



The International Information Center for Multiphase Flow

**NEWSLETTER**

No.9

October 1997

**ICeM**

The Japan Society of Multiphase Flow

**ICMF'98****Third International Conference on Multiphase Flow 98,  
June 8-12, 1998, Lyon, France**

by J. Bataille

About 600 abstracts have been received and are being currently reviewed. Notification of acceptance and instructions will be mailed to the authors before the end of October. Accommodation and registration will be handled by the following private company:

PACKAGE Organisation  
53, Rue Vauban  
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They have reserved blocks of hotel rooms of different categories.

Participants are asked to make contact WITH THEM DIRECTLY for any information concerning accommodation. (REFER TO ICMF98!)

Access to Lyon should not be a problem because it is well connected to most major European cities either by air or train. BUT PARTICIPANTS SHOULD KEEP IN MIND THAT THE SOCCER WORLD CUP WILL BE TAKING PLACE IN FRANCE AT THE SAME

TIME.

ACCORDINGLY WE RECOMMEND THEY MAKE FLIGHT/TRAIN RESERVATIONS WELL AHEAD OF TIME.

A final announcement containing all the necessary information will be mailed to all people on our mailing list in due time. In the meantime, however, participants are asked to read the home pages of our WEB SITE:

EUROPE: <http://www.mecaflu.ec-lyon.fr/ICMF98/>

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**To Join ICeM:**

Everybody, who has an interest in "multiphase flow", can become a member of ICeM. ICeM welcomes his/her joining. Please contact either of the following to register in ICeM.

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## FLOW RESEARCH IN HUNGARY

by J. Gyenis

The multiphase flow research in Hungary is concentrated to several research laboratories, such as Chemical Engineering and Flow Dynamics Departments of Technical University Budapest, University of Veszprem, and Research Institute of Chemical Engineering, Veszprem. Both experimental and theoretical studies are going on at these institutions, which are mainly focused on liquid and slurry mixing, gas-liquid two-phase flows, gas-liquid-solid three-phase and liquid-solid two-phase fluidized bed, dry particulate flow, gas-solid two-phase flow, study and application of static mixers.

### LIQUID AND SLURRY MIXING

A research team at the Technical University of Budapest, Department of Chemical Engineering has investigated the general principles of applications, design and scaling-up of mechanical stirrers in liquid or slurry phases. The experiments were mainly carried out in pilot scale and large industrial tanks, as well. HAVAS et al. have studied the homogenization effects of various design of mechanical stirrers in agitated tanks to blend and homogenize miscible Newtonian liquids in case of low and high viscosity of the components [1-3]. Axially pumping propellers, multi-paddle agitators, anchor impellers, helical ribbon agitators and screw agitators were evaluated comparing them with each others. General correlation have been obtained between the homogenization effect and the design and operating variables. The power consumption of various types of mechanical stirrer was examined by SAWINSKY and DEAK [4-5] in details.

Correlation between heat transfer coefficients and flow characteristics, in case of flow patterns which were modified by heating and cooling coils built in the vessels were investigated also by HAVAS et al. [6]. A modified Reynolds-number and a general equation have been found by them which proved to be applicable to evaluate the experimental data obtained in agitated vessels equipped with various types and sizes of turbine stirrers. By this results high accuracy predictions and design could be realized.

### GAS-LIQUID TWO-PHASE FLOWS

Hydrodynamic behavior of vapor and liquid phases in rotary film equipments have been studied by UJHIDY and BERKES at the Research Institute of Chemical Engineering, applying dif-

ferent rotor types and blades. Correlations have been found between the turbulence of the liquid film and the design and operational parameters [7].

Internal loop reactors with various types of risers, such as simple draft tube, vertically arranged series of conical draft tubes, without and with helical static mixer grids inside were investigated by UJHIDY Jr. et al. [8]. Liquid flow characteristics, mixing kinetics and mass transfer characteristics were determined in function of the superficial gas velocities and power input, also studying the influence of the design parameters.

### GAS-LIQUID-SOLID AND LIQUID-SOLID SYSTEMS

A multistage fluidized bed equipment has been developed by SISAK et al. [9], where the adjacent compartments in a vertical bubble column were separated by thick plates with several holes formed as Venturi-throats and valves on the top of these throats, to make suitable distribution and intensive contacts between the phase elements of liquid-solid and gas-liquid-solid systems [10]. Hydrodynamic studies in this equipment were carried out by KOMAROMI et al. [11], VENYIGE et al. [12] investigating the axial mixing and residence time distribution of the liquid phase, bubble size distributions, mass transfer coefficients, and other important flow characteristics.

FARKAS et al. have investigated the mixing characteristics of liquid phase and crystal slurries in a mechanically agitated precipitation vessels [13].

### DRY PARTICULATE FLOW

Mixing and flow pattern of free flowing bulk solids were studied by GYENIS et al. under non steady-state dry gravity flow conditions in a bulk solids batch mixer performing special alternating rotations [14-16]. GYENIS also has studied steady-state particulate flow in vertical mixer tubes containing a row of helical static mixer elements [17-19]. It was found that depending on the feeding and discharging conditions, three distinct flow regimes can exist, considerably differing in the flow characteristics, i.e. solids hold-up, particle and velocity distribution in the whole particle system. DPS computer simulations have also confirmed the experimental observations

[20-23].

### GAS-SOLID TWO-PHASE SYSTEMS

Recently, comprehensive studies have been carried out in gas-solid two-phase systems in a great variety of unit operations at the Research Institute of Chemical Engineering, Veszprem. These investigations comprise both experimental and theoretical studies in various flow systems: in gas-solid fluidized beds, mechanically stirred spouted beds (circulating fluidized bed), gas-solid co-current flows in pneumatic conveying and static mixer tubes, etc. Theoretical studies were mainly carried out by applying discrete particle simulation (DPS) or, in other words, distinct element method (DEM), in cooperation with Tsuji Laboratory, Osaka.

Extended investigations were made by DENCS to determine the hydrodynamic characteristics and the flow patterns of solid particles in dense fluidized bed. Local velocities of the particles across a mechanically agitated fluidized bed were measured by fiber optical method [24-25]. Hydrodynamic characteristics of the bed was determined from these measurements [26].

ORMOS and HAJDU investigated the hydrodynamical behavior of the gas and solid phases in gas-solid fluidized bed above a horizontally rotating gas-distributor disc [27-28]. The minimum fluidization gas velocity, the bed expansion and bed shape was determined in case of different disc revolution speed.

NEMETH et al. have made a survey on the basic studies of gas-solid two-phase flows in tubes containing vertical rows of helical static mixer elements [29]. Applying discrete particle simulation, ULBERT et al. established three-dimensional models and carried out DPS simulation to determine both the gas flow characteristics and the discrete particle movements during a gas-solids two-phase flow, streaming downwards through vertical tube containing static mixer elements [20-23].

The hydrodynamic characteristics of gas-solid spouted beds with simple draft tube and with open conveyor screw were studied by SZENTMARJAY et al. [30-31] and PALLAI et al. [32].

SZALAY et al. carried out investigation to determine the principles of hydrodynamical and geometrical design of vibrated bed dryers [33].

### STUDIES AND APPLICATION OF STATIC MIXERS

At the Research Institute of Chemical Engineering, Veszprem, extended studies are going on now in order to get useful technical information on the flow dynamics and practical applications of FIXMIX static mixer elements in differ-

ent unit operations and phase systems. NEMETH published comprehensive review papers [34-35] on these results and gave world wide used examples on the broad application possibilities of various types of static mixers in unit operations. Several studies recently carried out in Hungary, mentioned earlier in this paper are also related to this studies [14-23, 29].

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**Modelling and Computation of Multiphase Flows: Part I: Bases**  
**Part IIA: Water Reactor Applications Part IIB: Computational Modelling**  
**Zurich, Switzerland, March 17-21, 1997**

by George Yadigaroglu

The modelling and computation of multiphase flows and boiling heat transfer are of interest to researchers and engineers in the nuclear, chemical-process, oil-and-gas, cryogenic and other industries. One-week Short Courses on these subjects have been offered in the past at Stanford University, at the University of California-Santa Barbara and for 14th time now at ETH-Zurich.

The 1997 Zurich modular courses featured a coordinated, comprehensive series of lectures by experts in their fields. A common Part I was of interest to practicing engineers and to researchers who wish to obtain a condensed and critical view of present fundamental knowledge; this part of the course was updated this year to emphasize the modelling and computational aspects of multiphase flows. Two parallel sessions followed: Part IIA covered multiphase flow phenomena and applications of particular interest to the nuclear industry, with emphasis on severe accidents and on advanced Light Water Reactors. Part IIB covered in depth Computational Modelling and CFD techniques in relation to multiphase flows.

This series of courses aims at an interdisciplinary transfer of knowledge between the various industries for which two-phase flows are important (nuclear, process, cryogenics, petroleum, etc.). The courses provide the latest sources of information, data and correlations; knowledge about state-of-the-art modelling, design, analysis and computation methods, and discuss the availability and limitations of modern modelling techniques and codes.

The 1997 Short Course featured the following program.

**PART I. BASES**

1. Introduction, definitions, conservation equations: G. Hetsroni.
2. Flow regimes, pressure drop and void fraction: G. Hetsroni.
3. Modelling of flows with wall films (churn, annular and wispy annular): G.F. Hewitt.

4. Modelling of slug flow: G.F. Hewitt.
5. Two-phase heat transfer: G. Hetsroni.
6. Thermal non-equilibrium flows: G. Yadigaroglu.
7. Multicomponent systems: G.F. Hewitt.
8. Instabilities in two-phase flow: G. Yadigaroglu.
9. Multifield models: S. Banerjee.
10. Closure relationships: G. Yadigaroglu.
11. Numerical methods: S. Banerjee.
12. Computer codes: G.F. Hewitt.

**PART IIA. WATER REACTOR APPLICATIONS**

- 13A. LOCA phenomena: G. Yadigaroglu.
- 14A. Severe accidents: M.L. Corradini.
- 15A. Computation of transients and accidents: G. Yadigaroglu.
- 16A. Multiphase containment phenomena in advanced LWRs: M.L. Corradini.
- 17A. Steam generators: G. Hetsroni.
- 18A. Vapor explosions: M.L. Corradini.

**PART IIB. COMPUTATIONAL MODELLING**

- 13B. Computational fluid dynamics (CFD) modelling: Underlying methodology: G. I. Quarini.
- 14B. Computer simulation of turbulent systems: Basic principles: S. Banerjee.
- 15B. Modelling applications: G. I. Quarini.
- 16B. CFD modelling of separated flows: G.F. Hewitt.
- 17B. CFD modelling of bubbly flows: M. Lance.
- 18B. Applications of CFD simulation to turbulent systems: S. Banerjee.

A similar course will take place in Zurich again, March 16-20, 1998.

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**GAMM'97**  
**Annual Meeting of the Gesellschaft für Angewandte Mathematik und Mechanik**  
**Session 12 Multiphase Flows - including Drops and Bubbles**  
**March 24-27, 1997, Regensburg, Germany**

The GAMM Annual Meeting took place for the second time at the University of Regensburg. More than 1.200 participants have registered and altogether 998 lectures have been announced: 14 Invited Plenary Lectures, the 40th Ludwig Prandtl Memorial Lecture and 16 Minisymposia. The main part of the scientific program was organized within 23 Sessions consisting of 754 Short Communications and 108 Invited Special Topic Lectures- Keynote Lectures

About 5 Sessions were directly devoted to **Fluid Mechanics**, among them Session Nr. 12 was related to

**Multiphase Flows - including Drops and Bubbles**

and has been organized by Professor Dr. U. Schafflinger, Technical University Vienna, Austria and Professor Dr.-Ing.habil. G.H. Schnerr, University of Karlsruhe (TH), Germany. According to the aim of the organizers to cover all important actual topics of Multiphase Flows the final program of Session Nr. 12 consisted of 37 lectures which covered the following topics

1. Nonequilibrium phase transition in vapor flows
2. Two-phase flow modeling
3. Droplets, bubbles, bubbly flows
4. Phase transition in liquid flows - cavitation
5. Heat transfer
6. Liquid layers, free surfaces, interfacial phenomena
7. Particle laden flows
8. Rheology
9. Hydrodynamic diffusion, hydrodynamic instability
10. Granular Flow.

