

PROGRAM

Heat Exchanger Fouling and Cleaning - VII

July 1 - 6, 2007

Hotel dos Templários
Tomar, Portugal

Conference Chairs

Professor Hans Müller-Steinhagen
DLR / University of Stuttgart, Germany

Professor Paul Watkinson
University of British Columbia, Canada

and

Dr M. Reza Malayeri
(a member of organising committee)
University of Stuttgart, Germany

Conference Co-Sponsors

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NOTES

- Please observe "No Smoking" at ECI technical sessions, meals and social hours
- Speakers should allow sufficient time at the end of their presentation for questions and discussion
- Wireless internet access is available free of charge in the hotel lobby and outside the conference room.
- Audiotaping, videotaping and photography of presentations are strictly prohibited
- Turn your cellular telephones to vibrate or off during technical sessions
- Be sure to make any corrections to your name/contact information on the Master Participant List or confirm that the listing is correct. A corrected copy will be sent to all participants after the conference.

Sunday, July 1, 2007

14:30 – 16:30 Registration (level below hotel lobby)

16:30 – 16:40 **Welcome and Opening Address**
Hans Müller-Steinhagen, Conference Chair

16:40 – 16:50 Frank Schmidt, ECI Technical Liaison

SESSION 1: OVERVIEW

Chair: Hans Müller-Steinhagen, DLR/University of Stuttgart, Germany

16:50 – 17:15 **The Science of Cleaning of Dairy Fouling Layers**
R. Mercadé-Prieto, W.R. Paterson and D.I. Wilson
University of Cambridge, UK

17:15 – 17:40 **Fouling During the Use of 'Fresh' Water as Coolant - The Development of a 'User Guide'**
S.J. Pugh¹, G.F. Hewitt² and H. Müller-Steinhagen³
¹ IHS ESDU, UK, ² Imperial College of Science, Technology and Medicine, UK,
³ University of Stuttgart, Germany

17:40 – 18:05 **A Survey of Alfa Laval's Experience in the Field of Fouling Combating in Plate Heat Exchanger Systems**
A. Törnqvist
Alfa Laval Lund AB, Sweden

18:05 – 18:30 **Crude Oil Fouling – PETRONAS Refineries Experience**
M.S. Rafeen¹, M.F. Mohamed¹, M.Z. Mamot¹, N.A. Manan¹ and M. Ramasamy²
¹ PETRONAS Group Research, Malaysia, ² Universiti Teknologi PETRONAS, Malaysia

18:30 – 19:30 Welcome Drinks (In the lobby by the bar)

19:30 – 21:00 Dinner

21:00 – 22:00 Social Hour

Monday, July 2, 2007

07:30 – 09:00 Breakfast Buffet

SESSION 2: CRUDE OIL AND HYDROCARBON FLUID FOULING

Chair: Himanshu Joshi, Shell Global Solutions Int., .B.V., The Netherlands

09:00 – 09:25

Crude Oil Fouling in a Pilot-Scale Parallel Tube Apparatus

B.D. Crittenden, S.T. Kolaczowski, T. Takemoto and D.Z. Phillips
University of Bath, UK

09:25 – 09:50

Precipitation and Fouling of Heavy Oil-Diluent Blends

E. Hong¹ and A.P. Watkinson²

¹China University of Petroleum (Beijing), China, ²The University of British Columbia, Canada

09:50 – 10:15

Observation of an Isokinetic Temperature and Compensation Effect for High Temperature Crude Oil Fouling

C. A. Bennett¹, R. S. Kistler¹, K. Nangia², W. Al-Ghawas³, N. Al-Hajji³, and A. Al-Jemaz³
¹Heat Transfer Research, Inc., USA, ²Fluor Corporation, USA, ³KNPC, Kuwait

10:15 – 10:45

Coffee Break

10:45 – 11:10

Applying Technology Advancements to Improve Heat Exchanger Economic and Environmental Performance in Refinery Crude Preheat Trains

H. Joshi, F. Hoeve and E. van der Zijden

Shell Global Solutions International .B.V., The Netherlands

11:10 – 11:35

Simulating Operation of Refinery Preheat Trains for Assessing Fouling Mitigation Strategies

