

STUDIES IN INDUSTRIAL CRYSTALLIZATION

Being a thesis submitted in accordance with  
the regulations governing the award of the Doctorate of  
Philosophy in Chemical Engineering of the Indian Institute  
of Technology, Delhi.

by

S. Parkash

Department of Chemical Engineering,  
Indian Institute of Technology,  
DELHI.

### ACKNOWLEDGEMENTS

This opportunity is taken to thank Dr. Frank Rumford under whose guidance the author worked for first two years on this project. But for his inspiring guidance, constant advice and keen interest, this thesis would not have been possible.

The author thanks Dr. P.S. Lale for later guiding these investigations when Dr. Rumford left.

The author thanks Prof. T.K. Ghosh for many valuable suggestions and advice during the course of this work.

Thanks in full measure are due to the entire workshop staff for their continuous assistance.

## CONTENTS

|   |    |
|---|----|
| Acknowledgement   | i  |
| Introduction and outline of the problem                         | 1  |
| <u>CHAPTER - I. MECHANISM OF CRYSTALLIZATION</u>                |    |
| 1.1 Theories of crystal growth                                  | 4  |
| 1.2 Nucleation  | 15 |
| 1.3 Fluid mechanics of crystallization                          | 22 |
| 1.4 Temperature coefficient of reaction                         | 28 |
| <u>CHAPTER - II. EXPERIMENTAL MEASUREMENT OF GROWTH RATES</u>   |    |
| 2.1 Crystal growth in fluidised beds                            | 31 |
| 2.2 Apparatus and technique of experiment procedure.            | 32 |
| 2.3 Hydrates of Sodium sulphate                                 | 35 |
| 2.4 Sodium thiosulphate pentahydrate                            | 36 |
| 2.5 Ammonium sulphate   | 37 |
| 2.6 Barium chloride dihydrate                                   | 38 |
| 2.7 Potassium chloride  | 39 |
| 2.8 Transport properties  | 40 |
| 2.9 Mass Transfer in fluidised bed                              | 43 |
| 2.10 Laboratory Oslo Crystallizer                               | 45 |
| 2.11 Oslo Crystallizer Pilot Plant                              | 49 |
| <u>CHAPTER - III. DESIGN PARAMETERS</u>                         |    |
| 3.1 Residence times of crystals in a fluidised bed crystallizer | 63 |
| 3.2 Suspension densities of crystals in fluidised bed           | 68 |
| 3.3 Design of a fluidized bed crystallizer                      | 70 |
| <u>CHAPTER - IV.</u>  |    |
| Conclusions   | 73 |

.....