Highlights of Session No. 12 were the Invited Special Topic Lectures, overall 12, with speakers coming from all over the world. The largest part of the program was dedicated to topic No. 1: Nonequilibrium phase transition in vapor flows with 3 Keynote Lectures:

Non-equilibrium condensing flows in turbomachinery, Y.B. Young, University of Cambridge, England

Nucleation and droplet growth; wave tube experiments and industrial practice, M. van Dongen, C.C.M. Luijten, K.N.H. Looijmans, Eindhoven University of Technology, Netherlands

by G. H. Schnerr

The statistical thermodynamic properties and homogeneous nucleation rates of clusters of molecular nitrogen, P. Pal, Royal Holloway University of London, England.

Topic No. 3: Droplets, bubbles, bubbly flows was represented by 5 lectures including 2 Keynote Lectures

Micro-mezzo-macro scale analyses on bubbly flows, Y. Matsumoto, The Tokyo University, Tokyo, Japan

The impact of droplets on plane liquid surfaces, M. Rein, DLR - Göttingen, Germany

The subsequent topics were represented by the following Special Topic Lectures

Unsteady cavitation experiments and modeling, B. Stutz, O. Coutier, J. Fayoll, J.L. Reboud, H. Zara - LEGI/IMG Grenoble, France

Two-phase turbulence and heat transfer, G. Hetsroni, A. Mosyak, R. Rozenblit, L.P. Yarin, G. Ziskind - Technion, Haifa, Israel

Phase transition in driven 2-d liquids, D. Meinköhn, DLR - Hardtshausen, Germany

Rheology of suspension and emulsions, N. Aksel, Technical University of Chemnitz-Zwickau, Germany

Hydrodynamic diffusion models applied to bubbles in laminar flow, A. Dahlkild - KTH, Stockholm, Sweden

Simulations and models of particle laden flows, S. Schwarzer, H. Herrmann - University of Marburg, Germany

Fixed-grid numerical methods for multiphase flow simulations, S. Zaleski - Université Pierre et Marie Curie, Paris, France

One of the overall conclusions of Session No. 12, which reached a very high attendance, is the increasing importance of accurate prediction of multiphase flows and, therefore, the further necessity of detailed experiments, as presented by Hetsroni et al., and of efficient numerical codes to simulate 3-D unsteady multiphase flows, as shown by Zaleski. Due to the complexity of these flows there is still a need for research in many

fields like modeling of free surfaces with phase transition or modeling of turbulent flows with bubbles and drops. The complete program of the GAMM'97 and especially of Session No. 12 is available on the Internet using the following address: [http://www.uni-regensburg.de/Fakultaeten/nat\\_Fak\\_I/Mennicken/gamm.html](http://www.uni-regensburg.de/Fakultaeten/nat_Fak_I/Mennicken/gamm.html)

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## Report on the Convective Flow and Pool Boiling Conference

May 18-23, 1997, Irsee, Germany

by Gian Piero Celata and Paolo Di Marco

The International Conference on Convective Flow and Pool Boiling was held at Irsee, Bavaria, during 18-23 May 1997, organized by the Engineering Foundation and the Technical University of Munich. It was attended by about 70 people, and 52 papers have been presented, besides 5 keynote lectures. The Conference, which followed two previous Conferences held at Santa Barbara (Pool and External Flow Boiling, March 1992) and at Banff (Convective Flow Boiling, May 1995), confirmed the high level of the papers given at this conference series. This is also thanks to the interesting format of the Engineering Foundation Conferences, where the main target is a specific topic (boiling in the present case) which attracts the interest of the best experts of the international community. Being in a topical conference, discussion is possible in a very high level scientific forum, both during the technical sessions and the social hours. As most of the international experts in boiling were present (with few, but significant exceptions from Japan and USA), the level of the debate on the presentations has been very high.

The five keynote lectures gave the state-of-the-art review on hot topics in boiling, and dealt with: i) heat transfer in binary mixture boiling (Gorenflo, Paderborn University, Germany); ii) enhancement of boiling heat transfer (Bergles, RPI, USA); iii) molten metals/water explosions (Hughes, Surrey University, UK); iv) industrial applications and R&D in evaporators and reboilers (Wadekar, HTFS, UK) v) modeling of CHF in subcooled flow boiling (Celata, ENEA, Italy).

The contributed papers were presented in 11 sessions facing with the most relevant aspects of boiling phenomena in convective and pool boiling, and their applications. Some fundamental aspects of boiling have a common denominator in both the heat transfer configurations. In particular, the technical sessions referred to: pool boiling, nucleate boiling, subcooled boiling,

boiling in transients, heat transfer in convective flow boiling, modeling of boiling, formation and dynamics of bubbles, flow structure and regimes, critical heat flux and post-dryout heat transfer, special phenomena in boiling, heat exchangers and industrial applications. Without making a list of the most significant papers, it is worthwhile mentioning here some general topics widely reported in the presentations and debated during the discussion. Many participants have pointed out the role played by sliding bubbles in nucleate boiling, and the agreement on the importance of such a mechanism is almost unanimous. Similarly, the modeling of the nucleation phenomenon can no longer be treated, unless very special cases, without taking into account the wall thermal transient. Finally, much time has been dedicated to the discussion about the so called 'secondary nucleation' in flow boiling heat transfer. In spite of the discussion, no experimental evidence of it has been found so far. New and/or improved experimental techniques have been presented, with the aim of getting more and more detailed information on boiling local phenomena (probes development, image processing, etc.). Special care has been also taken at the production of experimental data on the thermal-fluid dynamic performances of new refrigerants. A selection of papers, after a review process, will be published in a bound volume. The next Conference will be held in March 2000 in the US (place to be decided).

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**The second Israel Conference for Conveying and Handling of  
Particulate Solids  
May 26-28, 1997, Jerusalem, Israel**

by Gabriel I. Tardos

The conference took place at the International Convention Center in Jerusalem, Israel on May 26-28, 1997. The conference was organized by Dr. Haim Kalman, Senior Lecturer in the Department of Mechanical Engineering at the Ben-Gurion University of the Negev helped by an Israeli based Organizing Committee and by an International Advisory Board with six members from five countries. An exhibition featuring Powder Technology instrumentation and equipment with thirteen exhibitors accompanied the conference. The main sponsors included the three major technical universities in Israel, Ben-Gurion University of the Negev, Technion-Israel Institute of Technology and Tel-Aviv University and twelve private corporations.

The conference had more than 230 participants with 90 outside of Israel representing 24 countries. A total of 16 invited lectures, 90 technical oral presentations and 17 technical posters were presented during the three days of the conference. There were four plenary sessions, 25 technical and two poster sessions. In addition, a workshop on education in the field of Powder Science and Technology was also held during which nine oral presentations were made on the subject. The proceedings of the conference were edited by Dr. H. Kalman and contain about 700 pages with 104 full papers and eight extended abstracts. Interested persons can obtain a copy of the proceedings or only individual papers by requesting them directly from the editor at E-mail Kalman@menix.bgu.ac.il or by Fax: (972)-7-647-2990.

The conference was opened by a plenary session in which Dr. R. Davies from E.I. du Pont de Nemours and Co., USA, presented a thought provoking lecture on "There is Hope for Solids Processing".

Individual Sessions were dedicated to all the important topics in Powder Science and Technology such as Powder Processing, Particle Characterization, Particle Breakage and Comminution, Mechanical and Pneumatic Conveying, Mixing and Segregation, Powder Storage, Size Enlargement and Agglomeration, Slurry Transport, Classification, Separation and Dust Control, and Drying. Each topic was then covered by an invited plenary speaker and several review and re-

search papers. These topics are also reflected in the chapters of the proceedings. There were four parallel running sessions of 90 minutes each during all three days of the conference with poster sessions organized during days two and three.

These are some excerpts of comments by I. C. Kemp of AEA Technology, UUK addressed to Dr. Haim Kalman, that largely represent the impressions of most participants: " As for the conference itself, I thought it was excellent and I got much more out of it than I normally do from a conference. The main reason for this was the excellent set of plenary lectures. I found that this helped me to find out a lot more about other subjects which are related to my own but which I do not normally have a chance to her about. In some ways it was more like a multi-disciplinary course than a research conference. In my opinion this makes it much more useful to industrial delegates than most other conferences, and I would recommend it to engineers involved either in industry or academia. The most valuable thing I found was that, in an age where we are increasingly specialized, this gave me the vital information I needed to know about related technologies... such as solids handling, conveying, agglomeration and attrition. I think there is an increasing need for engineers to be generalists as well as specialists. I hope that you will organize a similar conference again at some stage in the future. As mentioned above, I strongly support your format of extended-length plenary lectures. The evening meals and activities were all most enjoyable. Finally, you might consider renaming it the 3rd International conference ... the title "Israel conference" gives the slightly misleading impression that it is aimed mainly at a local audience and not at international delegates. However, the content and the organization were up to the highest international standards. Congratulations on your achievement."

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**Report on CHT'97**  
**International Symposium on Advances in Heat Transfer**  
**May 26-30 , 1997, Cesme, Turkey**

by Graham de Vahl Davis

About 120 participants attended CHT'97, held in the beautiful Golden Dolphin Holiday Village in Cesme, on Turkey's Aegean coast. The meeting was organised by the International Centre for Heat and Mass Transfer.

The Secretary-General of ICHMT is Professor Faruk Arinc, METU, Ankara, Turkey (fax: +90 312 210 1331).

A total of 100 contributed oral and poster presentations covered all aspects of the topic, including natural convection, forced convection, radiation, computational and mathematical methods, applications, solidification and melting, two phase flow, combustion, porous media, heat exchangers, turbulence modelling and code validation.

In addition, eight invited keynote lectures were given:

Pinhas Bar-Yoseph, Technion, Israel Institute of Technology, Israel  
"Novel Spectral and Finite Element Methods for Unsteady Heat Transfer Problems"

Selcuk Guceri, University of Illinois at Chicago, USA  
"The Role of Computational Research in Materials Processing"

Yogesh Jaluria, Rutgers University, USA  
"Transport Processes in Polymer Extrusion and Optical Fiber Drawing"

Tomasz Kowalewski, Polish Academy of Sciences, Poland  
"Experimental Validation of Numerical Codes

in Thermally Driven Flows"

Mikhail Mikhailov, Universite Federal de Rio de Janeiro, Brazil  
"Computational Heat Transfer with Mathematica"

George Raithby, University of Waterloo, Canada  
"Computational Radiation Using the Finite Volume Method"

Ramesh Shah, University of Kentucky, USA  
"Numerical Analysis of Compact Heat Exchanger Surfaces"

Tien-Mo Shih and W.J. Minkowycz, University Maryland and University of Illinois at Chicago (respectively), USA  
"Numerical Heat Transfer Modules on Internet"

The proceedings are to be published by Begell House, Inc.

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Please address information on multiphase flow researches and researchers to the Editor. Also, please invite colleagues working on multiphase flow in your country to join ICeM.

