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ANNOUNCEMENTS

BASES OF MULTIPHASE FLOW AND HEAT TRANSFER

A 5-DAY WORKSHOP

Hosted by
Department of Chemical and Nuclear Engineering,
The University of California, Santa Barbara, U.S.A.

25 February–1 March 1991

THE PROGRAM

Two-phase flow and boiling heat transfer continue to focus the attention of researchers and to frustrate and challenge the engineer in the chemical, nuclear, oil-and-gas, cryogenic and other industries. New data and information, ideas and hypotheses, and facts and erroneous theories continue to be produced.

The short course described here is patterned after similar courses offered for a number of years at Stanford University and more recently at the University of California—Santa Barbara and at ETH—Zurich. Its intent is to provide:

- A condensed and critical view of present knowledge including areas of uncertainty
- Transfer of knowledge from one area of application to another
- Sources of data and correlations
- System analysis and design philosophy and methods
- Limitations of modern codes will be pointed out

The course features:

- A program of coordinated lectures by experts in the field
- A complete set of lecture notes and copies of slides
- Movies to illustrate physical phenomena
- Limited enrolment.

The lecturers

Sanjoy Banerjee, Professor at the Department of Chemical and Nuclear Engineering, University of California, Santa Barbara, U.S.A. Also a Visiting Professor at the Swiss Federal Institute of Technology in Zurich (ETHZ).
Gad Hetsroni, Danciger Professor of Engineering at Technion—Israel Institute of Technology.
Geoffrey F. Hewitt, Professor of Chemical Engineering at the Imperial College of Science, Technology and Medicine, London, England.
George Yadigaroglu, Professor of Nuclear Engineering at the Swiss Federal Institute of Technology in Zurich (ETHZ) and head of the Thermal-Hydraulics Laboratory at the Paul-Scherrer Institute (formerly EIR), Switzerland.

CONTENTS OF LECTURES

Bases

1. **Introduction:** *G. F. Hewitt.* Nature of multiphase flows. Definition of basic quantities. Manifestation in industrial applications. Design needs for steady-state and transient operation.
2. **Basic Equations I:** *G. Hetsroni.* Averaging. Control volumes. Simplified forms of continuity, momentum and energy equations. Homogeneous model. Separated flow mode. Drift flux model. Pressure drop and void fraction correlations.
3. **Basic Equations II:** *S. Banerjee.* Rigorous averaging and derivations. Time and space dependent effects. Virtual mass. Multifluid models. Requirements for closure relationships.
4. **Flow Regimes:** *G. Hetsroni.* Description of flow regimes. Flow regime maps. Flow regime transitions.
5. **Numerical Methods:** *S. Banerjee.* Initial and boundary conditions. Method of characteristics. Finite difference methods. Stability. Explicit and implicit methods. Methods used in computer codes.
6. **Two-phase Flow in Vertical Pipes:** *G. F. Hewitt.* Bubble flow; drift flux correlations, void profile, turbulence. Plug flow; bubble rise velocity, mechanisms, stability. Annular flow; basic theory entrainment and deposition. Modelling, applications.

7. **Two-phase Flow in Horizontal and Inclined Pipes:** *G. F. Hewitt.* Stratified flow; simple and more advanced models, turbulence. Slug flow; flow behaviour in slugs, slug frequency and velocity.
8. **Closure Relationships:** *G. Yadigaroglu.* Interfacial area. Wall and interface friction. Relationships between void fraction and interfacial friction. Interfacial heat transfer. Empirical closure laws.
9. **Two-phase Heat Transfer:** *G. Hetsroni.* Regimes of heat transfer. Boiling heat transfer; nucleate boiling, forced convection. Correlation and models. Critical heat flux: mechanisms and correlations.
10. **Dryout and Post-dryout:** *G. Yadigaroglu.* Post-dryout heat transfer; non-equilibrium heat transfer regimes, transition boiling, inverted annular and dispersed flow film boiling.
11. **Multidimensional Modelling:** *S. Banerjee.* Basic multidimensional equations. Direct simulation. Large eddy simulation. Turbulence modelling; three-dimensional.
12. **Instabilities in Two-phase Flow:** *G. Yadigaroglu.* Modes of instability, fundamentals, mechanisms. The Ledinegg instability, flow distribution instabilities, density wave oscillations etc. Analytical tools, stability maps, BWR stability.