E.M. Ishiyama, W.R. Paterson and D.I. Wilson

University of Cambridge, UK

11:35 – 12:00

Scale Deposits in Porous Media and their Removal by EDTA Injection

J. Moghadasi^{1,4}, H. Müller-Steinhagen^{2,3}, M. Jamialahmadi¹ and A. Sharif⁴

¹Petroleum University, Ahwaz, Iran, ²University of Stuttgart, Germany, ³German Aerospace Centre (DLR), Germany, ⁴University of Surrey, UK

12:00 – 12:25

Heavy Hydrocarbon Fouling of Heat Exchangers in Propane Dehydrogenation Plant

Setu Sikin, Ahamad Zaimi Hassan, and Baharom Che Isa

Petronas, Malaysia

12:30 – 14:00

Lunch

14:00 – 17:00

Ad hoc Sessions and/or Free Time

Monday, July 2, 2007 (continued)

SESSION 3: FOULING IN POWER PLANTS

Chair: Jan Taler, Cracow University of Technology, Poland

- 17:00 – 17:25 **Crystallization Fouling Behaviour of Uranium Oxide Scale in High Level Nuclear Waste Medium**
J. Addai-Mensah¹, J. Li¹ and B. Wilmarth²
¹ Ian Wark Research Institute, Australia, ² Westinghouse Savannah River National Laboratory, USA
- 17:25 – 17:50 **Free Alkali-Indices for Optimizing the Fuel Mixture in Biomass Co-Firing**
T. Blomberg
Kiertomäentie 11 As.1, 01260 Vantaa, Finland
- 17:50 – 18:10 Afternoon Coffee
- 18:10 – 18:35 **Investigation of the Mechanisms of Heat Exchanger Corrosion in a Municipal Waste Incineration Plant by Analysis of the Raw Gas and Variation of Operating Parameters**
C. Deuerling¹, J. Maguhn¹, H. Nordsieck², B. Benker³, R. Zimmermann^{1,2,4} and R. Warnecke⁵
GSF-Forschungszentrum für Umwelt und Gesundheit GmbH, Germany, ² BfA-Bayerisches Institut für Angewandte Umweltforschung und –technik, Germany, ³ Cutec-Clausthaler Umwelttechnik-Institut, Germany, ⁴ Universität Augsburg, Germany, ⁵ GKS Gemeinschaftskraftwerk Schweinfurt GmbH
- 18:35 – 19:00 **Costs due to Utility Fouling in China**
Z.M. Xu¹, Z.B. Zhang² and S.R. Yang¹
¹ Northeast Dianli University, China, ² North China Electric Power University, China
- 20:00 – 21:30 Dinner
- 21:30 – 22:30 Social Hour

Tuesday, July 3, 2007

07:30 – 09:00 Breakfast Buffet

SESSION 4: FOULING DURING FOOD PROCESSING

Chair: Geoff Duffy, University of Auckland, New Zealand

09:00 – 09:25 **Flow Cell Studies on Fouling Caused by Protein-Calcium Phosphate Deposition in Turbulent Flow**

R. Rosmaninho¹, G. Rizzo², H. Muller-Steinhagen² and L.F. Melo¹

¹ University of Porto, Portugal, ² University of Stuttgart, Germany

09:25 – 09:50 **Fouling in a Centritherm Evaporator with Whey Solutions**

R.S. Jebson¹, H. Chen² and O.H. Campanella³

¹ Villa 102 166 Ruapehu Dr, New Zealand, ² Fonterra Coop Dairy Co Ltd, New Zealand, ³ Purdue University, USA

09:50 – 10:15 **Whey Protein Fouling In A Tubular Heat Exchanger: Effect Of Milk Temperature And Reynolds Number**

D.H.G. Pelegrine , K.F. Oliveira and M.T.M.S. Gomes

Department of Agronomy Science – Unitau, Brazil

10:15 – 10:45 Coffee Break

10:45 – 11:10 **Interaction of Whey Protein with Modified Stainless Steel Surfaces**