**The second International Topical Meeting on Advanced Reactor Safety (ARS'97)  
June 1-5, 1997, Orlando, USA**

by Francesco Oriolo

The second International Topical Meeting on Advanced Reactor Safety (ARS'97) was held on 1-5 June 1997 at Marriott's Orlando World Center, located just minutes from Central Florida's famous attractions. ARS'97 was the second in a series of International topical meeting sponsored by the Nuclear Installation Safety Division (NISD) of the American Nuclear Society (ANS). It was cosponsored by Atomic Energy Society of Japan, Canadian Nuclear Society, Korea Nuclear Society, European Nuclear Society, U.S. Department of Energy, Organization of Economic Cooperation and Development (OECD), and International Atomic Energy Agency (IAEA). Alvin Weinberg was the Honorary Chairman of the meeting, Mario Fontana, US NRC, and George Flanagan, Oak Ridge National Laboratory (ORNL) were General Chairmen; Rusi Taleyarkham of ORNL was the Technical Program Chairman. The objective of the Meeting was to provide a international forum communication and information exchange in the field of the safety of fast and thermal reactors, as well as other types of advanced reactors. In particular we have discussed the safety-related design, operational and accident aspects of advanced reactors and facilities and also the safety issue of advance research/test reactors and accelerator-based nuclear systems. The Meeting was developed in a very successful way, to favor the exchange of up-to-date Scientific experience. The social program included the very interesting visits to the St. Lucia Nuclear Power Plant, situated on the scenic Hutchinson Island and to the Kennedy Space Center and, for the guests, interesting amusement such as Sea World. More than 160 full papers, after an international review process, were presented on various aspects of advanced reactor safety and many of them are of archival quality, which will be published in a special edition of Nuclear Safety Journal. Additional papers have also been invited and presented during the plenary sessions and panel discussion. The great

success of this Meeting can be evaluated with a statistic: the number of the papers has increased about by 30 percent over the number of papers received for the previous ARS'94, with 70 percent of papers from outside USA. Three countries like Japan, Russia and South Korea have been present with more than 13 percent, France and Germany with 10 percent, Italy with about 8 percent and also a representative from Canada, England, India, IAEA, Slovene, Sweden and Switzerland. Russian participation has been favored by US Department of Energy, with the aim to increase the international cooperation, to encourage the scientific information exchange and the effective research coordination to meet the challenge of 21st Century. The papers were classified into 16 different topical areas, covering 22 sessions:

- Advanced Nuclear System with Perspectives on Safety (5 invited papers) · Advanced/Novel Concepts (13 papers)
- Advanced Reactor Severe Accident Issue and Research (26 papers) · Passive Systems (12 papers)
- Advanced Reactor Regulation / Regulatory Research / Licensing (7 papers)
- General Interest/Overview Issues (7 papers)
- Safety and Economic Considerations (7 papers)
- Steam Explosion Research and Issues (12 papers)
- Advanced in Research/Test Reactor Safety (8 papers) · Advanced Reactor Accident Management and Emergency Actions (7 papers)
- Advanced Reactor Instrumentation, Control and Human Factor (15 papers)
- Probabilistic Risk / Safety and Reliability Assessment (8 papers)
- Advanced Reactor Thermal Hydraulics (18 papers)
- Accelerator Driven Source Safety (8 papers)
- Liquid-Metal Reactor Safety (8 papers)
- Structural Assessment and Issue (5 papers)

Information on The Japan Society of Multiphase Flow (JSMF) and on The International Information Center for Multiphase Flow (ICeM) available on:

JSMF: <http://www.ijnet.or.jp/JSMF>

ICeM: <http://www.kz.tsukuba.ac.jp/~monji/> (tentative)

The ARS'97 Meeting has given a great emphasis to the plenary sessions, with the aim of focusing on the partnership among universities, industry, utilities, national and international laboratories and regulation leaders, addressing the issues related to the continued development of nuclear science and technology in the world.

These general discussions have allowed to overview the research developed in the last years of nuclear plant stagnation. Much of this research has been devoted to make advanced nuclear systems simpler and more reliable and to incorporate enhanced robustness from the severe accident challenge. The three plenary sessions consist of an invited paper session and two panel sessions on the following topics:

- I) Advanced Nuclear Systems with Perspectives on Safety  
Chair.: R. Taleyarkhan (ORNL, USA);  
Speakers: H. Bruschi (Westinghouse, USA), F. Buitielle (NPI, France), S.Y. Kim (KAERI, Korea), H. H. Hennies (FzK, Germany), B. Roche (EdF, France), K. Tomono (TEPCO, Japan), Woodrow (GE, USA), Thadai (NRC, USA).
- II) Role of Passive Systems in Safety Enhancements of Advanced Nuclear Systems  
Chair.: T. Kress (ACRS, USA);  
Panelists: C.S. Kang (Seoul Univ., Korea), S. Yokobori (Toshiba, Japan), J. Kudrick (NRC, USA), J. H. Thomson (DOE, USA).
- III) Role of Economics and Regulatory Aspects in Safety Decision of Advanced Nuclear Plants  
Chair.: R. Matzie (ABB Ce);  
Panelists: C.W. Bagnal (ABB Ce), A. Carnino (IAEA, Austria), R.L. Simard (NEI, USA), M. Vidard (EdF, France), W.H. Yoon (KINS, Korea).

During the first plenary session panelists have presented the design of four advanced nuclear power plants (ABWR, AP600, EPR and KNGR), the new goals of the design certification and also the last research and development of nuclear technology. In particular, the better acquaintance with the core meltdown phenomena made it possible to consider mitigative features for severe accidents, including core melt sequences, already during the plant design. The consequence is the further reduction of the core melt probability and the improvement of confinement function of containment under severe accident scenario. The Advanced Boiling Water Reactor (ABWR) has received the final design approval from US NRC. Two "first-of-a-kind" 1356 MWe units are in operation in Japan, after a 40 months construction period by an international consortium (GE, Toshiba and Hitachi). But a 1500/1700 MWe "Next generation"

ABWR design is in its final Phase III of "Entire Plant Concept", having the following goals of economics, user-friendliness and safety. The price for the two actual ABWR plants is 290000 Yen/kW and a reduction to 250000 Yen/kW is the main goal of the next generation project. About the design features, the large fuel bundle, the reduction in the refueling time and the use of active plus passive containment cooling systems have to be highlighted.

The Westinghouse AP600 is a 600 MWe pressurized reactor, which utilizes passive safety features that, once actuated, depend only on the natural circulation phenomena to perform all the required safety functions. These passive safety features result in an increased plant safety and can also significantly simplify plant systems, equipment and operation. AP600 is currently being reviewed by NRC and is scheduled to receive its final design approval in early 1998. This plant can compete with the largest plants now being designed, whether nuclear or coals. AP600 characteristics are "safety through simplicity" and a three-year timetable for construction. The plant is designed to have a shorter construction schedule through the use of modular construction techniques and also to technically support the elimination of the emergency planning zone beyond the site boundary.

The basic design of the European Pressurized Water Reactor (EPR) is completed, having provided all information necessary for the evaluation of a "site independent" preliminary safety analysis report and by providing bill of quantities for a reliable cost calculation. EPR unit size has been selected to be 1500 MWe with an average batch burnup of 60 MWd/kg, in order to draw profit from the economy of the scale effects, so that the specific investment costs remain in the range of current plants. The Korean Next Generation Reactor (KNGR) is being developed as an evolutionary plant under the sponsorship of the Korean government and electric power corporation KEPCO to meet the electricity requirements in the early part of the 21st century. Its design is based on the successful experience with the Korean Standard Nuclear Plant design. For the primary design requirements, an evolutionary type PWR with a capacity of 4000 MWt and a 60 year design life has been selected. A double, cylindrical and concrete containment design as been selected, taking into account the consequences of severe accidents. The economic goal of the KNGR is to accomplish a cost advantaged over coal power generation by at least 20%. Prevention and mitigation of severe accidents will be achieved by the design of enhanced safety systems, provisions for safety depressurization systems and mitigation facilities such as hydrogen mitigation and cavity flooding systems.

During the plenary sessions the utility point of view can be synthesized as in the following:

after TMI, they have improved, at same time, the economy and the safety of their existing nuclear power plants and, at the present, there have relatively low age plants and low growth rate of the electrical consumption in a situation of large deregulation on the electricity market in the western world. This situation leads to the paradox that the future of the nuclear power is the management of the existing plants during the first decade of the next century. The situation is quite different for the Asiatic Pacific Region, where new nuclear orders have been placed for many years and planned for the foreseeable future. On the other hand, for the existing plants, the importance of the investment in the kWh cost breakdown is lower than for new nuclear power plants, because the existing units are very competitive against any other kind of thermal power plants. The financial effect increases year after year but it could be limited by the dramatic decrease of the price of fossil fuels that reduced the financial advantage of the nuclear power increasing the competition between nuclear and fossil. During the plenary debate the two main reasons for the decrease of the nuclear power in the western world are usually put forward: the current price of the alternative means for the electric power generation and the political climate, which tends to be antinuclear after the bad influence for the public acceptance due to the Chernobyl accident. The first of these reasons is found in the low price of the natural gas, which is the preferred fuel for the recent power generation additions. These additions have principally been used as peaking units, which are required only during the highest demand periods and not as base load units. The second reason derives from some bad experiences in the post-TMI era, when projects experienced a rapidly changing regulatory environment, a long schedule stretch-outs, and huge cost overruns. In spite of this relatively poor environment for new nuclear power plants, the major programs to develop advanced light water reactors continue to keep the nuclear option alive. These advanced designs are aimed at capturing the lesson from the past experience and to ensure

the success for the future projects. The main question to which the discussion has tried to give an answer has been: will these changes in the design, construction and operation of nuclear power plants be sufficient to make them economically competitive? The answer given has pointed out the major economic factors that contribute to reduce the capital, operation and maintenance costs for the future nuclear power plants. The new plants can be competitive with other sources of electrical power at the following conditions: they must have a large plant output, be constructed over a short time period (on the order of three or four years), be of standardized designs which can be pre-licensed, and achieve a high availability through the use of longer operating cycles and shorter refueling outages.

The approach of developing advanced nuclear systems is with the continuing goals of enhanced safety and better economics. The safety enhancements can be achieved by employing passive safety features, without a too high economic cost to get a better economics. To conclude, the new power generation plants must improve, at the same time, economy and safety, with more simplified, more economics and safer nuclear reactors.

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## Report on the 4th World Conference on Experimental Heat Transfer, Fluid Mechanics and Thermodynamics

June 2-6, 1997, Bruxelles, Belgium

by Gian Piero Celata and Paolo Di Marco

The 4th World Conference on Experimental Heat Transfer, Fluid Mechanics and Thermodynamics was held at Bruxelles, during 2-6 June 1997, organized by the Universite Catholique de Louvain-la-Neuve and by the Assembly of World Conferences.

The Conference has been organized in 24 technical sessions dealing with almost all the aspects of thermal-fluid-dynamics, plus two Symposia, the Symposium on Annular and Dispersed Two-Phase Flow and the Symposium on Combustion in Engines and Industrial Systems, for a total of 326 papers, with more than 370 participants from about 35 countries. Among the presentations at the Conference, we find 8 keynote lectures and 26 invited lectures.

In particular, among the topics treated at the Conference we can find: measurement techniques (velocity, temperature, and void fraction), industrial applications (process, heat transfer, energy systems, thermal-fluid dynamics), heat transfer in two-phase flow (boiling, nuclear reactor thermal-hydraulics, CHF, flow patterns, bubble dynamics, two-phase flow), fluid dynamics (turbulence and boundary layers, unstable flows and transients, rotating flows, external flows, single-phase flow in pipes and channels, critical flows, jets), heat transfer (heat transfer enhancement, solidification, radiation, heat exchangers, convective flow, fluidized beds and porous media, refrigeration).

Although the six parallel oral sessions reduced the possibility to follow many of the papers presented at the Conference, the large participation (25% from Japan) enabled attendees to meet the more outstanding experts in the field.

The eight keynote lectures, in plenary session, have dealt with topics of relevance for the thermal-fluid dynamic research, and have been given by outstanding personalities: thermographic measurements in turbulent boundary layers (G. Hetsroni), infrared thermography in convective heat transfer (G. Carlomagno), turbulent flow modeling in engines (R. Borghi), theory and application of the autopropagative synthesis of refractive materials (A. Merzhanov), measurement techniques in fluidized beds (J. Werther), three-phase flow in vertical channels (T. Sakaguchi), annular gas-liquid flow (T. Hanratty), transport phenomena in multicomponent materials solidification (F. Incropera).

The 26 invited lectures have been presented in the frame of the parallel sessions, and dealt with the topic of the specific session. Although it

is not simple to report briefly the most significant breakthroughs presented at the Conference, it is nonetheless worth spending few words about very interesting papers. Among the measurement techniques we can acknowledge interesting developments in e neutron radiography and the x tomography for void fraction measurements and flow pattern identification, together with applications of holographic interferometry and liquid crystals for temperature measurements. Boiling and CHF sessions have been particularly rich, either for pool boiling and convective flow, with special attention to refrigerant mixtures and high heat fluxes.

A special mentioning has to be made for flow pattern identification and bubble dynamics. They have been discussed in many papers, using non-intrusive techniques (optical techniques, capacitance probes) and intrusive techniques (optical probes).

