

## **HEAT EXCHANGER FOULING AND CLEANING VIII – 2009**

14-19 June 2009, Schladming, Austria

### **PREFACE**

Heat exchangers play a crucial role in most chemical/petrochemical, food processing and power generating processes. However due to the nature of fluids involved in the process, deposits tend to form on the heat transfer surface which greatly reduce the efficiency of the apparatus. The main purpose of this series of conferences on heat exchanger fouling and cleaning has been to facilitate innovative thinking and to explore new theoretical and practical approaches to address the tremendous challenges associated with fouling of heat exchangers, such as:

- The design of heat exchangers for conditions where severe fouling may be expected
- The inefficient use of primary energy due to fouling, resulting in accelerated depletion of fossil resources and adverse effects on our environment
- Safety and product quality issues related to deposit formation on heat exchanging surfaces
- Reduction of environmentally harmful and potentially hazardous chemical additives
- Efficient monitoring and cleaning tools to offset the impact of fouling,

This series of bi-annual conferences has successfully provided a forum for experts from industry, academia and government research centres from around the world, to present their latest research and technological developments in the areas of fouling mitigation and cleaning technologies. These meetings generally involve overview presentations, technical papers, poster sessions, and panel discussions. Following the meetings organised by Engineering Conferences International in San Luis Obispo, USA (1995), Lucca, Italy (1997), Banff, Canada (1999), Davos, Switzerland (2001), Santa Fé, USA (2003), Kloster Irsee, Germany (2005), Tomar, Portugal (2007), the 8th conference in this series has for the first time been organised under the auspices of EURO THERM. This conference was held in Schladming, Austria, in June 2009 and provided participants with excellent technical presentations and a very conducive environment for personal discussions. Despite significant financial restrictions world-wide, a record number of 101 participants from 25 countries attended the conference, presenting 81 papers/posters.

The Schladming conference saw many references to the 1983 paper by Prof. Norman Epstein, entitled 'Thinking about heat transfer fouling: A 5 5 matrix', [*Heat Transfer Engineering*, Vol. 4(1): 43-56]. There, Epstein presented an overview of the state of understanding of the five steps (initiation, transport, attachment, removal and ageing) involved in deposit formation for each of the five principal mechanisms of fouling (particulate, chemical reaction, crystallisation, corrosion and bio-fouling). Given that 25 years had passed since the concept was introduced, the organisers through Dr Ian Wilson, who collated and analysed the data, asked the delegates at the conference – as a representative sample of those active in fouling and cleaning research worldwide – to express their view of the current state of understanding. This was performed by means of a questionnaire, where respondents were asked to indicate their level of experience in their assessment as either (A) expert, (B) experienced, or (C) less confident. The scale of understanding was set as ranging from 1 (little or no understanding) to 5 (understanding well developed).

22 responses were received, some of which were submitted by groups. Respondents were also asked to indicate how long they had been working on fouling and cleaning, this information is provided in Figure 1.

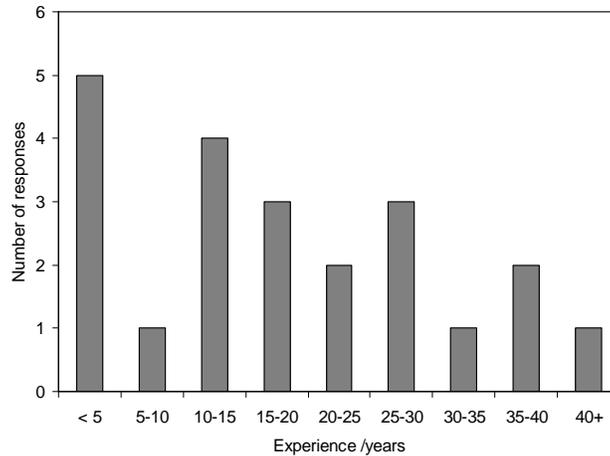


Figure 1 Questionnaire respondents' experience in fouling and cleaning research.

The distribution of expertise in Table 1 indicates a relatively low level of expertise in the areas of biofouling and, to a certain extent, corrosion fouling. This reflected the coverage of these topics in the conference papers. The biofouling area, in particular, was noted as one where a parallel community exists, with dedicated journals and conferences.

Table 1 Respondent's level of expertise in each fouling mechanism (in %). Sample population 22: not all respondents submitted assessments for each mechanism.

<i>Mechanism</i>	#	Expert	Experienced	Less confident
Biofouling	19	<b>9</b>	27	<b>63</b>
Particulate	19	17	63	19
Chemical reaction	18	20	54	26
Crystallisation	18	27	46	28
Corrosion	18	21	44	<b>34</b>

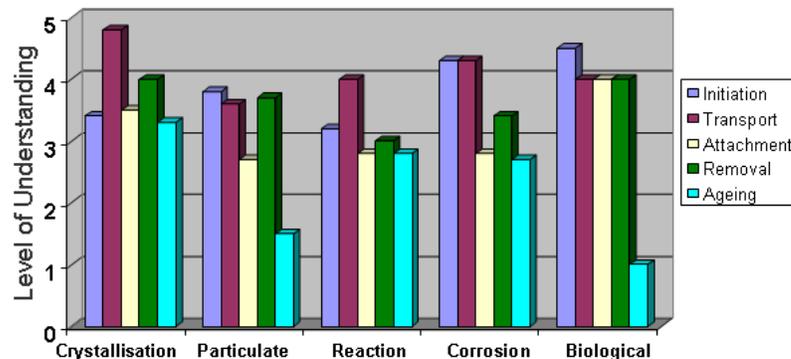


Figure 2 Summary of matrix scores for all levels.

The noteworthy points are the presence of several of high scores, particularly in crystallisation fouling, and the paucity of low scores (< 2), with the exception of ageing, indicating that progress has been made. Interestingly, ageing was identified as the topic having received least attention in the 1983 paper. The general lesson appears to be that there is still work to be done, as the award of '5' indicated that the topic was well understood, managed in practice or reliable software available to guide mitigation. One respondent commented on the fact that the matrix only considers each fouling mechanisms in isolation – if fouling caused by combinations of mechanisms is taken into consideration as well, then there is a whole 'Rubik's Cube' waiting to be tackled!

The next international meeting on heat exchanger fouling will be held in the first half of June 2011, most likely on the island of Crete in Greece. More information will soon be available at:

[www.heatexchanger-fouling.com](http://www.heatexchanger-fouling.com)

The following papers have been presented at the Schladming conference and have been recommended for publication in the final conference e-proceedings after a careful refereeing and revision process. The e-proceedings cover various aspects of heat exchanger fouling along with updated state-of-art fouling mitigation and cleaning strategies. The present e-proceedings as well as those from the previous conferences since 2003 can be obtained free of charge on the above internet homepage.

The editors wish to thank everybody who contributed to the conference and the conference proceedings, i.e.

- all the authors and participants who invested substantial efforts to produce high-quality papers and to attend the conference
- the technical referees who helped to improve the quality of these papers even further, by providing valuable and helpful comments
- the Conference Advisory Committee and the Session Chairmen
- Mrs Elham Key Manesh and Mrs Renate Steinhagen, for the preparation and finalisation of the program, the compilation of the final proceedings and maintenance of the conference homepage.

### **Editors**

Hans Müller-Steinhagen  
German Aerospace Centre and University of Stuttgart (Germany)

M. Reza Malayeri  
University of Stuttgart (Germany)

A. Paul Watkinson  
University of British Columbia (Canada)

### **Guest editor for the preface**

Ian Wilson  
University of Cambridge (UK)