Fouling Of Heat Exchanger Surfaces

Crude Oil Fouling
Baffle (in Vessel), Concentric Tube Heat Exchanger, Downhole Heat Exchanger, Dynamic Scraped Surface Heat Exchanger, Flue-Gas Condens
Study of Heat Transfer and Fouling of Heat Transfer Surfaces in the Deep Ocean Heat Exchangers
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Fouling of Heat Exchange Surfaces by Skim Milk
Fouling of Heat Exchangers
Proceedings of "Fouling Mitigation of Industrial Heat-exchange Equipment," an International Conference Held at the Cliffs at Shell Beach, San Luis Obispo, California, USA, June 18-23, 1995
Fouling of Heat Transfer Equipment
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Compact Heat Exchangers

Final Report
Fouling Science and Technology
International Conference on Fouling of Heat Exchanger Surfaces : White Haven, Pennsylvania, October 31-November 5, 1982
A Laboratory Method to Study the Fouling of Heat Exchange Surfaces by Biological Fluids
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Principles, Applications and Rules of Thumb
Compact Heat Exchangers for Energy Transfer Intensification
Corrosion-fouling on Heat Transfer Surfaces
Study of Mineral Fouling and Fouling Mitigation on Heat Exchanger Surfaces
Plate Heat Exchangers
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Selection, Design and Operation
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Final Report on a Laboratory Feasibility Study
Effect of Fouling on Performance of Exchangers Cooled by Air. Ramifications for Exchanged Heat and Cooling Effectiveness

From Synthesis to Applications
Heat Exchanger Fouling
literature evaluation and experiment design
Fouling of a Plate Heat Exchanger by Milk
Fouling of Heat-exchanger Surfaces
Advanced Features and Applications
VDI Heat Atlas
A Festschrift for A.L. London
Process Heat Transfer
Thermal-Hydraulic Fundamentals and Design
Study of Mineral Fouling on Heat Exchanger Surface

SMITH ELLISON

Crude Oil Fouling Fouling of Heat Exchangers
Process Heat Transfer is a reference on the design and implementation of industrial heat exchangers. It provides the background needed to understand and master the commercial software packages used by professional engineers in the design and analysis of heat exchangers. This book focuses on types of heat exchangers most widely used by industry: shell-and-tube exchangers

(including condensers, reboilers and vaporizers), air-cooled heat exchangers and double-pipe (hairpin) exchangers. It provides a substantial introduction to the design of heat exchanger networks using pinch technology, the most efficient strategy used to achieve optimal recovery of heat in industrial processes. Utilizes leading commercial software. Get expert HTRI Xchanger Suite guidance, tips and tricks previously available via high cost professional training sessions. Details the development of initial configuration for a heat exchanger and how to systematically modify it to obtain an efficient final design. Abundant case studies and rules of thumb, along with copious software examples, provide a complete library of reference designs and heuristics for readers to base their own designs on.

Baffle (in Vessel), Concentric Tube Heat Exchanger, Downhole Heat Exchanger, Dynamic Scraped Surface Heat Exchanger, Flue-Gas Condens John Wiley & Sons

Durch die gezielte Strukturierung von wärmeübertragenden Oberflächen, wie beispielsweise durch Dellen oder Rippen, kann die örtliche Turbulenz und damit die thermische Durchmischung gesteigert werden. Dies kann die Effizienz von Wärmeübertragern oder Bauteilkühlsystemen erheblich erhöhen. Derartige Oberflächenstrukturrierungen begünstigen jedoch das Partikelfouling, daher die Ablagerung suspendierter Partikel, wie z.B. Sand, Schlamm oder Korrosionsprodukte. Gegenstand dieser