Another interesting topic, also for its possible industrial applications, was the heat transfer enhancement. Active techniques (electric fields) and passive devices (swirl flow, finned surfaces) have been presented. Statistically, 86 papers came from Japan, 41 from Russia (but only 40% of them were presented), 33 from Belgium (the hosting country), 28 from Germany, 23 from Italy, 21 from the USA, 16 from France, etc. It is clear the supremacy of Japan in investments in heat transfer research. The next Conference will be held in 2001, in Europe, and the chair has been assigned by the Assembly of World Conferences to Dr. G.P. Celata. During the Conference, the Nusselt-Reynolds Prize has been presented to Prof. G. F. Hewitt and Prof. J. Whitelaw.

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**Report on the 35th edition of the European Two-Phase Flow Group Meeting Bruxelles  
6-7 June 1997**

by Gian Piero Celata and Paolo Di Marco

The 35th edition of the European Two-Phase Flow Group Meeting has been organized by the Universite Catholique de Louvain-la-Neuve, in Bruxelles, 6-7 June 1997. The meeting was held soon after the 4th World Conference on Experimental Heat Transfer, Fluid Mechanics, and Thermodynamics, held in Bruxelles from 2 to 6 June. As many two-phase flow aspects have been presented at the World Conference, including a Symposium on Two-Phase Annular and Dispersed Flow, the 1997 ETPFGM Meeting has been organized in a contracted format (one and a half day), but 25 papers have been presented and it was attended by 52 delegates.

Such an organization enhanced the special features of this 'meeting', which are informality and friendly atmosphere. Many research papers have been presented as 'progress reports', opening fruitful discussions about the research work, its possible evolution' and new ideas. As is known, in large international conferences, papers have to be submitted between 6 and 10 month ahead the conference dates, and this makes the possibility of reorienting the research work very difficult. Among the papers presented in 5 technical sessions, such as measurement techniques and transient, two-phase flow applications, heat transfer and CHF, two-phase critical flows, flow structure, it is worthwhile mentioning here few general topics treated at the meeting. They are: i) impedance probe for falling film measurements; ii) flashing of binary mixtures due to fast depressurization, which, in addition to thermal non-

equilibrium, must take into account mass diffusivity, typical of multicomponent mixture boiling; iii) sizing of two-phase flow safety valves; iv) visualization of burnout; v) pool boiling in microgravity with EHD; and vi) droplet evaporation.

The next meeting of the European Two-Phase Flow Group will be held at Portoroz, organized by the University of Ljubljana. This will be a special European-Japanese Meeting, as it will be open to a large delegation from Japan (about 20 people). The opportunity is connected to the 3rd ICMF to be held in Lyon early in June, where it is expected a large participation from Japan.

The next Meeting is therefore looked as a special event, in view of the high level of the multiphase flow research in Japan.

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**All Correspondence Concerning**

News items of general interest to ICM members, notice of future meetings and conferences, personal news items, new books, etc. should be addressed to the editor or to regional corresponding members. It will be very helpful if any manuscripts proposed for publication are sent by E-mail or if diskettes are also attached to the manuscripts.

**Report "ITEEC 97, 3rd International Thermal Energy & Environment Congress:  
Environment symposium"  
June 9 - 12 , 1997 , Marrakech - Morocco**

by M. Mansour

The third International Thermal Energy and Environment Congress (ITEEC 97) was hosted by the university Cadi-Ayyad, Faculty of Science Semlalia in Marrakech and organised by Prof. A. Mir, Ecole Superieure de Technologie, Agadir, Morocco. There were participants from France, Spain, Germany, Belgium, United Kingdom, Italy, Greece, Poland, Russia, Korea, Thailand, Japan, Slovakia, Brazil, USA, Canada, Syria, Egypt, Palestine, Libya, Tunisia , Morocco, and Jordan. The papers presented covered the following areas:

a) Session on Environment b) Session on Natural convention d) Session New Energy Technologies d) Session of Heat Mass Transfer and Energy Systems. The topic that attracted most participants at this symposium and evoked a lot of discussions was the complexity of new technology and environment. The plenary and invited lecturers ranged over a wide area : Theoretical Chemistry and Physics Thermal Energy and Transfer, Chemistry in the Solid State, Aquatic Photochemistry, Analysis of Air in Indoor and Outdoor and in Buildings, Heat pumps, Solar Energy, Transfer in Heterogeneous Porous Media, Photovoltaic System and Sea water Desalination. Thus in addition to mathematical, physical modelling, the meeting included experts in different disciplines with a wide representation across the world and including researchers from universities, research institutes and industrial laboratories. During the sessions, delegates asked to focus on the future rather than emphasize past research contributions. The conference showed that in various types of thermal energy and environment many

processes of new energy technologies for the protection of environment are of great importance and that significant progress has been made in the quantitative and qualitative analysis mechanism of these processes. The general opinion favoured good quality research and especially growing exchange with centers in Europe, America, Asia and Africa to make up for the lack of infrastructure in the region. The meeting allowed all participants to learn about various interesting thermal energy and environment researches in progress in different participating countries and to enjoy some famous and beautiful spots in Marrakech ( Jamaa El fna , Koutoubia, Ourika , ..... ) The purpose of the meeting was to bring together researchers and scientists who are active in different branches of thermal energy and environment and favour the exchange of ideas and suggestions. Original contributions in form of 10 invited lecturers, 44 communications and 99 posters have been presented and covered different fields of research on thermal energy and environment. Finally , as the chairman of the environment session, I would like to thank the authors and the organizing committee for their helpful co-operation.

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**Report on Sixth International Symposium on Gas-Liquid Two-Phase Flows,  
held at the ASME Fluids Engineering Division Conference,  
June 22-26, 1997, Vancouver, Canada**

by Timothy J. O'Hern

This Symposium was sponsored by the Multiphase Flow Technical Committee of the ASME Fluids Engineering Division. The organizers were T. J. O'Hern, Sandia National Laboratories, USA; J. Bataille, University of Lyon, France; U. S. Rohatgi, Brookhaven National Laboratory, USA; M. Shoukri, McMaster University, Canada; J. Navickas, McDonnell Douglas Aerospace, USA; and I. Celik, West Virginia University, USA.

Gas-liquid two-phase flows appear in many engineering systems covering a wide range of applications: boilers and condensers, chemical process plants, nuclear reactors, electronic equipment cooling, hydrodynamic propulsion, spray systems, and evaporators of refrigeration systems, to name but a few. The purpose of this Symposium is to provide an opportunity for engineers and scientists to meet in technical sessions to present the state-of-the-art, discuss new developments, and exchange ideas in this important area.

The papers in this Symposium deal with some recent developments in the field. The authors of these papers represent numerous technical fields, and countries of residence, while the papers reflect a balance between basic research and practical applications. We are fortunate in having six invited papers as part of this Symposium. These papers, by individuals who have contributed greatly to the field for a number of years, stand as cornerstones to the Symposium. We hope that this volume will contribute to advancing the state-of-the-art knowledge in the field. We hope to stimulate further research in these important areas, and to serve as a timely reference for researchers and practitioners.

The Symposium consisted of 50 papers, including 6 invited keynote papers. The Symposium was divided into the following sessions:

**Bubble columns and vertical flows:**

5 papers, including the invited talk "Fluid Dynamics in Bubble Columns: Measurements and Modeling," by S. B. Kumar, S. Degaleesan, and M. P. Dudukovic. Other topics included measurements in two-phase refrigerant flow (Trabold, Moore, and Morris), bubble characteristics using a conductivity probe (Zhang, Epstein, Grace, and Lim), disturbance wave instability model for annular-to-intermittent transi-

tion (Lim and No), and simulation of void waves in core-void-peaking bubbly flow (Kljcnak).

Bubbly Flows (three sessions, covering flow regimes ranging from bubbly to slug): 16 papers in three sessions, including the invited talks "The Forces Acting Upon Bubbles and Rigid Particles" by J. Magnaudet and "Interfacial Area Measurement and Interfacial Area Transport Equation" by M. Ishii. Other papers covered topics including thermocapillary migration of bubbles in shear flow (Esmaeeli, Tryggvason, and Arpaci), forces on ellipsoidal bubbles in a turbulent shear layer (Ford and Loth), linear stability of parallel two-dimensional shear layers containing vapor-gas bubbles (d'Auria, d'Agostino, and Burzagli), flash X-ray radiography for visualizing gas flows in opaque liquid/fiber suspensions (Heindel and Monefeldt), new structures of Poiseuille bubbly flows due to clustering (Cartellier, Timkin, and Riviere), velocity measurements by comparison of simultaneous hot-film and laser-Doppler anemometer signals (Ellingsen, Risso, Roig, and Suzanne), wakes behind spheroidal bubbles and particles (Lunde and Perkins), oscillations of a gas bubble in a liquid filled flask (Nigmatulin, Akhatov, Vakhitova, and Lahey), bubbly cavitating flows through a converging-diverging nozzle (Wang and Brennen), bubble dispersion in a turbulent boundary layer (Tran-Cong, Marie, and Perkins), bubble motion in a turbulent boundary layer using proper orthogonal decomposition (Joia, Ushijima, and Perkins), combined mass and heat transfer in gas-liquid slug flow (Elperin and Fominikh), gas fraction in slugs in flow with inclination (Nuland, Malvik, Valle, and Hedne), and influences of liquid properties on gas entrainment at the bottom of a fixed bubble (Su and Metcalfe).

Modelling: 4 papers including the invited talk "Three-Fluid Modeling with Dynamic Fragmentation and Coalescence: Fiction or Daily Practice?" by N. Kolev. Also papers on the instability of cylindrical gas jets (Shen and Li), hyperbolic two-fluid models (Gavrilyuk, Gouin, and Perepechko), and plume formation due to gaseous bubble (Khoo, Chong, Yeo, and Png).

Pipe flows: 5 papers including topics such as film distributions in large diameter horizontal pipes (Dykhno and Hanratty), two-phase pressure drop and phase distribution at horizontal tee



junctions (Walters, Soliman, and Sims), prediction of pressure drop and liquid hold-up in horizontal stratified pipe (Wongwisets), flow of a multiphase fluid through piping (Morris, Hourigan, and Thompson), and rising of a thin film on vertical wall due to thermocapillary force (Karibullina, Tazioukov, Garifoullin, and Norden).

Sprays and droplets: 3 papers, including invited talk "Current Research Trends on Droplet and Spray Behavior" by J. Tishkoff. Other papers covered numerical simulations of multi-fluid flows in atomizers (Steinhorsson, Ajmani, Tryggvason, and Benjamin), monodisperse droplet generation by spontaneous condensation of steam flow (Lai, Kadambi, and Rohatgi), and droplet deformation dynamics in convective flow fields (Farshchi and Rahimian).

Industrial Applications: 5 papers, including the invited talk "Two Phase Challenges in Oil and Gas Production" by T. Hill. Other topics included simulation of flow in

gas-liquid cyclone separators (Motta, Erdal, Shirazi, Shoham, and Rhyne), gas entrainment in stratified gas/liquid flow (Lunde), comparison of mixing in fuel-bundle geometries with different coolants (Doerffer and Kiteley), and lateral velocities due to diversion cross-flow and void drift in a two-phase subchannel flow (Sadatomi, Kawahara, and Sato).

Steam-water flows: 4 papers covering the topics of flow regime identification of steam-water flow in a large vertical pipe at elevated pressures (Hasanein, Kawaji, Chan, and Yoshioka), finite element analysis of droplet deposition in a BWR fuel subchannel around spacer using large eddy simulation (Yamamoto, Mitsutake, Hoshide, and Morooka), droplet formation in steam flows (Cinar and Yilbas), and turbulence modelling in steam-water flows (Morel and

Bestion).

Free surface flows: 3 papers covering the onset of splashing from free liquid surfaces exposed to impinging gas jets (Trabold and Obot), conditionally averaged turbulent events under a wavy-sheared interface (Nasr-Esfahany and Kawaji), and experimental simulation of a bow wave (Waniewski, Brennen, and Raichlen).