S.S. Premathilaka, M.M. Hyland, X.D. Chen, L.R. Watkins, and B. Bansal

The University of Auckland, New Zealand,

11:10 – 11:35 **The Thermo-Hydrodynamics of a Concentric Ohmic Heater for Processing Dairy Fluids**

H.J. Tham¹, X.D. Chen², B.Young¹, B. Bansal¹, L. Zhang¹ and G. Duffy¹

¹ University of Auckland, New Zealand, ² Monash University, Australia

12:00 – 13:00 Lunch

13:15 – 16:30 Optional tour of Convento de Cristo (Knights Templar castle), Tomar

SESSION 5: EXPERIMENTAL INVESTIGATION OF FOULING MECHANISMS

Chair: Norman Epstein, The University of British Columbia, Canada

17:00 – 17:25 **The Study of the Organic Crystallization Fouling Problems**

H. Inokuchi, M. Nakamura and Y. Koga

Mitsubishi Chemical Corporation, Japan

17:25 – 17:50 **The Effect of Operating Variables on the Structure of Biofilms and their Composition**

T.D. Patel and T.R. Bott

University of Birmingham, UK

17:50 – 18:15 Afternoon Coffee

Tuesday, July 3, 2007 (continued)

- 18:15 – 18:40 **Experiments and Modeling of Calcium Sulphate Precipitation under Sensible Heating Conditions: Initial Fouling and Bulk Precipitation Rate Studies**
F. Fahiminia^{1,2}, A.P. Watkinson¹ and N. Epstein¹
¹ The University of British Columbia, Canada, ²NOVA Research and Technology Centre, Canada
- 18:40 – 19:05 **Fouling Mitigation with Synthetic Fibres in a CaSO₄ Supersaturated Solution**
M. Rost¹ and G.G. Duffy²
¹ University of Stuttgart, Germany, ²University of Auckland, New Zealand
- 19:05 – 19:30 **A Real Time Monitoring Model of the Crystallization Fouling Induction Period Based on the Conductance Titration**
YANG Shanrang¹, CAO Shengxian^{1,2}, CHEN Lijun^{1,2}, XU Zhiming¹, YU Mingle¹ and SUN Weihua¹
¹ Northeast Dianli University, China, ² North China Electric Power University, China
- 20:00 – 21:30 Dinner
- 21:30 – 22:30 Social Hour

Wednesday, July 4, 2007

07:30 – 09:00 Breakfast Buffet

SESSION 6: EFFECT OF SURFACE MATERIALS

Luis Melo, University of Porto, Portugal

09:00 – 09:25 **Surface Treatment for the Mitigation of Whey Protein Fouling**

W. Augustin, T. Geddert and S. Scholl
Technical University of Braunschweig, Germany

09:25 – 09:50 **Investigation of Fouling Process for Convective Heat Transfer in a Annular Duct**

Y.C. Chen, Z.H. Quan and C.F. Ma
Beijing University of Technology, China

09:50 – 10:15 **Extending the Induction Period of Crystallization Fouling through Surface Coating**

T. Geddert¹, I. Bialuch², W. Augustin¹ and S. Scholl¹
¹ Technical University of Braunschweig, Germany, ² Fraunhofer Institute for Surface Engineering and Thin Films, Germany

10:15 – 10:45 Coffee Break

10:45 – 11:10 **Use of Catalytic Alloys for Physical Water Treatment Technology to Mitigate Mineral Fouling in Heat Exchangers**

L.D. Tijjing¹, B.C. Pak¹, B.J. Baek¹, D.H. Lee¹ and Y.I. Cho²
¹ Chonbuk National University, Korea, ² Drexel University, USA

11:10 – 11:35 **Bacterial and Protein Adhesion on Ni-P-PTFE Coated Surfaces**

Q. Zhao, C. Liu, Y. Liu and S. Wang
University of Dundee, Dundee, UK

SESSION 7: FLUIDIZED BED HEAT EXCHANGERS

Chair: Reza Malayeri, University of Stuttgart, Germany

11:35 – 12:00 **Low Fouling Crude Oil Preheaters**

D.G. Klaren¹, E.F. de Boer¹ and D.W. Sullivan²
¹ Klaren BV, The Netherlands, ² Whitson Sullivan Co., Houston, United States