Arbeit ist die Entwicklung eines universellen, numerischen CFD-Verfahrens zur Vorhersage des partikulären Foulings auf strukturierten Oberflächen, speziell Dellenoberflächen. Das entwickelte Verfahren basiert auf einer Kombination des Lagrangian-Particle-Trackings zur Beschreibung der dispersen Phase (Foulingpartikel), sowie räumlich und zeitlich aufgelöster Large-Eddy Simulation für die Berechnung der kontinuierlichen Phasen (Trägerfluid). Dieses Vorgehen ermöglicht nicht nur die Auswertung der infolge der Partikelablagerungen verminderten thermo-hydraulischen Effizienz, sondern auch die Untersuchung der Wechselwirkungen zwischen turbulenten Strömungsstrukturen und dem partikulärem Fouling. Dadurch kann gezeigt werden, dass die Verwendung von sphärischen Dellen als Oberflächenstrukturen nicht nur aus thermo-hydraulischer Sicht die optimale Wahl darstellt, sondern auch eine substantielle Verminderung des Partikelfoulings begünstigt. The application of structured heat transfer surfaces, such as dimples or ribs, increase the local turbulence and thus thermal mixing. This can improve the efficiency of heat exchangers or cooling systems significantly. However, structured surfaces are known to promote particulate fouling, hence the unwanted accumulation and deposition of suspended particles (e.g., silt, sludge or iron oxide). The scope of this work is the development of a universal numerical CFD method for the prediction

of particulate fouling, especially on dimpled surfaces. The proposed approach is based on a combination of the Lagrangian point-particle tracking for the description of the disperse phase (fouling particles), and spatially and temporally resolved large-eddy simulations for the calculation of the continuous phase (carrier fluid). This approach allows not only the evaluation of the reduced thermo-hydraulic efficiency due to particle deposition, but also the investigation of the interaction between turbulent flow structures and the particulate fouling. It can be shown that the usage of spherical dimples as surface structures is not only the optimal choice from a thermo-hydraulic point of view, but also favors a substantial reduction of particulate fouling.

Study of Heat Transfer and Fouling of Heat Transfer Surfaces in the Deep Ocean GRIN Verlag

Compact Heat Exchangers for Energy Transfer Intensification: Low-Grade Heat and Fouling Mitigation provides theoretical and experimental background on heat transfer intensification in modern heat exchangers. Emphasizing applications in complex heat recovery systems for the process industries, this book:Covers various issues related to low-grade hea

Heat Exchangers John Wiley & Sons

Please note that the content of this book primarily consists of articles available from Wikipedia or other free sources online. Pages: 30. Chapters: Baffle (in vessel), Concentric tube heat exchanger, Downhole heat exchanger, Dynamic

scraped surface heat exchanger, Flue-gas condensation, Fouling, Grate heater, Jacketed vessel, Micro heat exchanger, Pillowplate, Plate fin heat exchanger, Plate heat exchanger, Regenerative heat exchanger, Shell and tube heat exchanger, Thermal wheel, Waste heat recovery unit, Wellman Group. Excerpt: Fouling is the accumulation of unwanted material on solid surfaces to the detriment of function. The fouling material can consist of either living organisms (biofouling) or a non-living substance (inorganic or organic). Fouling is usually distinguished from other surface-growth phenomena in that it occurs on a surface of a component, system or plant performing a defined and useful function, and that the fouling process impedes or interferes with this function. Other terms used in the literature to describe fouling include: deposit formation, encrustation, crudding, deposition, scaling, scale formation, slagging, and sludge formation. The last six terms have a more narrow meaning than fouling within the scope of the fouling science and technology, and they also have meanings outside of this scope; therefore, they should be used with caution. Fouling phenomena are common and diverse, ranging from fouling of ship hulls, natural surfaces in the marine environment (marine fouling), fouling of heat-transfer components through ingredients contained in the cooling water or gases, and even the development of plaque or calculus on teeth, or deposits on solar

panels on Mars, among other examples. This article is primarily devoted to the fouling of industrial heat exchangers, although the same theory is generally applicable to other varieties of fouling. In the cooling technology and other technical fields, a distinction is made between macro...

