



The Royal Academy  
of Engineering

# Distinguished Visiting Fellowship Scheme Case Study

## Heat Exchanger Fouling



**Host:**  
**Cambridge University**  
**Dr D Ian Wilson**  
Reader in Chemical Engineering



**Distinguished Visitor:**  
**Professor A Paul Watkinson**  
Emeritus Professor of Chemical Engineering  
University of British Columbia  
CANADA



The application for this fellowship followed the award of an EPSRC grant on crude oil fouling to researchers at universities of Bath, Cambridge and Imperial College. Crude oil fouling is a serious operating problem in oil refinery distillation units, particularly when oil and energy prices are high. The phenomenon is often controlled by the behaviour of heavy, polar molecules in the oil, known as asphaltenes. Asphaltene precipitation, fouling and coking have been studied at University of British Columbia (UBC) for some years. Visits to the above UK laboratories would permit exchange of experience in this research area, and exploration of opportunities for future collaboration.



Jesus College – University of Cambridge

The Department of Chemical Engineering and Biotechnology at University of Cambridge is equipped with modern (some world-leading) research facilities. It is internationally recognized for its research in chemical

engineering and related disciplines. Research activities with particular overlap with the Fellow are in the areas of fouling and cleaning in heat transfer systems, particle technology, particularly rotary kilns, fluidization and energy.

As a faculty member in the Department of Chemical and Biological Engineering at the University of British Columbia, Professor Watkinson has been active in fouling research over several decades. He has an

international reputation for research in organic fluid chemical reaction fouling, and coking. He has co-chaired or chaired, and co-edited proceedings from five international conferences since the late 1990s, and has participated in giving short courses in numerous countries to engineers working in this field. At UBC, he served in the professorial ranks, and for nine years was Head of the Department of Chemical and Biological Engineering. Other research interests include gasification of coal and bio-mass, and combustion and reaction in rotary kilns.

### Statement from the Distinguished Visitor:

*The EPSRC grant on crude oil fouling through its collaboration among researchers in three UK universities and an industrial working party, is the first broad-based attack on this important problem. The Fellowship award provided an excellent opportunity to interact with the research teams and their collaborators through an initial two-day review meeting with researchers and industry representatives followed with detailed discussions during visits to the laboratories and an intensive workshop on hydrocarbon fouling presented to industry representatives from the UK and abroad. It was a pleasure to take part in the many penetrating questions and lively discussions, which arose based on the high level of scientific curiosity and practical experience of the audience. Links between industry and academia were further developed and strengthened.*

*The timing of the Fellowship, and the excellent organisation through the University of Cambridge, contributed greatly to the success and impact of the visit. Several areas of future collaboration between UBC and the UK universities were identified. The eventual publication of the course materials should make a lasting contribution from the Fellowship.'*

Professor A Paul Watkinson  
The University of British Columbia,  
Canada



Bracknell discussions

## Why a visit?

The specific objectives of the visit were:

- To receive input from an international expert into a major EPSRC-funded research project on refinery fouling through advice given at three research centres (Bath, Cambridge and Imperial) and to enable researchers to develop networks with other groups and companies in North America and elsewhere.
- To facilitate training from the visiting expert in crude oil heat exchanger fouling for the researchers on the large EPSRC project as well as engineers and researchers from other institutions and companies in the energy sector.
- To develop networking and research collaborations with one of the leading departments in Canada with significant overlap in energy, heat transfer, reaction engineering and rheology.

## Visit outcomes

- Professor Watkinson spent several days with the researchers involved in the EPSRC-funded project followed by visits to each site for detailed local discussions strengthening the group's research activity and leading to ideas for other projects.
- The Fouling workshop was an outstanding success, with delegates attending from the UK and beyond leading to discussions on the scope and form of a review article based on the workshop materials.

## Statement from Industry:

*'On behalf of IHS ESDU and a number of companies with which we collaborate, I would like to express our gratitude to the Royal Academy of Engineering for funding the Distinguished Visiting Fellowship of Professor Paul Watkinson. Professor Watkinson is arguably the world's leading researcher in the important field of fouling of hydrocarbon streams.*

*From an industrial perspective I can comment on some of the immediate benefits that Professor Watkinson was able to provide to the oil industry. As part of his Fellowship he presented a two-day course on crude-oil fouling to an audience drawn from the oil industry, the research team and other energy-related companies. From conversations with the attendees I can report unanimous appreciation for the unique opportunity to learn directly from Professor Watkinson. Following the course, I was made aware of an operational problem in crude oil fouling, where the engineers present were confident that Professor Watkinson's insight was likely to lead to real improvements...with significant effects in terms of economics, energy usage, emissions and energy security.'*

Simon J Pugh  
Head of Process Engineering Technology  
ESDU International Plc

## Statements from the Host

*'Professor Watkinson is an academic of the highest standing. He is the recipient of this year's R.S. Jane Memorial Award, the premier award of the Canadian Society for Chemical Engineering, in recognition of his significant contributions to chemical engineering in Canada. He is an internationally recognised expert in the area of heat exchanger fouling and during his visit has worked closely with Dr Wilson and his colleagues at University of Cambridge, as well as groups at Imperial and Bath, to apply his expertise to a major EPSRC-funded project. The strategic importance of this topic has been recognised in recent times via its impact on Carbon Dioxide emissions and energy efficiency in the era of high crude oil prices. Professor Watkinson's visit has benefited not just Cambridge, but the UK interest in this area of chemical engineering.'*

Professor Lynn F Gladden OBE FREng FRS  
Head of Department  
Shell Professor of Chemical Engineering

*'Professor Watkinson's visit is considered to have been an outstanding success. He has made an extremely positive contribution to the progress of the EPSRC-funded project on crude oil fouling, both in terms of advising on current and planned activities, and in training a whole cohort of researchers and industrial practitioners on the history and current standing of knowledge in this topic area, which is growing in importance. He has helped to strengthen relationships between the three UK universities involved, as well as developing new relationships between the UK and one of the leading Canadian research universities.'*

Dr D Ian Wilson  
Deputy Head of Department

- Professor Watkinson spent several days at Cambridge holding scheduled meetings with other researchers in the department of Chemical Engineering leading to the identification of future collaboration areas.
- Professor Watkinson also met several Fellows of Jesus College (from many different disciplines) resulting in further networking and links between the universities of British Columbia and Cambridge.



Professor Watkinson with Dr Keith Lawson from ConocoPhillips (UK) Ltd

## Future links and collaboration

- All of the groups working on the EPSRC fouling project benefited from the interaction with Professor Watkinson and plans are in place to continue the collaborations in the crude oil fouling area through joint publications, the provision of experimental data and advice from UBC and further experiments at UBC.
- Dissemination of the practical lessons from the Fouling workshop will be led by the IHS ESDU staff, who co-ordinate a series of good practices in energy efficiency with the major oil companies in the UK (and other energy companies). Dissemination of the Fouling workshop material via technical papers is under consideration.

Several research exchanges are planned between the host's department and UBC including research student visits, sabbatical leave at UBC as well as collaborations on existing and new topics.

## For further information please contact

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The scheme application form and guidance notes for applicants are available to download from The Academy's website:

<http://www.raeng.org.uk/research/researcher/dvfs/apply.htm>