12:00 – 12:25 **Study of the Online Three-Phase Fluidization to Remove Fouling on Outside Tube Wall of Horizontal Shell-Tube Heat Exchangers**

Tianlan Yu^{1,2}, Xiuming Yu^{1,2}, Xiaoheng Zhi³ and Zhiling Yin²
¹ Hunan University of Technology, China, ² Hunan Zhongxing Energy-saving Equipment Ltd, China, ³ Chenzhou Occupational Technology College, China

12:25 – 12:50 **Achievements and Potential of Self-Cleaning Heat Exchangers Using Untreated Natural Seawater as a Coolant**

D.G. Klaren and E.F. de Boer
KLAREN BV, Hillegom, the Netherlands

12:50 – 14:00 Lunch

Wednesday, July 4, 2007 (continued)

14:00 – 16:00 *Ad hoc* Sessions and/or Free Time

SESSION 8: MODELLING

Chair: Ian Wilson, University of Cambridge, UK

16:00 – 16:25 **Modelling of Particulate Fouling on Heat Exchanger Surfaces: Influence of Bubbles on Iron Oxide Deposition**

F. Cussac and D.H. Lister
University of New Brunswick, Canada

16:25 – 16:50 **Intelligent Discrimination Model to Identify Influential Parameters during Crystallisation Fouling**

M.R. Malayeri¹ and H. Müller-Steinhagen^{1,2}
¹University of Stuttgart, Germany, ²German Aerospace centre, Germany

16:50 – 17:15 **Simultaneous Consideration of Flow and Thermal Effects of Fouling in Crude Oil Preheat Trains**

G.T. Polley¹, A. Morales Fuentes¹ and D.I. Wilson²
Universidad de Guanajuato, Mexico, ² University of Cambridge, U.K

17:15 – 17:40 Afternoon Coffee

17:40 – 18:05 **Fouling Mechanism by Molecular Modelling - Condensation Reactions and Adsorption of Anions and Cations**

E. Puhakka¹, M. Riihimäki² and R.L. Keiski²
¹VTT Technical Research Centre of Finland, Finland, ² University of Oulu, Finland

SESSION 9: CFD STUDIES

Chair: Camilo Rindt, Eindhoven University of Technology, The Netherlands

18:05 – 18:30 **Numerical Studies on Particle Adhesion/Deposition on Pipelines. A Novel Lagrangian Particle Tracking Code Dedicated to CFD Data Post-Processing**

M. Losurdo¹, C. Bertrand² and H. Spliethoff³
¹ TU Delft, The Netherlands, ² ECN, The Netherlands, ³ TU Munich, Germany

18:30 – 18:55 **Computation and Evaluation of Wall Shear Stress Distribution at the Lower Surface of a Radial Flow Cell**

J.G. Detry¹, B.B.B. Jensen², C. Deroanne¹ and M. Sindic¹
¹ Unité de Technologie des Industries agro-alimentaires, Belgium, ² Technical University of Denmark, Denmark

20:00 Conference Banquet followed by Social Hour

Thursday, July 5, 2007

07:30 – 09:00 Breakfast Buffet

SESSION 10: DESIGN OF HEAT EXCHANGERS

Chair: Derek Lister, University of New Brunswick, Canada

09:00 – 09:25 **Incorporation of a Consideration of Fouling into the Design of Vertical Thermo-siphon Re-boilers**

G.T. Polley¹ and S.J. Pugh²

¹ Universidad de Guanajuato, Mexico, ² IHS ESDU International plc, UK

09:25 – 09:50 **Optimization of Flow Direction to Minimize Particulate Fouling of Heat Exchangers**

M.S. Abd-Elhady¹, C.C.M. Rindt² and A.A. van Steenhoven²

¹ Beni-Suef University, Egypt, ² Eindhoven University of Technology, The Netherlands

09:50 – 10:15 **Effect of Thermal Contact Resistance on the Heat Transfer in Plate Finned Tube Heat Exchangers**