Deposit Characterization, Measurements, and Modeling

Bookboon

This book presents contributions from renowned experts addressing research and development related to the two important areas of heat exchangers, which are advanced features and applications. This book is intended to be a useful source of information for researchers, postgraduate students, academics, and engineers working in the field of heat exchangers research and development.

Fouling of Heat Transfer Surfaces with Particular Reference to Cooling Water Systems Springer Science & Business Media

The growth of fouling layers on heat exchanger surfaces and the corrosion of heat exchanger materials exposed to seawater have been recognized since the beginning of OTEC research as basic problems which could render the concept uneconomical. Consequently, a significant effort has been directed toward predicting, measuring, identifying, explaining and solving potential biofouling and corrosion phenomena. To address this problem, the feasibility of establishing a practical microacoustic technique to measure

fouling film thickness in situ on typical OTEC heat exchanger tasks was studied. Seven techniques were studied for this application, including velocity measurements, acoustic diffraction, acoustic interferometer, Doppler flow velocity, pulse echo, critical angle, and surface (shear) wave effects. Of these, the latter five were laboratory tested using conventional microacoustic system components in various configuratons. Only the pulse echo technique yielded promising results. On fouled aluminum plates, thin film layers of 40 .mu.m and greater were measured using a focused 30 MHz ceramic transducer operated at 25 MHz; this represents a resolution of about 2/3 wavelength. Measurements made on the inside of fouled 1'' aluminum pipes yielded film thicknesses of 75 to 125 .mu.m. The thinnest layer resolved was approximately 1-1/4 wavelength. The resolution of slime layer thicknesses in the magnitudes of OTEC interest (5 to 30 .mu.m) using pulse echo microacoustics will require transducer development. In particular, a higher operating frequency (150 to 200 MHz) and advanced material construction is recommended for further research.

Energy Management and Efficiency for the Process Industries Springer Science & Business Media

This thesis presents a thorough examination of the corrosion and fouling behaviour of crude oil at refining conditions on industrially applicable heat transfer surfaces. The depletion of light sweet crude oil reserves means that the

processing of ever heavier and more sour crude oils is inevitable. These less-ideal crude oils present a particularly challenging set of problems for a refinery. They often have a high asphaltene and sulfur content, which creates a very aggressive feedstock in terms of fouling and corrosion. Thermal processing is known to exacerbate the situation, however the inorganically driven fouling behaviour from corrosion of heat exchanger materials at high temperature is not well understood. An atmospheric bottoms fraction of crude oil (340 °C+) with an asphaltene content of 8.47 wt% and a sulfur content of 3.43 wt% was used in this thesis to evaluate its effects on high temperature corrosion and fouling of pure iron and 316 stainless steel. A surface temperature of 540 °C was chosen for this study, to approximate the conditions of a delayed coker heat exchanger. The experiments were carried out using a stirred, batch-style fouling reactor that enabled the preferential resistive heating of a metallic wire, which was submerged in the test oil. The change in the fouling resistance (fouling factor) of the wire was measured with time. The behaviour of the fouling factor was found to be asymptotic with time, as the buildup of coke on the surface of the wire attenuated the surface corrosion reactions. This in turn reduced the amount of inorganic foulant being ejected into the foulant layer. The foulant was examined using SEM-EDX, XRD, TEM, FIB, and AES. It was determined to be a mixture of organic