Applications

13. **LOCA Phenomena:** *G. Yadigaroglu.* Loss-of-coolant accidents, small-break, large-break; emergency core cooling phenomena and their understanding. Reflooding and rewetting of the core.
14. **Steam Generators:** *G. Hetsroni.* Nuclear steam generators. Design considerations. Operational problems; corrosion, vibration etc. Extension of lifetime.
15. **Process Boilers and Condensers:** *G. F. Hewitt.* Process boilers, waste heat recovery, reboilers, operational problems. Process condensers; selection of pipe venting, multicomponent systems.
16. **Computer Codes:** *G. F. Hewitt.* Generic approach in computer codes for nuclear reactor transient analysis. Specific codes (RELAP, TRAC etc). Achievements and limitations of codes. Future development and applications in nuclear and non-nuclear systems.
17. **Severe Accidents:** *G. Yadigaroglu.* Severe accident scenario and phenomena. Vapour explosions. Debris-bed cooling etc.
18. **Space and Microgravity Applications:** *S. Banerjee.* Two-phase phenomena in a microgravity environment heat transfer and flow regimes. Space boiling and condensation systems.

HOTEL INFORMATION

Participants may stay at the Sheraton Santa Barbara at a special room rate of $89/night. Please contact the hotel directly [*Tel*: (805) 963-0744 or *Fax*: (805) 962-0985] and mention the workshop.

REGISTRATION INFORMATION

Registration is requested by **20 January 1991**. To request space after this date call (805) 893-4993 or 893-3456. No refunds will be granted after this date unless the workshop is cancelled. To secure registration, send registration form plus payment prior to **20 January**.

WORKSHOP FEES

Registration fees are $1100(U.S.) and include lectures notes, copies of all slide notes, reception and workshop banquet. The lectures will be conducted at the Sheraton. Because of space limitations, participants are urged to register well before the deadline.

FOR FURTHER INFORMATION CALL
PROFESSOR S. BANERJEE
***Tel.* (805) 893-4993 *Fax*: (805) 893-3456**

Call for Papers

DIVISION OF COLLOID AND SURFACE CHEMISTRY OF THE AMERICAN CHEMICAL SOCIETY
SYMPOSIUM ON
ELECTROCHEMISTRY IN MICROHETEROGENEOUS FLUIDS

202nd ACS NATIONAL MEETING
New York, N.Y., U.S.A.

25–30 August 1991

Experimental and theoretical studies which address fundamental and applied aspects of electrochemistry in microheterogeneous fluids will be discussed. The range of microheterogeneous fluids to be examined includes

micellar solutions, microemulsions, emulsions, latexes and dispersions of solids in liquids. Examples of suitable topics include, but are not limited to, the following: electrosynthesis; electrocatalysis; electroactive solute distribution and transport; interphase transport kinetics; redox and electron transfer phenomena in colloidal semiconductors; metal colloid formation; particle sizing; particle diffusion; and micelle assisted electro-analytical methods.

Titles and abstracts (200–300 words) on standard ACS abstract forms should be submitted by **31 March 1991** to either of the symposium organizers. It is anticipated that the proceedings will be published. Full papers for referred review will be required by **31 July 1991**.

Further information may be obtained from the organizers:

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Rochester, NY 14650-2109
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Preliminary Announcement

INTERNATIONAL SYMPOSIUM ON INSTABILITIES IN MULTIPHASE FLOWS

URA CNRS 230, INSA de Rouen, France

11–14 May 1992

Objectives

Instabilities in multiphase flows is a topic of great interest both to practising engineers and to researchers. However, a serious lack of unity among its various and diverse features has made this area an historically disconnected field of research. The aim of this symposium will be to provide a forum in which a special effort will be made to develop more unity in the field. It is hoped that a more extensive and systematic use of concepts from the modern theory of dynamical systems will help achieve this objective. Although the symposium is meant to be a forum for all kinds of ideas relevant to instabilities in multiphase flows, emphasis on the use of the theory of dynamical systems in this context will be particularly welcome.

Sessions

Four plenary lectures and about 10 formal sessions (including about 40 papers) plus a poster session are planned. In addition, the accepted posters will be displayed throughout the entire period of the symposium. Contributed papers and posters on all kinds of instabilities in multiphase flows will be welcome. Experimental papers are welcome, but they should be accompanied by theoretical discussion. In any case, authors should make an effort to present their results with a unifying perspective, preferably using concepts from the modern theory of dynamical systems. More information concerning abstracts and deadlines will be provided later.

Scientific Committee

J. M. Delhaye, CENG, Grenoble, France
J. J. Dorning, University of Virginia, U.S.A.
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Information

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