Microgravity effects: 5 papers, including numerical simulation of slug flow at zero gravity (Mack, Bugg, and Rezkallah), slip ratio in gas-liquid flow at normal and microgravity conditions (Rezkallah and Nakazawa), thermo-fluid-dynamic modeling of a contained liquid in variable heating and acceleration environments (Grayson, Watts, and Jurns), bubble growth and departure from artificial nucleation sites (Mori and Baines), and design of helical coil apparatus for study of two-phase flow in DC-9 microgravity flight tests (Keshock, Lin, and Edwards).

The Proceedings of this Symposium, as with all Symposia and Fora of this ASME Conference, were released on a CD-ROM that each registrant received at the meeting. This Symposium will next be held at the 1999 Fluids Engineering Division meeting, joint with the Japanese Society of Mechanical Engineers, in San Francisco, CA, USA, July 18-23, 1999.

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**Report on the International Conference on Compact Heat Exchangers for the Process Industries**  
**June 22-27, 1997, Snowbird, USA**

by Ramesh K. Shah

The first International Conference on Compact Heat Exchangers for the Process Industries was held during June 22-27, 1997 in Snowbird, Utah. It was sponsored by Engineering Foundation. The conference program included the following: 17 Invited Lectures, 2 Tutorial Lectures, 5 Panel Discussions, and 45 Contributed Papers.

The Conference was the first of its kind and brought together a good mix of participants from industry, universities and government organizations. The conference was attended by 77 participants (41 industrial including industrial research organizations, 28 academic and 8 governmental) from 13 countries. Thus the balance of participants from industry, research organizations and universities was good. A fair mix of CHE users and manufacturer participated actively in the conference; only section of industry that was not represented well was the contracting companies. The focus of this Conference was on a subject very important for the process industries, and the Conference was successful in the sense that we had an excellent industrial participation. The Conference provided an enjoyable backdrop for sharing information both practical and theoretical on CHEs.

**Contents of the Program:**

· Invited lectures on: various forms of commercially available compact heat exchangers, analytical and computational methods for design and rating of CHEs, special areas of interest (and concern) for CHEs such as two-phase applications, fouling, process intensification and process industry experiences, and views on CHEs and not-so-compact HEs.

· Contributed papers: experimental data on thermal hydraulics of CHEs, experimental techniques and uncertainty, heat transfer enhancement, design theory and numerical methods, two-phase flow and heat transfer, commercially available techniques for fouling mitigation, and many papers on specific applications. The contributed papers were generally well received and led to many useful discussions. Some too theoretical papers were not well received.

**Content and Outcome of the Panel Discussions:** see the following pages for the details.

There was a general feeling that some presentation of CHE software would have been useful. However, this is a tricky issue and there is a dan-

ger that it may degenerate into sales demos.

Because of the specific format of the Engineering Foundation Conferences, the conference atmosphere provided an excellent opportunities for networking and informal discussions among the participants since most of the participants were together daily through three meals and up to 10:30 PM for four days.

Conference Proceedings, which includes most of the invited and contributed papers (totaling 59 papers and 598 pages), were distributed at the Conference, and are now also available for others from the publisher: Begell House, Inc., 79 Madison Avenue, Suite 1205, New York, NY 10016, USA. Tel: 212-725-1999; Fax: 212-213-8368; E-mail: begellhouse@worldnet.att.net. Price: US \$97.50 + \$10 shipping in the USA, and \$13 shipping outside; prepayment required.

Next Conference: Based on the enthusiasm and the response from the participants, it has been decided that we will have the next conference within a 2-3 year time frame. Tentatively, the subject will be Compact Heat Exchangers and Heat Transfer Enhancement for the Process Industries since both technologies are closely linked. Exchanger selection by industry is based on the considerations of cost, reliability and safety, and not only by type, and the participants will be able to compare and contrast both technologies. Your suggestions on improving the next conference are most welcome.

**Summary Comments on the Panel Discussions at the International Conference on "Compact Heat Exchangers for the Process Industries"**

Snowbird, Utah, June 22-27, 1997

**Introduction**

Five panel discussions were held during the Engineering Foundation International Conference on "Compact Heat Exchangers for the Process Industries." These discussions were respectively entitled "Applications of CHEs by the Users," chaired by Dr. Peter Hills (June 23); "Barriers and Concerns on the Use of CHEs in the Process Industries," chaired by Dr. Tom Rudy (June 24); "Research Needs by Users, Manufacturers and Contractors," chaired by Mr. Nick Johnston (June 25); "Removing the Barriers for the Use of the CHEs," chaired by Dr. Ken Bell (June 26), and "Prioritizing the Efforts to Remove the Bar-

riers," chaired by Dr. Bell (June 27). This is a brief summary of the discussions and the views set forth by the participants.

#### Applications of CHEs by the Users

The session began with the Chairman adding several examples to his earlier presentation of successful and unsuccessful attempts to introduce CHEs into ICI,s process plants. No detailed notes were made of this session, but there was a wide-ranging discussion on these cases which led into the introduction of several other case studies from the floor, mainly from manufacturers. Several of the comments concerned barriers to the use of CHEs, a subject pursued in more detail in the subsequent panel discussions.

#### Barriers and Concerns on the Use of CHEs in the Process Industries

For this session, the Chairman elicited contributions from the entire audience in the form of "I wish  $\Sigma$ " and "How to  $\Sigma$ " statements. At the end of the session, each participant was allowed to vote on only three statements of the greatest significance to removal or reduction of the barriers facing the greater applications of CHEs in the process industries. These comments were summarized by Dr. Rudy and categorized by Dr. Shah into a small number of major categories. These results are attached to this summary as Appendix I. The greatest perceived need (36 votes out of 85 total) was the provision of a database of suppliers, applications, experiences, and configuration data. Second was the availability of software so that the potential user could compare and validate designs. Third was a means of overcoming psychological barriers to using CHEs. The next items (8 votes each) called for a "Consortium of Manufacturers, Suppliers, Customers" (which would seem to be very closely related to the first three wishes) and better education of engineering students about CHEs. Remarkably, only 3 votes were received for topics related to fouling and maintenance; this topic reappears in the last panel discussion.

#### Research Needs by Manufacturers, Users and Research Organizations

The Chairman of this Panel divided the audience into three groups - Research Organizations, Manufacturers, and Users. Each of these groups then proceeded to prioritize the research needs as the members of each group saw them. The results of this survey were organized by Dr. Tom Rudy and are attached as Appendix II of this summary. There is a clear correlation between the identified needs and the corporate goals of each group, but there is also obvious cross-linking, e.g., the sup-

port for field testing among the Research Organizations and for fundamental thermal-hydraulic studies from the Users. Interestingly enough, all groups identify fouling research as one of the needs, even though fouling did not score very high on the "Barriers and Concerns" list. Overall, the coherence between the three lists of R&D Needs is striking. The Research Organizations, not surprisingly, put their finger on the critical issue: Research costs money - where is the money to come from?

#### Removing the Barriers

The Chairman of this Panel started with the list of the barriers arrived in a previous panel discussion. Some specific outcome of this panel discussion organized by Dr. R. Shah is presented in Appendix III.

#### Prioritizing the Efforts to Remove the Barriers

Through the week of the Conference, the Chairman of this Panel Discussion received many comments to the effect of "I suppose that we will come up with a list of priorities for future work that will give us all a warm fuzzy feeling that we have done something important, and then we will go home and forget about it." The Chairman can identify with this expectation and indeed has often indulged in it. But that is not quite the whole story. The fact is that every participant in the Conference arrived with a set of priorities concerning the subject of the Conference, and each left with a set of priorities that, in the mind of that participant, will maximally advance his personal and corporate interests. No list of priorities arrived at in a last-minute session just before everyone leaves for the airport (or otherwise to get on with their lives) is likely to impact the actions of any single person at the Conference. What does matter is the information that was acquired at the Conference from all the forms of input, and the effect of that information in altering and hopefully strengthening those priorities and the will to act upon them. The outcome of the sum of the actions based on these priorities determines what the compact heat exchanger field will be like in the future.

The Chairman also took the liberty of suggesting that there was regrettably little material offered at the Conference in three major problem areas: Fouling, flow maldistribution, and maintenance. In thumbnail sketches, one can summarize the problems as follows:

- Fouling: Depending upon the type of fouling, fouling is either a very good reason for choosing a compact heat exchanger or a very good reason for rejecting a compact heat exchanger. Also we need to consider the interaction

of the fouling removal devices as part of the system with the exchanger or differentiate between the type of fouling ^ fouling that comes with the system versus fouling that forms in the exchanger; a combination of filtering with the exchanger may a valuable solution for some applications. Thus we need better understanding of the mechanisms of fouling formation and removal in order to make the right decision in each case.

· Flow maldistribution: The much-publicized ability of CHEs to work to very close temperature approaches requires very nearly perfect flow distribution among multitudinous parallel channels, each of which has very nearly identical dimensions. Little was offered to put either of these on a confident quantitative basis or to offer tools for evaluating the consequences of non-ideal distributions. (The work of Professor Roetzel and his students is very interesting in this regard and brings to bear a technique not much employed in heat exchanger analysis (though well known in chemical reactor analysis)).

· Maintenance: A major center of opposition to the use of certain kinds of CHEs in process plants is the Maintenance Department. While this may be a misperception, it is one that must be addressed in the practical terms that maintenance people demand.

The reports of the second and third Panel Discussions were then put on the overhead screen and briefly reviewed, and the floor was opened for discussion. There was evidently general agreement (or at least acquiescence) with the recommendations and conclusions offered. There was regret expressed that there were not more process companies represented at the Confer-

ence, and there was an opinion offered that there were too many papers presented, resulting in too little time for informal discussion of more general interest. Several attendees pointed out that getting approval to attend these Conferences usually depends upon presenting a paper, participating in a panel discussion or chairing a panel/session, accounting for both of the problems identified.

Also at the end, a brief discussion was held on how to improve the next conference based on the experience of this conference. A short list of suggestions are included in Appendix V.

Following information is omitted.

Appendix I- Barriers and Concerns on the Use of CHEs  
Appendix II- Research Needs by Manufacturers, Users and Research Organizations  
Appendix III- Removing Barriers  
Appendix IV- suggestions on the Next Conference  
Appendix V - A List of Heat Exchanger Software

Further communication can be obtained from:

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#### **Executive Committee of The Japan Society of Multiphase Flow(1997-1998)**

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**ILASS-Europe - 13th Annual Conference on Liquid Atomization and Spray Systems  
July 9-11, 1997, Florence, Italy**

by Joachen Domnick

From July 9 to 11 the 13th Annual Scientific Conference of ILASS-Europe was held in Florence, Italy. For the first time, the ILASS-Europe meeting was composed of different dedicated topical sessions, including Diesel injection, cryogenic droplets and sprays, atomizer design and technology, spray impact on walls and films, gas turbine applications and fundamentals of liquid atomization. Each day started with a plenary lecture, given by well recognized experts in the field:

Role Models - M.F. Russel, Lucas Diesel System Diesel Spray Modelling - A Review, D. Gosman, Imperial College Experimental Aspects of Spray Impact on Walls and Films - F. Obermeier, Universitaet Freiberg

A total number of 66 oral papers and 6 posters were presented in two parallel sessions. 105 participants were registered from more than 10 countries from Europe, Israel and overseas. The conference took place in a stimulating atmo-

sphere in a Hotel nicely located close to downtown Florence, perfectly organized by Dr. M. Graziadio of ENEL-CRTN, Pisa. All participants expressed their gratitude to Dr. M Graziadio and his co-workers for their efforts in organizing an outstanding ILASS-Europe meeting.

Those who are interested in receiving full size paper proceedings from the conference should contact Dr. M. Graziadio, ENEL-Centro di Ricerca Termica, Via A. Pisano, 120, 56122 Pisa, IT, Tel. +39 50 535621, Fax. +39 50 535521.

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**A Note from the Editor**

Members, who have paid the membership fee but did not send their Biographical Questionnaire, please send the Questionnaire to the Editor as soon as possible.

Members, who have sent the Biographical Questionnaire but did not pay the membership fee, should pay the fee to ICeM.

The annual membership fee is ¥3,500 (Japanese yen) (¥1,500 for members of the Japan Society of Multiphase Flow (JSMF) ); the fee for 3 years(1997-1999) is ¥10,000.