carbonaceous coke, interspersed with an inorganic phase, which was found to be predominantly the pyrrhotite phase (Fe(1-x)S) of iron sulfide. Initially it was observed that the buildup of a thin iron sulfide layer occurred almost instantaneously, and preceded the formation of any surface coke. This led to the hypothesis that the iron sulfide is actually catalytic toward the formation of coke, alluding to the fact that it is a strong catalyst of dehydrogenation and condensation reactions. The attenuation of the fouling factor with time was attributed to the reduction in the amount of iron sulfide being ejected into the foulant layer and erupting at the foulant-oil interface. Thiophene was also added to the oil bath to evaluate its effects on fouling. It was thought that the addition of a thermally stable, surface-active solvent would both solubilize the asphaltenes and reduce the interaction of corrosive species with the surface of the metal by blocking adsorption sites. The compound was added to the oil bath at concentrations of 0.5, 1.3, and 5.7 vol%. Fouling behaviour was evaluated for 250, 1000, and 1400 minutes of exposure at temperature. Thiophene was found to be very effective at reducing both the fouling factor, and the amount of surface corrosion on 316 stainless steel at all exposure levels and times. Chapter 4, a review of MoS2 for lithium ion batteries, represents a seminal contribution to that field. At the time of its publication, there was a large debate in open literature regarding the lithiation mechanism and lithiation products of

MoS2 during charge/discharge cycling. A thorough study of open literature, combined with a small number of my own experiments (shown in Appendix B), revealed evidence which helped to elucidate the lithiation mechanism. This work has begun to change what was the minority view at the time, into the majority view. MoS2 converts to lithium sulfide and molybdenum metal, and functions as a lithium sulfur battery after the first discharge cycle. Initially it was thought that the MoS2 functions as an intercalation electrode over its full voltage range of 0-3V vs Li/Li+. However, the MoS2 actually decomposes after lithiation, and never re-forms in subsequent cycles. The paper presented as Chapter 4 was instrumental in bringing about that paradigm shift, and remains extremely well-received by the scientific community.

Fouling of Heat Exchange Surfaces by Skim Milk BoD – Books on Demand

This handbook presents the most important technologies concerning the reduction of fouling in heat exchangers and the appropriate technologies of removal and cleaning. Furthermore, the general and scientific fundamentals of heat transfer are explained. Written by experts from Germany, UK and the USA, this book is a reliable adviser for engineers, managers, technicians and students who want to have an overview concerning this field. Advertisements and a table of addresses will enable the reader to get in direct contract with the specialised problem solvers.

Fouling of Heat Exchangers Nova

Publishers
This book presents the ideas and industrial concepts in compact heat exchanger technology that have been developed in the last 10 years or so. Historically, the development and application of compact heat exchangers and their surfaces has taken place in a piecemeal fashion in a number of rather unrelated areas, principally those of the automotive and prime mover, aerospace, cryogenic and refrigeration sectors. Much detailed technology, familiar in one sector, progressed only slowly over the boundary into another sector. This compartmentalisation was a feature both of the user industries themselves, and also of the supplier, or manufacturing industries. These barriers are now breaking down, with valuable cross-fertilisation taking place. One of the industrial sectors that is waking up to the challenges of compact heat exchangers is that broadly defined as the process sector. If there is a bias in the book, it is towards this sector. Here, in many cases, the technical challenges are severe, since high pressures and temperatures are often involved, and working fluids can be corrosive, reactive or toxic. The opportunities, however, are correspondingly high, since compacts can offer a combination of lower capital or installed cost, lower temperature differences (and hence running costs), and lower inventory. In some cases they give the opportunity for a radical re-think of the process design, by the introduction of process intensification (PI) concepts such as combining process

elements in one unit. An example of this is reaction and heat exchange, which offers, among other advantages, significantly lower by-product production. To stimulate future research, the author includes coverage of hitherto neglected approaches, such as that of the Second Law (of Thermodynamics), pioneered by Bejan and co- workers. The justification for this is that there is increasing interest in life-cycle and sustainable approaches to industrial activity as a whole, often involving exergy (Second Law) analysis. Heat exchangers, being fundamental components of energy and process systems, are both savers and spenders of exergy, according to interpretation.

Proceedings of "Fouling Mitigation of Industrial Heat-exchange Equipment," an International Conference Held at the Cliffs at Shell Beach, San Luis Obispo, California, USA, June 18-23, 1995 Hemisphere Pub

Plate-and-frame heat exchangers (PHEs) are used in many different processes at a broad range of temperatures and with a variety of substances. Research into PHEs has increased considerably in recent years and this is a compilation of knowledge on the subject. Containing invited contributions from prominent and active investigators in the area, it should enable graduate students, researchers, and research and development engineers in industry to achieve a better understanding of transport processes. Some guidelines for design and development are also included.

