calgary, Alberta. At GLE he has worked on a variety of projects, which included natural gas sweetening, hydrocarbon processing, acid gas injection, and fluid phase equilibrium. He is the instructor for several courses offered by Technical Training Services.

UNDERSTANDING NATURAL GAS HYDRATES

- What *is* a hydrate?
- What compounds form hydrates?
- What are the physical properties of hydrates?
- Under what conditions of temperature and pressure do they form?
- What problems do they cause?
- What can be done about them?

Learn the answers to these and many other questions in this one-day course offered by:

Gas Liquids Engineering Ltd.

#300, 2749 – 39th Avenue NE

Calgary, Alberta

CANADA T1Y 4T8

Ph: (403) 250-2950

FAX: (403) 290-9730

<http://www.gasliquids.com>

This intensive course is for engineers and scientists who must contend with gas hydrates. The following topics will be discussed:

1. The water molecule and the hydrogen bond

- > *Why water is different?*
 - boiling point
 - enthalpy of vaporization
 - expansion upon freezing
- > *The structure of ice*

2. Hydrate and non-hydrate formers

- Type I
 - Type II
 - Type H
- > *Structures of hydrates*

3. Hydrate compositions

- > *Theoretical composition*
- > *Actual compositions*

4. Calculation of hydrate forming conditions

- > *Hand calculation methods*
 - gas gravity method
 - K-factor method

5. Advanced calculation methods (software calculations)

- van der Waals and Platteeuw
- Parish and Prausnitz
- Ng and Robinson

6. Methods for combating hydrate formation

- > *Chemicals*
 - inhibitors (methanol)
 - Hammerschmidt equation:
 - advanced methods
 - methanol injection rates
- > *Heat*
 - line heaters and heat tracing
- > *Dehydration*
 - glycol dehydration
 - refrigeration
 - molecular sieves

7. Physical properties of hydrates

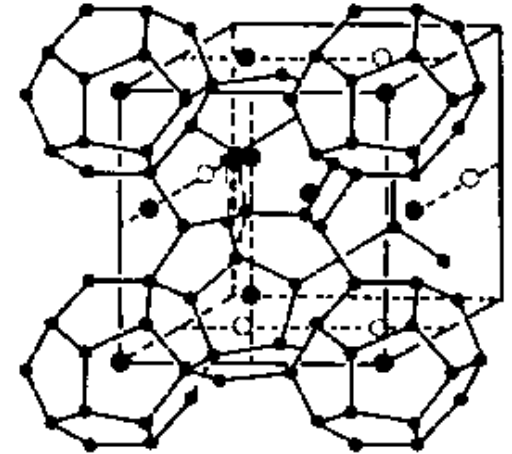
- density
- heat capacity
- heat of formation
- mechanical properties

8. Water content of gas

9. Use of phase diagrams to understand the subtleties of hydrate formation conditions

- phase loci
- triple points
- quadruple points
- pressure-temperature diagrams
- pressure-composition diagrams
- temperature-composition diagrams

10. Natural occurrence of hydrates



This intensive, one-day course is offered two to four times per year. It is conducted by Gas Liquids Engineering Ltd., Calgary, Alberta.

Usually the course is held in the classroom at Gas Liquids Engineering. However, arrangements can be made to put on this course in your company's offices. Contact us for more information.

Cost: \$400.00 (Can.) - subject to change without notice

Please contact us for additional information, especially regarding the dates for upcoming courses.

Enrollment in the course is limited.