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ANNOUNCEMENT

TWO PHASE HEAT TRANSFER IN STEADY AND TRANSIENT STATES

Stanford University
Department of Chemical Engineering

20–24 August 1979

TWO PHASE FLOW HEAT TRANSFER

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

The purpose of this course is to provide the practicing engineer with:

- An up-to-date condensed and critical view of the state of knowledge.
- Highlight of salient points.
- Sources of data and correlations.
- Design philosophy and methods.
- The outstanding areas of uncertainties.

The course will consist of:

- A series of coordinated lectures by well-known experts.
- Lecture notes to be distributed prior to the course.
- Discussions.
- Selected movies and slides to illustrate physical phenomena.
- Excellent and convenient accommodations on Stanford Campus.
- Limited attendance.

Lecturers

S. Banerjee, Professor of Engineering Physics, McMaster University, Canada.
K. J. Bell, Professor of Chemical Engineering, Oklahoma State University, Stillwater, Oklahoma.
R. B. Duffey, Program Manager, Electric Power Research Institute, Palo Alto, Calif.
W. T. Hancox, Director, Applied Science Division, Whiteshell Nuclear Research Est., Canada.
G. Hetsroni, Program Manager, Electric Power Research Institute, Palo Alto, Calif.
G. F. Hewitt, Manager, HTFS, AERE Harwell, England.
W. M. Rohsenow, Professor of Mechanical Engineering, M.I.T., Cambridge, Mass.
J. T. Taborek, Technical Director, HTRI, Alhambra, Calif.

Course Director:
G. Hetsroni, Visiting Scholar,
Department of Chemical Engineering,
Stanford University,
Stanford, California, CA 94305, U.S.A.

MONDAY, 20 AUGUST

Introduction—G. F. Hewitt

Explanation of philosophy of course, introduction to applications of two phase flow, brief survey of modelling methods, description of techniques, survey of equipment. Sets scene for the rest of the material in the course.

Flow regimes and modelling—S. Banerjee

Introduction to flow patterns including cine films of flow patterns, general description, classification, flow pattern maps and basic equations.

Flow regimes and modelling II—S. Banerjee

Modelling methods and their applications in various flow regimes. Drift flux model, two fluid models, regime related models (e.g. annular flow).

Phase change processes—W. M. Rohsenow

Introduction to bases of phase equilibria, processes of nucleation, homogeneous and heterogeneous nucleation, bubble growth basics.

TUESDAY, 21 AUGUST

Pool boiling—W. M. Rohsenow

Pool boiling curve and mechanisms, bubble nucleation and growth, correlations for pool boiling, pool boiling under transient conditions.

Forced convective boiling—W. M. Rohsenow

Sub-cooled boiling, quality boiling, onset and suppression of nucleate boiling, correlations, theoretical models, transient forced convective boiling.

Boiling equipment—G. F. Hewitt

Classification of equipment, waste heat boilers, reboilers, submerged combustion. Boiling in cross flow, circulation effects, problems encountered in each type of equipment.

Tube vibration—G. Hetsroni

Mechanisms of vibration, turbulent buffeting, vortex shedding, fluid elastic. Prediction of tube vibration in heat exchangers. Applications in steam generators.

WEDNESDAY, 22 AUGUST

Condensation—K. J. Bell

Bases of condensation heat transfer—Nusselt, corrections for vapour shear, in-tube condensation, shellside condensation. Multicomponent systems, incondensibles, vapour mixtures.

Condensation equipment—K. J. Bell

Types of condenser—shell and tube (tube and shell side), air-cooled, direct contact. Problems encountered in various types: sub-cooling effects, flow patterns flow distribution in headers, venting problems.

Fouling—J. T. Taborek

Mechanisms of fouling—particulate, crystalline, etc. Nature of fouling in heat exchangers. Theoretical bases for prediction of fouling. Special problems of fouling in boiling, condensing and other two phase flow systems.

Principles of equipment design—J. T. Taborek

LMTD methods and correction factors to them. Stepwise methods for design and their limitations. Point design methods.

THURSDAY, 23 AUGUST

Blow-down and refill—R. B. Duffey

Blow-down of nuclear plant, venting problems in chemical plant. Description of the blow-down-refill cycle in water reactors with reviews of the problem areas.

Computer modelling of two phase flow systems—S. Banerjee

Review of available computer models. Problems in computer modelling: illposedness, real characteristics, etc. Future development of computer modelling.

Burnout—G. F. Hewitt

Parametric effects on burnout, correlations, prediction of burnout in annular flow.

Steam Generators—G. Hetsroni

Types of steam generators, main problems encountered, design principles, future development requirements.

FRIDAY, 24 AUGUST

Post-dryout and rewetting—R. B. Duffey

Post-dryout heat transfer in forced convective systems, experimental data, correlations, modelling methods. Rewetting of hot surfaces. Quenching during reflood.

Instability—W. T. Hancox

Types of instability—chugging, Ledinegg, oscillatory, acoustic, etc. Prediction methods and means of avoiding instabilities.

Instrumentation and control—W. T. Hancox

Measurement principles in two phase flow, instrumentation for nuclear and process plant, control systems.

RESERVATIONS

The course fee including room and board is $700 per registrant. Accommodations will be made on campus at one of Stanford's newest and most comfortable student residences (w/o private baths). Three meals per day will be provided. The course fee EXCLUSIVE of room and board is $500. Course fee includes printed lectures.

Please make checks payable to Stanford University and mail to:

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