Please send your remittance to the Editor in one of the following ways.

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- ICeM will send the membership card and the receipt of membership fee for those who pays the fee.
- The ICeM Newsletter is published twice a year and the next issue will be published in April 1998.
- Space may be bought in the Newsletter for advertisements. Please contact the Editor for details and rates.
- Any questions/comments are also welcome.

**Report on Thermal Spray Processing of Nanoscale Materials  
August 3-8, 1997, Davos, Switzerland.**

by Enrique J. Lavernia

Thermal spray processes, such as plasma and high velocity oxygen-fuel (HVOF) techniques, have evolved into sophisticated and practical methods for synthesis of engineering coatings. Thermal spraying has attracted commercial interest for its ability to produce coatings combining high hardness and bond strength with minimal porosity, tailored thickness and surface roughness. Advances made in the requisite hardware and coating materials have therefore brought the benefits of thermal spraying technology into the mainstream of industrial coating processes. In recent years, HVOF thermal spraying has been proven to successfully fabricate nanostructured coatings using nanocrystalline powder feedstock. The relatively low temperatures and short dwell time which the powder particles attain during HVOF thermal spraying appear to preserve the nanocrystalline structure in the final coatings. The purpose of this conference is to understand the science and technology of thermal sprayed nanocrystalline coatings by assessing various processing techniques and mechanical behavior.

Overviews of various synthesis techniques, thermal stability and mechanical properties of nanocrystalline materials were presented by H. Hahn (Technical University Darmstadt), B. Kear (Rutgers University), J. Rawers (U.S. Department of Energy) and K. Koch (North Carolina State University). Among various synthesis techniques, vapor condensation and solution precipitation methods have been scaled up to produce tonnage quantities of nanoscale ceramic, metal, and composite powders for commercial usage.

The current understanding of various thermal spray processes was described, in which spraying parameters are critical in obtaining coatings with optimal properties. These parameters can be

determined by various modeling methods. Modeling and available diagnostic analysis on various HVOF systems on WC/Co were presented by S. Eidelman (Science Applications, Inc.), S. Sampath (State University of New York-Stony Brook) and R. Nieser (Sandia Laboratory). The synthesis and properties of nanocrystalline Ni, Inconel 718, and 316-stainless coatings were presented by E.J. Lavernia, s group at the University of California, Irvine. Microhardness values of the thermal sprayed nanocrystalline Ni, Inconel 718, and 316-stainless steel coatings have been shown to be approximately 20%, 60% and 36% higher than those of conventionally sprayed coatings. P. Strutt, s group at Inframat Corporation also found increased hardness (up to 1800-1900 VHN) in nanocrystalline WC/10Co coatings sprayed by HVOF. Furthermore, initial reports on the thermal spraying of nanostructured WC/12Co and WC/15Co coatings show promising results. Coating structures of nanoscale WC particles dispersed in an amorphous Co-rich phase were observed and good bonding was achieved.

The first Thermal Spray Processing of Nanoscale Materials conference was deemed to be highly successful and a follow up conference is being planned in 1999.

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**To Members**

For forthcoming data bank on Multiphase Flow Research/Researchers, ICeM would like to have your personal data. Please write your name, address, research field and a list of papers etc. to the Editor.

ICeM would also be very grateful to receive recent reprints, along with up to five keywords per paper.

ICeM welcomes research articles on multiphase flow or articles on personalities in the field for inclusion in the future Newsletters. It would be very helpful if the manuscripts are sent by E-mail or diskettes are attached to the manuscript submitted.

## A TRIBUTE TO THE MEMORIES OF PROFESSOR TOSHIO KAWASHIMA

by Hiroshi Takahashi, Tohoku Univ.

Prof. Kawashima passed away on August 22, 1997 at Tohoku University Hospital. We would like to express our regret.

Prof. Kawashima's career:

1945 Graduated Tohoku University (Dept. of Mechanical Engineering) 1948 Lecture of Tohoku University

1951 Associate Professor of Tohoku Univ. 1971 Professor of Tohoku Univ.

1986 Retired from Tohoku University

1986 Professor of Hachinohe Institute of Technology 1995 An Assistant of Chancellor of Hachinohe Institute of Technology

Prof. Kawashima's Research:

His main research was slurry transportation by pipelines. He was interested in solid-liquid flows, air-solid-liquid flows, homogeneous non-Newtonian flows, transportation of solids by air-lift pump, jet cutting of coal. Especially, his research related to the air-lift pump showed a new analyzing procedure of experimental data regardless of the scale of the experimental appa-

ratus and experimental conditions. He received a prize by this study from Mining and Metallurgical Institute of Japan in 1973.

After he moved to Hachinohe Institute of Technology, he developed the snow drain system by using the pipeline and channel.

Snow drain channel has been already used in snowy country, but in order to construct the snow drain channel, the terrain slope is necessary. He joined the pipeline and channel, and developed the drain system which is not affected by the terrain slope. Furthermore, he was a president of Slurry Transport Society of Japan and an honorary member of British Hydromechanics Research Association, that is, he was a leader in slurry transportation all over the world.



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## IN MEMORY OF THE LATE PROFESSOR KUNIO HIJIKATA

by Akira Yabe, Mech. Eng. Lab., AIST, MITI

Prof. Kunio HIJIKATA

Born in Takasaki City Gumma, Japan on September 12, 1943

Bachelors, Masters, and Doctorate degrees from the Tokyo Institute of Technology

Research Associate at the Tokyo Institute of Technology in 1971

Full Professor at the Tokyo Institute of Technology in 1987

Prof. Hijikata published his research results in more than 250 journal articles, books, monographs, and invited articles in wide areas of Heat Transfer and Multiphase Flow through his keen insights in the fundamental mechanism that underlie complex applications of thermal engineering.

Kunio Hijikata, Professor of Mechano-Aerospace Engineering Department at the Tokyo Institute of Technology passed away on May 18, 1997. He was still in the prime of his life, only 53 years old.

Prof. Hijikata was not only a senior graduate of Prof. Yasuo Mori, but my teacher and adviser. When I met Prof. Hijikata recently, he said "No matter how busy you are, you still must study. I studied quantum mechanics by myself to con-

quer a new field. Even if you are busy, you have to nurture your students. If you don't directly see the data and analyze the results of numerical calculations by yourself, you can't carry out excellent research." We could sense that he always kept challenging his

limitations, which gave great encouragement to all of us and prompted us to redouble our efforts.

Even though Prof. Hijikata unfortunately died while his goals were only halfway accomplished, he left us many outstanding precepts and behaviors.

Surely Prof. Hijikata would offer his heartfelt apology to his family and say "I wanted to do more and more research." and "Always do your best!", his best advice to us all, and "Hello, This is me . . ." - I can still hear his friendly greeting over the phone.



## Future Meetings

Listings include Conference Name, Place, Date and Contact.

### **The Impact of Mineral Impurities in Solid Fuel Combustion**

Kona, HAWAII, November 2-7, 1997  
Engineering Foundation Conferences, 345 East 47th Street, NEW YORK, N.Y. 10017  
Tel: +1-212-705-7836, Fax: +1-212-705-7441  
E-mail: engfnd@aol.com, www: http://www.engfnd.org/engfnd  
Chair: T.F. Wall, CRC for Black Coal Utilization, Department of Chemical Engineering, University of Newcastle, Callaghan NSW2308, AUSTRALIA  
E-mail: cgtfw@cc.newcastle.edu.au

### **International Symposium on Liquid-Liquid Two-Phase Flow and Transport Phenomena**

Antalya, TURKEY, November 3-7, 1997  
Dr. Faruk Arinc, ICHMT Secretary General, Mechanical Engineering Department, Middle East Technical University 06531 Ankara, TURKEY  
Tel: +90-312-210 5214 & 1429, Fax: +90-312-210 1331 & 1266, E-mail: arinc@metu.edu.tr, www: http://www.metu.edu.tr/~wwwichmt  
Prof. D.M. Maron, Fax: +972 3 502 6510  
E-mail: barad\_r@milkc.teh.ac.il

### **AIChE 1997 Annual Meeting**

Los Angeles, USA, November 16-21, 1997  
Dr. Dianne Dorland, E-mail: LA97@d.umn.edu

### **ASME International Mechanical Engineering Congress & Exposition**

Dallas, Texas, USA, November 16-21, 1997

- **Symposium on Dispersed Flow in Combustion, Incineration and Propulsion Systems**  
Prof. D.E. Nikitopoulos, Mechanical Eng. Dept. Louisiana State Univ., Baton Rouge, LA 70803  
Tel: +1-504-388-5903, Fax: +1-504-388-5924  
E-mail: meniki@me.lsu.edu
- **4th International Symposium on Fluid-Structure Interaction, Aeroelasticity, Flow-Induced Vibration & Noise**  
Prof. Michael P. Paidoussis, Department of Mechanical Engineering McGill University, 817 Sherbrooke Street West, Montreal, QC, Canada H3A 2K6  
Tel: +1-514-398-6294, Fax: +1-514-398-7365  
E-mail: maryf@mecheng.lan.mcgill.ca

### **IMCE'97-OPEN FORUM :UNIVERSITY -INDUSTRY COLLABORATIVE RE-SEARCH IN MULTIPHASE FLOW**

Dallas, USA, November 17-22, 1997  
Dr. M. C. Roco, National Science Foundation, Engineering Directorate, Suite 525, 4201 Wilson Blvd., Arlington, VA 22230, USA  
Tel: 703-306-1371, Fax: 703-306-0319  
E-mail: mrocco@nsf.gov  
http:www.eng.nsf.gov/ptf

### **IMP'97 - Modelling of Design and Fluid-Flow Machinery**

Gdansk, POLAND, November 18-21, 1997  
Maria Baginska, Institute of Fluid-Flow Machinery, ul. Gen. J. Fiszera 14, PL-80 952 Gdansk, POLAND, Fax: +48 58 41 61 44  
E-mail: maja@ziutok.imp.pg.gda.pl

### **The Sixth Western Pacific Regional Acoustics Conference**

Kowloon, HONG KONG, November 19-21, 1997  
Dr. S. K. Tang, Department of Building Services Engineering, The Hong Kong Polytechnic University, Hung Hom, Kowloon, HONG KONG  
Tel: (852) 27665855, Fax: (852) 27746146  
E-mail: besktang@polyu.edu.hk

### **The Tenth International Symposium on Transport Phenomena in Thermal Science and Process Engineering**

Kyoto, JAPAN, November 30 - December 3, 1997  
Prof. K. Suzuki, ISTP-10 Secretariat, Department of Mechanical Engineering, Kyoto University, Kyoto 606-01, JAPAN  
Tel: +81-75-753-5250, Fax: +81-75-753-5851  
E-mail: ksuzuki@htrans.mech.kyoto-u.ac.jp

### **Compact Fired Heating Systems - EURO THERM Seminar 54**

Louvain, BELGIUM, December 11-12, 1997  
Prof. E. Van den Bulck, Fax: +32 163 22985

### **Fifth International Congress on Sound and Vibration**

South Australia, AUSTRALIA, December 15-18, 1997  
Prof. Colin Hansen, Congress Secretariat, Fifth International Congress on Sound and Vibration, Department of Mechanical Engineering, University of Adelaide, 5005, AUSTRALIA  
Tel: +61 8 303 5460, Fax: +61 8 303 4367  
E-mail: icsv5@mecheng.adelaide.edu.au

### **SFAIF-98, Space Technology & Applications International Forum**

Albuquerque, NM, USA, February 15-19, 1997  
Prof. Mary J. Bragg, Fax: +1-505-277-4950  
E-mail: mjbragg@unm.edu

### **A.2nd Conference on Future Space and Earth Science Mission**

Dr. Peter Ulrich, Fax: +1 202 358 3096  
E-mail: peter.ulrich@hq.nasa.gov

### **B.2nd Conference on Applications of Thermophysics in Microgravity**

Dr. Rodney Herring, Fax: +1 514 926 4766  
Email: rodney@space.gc.ca

### **C.3rd Conference on Commercial Development of Space**

Dr. Raymond P. Whitten, Fax: +1 202 358-2886



E-mail: [rwhitten@osat.hq.nasa.gov](mailto:rwhitten@osat.hq.nasa.gov)

