Experts in Gas Hydrates, Flow Assurance, PVT Phase Behaviour and Properties of Reservoir Fluids

Hydrate & Flow Assurance Consulting
Technologies & Training

www.hydrafact.com
Hydrafact is the world leader in gas hydrate, flow assurance, PVT and EOR consultancy and technical services to the oil and gas industry.

**History**

Hydrafact was formed in 2006 by senior members of the Gas Hydrate and PVT research groups at the Institute of Petroleum Engineering, Heriot-Watt University, to help fulfil the growing demand in industry for specialist hydrate and flow assurance services. The company also acts as a commercial route to industry for cutting-edge technology, developed through many years of research at the University.

**People**

Our people have worked on some of the industry’s most challenging problems and have extensive experience working on major projects. Our team combines a wealth of knowledge and expertise in the fields of gas hydrates, flow assurance, PVT and EOR, comprising well over 100 years experience combined and more than 500 published papers and 13 patents, of which 4 are commercialised.

**Facilities**

We have access to some of the most cutting edge and specialised facilities currently available, including H₂S laboratories. Our equipment allows a comprehensive range of studies to be carried out and in addition we have the flexibility to design and custom build our own set-ups that can be tailored to the customers specific requirements.
CONSULTING & TECHNICAL SERVICES

Our Expertise

Hydrafact has an established track record of excellence in providing gas hydrate, flow assurance, PVT and EOR consultancy and technical services to the oil and gas industry.

Our expertise covers complex and unusual flow assurance challenges for the transportation of oil, gas and multi-phase products through a variety of systems from the reservoir to the end user.

The Hydrafact team has been providing specialist consultancy and technical laboratory services to the oil and gas industry for more than 100 years combined on over 800 projects worldwide.

Key Capabilities

Hydrafact can offer a wide range of valuable and often highly bespoke evaluation and testing services to support the oil and gas industry.

A key element of the services we provide is our ability to carry out experiments on actual hydrocarbon samples at extreme operating conditions, involving high pressure (3,000 bar) and a wide range of temperatures (-80 to 250 °C).

In addition to experimental work, Hydrafact can perform a comprehensive series of thermodynamic modelling calculations using our own HydraFLASH software package. Experimental work can then be used as a validity check for the accuracy of the predictions.

Comparing Methanol and Ethanol as Hydrate Inhibitors

Hydrafact was approached by a major operator looking to replace methanol with ethanol in a multiphase pipeline. They were experiencing high methanol loss into the gas phase and wanted a less toxic alternative. A feasibility study was carried out to investigate the amount of ethanol required to avoid hydrate formation over a wide range of operating conditions. Modelling and experimental work was done to accurately predict inhibitor loss in vapour and liquid hydrocarbon phases, also taking into account ethanol hydrate formation characteristics.

Measuring Wax Appearance and Disappearance Temperature for Live Gas Condensates

Wax formation and deposition is a serious problem in some gas condensate systems. Our customer approached us with a concern about the likelihood of wax formation, deposition and potentially blockage in a condensate transport pipeline. The major challenge in this case was conducting tests on live gas condensate systems as measurements on stabilised samples could be misleading. A novel technique was developed and used successfully to provide the customer with wax measurements for very small condensate volumes using a high pressure (10,000 psi) temperature controlled (-60 to 90 °C) set-up.

Risk of Water Condensation and Hydrate Formation in Low Water Content CO_2 & CO_2+H_2 Systems

Water condensation in CO_2 transport systems poses a serious risk of corrosion, ice and hydrate formation. Our customer wanted to investigate the dehydration requirements for pure CO_2 & CO_2+H_2 systems to avoid water condensation for their system at operational pressure and temperatures. An integrated experimental and modelling approach was used to determine the water content of CO_2 and CO_2 & CO_2+H_2 systems in the presence of free water and gas hydrate water. The results provided hydrate stability zone and dehydration requirements for avoiding water condensation and hydrate formation under pipeline conditions.
At Hydrafact we specialise in delivering highly tailored, field specific solutions for the most challenging flow assurance problems.

Our Facilities

Hydrafact has access to state-of-the-art laboratory facilities and the industry’s most advanced equipment. This includes a high pressure rheometer, flow loop, FT-IR, H₂S testing facilities and a variety of high pressure, high/low temperature test facilities.

With our combined experience and excellent facilities Hydrafact is well placed to offer a range of services in the following areas, including:

### Hydrate Studies

- Hydrate stability zone and phase equilibria for gas (including H₂S), condensate and oil systems with condensed water, formation brines, organic inhibitors (methanol, glycols), drilling muds and completion fluids
- Hydrate formation/dissociation kinetics
- Blockage avoidance and safe removal
- Kinetic Hydrate Inhibitor (KHI) evaluation for various simulated pipeline scenarios
- Transportability of systems containing gas hydrates and anti-agglomerant (AA) performance
- Inhibitor loss to hydrocarbon phases
- Hydrate formation in low water content gases (including CO₂-rich systems)

### Wax and Asphaltene Studies

- Wax Appearance Temperatures (WAT) and Wax Disappearance Temperatures (WDT) and pour point measurements for dead or live reservoir fluids
- Evaluating wax build-up rates and normal/co-axial “Cold Finger”
- Wax flow loop
- Assessment/screening of wax inhibitors
- Asphaltene risk evaluation and inhibitor screening
- Effect of CO₂ injection

### Other Studies

- Hydrocarbon dew and bubble points
- Mutual solubility in various Liquid-Vapour systems
- Freezing /melting points of aqueous salt and organic inhibitor solutions
- Salt solubility and salting-out
- VLE for multi-component systems at sub-atmospheric and high pressures, including slim tube
- Phase behaviour and properties (viscosity, density and IFT) of hydrocarbon and/or CO₂-rich systems
- Enhanced Oil Recovery (EOR) studies
Versatile Hydrate and PVT Prediction with HydraFLASH

HydraFLASH is a hydrate and PVT prediction model designed to calculate the phase equilibria and physical properties of petroleum reservoir fluids over a wide range of conditions.

