BUBBLE HYDRODYNAMICS IN GAS FLUIDIZED BEDS

by

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To my mother

DECLARATION

This thesis contains no material which has been accepted for the award of any other degree or diploma in any University and, to the best of the author's knowledge and belief, the thesis contains no material previously published or written by another person, except where due reference is made in the text or where common knowledge is assumed.

The author consents to the thesis being made available for photocopying and loan if accepted for the award of the degree.

Kym M. Ide

PREFACE

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ABSTRACT

Thorough knowledge of the hydrodynamic properties of gas fluidized beds is a prerequisite for complete mastery of fluidization as a process technology. Detailed analyses require prohibitively large quantities of computer time and effort. Only limited bubble size and velocity distribution data are available in the literature. Invariably, mean bubble properties are tabulated, reducing the quantity of data available for model fitting and calculation of bed performance. The aim of this investigation was to develop a technique capable of quick, simple and inexpensive measuring of the distribution of bubble sizes and velocities in a gas fluidized bed. An extensive tabulation of measured bubble characteristics is provided.

Tests were conducted in a 23 cm diameter gas fluidized bed. Construction in perspex enabled visual observation of the fluidization process. AB Glass ballotini served as the bed material with air as the fluidizing medium. A dual tipped capacitance probe was employed to measure the local variations in bed porosity. Unique computer software enabled the elimination of many complex hardware components previously employed in this type of study. All data collection and analysis was performed in real-time by the computer software.

Comparison of the collected data with a population balance model proposed by Agarwal (1986) was performed. The model predictions were in good agreement with the experimental bubble vertical dimensions but significant departures from the bubble rise velocities were noted. The median bubble characteristics derived from the experimental data and correlations were

contrasted with predicted average values. The average bubble characteristics were greater than the median values. A significant contribution from small bubbles may be neglected when an average characteristic is employed.

Figures detailing the distributions of bubble vertical dimensions and rise velocities are presented. As bed height increases the bubbles conglomerate towards the centre of the bed and as a consequence bubble size and rise velocity increase in the centre of the bed.

This investigation should be of great benefit to future studies linking bed hydrodynamics to fluidized bed performance and any study where high speed data acquisition is necessary given the improvement in the ease of measurement.