**D.3rd Conference on Next Generation Launch Systems**

Dr. Jess Sponable, Fax: +1 505 846 8930

E-mail: [sponablj@plk.af.mil](mailto:sponablj@plk.af.mil)

**F.15th Symposium on Space Nuclear Power and Propulsion and Synergistic Technologies**

Dr. Michael G. Houts, Fax: +1 505 665 3167

E-mail: [houts@lanl.gov](mailto:houts@lanl.gov)

**IMuST Annual Meeting**

Santa Barbara, CA, USA, February 26-28, 1998

E-mail: [theo@theo.ucsb.edu](mailto:theo@theo.ucsb.edu)

**Microscale Heat Transfer - EUROTHERM Seminar 57**

Poitiers, FRANCE, February 1998

Prof. J.B. Saulnier, Fax: +33 49 49 81 01

**The International Technical Conference on COAL UTILIZATION & FUEL SYSTEMS**

Clearwater, FL, USA, March 9-13, 1998

(Abstracts due: October 24, 1997)

Coal Utilizations & Fuel Systems Conference Committee, 1156 Fifteenth Street, N. W., Suite 525, Washington, D. C. 20005, USA

**Heat Transfer in Radiating and Combusting Systems 3 - EUROTHERM Seminar 56**

Athens, GREECE, April 1-3, 1998

Dr. E. Kakaras, Fax: +30 1 380 1712

**The 9th International Symposium on Freight Pipelines**

Monterrey, MEXICO, April 21-23, 1998

Dr. George E. Klinzing, Vice Provost for Research, University of Pittsburgh, 323 Benedum Hall, Pittsburgh, PA 15261, USA

Tel: 412 -624-0784, Fax: 412-383-9640

E-mail: [Klinzing@engrng.pitt.edu](mailto:Klinzing@engrng.pitt.edu)

**Gaviation 98 - 3rd International Symposium on Cavitation**

Grenoble, FRANCE, April 1998

J.M. Michel, LEGI/IMG, BP 53, F-38041

Grenoble Cedex 9

Fax: +33 0476 82 52 71

**EUROMECH Colloquium 376 - Waves in Two-phase Flows**

Istanbul, TURKEY, April 1998

C.F. Delale, Dept. Mech. Engineering, Istanbul University, Avcilar Kampusu, 34850 Avcilar, Istanbul, TURKEY

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**Fluidization IX**

Durango, USA, May 17-22 1998

Engineering Foundation Conferences, 345 E. 47th Street New York, NY 10017

Tel: +1-212-705-7836, Fax: +1-212-705-7441

E-mail: [engfnd@aol.com](mailto:engfnd@aol.com), www: <http://www.engfnd.org/engfnd>

Chair: Dr. L.S.Fan, Department of Chemical Engineering at The Ohio State University, E-mail: [FAN.1@OSU.EDU](mailto:FAN.1@OSU.EDU)

**International Symposium on Heat and Mass Transfer in Biological and Medical Engineering**

Kusadasi, TURKEY, June 8-12, 1998

Prof. Faruk ARINK

Mechanical Engineering Dept., Middle East Technical Univ., 06531 Ankara, TURKEY

Tel: +90-312-210-1429 or 210-5213 or 210-5214

Fax: +90-312-210-1331 or 210-1266

E-mail: [ichmt@metu.edu.tr](mailto:ichmt@metu.edu.tr)

<http://www.metu.edu.tr/~wwwichmt>

**ICMF '98-Lyon, 3rd International Conference on Multiphase Flow**

Lyon, FRANCE, June 8-12, 1998

(Abstracts due: July 15, 1997)

Prof. J. Bataille, Laboratoire de Mécanique des Fluides et d' Acoustique, Ecole Centrale de

Lyon, BP 163, 69131 ECULLY cedex, France

Tel: +33 72 18 61 56, Fax: +33 78 64 71 45

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www: <http://www.mecaflu.ec-lyon.fr/ICMF98/>

**1998 ASME Fluids Engineering Division Summer Meeting**

Washington, DC, USA, June 21-25, 1998

Prof. C.T. Crowe, Washington State University, USA, Fax: 509-335-4662

E-mail [crowe@mme.wsu.edu](mailto:crowe@mme.wsu.edu)

**Thirteenth U.S. National Congress of Applied Mechanics**

University of Florida, USA, June 21-26, 1998

(Abstracts due: November 1, 1997)

USNCAM13, Attn: R. Mei, AeMES Dept., Univ. of Florida, PO BOX 116250, Gainesville, FL 32611-6250, USA

Tel: 352-392-0961, Fax: 352-392-7303

E-mail: [USNCAM13@aero.ufl.edu](mailto:USNCAM13@aero.ufl.edu)

<http://www.aero.ufl.edu/usnc/usnatcon.html>

**Heat Exchangers for Sustainable Development**

Lisbon, PORTUGAL, June 22-25, 1998

Prof. M.G. Carvalho, Fax: +351 1 847 5545/726 2633

**THE THIRD INTERNATIONAL CONFERENCE ON FLUID MECHANICS**

Beijing, CHINA, July 7-10, 1998

(Abstracts due: November 30, 1997)

Prof. Li Jiachun, Institute of Mechanics, Chinese Academy of Sciences, 15 Zhong Guan Cun Road, Beijing 100080, CHINA

Fax: +86-10-6255-9588

E-mail: [jcli@cc5.imech.ac.cn](mailto:jcli@cc5.imech.ac.cn)

**World Congress on Particle Technology 3**

• **Third International Particle Technology Forum (Third IPTF)**

The Brighton Centre, ENGLAND, July 6-9, 1998  
IChemE, Davis Building 165-189 Railway Terrace Rugby, CV21 3HQ, ENGLAND  
Tel: +44-(0)1788-578214, Fax: +44-(0)1788-577182, E-mail: j.morgan@icheme.org.uk  
www: <http://icheme.chemeng.ed.ac.uk/wcpt.htm>  
Chairman: Prof. M.C.Roco, National Science Foundation, 4201 Wilson Blvd., Suite 525 Arlington, VA 22230, U.S.  
Tel: 703 306 1371, Fax: 703 306 0319  
E-mail: mroco@nsf.gov

**Ninth International Symposium on Application of Laser Techniques to Fluid Mechanics**

Lisbon, PORTUGAL, July 13-16, 1998  
(Abstracts due: December 19, 1997)  
Prof. Manuel V. Heitor, Dept. of Mechanical Engineering Instituto Superior Tecnico, Av. Rovisco Pais, 1096 LISBOA CODEX PORTUGAL, Tel: 351-841 73 79, Fax: 351-849 61 56  
E-mail: mheitor@termcomb.ist.utl.pt  
www: <http://gep.ist.utl.pt/Fluid-Laser-Symp>

**1998 Joint ASME/JSME Pressure Vessels and Piping Conference**

San Diego, CA, USA, July 26-30, 1998  
(Abstract due: September 30, 1997)  
Dr. Vladimir Kudriavtsev, System Engineering, Watkins-Johnson Company, 440 Kings Village Road, Scotts Valley, CA 95066, USA  
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E-mail: vladimir.kudriavtsev@wj.com  
<http://www.netcom.com/~vvk>

**Heat and Mass Transfer, and Thermodynamics of Inverse Cycle Machines - EURO THERM Seminar 59**

Nancy, FRANCE, July, 1998  
Prof. M. Feidt, Fax: +33 83 59 55 51

**11th International Heat Transfer Conference**

Kyongju, KOREA, August 23-28, 1998  
Prof. J. S. Lee,  
Tel: +82-2-880-7117 Fax: +82-2-883-0179  
E-mail: jslee@gong.snu.ac.kr  
<http://ihtc.snu.ac.kr>

**5th Asian Thermophysical Properties Conference(ATPC '98)**

Kyongju, KOREA, August 31-September 2, 1998  
(Abstract due: January 31, 1998)  
Prof. M. S. Kim, Secretary General of ATPC '98, Dept. of Mechanical Engineering, Seoul National Univ., Seoul 151-742, KOREA  
Fax: +82-2-883-0719  
E-mail: minskim@plaza.snu.ac.kr

**Second International Symposium on Measuring Techniques for Multiphase Flows**

Beijing, CHINA, August 31-September 1, 1998  
(Abstracts due: August, 1997)

Prof. Xu Yiqian, Thermoenergy Engineering Research Institute, Southeast University, Nanjing 210096, CHINA  
Tel: +86-25-3794395, Fax: +86-25-7714489  
E-mail: yiqnxu@seu.edu.cn

**8th International Symposium on Flow Visualization**

Sorrent(NA), ITALY, September 1-4, 1998  
(Abstracts due: December 15, 1997)  
8th ISFV- Prof. G. M. Carlomagno, Facolta di Ingegneria-DETEC, Piazzale Tecchio, 80, 80125 Napoli, ITALY  
Tel: +39-81-7682178, Fax: 2390364  
E-mail: carmagno@unina.it

**9th European Symposium on Comminution**

Albi, FRANCE, September 8-10, 1998  
(Abstracts due: May 15, 1997)  
PROGEP Comminution 98, Florence Foucaud 18 Chemin de la Loge, 31078 Toulouse Cedex 4, FRANCE, Tel: +33 (0)5 62 25 23 80, Fax: +33 (0)5 62 25 23 18, E-mail: Progep@ensigct.fr  
www: <http://www.enstima.fr/manif/comminution98>

**EFMC-3, 3rd European Fluid Mechanics Conference**

Göttingen, GERMANY, September 15-18, 1998  
G.E.A. Meier, DLR Institut für Strömungsmechanik, Bunsenstrasse 10, D-37073 Göttingen  
E-mail: efmc97@msfd1.dnet.gwdg.de

**THE FORTH KSME-JSME FLUIDS ENGINEERING CONFERENCE**

Pusan, KOREA, October 18-21, 1998  
(Abstracts due: November 30, 1997, Submission form prepared on FEC4 Web Site)  
Prof. Moon J. Lee, FEC4 Secretariat, Dept. of Mechanical Engineering, Pohang Univ. of Science and Technology, Pohang 790-784, KOREA  
Fax: +82-0-562-279-3199, 5567  
E-mail: mjlee@postech.ac.kr  
Prof. Yoichiro Matsumoto, FEC4 Secretariat, Dept. of Mechanical Engineering, The Univ. of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113, JAPAN, E-mail: ymats@mech.t.u-tokyo.ac.jp  
FEC4 Web Site <http://mech.postech.ac.kr/FEC4/>

**IMECE98-CHARACTERIZATION OF FLOW PATTERNS IN MULTIPHASE FLOW SYSTEMS**

Anaheim, CA, USA, November 15-20, 1998  
(Abstracts due: January 5, 1998)  
Dr. Jovica R. Riznic, Atomic Energy Control Board, Research and Support Section, 280 Slater, P.O.Box 1046, Station B, Ottawa, CANADA K1P 5S9  
Tel: 613-943-0132, Fax: 613-943-8954  
E-mail: riznic.j@atomcon.gc.ca

**IMECE '98- OPEN FORUM: UNIVERSITY-**

**INDUSTRY COLLABORATIVE RESEARCH IN MULTIPHASE FLOW**

(Abstracts due: April 30, 1998)

Dr. M. C. Roco, National Science Foundation, Engineering Directorate, Suite 525, 4201 Wilson Blvd., Arlington, VA 22230, USA  
Tel: 703-306-1371, Fax: 703-306-0319  
E-mail: mroco@nsf.gov  
<http://www.eng.nsf.gov/ptf>

**13TH AUSTRALASIAN FLUID MECHANICS CONFERENCE**

Monash University, AUSTRALIA, December 13-18, 1998

(Abstract due: April 30, 1998)

Secretariat: 13th Australasian Fluid Mechanics Conference, Dept. of Mechanical engineering, Monash University, Clayton, Victoria 3169, AUSTRALIA

Tel: 61-3-9905-9646, Fax: 61-3-9905-3558

E-mail: afmc@monash.eng.edu.au

<http://www.monash.edu.au/mecheng/seminars/afmc>

25th National Conference on Fluid Mechanics & Fluid Power and 1st International Conference on Fluid Mechanics & Fluid Power