Fouling of Heat Transfer Equipment CRC

Press
Heat exchangers are a crucial part of aerospace, marine, cryogenic and refrigeration technology. These essays cover such topics as complicated flow arrangements, complex extended surfaces, two-phase flow and irreversibility in heat exchangers, and single-phase heat transfer.
Fouling and Fouling Mitigation on Heat Exchanger Surfaces IChemE
Deposition of amorphous silica (SiO2) and calcium oxalate (CaOx) on the calandria tubes of juice evaporators cause serious processing problems in Australian cane sugar mills. The removal of these deposits by mechanical and chemical means is a time-consuming and costly experience. The cost of downtime and chemical cleaning can be several million dollars per year for the Australian sugar industry. The interactions between CaOx and SiO2 have not been investigated previously because conventional studies only address fouling by individual components. The present work evaluates their interactions using two experimental approaches: batch tests for assessing kinetic and thermodynamic behaviour, and fouling-loop experiments for examining composite fouling behaviour under different operating conditions. These two approaches were employed both in the absence and in the presence of sugar to elucidate the effect of sugar on composite fouling mechanisms and to determine the controlling species responsible for composite fouling. The combined information obtained from

both the batch and fouling-loop tests in this study offer a unique insight into the mechanisms of composite fouling of CaOx and SiO2.

Compact Heat Exchangers Academic Press

Scientific Essay from the year 2018 in the subject Physics - Thermodynamics, , language: English, abstract: This work is concerned with the effects of fouling on different fin tubes and exchangers cooled by air. During operation of heat exchangers layers of deposits or corrosive products may be formed and accumulated on heat exchanger surfaces over time. This leads to additional heat transfer resistance and constriction of fluid flow area. In consequence, the exchanged heat duty is badly affected. The loss of heat duty is extreme if local heat transfer coefficients are high at clean conditions. However, maintaining cooling effectiveness is paramount in most applications. As a remedy, surfaces must be regularly cleaned. Fin tubes are core elements in air cooled exchangers or condensers to transfer heat. Fin tube exchangers are characterized by a multitude of circular, elliptical or channel type core tubes with air-side finning. Generally, the process medium flows on the tube internal side with air as coolant on the external fin side. The report deals with air cooled heat exchangers and condensers under forced or natural draft in dry cooling applications with the focus on the effect of fin side fouling. Water spray injection into the cooling air flow is excluded. Consequently, the effect of fin side

fouling layers will be assessed as well as the consequence for air flowrate and heat duty at different convection types. Special attention is given to the effect of fouling on the performance of dry air cooled condensers. Also, differences of forced, induced or natural draft dry cooling applications will be covered.

Final Report Cuvillier Verlag

With production from unconventional rigs continuing to escalate and refineries grappling with the challenges of shale and heavier oil feedstocks, petroleum engineers and refinery managers must ensure that equipment used with today's crude oil is protected from fouling deposits Crude Oil Fouling addresses this overarching challenge for the petroleum community with clear explanations on what causes fouling, current models and new approaches to evaluate and study the formation of deposits, and how today's models could be applied from lab experiment to onsite field usability for not just the refinery, but for the rig, platform, or pipeline. Crude Oil Fouling is a must-have reference for every petroleum engineer's library that gives the basic framework needed to analyze, model, and integrate the best fouling strategies and operations for crude oil systems. Defines the most critical variables and events that cause fouling Explains the consequences of fouling and its impact on operations, safety, and economics Provides the technical models available to better predict and eliminate the potential for fouling in any crude system