D. Taler

Academy of Science and Technology, Poland

10:15 – 10:45 Coffee Break

SESSION 11: MICRO HEAT EXCHANGERS

Chair: Wolfgang Augustin, Technical University of Braunschweig, Germany

10:45 – 11:10 **Metallic Micro Heat Exchangers: Properties, Applications and Long Term Stability**

J.J. Brandner, W. Benzinger, U. Schygulla, S. Zimmermann and K. Schubert
Forschungszentrum Karlsruhe, Germany

11:10 – 11:35 **Influence of Different Surface Materials on the Fouling Process in a Microstructured Heat Exchanger**

W. Benzinger, J.J. Brandner, U. Schygulla and K. Schubert
Forschungszentrum Karlsruhe, Germany

SESSION 12: FOULING MITIGATION-I

Chair: Paul Watkinson, University of British Columbia, Canada

11:35 – 12:00 **Towards an Understanding of how Tube Inserts Mitigate Fouling in Heat Exchangers**

B. Aquino¹, C. Derouin¹ and G.T. Polley²

¹TOTAL, France, ² Universidad de Guanajuato, Mexico

12:00 – 12:25 **HITRAN[®] Wire Matrix Inserts in Fouling Applications**

J.M. Ritchie¹, P. Droegemueller² and M.J.H. Simmons¹

¹ The University of Birmingham, ² Cal Gavin Ltd, Minerva Mill Innovation Centre, UK

12:30 – 14:00 Lunch

14:00 – 16:00 *Ad hoc* Sessions and/or Free Time

Thursday, July 5, 2007 (continued)

16:00 – 17:00

Afternoon Coffee and

SESSION 13: POSTERS

Recent Developments Relating to the Analysis of Exchanger Monitoring Data

G.T. Polley and G. Gonzalez Garcia
Universidad de Guanajuato, Mexico

Simulation of Calcium Phosphate Deposition on Stainless Steel Surfaces: A New Approach Based on Cellular Automata

F.G. Martins, T. Campos, R. Rosmaninho and L.F. Melo
University of Porto, Portugal

Solving a Hydrotreater Feed Filter Fouling Problem

A. Wu¹ and K. Chung²
¹ Syncrude Canada Ltd., Canada, ² 3919 – 149A St, Edmonton, Canada

Fluid Dynamic Gauging in Duct Flows – Experiments and CFD Simulations

T. Gu, Y.M.J. Chew, W.R. Paterson and D.I. Wilson
University of Cambridge, UK

A Theoretical Model of Composite Fouling of Particulate and Crystallization

XU Zhi-Ming¹, ZHANG Zhong-Bin² and YANG Shan-Rang¹
¹ Northeast Dianli University, China, ² North China Electric Power University, China

Automatically Remove Water Fouling Online of Cast Steel Staves of Blast Furnace

Tianlan Yu¹, Tieguo Hu², Xiuming Yu¹ and Xuefeng Yao¹
¹ Hunan University of Technology, China, ² Hunan Zhongxing Energy-saving Equipment Ltd., China

Evaluation of Heat Transfer Boundary Conditions of CFD in the Case of 3D Plate Heat Exchanger Geometry

T.M. Pääkkönen, M. Riihimäki, R. Ylönen, E. Muurinen and R.L. Keiski
University of Oulu, Finland

Influence of Different Surface Materials on Nucleation and Crystal Growth in Heat Exchangers

T. Geddert, S. Kipp, W. Augustin and S. Scholl
Technical University of Braunschweig, Germany

Experimental Investigation of Crystallisation Fouling on Grooved Stainless Steel Surfaces during Convective Heat Transfer – First Results

A. Herz¹, M.R. Malayeri¹ and H. Müller-Steinhagen^{1,2}
¹ University of Stuttgart, Germany, ^{1,2} German Aerospace Research Centre

Formation of Gum and Deposits in an Oxygenated Naphtha Stream

Y. Li¹, A.P. Watkinson¹, P. Herrera², F. Fahiminia² and M. James²
¹ The University of British Columbia, Canada, ² NOVA Chemicals Corporation, Canada

Thursday, July 5, 2007 (continued)