The HydraFLASH model has evolved through over 40 years of R&D collaboration between industry and Heriot-Watt University. Over this period the model has been continuously evaluated against a wide range of scenarios and is constantly tuned and validated using our in-house and other experimental data.

HydraFLASH®

HydraFLASH allows you to easily perform:

- Calculations for multicomponent, multiphase systems including water, liquid and vapour, ice and salt, hydrates, wax, asphaltene
- Calculations for wide range of pressure and temperature conditions
- Calculating the amount of inhibitor required for preventing hydrates (including KHI estimation)
- Calculating the amount of hydrate, wax and asphaltene

HydraFLASH includes 5 different equations of state (EoS) with different mixing rules for modelling phase equilibria, allowing the user to choose the one which best fits their needs. The EoS used in HydraFLASH are SRK, PR, VPT, CPA and PC-SAFT.

With HydraFLASH you can accurately model:

- Different scenarios for hydrate/wax/asphaltene formation including low water content systems
- Effect of salts and different hydrate inhibitors on the hydrate stability zone (MEG, MeOH, EtOH, KHI etc.)
- Inhibitor distribution in different phases
- Different hydrate structures (sI, sII, sH)
- CO₂, H₂S and CO₂-rich systems and the effect of impurities

HydraFLASH is the most accurate software for all hydrate predictions

Equations of State

Physical Property Database

The HydraFLASH package has been tuned and validated against a full physical property database (literature and in-house) containing more than 170 oil and gas related components, alcohols, glycols and electrolytes. The database is also available to the end users as part of the software.

**Predicted Hydrate Phase Boundary in the Presence of Different Methanol Concentrations for a North Sea Natural Gas**

**Water Content in the Vapour and Liquid Phases of Carbon Dioxide-Water System**

**Typical Phase Envelope of a Petroleum Reservoir Fluid**
Reliable Hydrate Inhibition Monitoring with HydraCHEK

HydraCHEK is an oilfield analysing solution which measures the actual concentration of hydrate inhibitors and salts from a produced water sample.

The system was developed as part of an industry sponsored project to address the growing need for a method to monitor the hydrate safety margin in oil and gas production systems. It has been deployed in many fields around the world with £100s millions of cost cuttings and/or field life extension and minimising the environmental impact (please contact us on info@hydrafact.com for further details/case studies).

HydraCHEK is fast, accurate and straightforward to use. It enables the operator to:

- Optimise hydrate inhibitor injection rates and cut inhibitor costs while improving reliability
- Manage hydrate risks and increase confidence in your system by finding the exact hydrate stability zone
- HydraCHEK played a major role in Heriot-Watt University winning the Queen's Anniversary Prizes in 2016

HydraCHEK measures the exact salt & inhibitor concentration in a water sample and predicts hydrate phase boundary using HydraFLASH engine, enabling inhibitor optimisation.

HydraCHEK (Lab-Based or On-Line) is:

- **Versatile** - works with all salts and inhibitors (MEG, Methanol, Ethanol, DEG, TEG, KHIs, AAs, etc)
- **Fast** - delivers results in under 10 seconds
- **Accurate/reliable** - proven performance
- **Easy** – Simple to use and prepare samples, no chemicals or consumables required

HydraSENS

HydraSENS is a device for detecting early signs of hydrate formation providing early warning to operators for avoiding hydrate blockage. It has been successfully field tested.

HydraSENS benefits from different affinities of hydrate forming compounds by monitoring the concentration of a strong hydrate former or the ratio between a weak hydrate former and a strong hydrate former using our in-house algorithm.

HydraSENS is:

- **Fast** - delivers results in real time,
- **Accurate/reliable** - proven performance,
- **Easy** – Simple to use and no chemicals required

KHI3R (Kinetic Hydrate Inhibitor Removal, Recovery and Re-use)

Hydrafact developed a technology for removing, recovery and re-use of Kinetic Hydrate Inhibitors (KHI) from produced water, reducing OPEX/CAPEX and minimising environmental impact of hydrate inhibition.
We have an outstanding history and a wealth of experience when it comes to training personnel from the petroleum industry and through close links with Heriot-Watt University can provide a range of courses to suit your needs. The courses/trainings could be in-house and/or in our premises.

The Current Courses Include:

- Flow Assurance & Gas Hydrates
- PVT and Phase Behaviour of Reservoir Fluids
- Petroleum Engineering for Other Disciplines
- Introduction to Production Engineering
- Hydrates and Phase Behaviour Modelling
- Multiphase Flow in Pipeline Networks
- Process Equipment Design Procedures In Oil and Gas
- Applications of Equations of State in the Petroleum Industry
- Fundamentals of Reservoir Engineering
- Reservoir Simulation and History Matching
- Enhanced Oil Recovery

For any other specific course please contact us on info@hydrafact.com

The most up to date courses and latest developments to keep you ahead in the fast moving oil and gas industry.

Course material will include case studies and an overview of key lessons learned in the industry over the last 40 years.

Hydrafact can design and manufacture a wide range of specialised laboratory equipment for flow assurance and reservoir fluid studies.

We can design and customise equipment for your specific requirements and can offer equipment covering a range of PT conditions.

Hydrafact can provide training in our premises or in-house to maximise the performance of the equipment and support you in your research projects and consultancies.

We can also provide training programmes to your staff on various test techniques in our laboratories.

EXPERIMENTAL EQUIPMENT

- Blind Autoclaves
- Visual Autoclaves
- Rocking Cells