CIRCULATING FLUIDIZED BED TECHNOLOGY III

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PREFACE

High velocity circulating fluidization includes two fluidization regimes - the turbulent regime and the fast regime. Although these regimes are believed to have been observed by people who joined the first fluid catalytic cracker development in the 1930s, they have been left from scientific investigation for a long period presumably due to the following reasons: 1) industrial applications of high velocity modes did not mature quickly, 2) the bubbling mode, instead, was successfully commercialized after World War II, 3) even bubbling fluidized beds had provided sufficiently difficult hydrodynamic problems for scientists and engineers to solve. In the middle of the 70s high velocity circulating fluidized beds were introduced to boiler industries. Since then the high velocity regimes has been recognized as wild continent, perhaps the last, in the study of gas-solid suspensions laying between bubbling fluidization and pneumatic transport. Its significance was recognized widely by the scientific community in the middle of the 80s in the wake of the successful First International Conference on Circulating Fluidized Beds held in Halifax, Nova Scotia, Canada in 1985. It did not take time to reorganize experimental findings and the scientific questions. It also did not take much time to attract the market because of the superior performance of circulating fluidized bed boiler in terms of combustion efficiency, emission control and load turndown capability.

Now we are in the hydrodynamic period of circulating fluidization research, which reminds us of the period between the late 50s and the early 60s for bubbling fluidization. The hydrodynamics of circulating fluidization is much significant for commercial development and design because of its close relationship with solids mixing, heat transfer, emission control and scale-up. However, there are other players in this game like the structure of a system which include cyclones, down-comers, loop seals and the shape of riser exits. To define a hydrodynamic performance of a circulating fluidized bed, rather continuous monitoring is required for solid circulation flux, for the total pressure loop, for pressure fluctuation and even for the radial solid velocity distribution to determine the core and annulus structure. In this regard an experiment of circulating fluidization requires not only tall columns but also much heavier instrumentation than those for ordinary bubbling bed researches.

The First International Conference on Circulating Fluidized Beds sparked intensive research programs and encouraged worldwide exchange of information on this process. This conference has been characterized by a focus on the specific problems to be solved, a good balance between industries and academics and with an atmosphere of hot discussion on many interesting and difficult-to-answer problems. Circulating fluidized bed is extending its horizon much beyond the traditional field of combustion. Besides, catalytic reactions, new applications are taking place in many areas including fine powder processing, though they might be still on primitive stages. This makes the need for this forum of exchange of ideas more important than ever.

In the Second International Conference on Circulating Fluidized Beds held in Compiegne, France, one of the hot issues was the flow structure. A near consensus was established concerning the existence of the core and annulus structure in the riser. However, many problems were left for discussion for the next conference such as the more detailed microscopic structure of suspension, the relationship between the macro and micro scale phenomena, how to formulate heat transfer coefficients, how to evaluate gas flow and mixing in the riser gas, etc.

The Third International Conference on Circulating Fluidized Beds was held at Nagoya, Japan, from October 15 to October 18, 1990 by the Society of Chemical Engineers Japan in cooperation with its International Secretariat at Halifax, Canada. Five plenary lectures and 97 papers were presented by people from 19 different countries. All papers were presented both in parallel oral sessions (a five minute presentation) as well as in poster sessions. The attendants, 283 people from 20 countries, enjoyed different modes of discussions, one immediately after each oral presentation and those in poster sessions and in workshops. This conference drew attention to newer application to fields like direct iron ore reduction, pressurized combustion-gasification, material science etc. We are sure that the 3rd conference contributed successfully to the progress of circulating fluidization technology. Researchers are now on their way to formulate comprehensive understanding of hydrodynamics, heat transfer, chemical reactions and recirculating systems.

We thank all authors and delegates who participated in this conference. The reviewers did a commendable job to help maintain the archival standard of this publication. We also would like to express our gratitude to all people who worked hard for the organization, to the special dedication of Professor S. Mori of Nagoya Institute of Technology, Dr. F. Watanabe of Nagoya University and Dr. K. Kato of Gumma University. We wish to thank the continuous effort of Ms. Mari Hasegawa (Nagoya University), Mrs. Noriko Tsuchida (Tokyo University of A&T), and the Continuing Education Division of the Technical University of Nova Scotia. Mrs. Zhuan Zeng and Rita Gyarmati need special mention for superb handling of the review process and typing, formatting, pasting etc. of scores of manuscripts. We also thank Dr. A. A. Avidan and W. C. Yang who served on the paper selection committee and we finally thank the members of the Advisory Board of the International Conference on Circulating Fluidized Beds. We gratefully acknowledge the contribution of Badger Corporation, Daiko Foundation, Ishida Foundation, E.M.I Nemour DuPont, Hatakeyama Foundation, Kato Foundation of Nagoya University, Pyropower Corporation, Research Foundation for the Electrotechnology of Chubu and 69 Japanese industries

This volume contains 88 technical papers grouped under 9 different topics. In addition, five overviews present an account of the 'state of the art' of different facets of this technology. We hope this volume will provide scientific and technical information of lasting value for the continued development of the Circulating Fluidized Bed technology.

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