Fouling Science and Technology Springer

Science & Business Media
The first book to describe the state-of-the-art in the interdisciplinary field of metal phosphonate chemistry, aimed at academic and industrial researchers.
International Conference on Fouling of Heat Exchanger Surfaces : White Haven, Pennsylvania, October 31-November 5, 1982 WIT Press
Provides a unique overview of energy management for the process industries Provides an overall approach to energy management and places the technical issues that drive energy efficiency in context Combines the perspectives of freewheeling consultants and corporate insiders In two sections, the book provides the organizational framework (Section 1) within which the technical aspects of energy management, described in Section 2, can be most effectively executed Includes success stories from three very different companies that have achieved excellence in their energy management efforts Covers energy management, including the role of the energy manager, designing and implementing energy management programs, energy benchmarking, reporting, and energy management systems Technical topics cover efficiency improvement opportunities in a wide range of utility systems and process equipment types, as well as techniques to improve process design and operation
A Laboratory Method to Study the Fouling of Heat Exchange Surfaces by Biological Fluids Gulf Professional Publishing

These Engineering Foundation Proceedings resulted from the International Conference on the Fouling Mitigation of Industrial Heat Exchangers held in California in 1995. The goal of the conference was to bring together researchers and engineers in industrial organizations who are interested in methods of mitigating fouling of heat transfer equipment. The conference focused on methods of mitigating fouling, energy efficiency, environmental problems, and product costs.

Inverse Heat Conduction and Heat Exchangers BoD – Books on Demand

Two-phase flow heat exchangers are vital components of systems for power generation, chemical processing, and thermal environment control. The art and science of the design of such heat exchangers have advanced considerably in recent years. This is due to better understanding of the fundamentals of two-phase flow and heat transfer in simple geometries, greater appreciation of these processes in complex goemetries, and enhanced predictive capability through use of complex computer codes. The subject is clearly of great fundamental and practical importance. The NATO ASIan Thermal-Hydraulic Fundamentals and Design of Two-Phase Flow Heat Exchangers was held in Povoa de Varzim (near Porto), Portugal, July 6-17, 1987. participating in the organization of" the ASI were the Department of Mechanical Engineering and the Clean Energy Research Institute, University of Miami; Universidade do Porto; and the Department of Mechanical

Engineering, Aeronautical Eng ineer ing, and Mechanics, Rensselaer Polytechnic Institute. The ASI was arranged primarily as a high-level teaching activity by experts representing both academic and industrial viewpoints. The program included the presentation of invited lectures, a limited number of related technical papers and discussion sessions.

Principles, Applications and Rules of Thumb Royal Society of Chemistry Fouling of feed/effluent heat exchanger in Hydrotreating unit have a significant impact on the operation efficiency. Hydrotreater fouling presents loss of heat transfer, enlargement of energy consumption, increasing in maintenance cost and throughput limitation. Thus, to solve these problems, heat exchangers are cleaned during shutdown. In this research, an artificial neural network has been used to develop the fouling model of feed/effluent heat exchanger in Hydrotreating unit. Developed algorithm is employed to determine the optimal operation and cleaning interval of the feed/effluent heat exchanger surfaces. The artificial neural network is widely applied in modeling and optimization of chemical process especially nonlinear systems. The main advantage of the use of artificial neural network is obtaining a highly accurate mathematical model of the system without the detail of the system. The process modeling applications use the artificial neural network to approximate the relationship between the input and output variables.

Compact Heat Exchangers for Energy

Transfer Intensification Begell House Publishers
Heat Transfer Principles and Applications is a welcome change from more encyclopedic volumes exploring heat transfer. This shorter text fully explains the fundamentals of heat transfer, including heat conduction, convection, radiation and heat exchangers. The fundamentals are then applied to a variety of engineering examples, including topics of special and current interest like solar collectors, cooling of electronic equipment, and energy conservation in buildings. The text covers both analytical and numerical solutions to heat transfer problems and makes considerable use of Excel and MATLAB(R) in the solutions. Each chapter has several example problems and a large, but not overwhelming, number of end-of-chapter problems.

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