Indian Institute of Technology, Delhi, INDIA, December 15-17, 1998

(Abstracts due: February 28, 1998)

Prof. S N. Singh, Organising Secretary, Dept. of Applied Mechanics, Indian Institute of Technology, Delhi, Hauz Khas, New Delhi-110 016, INDIA

**Energy-Related Process Integration Technologies - EUROTHERM Seminar 52**

Manchester, UK, 1998

Prof. B. Linnhoff, Fax: +44 161 236 7439

**2nd International Symposium on Two-Phase Flow Modelling and Experimentation**

Pisa, ITALY, May 23-25, 1999

Dr. G.P. Celata, Tel: +39 6 3048 3905, Fax: +39

6 3048 3026, E-mail: celata@casaccia.enea.it

Prof. R.K. Shah, Fax: +1 606 257 3304, E-mail:

shah@engr.uky.edu

Dr. P. Di Marco, Tel: +39 50 569 610, Fax: +39 50 569 666, E-mail: dimarco@cii.unipi.it

**The Second International Conference on PNEUMATIC AND HYDRAULIC CONVEYING SYSTEMS**

Davos, SWITZERLAND, June 20-25, 1999

(Abstracts due: November 1, 1998)

Engineering Foundation, 345 East 47th Street, New York, NY 10017, USA

Tel: +1-212-705-7836, Fax: +1-212-705-7441

E-mail: engfnd@aol.com

<http://www.engfnd.org>

**7th International Symposium on Gas-Liquid Two-Phase Flows, 1999 ASME FED Summer Meeting**

San Francisco, USA, June 22-26, 1999

(Abstract due: July, 1998)

Dr. Upendra S. Rohatgi, Brookhaven National Lab., Dept. of Nuclear Energy, Upton, NY 11973, USA

Tel: +1-516-282-2475, Fax: +1-516-282-2613

E-mail: rohatgi@bnl.gov

**8th International Symposium on Gas-Particle Flows, ASME-JSME Fluids Engineering Conference**

San Francisco, USA, July 18-23, 1999

(Abstracts due: August 14, 1998)

Prof. David E. Stock, Dept. of Mech. & Matls. Engrg., Washington State Univ., Pullman, WA 99164-2920, USA

Tel: +1-509-335-3223, Fax: +1-509-335-4662

E-mail: stock@mme.wsu.edu

**Integral Methods in Science and Engineering 2000**

Alberta, CANADA, June 12-15, 2000

Dr. P. Schiavone, Department of Mechanical Engineering, University of Alberta, 4-9 Mechanical Engineering Building, Edmonton, ALBERTA, T6G 2G8, CANADA

Tel: (403)492-3638, Fax: (403)492-2200

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**1998 ASME FLUIDS ENGINEERING DIVISION  
SUMMER MEETING  
June 21-25, 1998 , Washington D. C., USA**

The Fluids Engineering Division (FED) of ASME is organizing its 1998 Summer Meeting, to be held in Washington D.C. The 1998 FED Summer Meeting will consist of quality technical paper presentations, panel discussions, and expert keynote addresses.

In addition to these traditional paper sessions, a Small Business Forum will be offered. A Global Trade Program is also being developed and will provide a forum for discussion of applied fluids engineering issues critical to industry, as well as two Tutorials and Clinic sessions. All of these sessions are available to conference registrants. This announcement is a Call for Fo-

rum papers.

Abstracts are now being accepted. Please see the detailed announcement for these Forums at the ASME Web Site: <http://www.asme.org> -- The Call for Forum papers announcement is reached by selecting Meetings & Exhibits, then ASME Sponsored Conferences, and finally ASME Fluids Engineering Conference and Exhibition.

For more information, please contact Jacinta McComie at [mccomie@asme.org](mailto:mccomie@asme.org), 212-705-8257 (phone), 212-705-7856 (fax) or at the ASME Meetings Dept., 345 East 47th Street, New York, NY 10017-2392. Thank you.

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**CHARACTERIZATION OF FLOW PATTERNS IN MULTIPHASE FLOW SYSTEMS  
1998 ASME International Congress & Exposition (IMECE98) Anaheim, California,  
November 15-20, 1998**

by Jovica R. Riznic

The K-13 Nucleonics Heat Transfer Committee of the ASME Heat Transfer Division is sponsoring a technical session on "Characterization of Flow Patterns in Multiphase Flow Systems" at the 1998 ASME International Congress & Exposition (IMECE98) to be held in Anaheim, California, November 15-20, 1998. The goal of the session is to bring together researchers, scientists and engineers who are interested in modern methods and techniques for identification and characterization of flow patterns/regimes in all types of multiphase flow systems. Papers are sought covering a broad range of modelling, numerical and experimental investigations. Appropriate topics for this session include, but are not limited to, the following:

- Modern studies of internal structure and flow pattern definition in multiphase flow
- New methods in time series analysis. Characterization of voidage and pressure signal.
- Industrial and laboratory applications in fluidized beds, boiling systems, combustion, manufacturing and material processing technologies
- Emerging models and methods for identification and characterization of a flow pattern in multiphase flow systems. Nonlinear dynamics and complex systems identification methods. Identification of chaos in multiphase flows and control of chaos.

The planning schedule for this session is:

Three copies of a 500 words abstract due: January 05, 1998, Notification of abstract acceptance due: February 02, 1998, Full-length paper due for review: March 16, 1998, Notification of paper acceptance: May 18, 1998, Final paper on mats due: July 06, 1998

Three copies of a 500 words abstract should be submitted to one of the following session organizers:

Dr. Jovica R. Riznic  
Atomic Energy Control Board, Research and Support Section, Dept. 280 Slater, P.O.B 1046, Ottawa, CANADA K1P 5S9  
Phone: 613-943-0132, Fax: 613-943-8954  
E-mail: [riznic.j@atomcon.gc.ca](mailto:riznic.j@atomcon.gc.ca)  
Professor Cila Herman  
The Johns Hopkins Univ., Mech. Engineering, 304 Latrobe Hall, 3400 N.Charles Str., Baltimore, MD 21218-2686  
Phone: (410) 516-4467, Fax: (410) 516-7254  
E-mail: [herman@titan.me.jhu.edu](mailto:herman@titan.me.jhu.edu)

A copy of the abstract with an indication of the session (i.e., Characterization of Flow Patterns in Multiphase Flow Systems) should be submitted to the 1998 IMECE Technical Program Chair:

Dr. Ralph A. Nelson, Jr.  
TSA 10, Los Alamos National Lab. MS- K575,  
Los Alamos, NM 87545  
Fax: (505) 665- 2897



CALL FOR PAPERS  
1999 ASME-JSME FED Summer Meeting



**8th International Symposium on Gas-Particle Flows**

Call for Abstracts

**OPEN FORUM:  
UNIVERSITY-INDUSTRY COLLABORATIVE RESEARCH IN  
MULTIPHASE FLOW**

1998 INTERNATIONAL ME CONGRESS AND EXHIBITION  
November 15-20, 1998

The Multiphase Flow Committee of ASME sponsors an Open Forum on university-industry interaction in multiphase flow research. The objectives are to introduce new areas of multiphase flow research developed as result of university-industry partnerships, to present models of collaboration between university and industry researchers, and to highlight special technical accomplishments and synergistic effects. Completed work and work in progress may be presented. A special interest is to identify opportunities and trends for future interactions. Private and government funding programs supporting those collaborations and linkages also will be presented.

Selection of the contributions will be based on one page abstracts, which have to be submitted to the organizer seven month before the meeting and will be reviewed. To encourage informal discussion on on-going projects and to facilitate industrial participation, contributors are not requested to submit papers.

Prospective contributors are requested to submit two copies of their abstracts by April 30, 1998. Notification of acceptance will be given by May 15, 1998.

M.C. Roco

National Science Foundation  
Engineering Directorate, Suite 525  
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ASME-JSME Fluids Engineering Conference  
July 18-23, 1999, San Francisco, California

**Purpose**

Gas-particle flow problems occur in a wide range of applications such as pneumatic transport, droplet and coal combustion, particle classifiers and separators, fluidization, pollution control, and medical applications. New information concerning gas-particle flows is continually being obtained through the use of analytical models, numerical simulation, and experimental studies. The purpose of this symposium is to provide a forum for researchers and engineers currently working on problems related to gas-particle flows to discuss recent advances as well as new engineering applications relevant to this area.

**Organization and Scope**

This symposium is organized by the Multiphase Flow Committee of the ASME Fluids Engineering Division in cooperation with the JSME. Fifteen technical sessions with ten invited papers and a panel discussion are planned. It is expected that sessions will focus on the following topics: analytical/numerical models of gas-particle flows; dense flows; fluidized beds; turbulence modification due to the presence of particles; simulation of gas-particle flows; experimental studies; new experimental techniques; and engineering applications related to gas-particle flows. Papers related to near wall effects, deposition, and resuspension are encouraged.

**Paper Submission and Selection**

Authors should submit five copies of a 300 to 500 word abstract. The abstract should clearly state the purpose, results, and conclusions of the project along with supporting figures. The cover letter for the abstract should contain: 1) a few keywords to describe and categorize the work; 2) the name, address, phone number, and fax number of the corresponding author; 3) the name of the author that will be presenting the paper. The abstracts will be used for preliminary screening and planning of the sessions. Final acceptance of the papers will be based upon the review of the complete manuscript according to ASME standards. All accepted papers will be published in a symposium volume that will be available at the meeting.

**Deadlines**

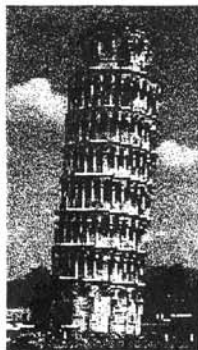
Submission of abstract to a Symposium Co-Chair  
Authors notified of preliminary acceptance  
Full-length papers due to Symposium Chair  
Authors notified of final acceptance and sent mats  
Author-prepared ASME mats due to Symposium Chair

Aug. 14, 1998  
Sept. 14, 1998  
Nov. 2, 1998  
Dec. 28, 1998  
Mar. 22, 1999

**Symposium Organizers**

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## 2nd International Symposium on Two-Phase Flow Modelling and Experimentation

May 23-25, 1999

*Pisa, Italy*

by Gian Piero Celata

The first International Symposium on Two-Phase Flow Modelling and Experimentation was held in Rome, and was attended by about 220 delegates from more than 35 countries.

The objectives of the Symposium are to bring together researchers, designers, experimentalists, modellers, and numerical analysts from industry, laboratories and academia active in the area of two-phase flow to present the state-of-the-art, to exchange their expertise and experiences and to further stimulate their research activities. The Symposium is organized by the Assembly of World Conferences on Experimental Heat Transfer Fluid Mechanics and Thermodynamics, and the ENEA Institute of Thermal-Fluid Dynamics, with participation of the Japan Society of Multiphase Flow.

Contributed papers are solicited dealing with experimental work, theory, analysis, design, numerical studies, modelling on fundamentals and applications of two-phase flow, including heat and mass transfer, fluid mechanics and thermodynamics aspects. Papers are also solicited reporting measurement techniques, visualization techniques, instrumentation, and analysis of experimental data as well as theory or numerical results. Some of the subject areas are as follows: annular flow and entrainment, coalescence phenomena, countercurrent flow and flooding, critical flows, flow pattern identification, horizontal and inclined flows, interfacial phenomena, phase distribution and separation, pressure drop, stratified flow, turbulence, waves on interfaces, boiling heat transfer, boiling of mixtures, critical heat flux, direct contact boiling, flow instabilities, subcooled boiling, thermodynamic non-equilibrium, condensation, condensation of mixtures, direct contact condensation, transient flow phenomena, zero gravity flows, flow visualization,

measurement techniques and instrumentation, and code development. Pertinent papers in areas other than those listed above are also welcome.

### DEADLINES

March 31, 1998 Three copies of abstracts due to the Lead Scientists closest to your region.

May 15, 1998

Authors to be notified of abstract acceptance.

July 24, 1998

Full length manuscript due to the Lead Scientist.

December 10, 1998

Authors to be notified of paper acceptance.

February 18, 1999

Author-prepared mats due.

For further information and abstract see:  
<http://docenti.ing.unipi.it/~d6600/pisa99/>

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