A Multi-Function Fouling Characteristics Dynamic Simulator Experiment Apparatus and its Application

Lijun Chen^{1,2}, Shanrang Yang¹, Shengxian Cao^{1,2} and Zhiming Xu¹

¹ Northeast Dianli University, China, ² North China Electric Power University, China

Electrochemical Impedance and Digital Image Methods to Detect Microorganism

H. Men, S.W. Mu, Z.W. Lu, Y.L. Chen, S.R. Yang, Y.P. Jia and S.X. Cao

Northeast Dianli University, China

SESSION 14: FOULING MITIGATION-II

Chair: Paul Watkinson, University of British Columbia, Canada

17:00 – 17:25

Biofouling Control in Heat Exchangers using High Voltage Capacitance Based Technology

Rodrigo F.V. Romo¹, M. Michael Pitts¹ and Naresh B. Handagama²

¹Zeta Corporation, USA, ²Tennessee Valley Authority, USA

17:25 – 17:50

Double Perforated Impingement Plate (DPIP)

S.S. Al-Anizi and A.M. Al-Otaibi

Saudi Aramco Company, Saudi Arabia

SESSION 15: CLEANING OF HEAT EXCHANGERS

Chair: Reg Bott, University of Birmingham, UK

17:50 – 18:15

Cleaning and Prevention of Inorganic Deposits in Plate Heat Exchangers Using Pulsating Current

A. Pehkonen, J. Aromaa, O. Forsén, J. Virtanen and I. Galfi

Helsinki University of Technology, Finland

18:15 – 18:40

Cleaning High-Speed Marine Separators with an Environmentally-Friendly CIP Agent

Ulf Nylén¹, Roger Andersson¹ and Peter Forsberg²

Alfa Laval Tumba AB, Sweden, ² Invekta Green AB, Sweden

18:40 – 19:05

Automatic Tube Cleaning System (ATCS) Installation in Sulfide Retrieval Monoethanolamine Treatment Plant: Case Study and Fouling Global Perspectives

Chemi Sugarmen¹, Udi Siboni¹ and Ruth Volansky²

¹ CQM Ltd., Israel, ² Paz Ashdod Refinery Ltd., Israel

20:00 – 21:30

Dinner

21:30 – 22:30

Social Hour

Friday, July 6, 2007

07:30 – 09:00 Breakfast Buffet

SESSION 16: HEAT EXCHANGER FOULING MONITORING

Chair: Barry Crittenden, University of Bath, UK

- 09:00 – 09:25 **Fouling Monitoring and Cleaning Optimisation in the Heat Exchanger Network of a Crude Distillation Unit**
A. Heins¹, R. Veiga¹, C. Ruiz² and A. Riera²
¹ Argentinean Technology Center (CTA) - REPSOL YPF, Argentina, ² SOTEICA, Ideas & Technology, Argentina
- 09:25 – 09:50 **Thickness Measurement of Fouling inside Piping or Vessels by Using the Guided Wave**
S. Iwahashi and K. Watanabe
Mitsubishi Chemical Corporation, Japan
- 09:50 – 10:15 **Diagnostic System for Boilers and Furnaces using CFD and Neural Networks**
H. Calisto¹, N. Martins¹ and N. Afgan²
¹ DEM-Universidade de Aveiro, Portugal, ² Instituto Superior Técnico, Lisboa, Portugal
- 10:15 – 10:45 Coffee Break
- 10:45 – 11:10 **Slag Monitoring System for Combustion Chambers of Steam Boilers**
J. Taler¹ and D. Taler²
¹ Cracow University of Technology, Poland, ² Cracow University of Science and Technology, Poland
- 11:10 – 11:35 **Fouling Monitoring using Controlled Nano-Vibrations**
A. Pereira, J. Mendes and L.F. Melo
University of Porto, Portugal
- 11:35 – 12:00 **Design and Operation of a Fouling Monitoring Device**
Luai M. Al Hadrami, S.M. Shaahid and Mirza Zaheer Baig
King Fahd University of Petroleum and Minerals, Saudi Arabia
- 12:00 – 12:30 Final Discussion
- 12:30 – 14:00 Lunch and Conference Adjournment