

STUDIES ON UREA HYDROLYSIS USING IMMOBILIZED
WHOLE MICROBIAL CELLS

V.KANNAN

THESIS SUBMITTED TO THE INDIAN INSTITUTE OF TECHNOLOGY, DELHI
FOR THE AWARD OF THE DEGREE OF
DOCTOR OF PHILOSOPHY

BIOCHEMICAL ENGINEERING RESEARCH CENTRE
DEPARTMENT OF CHEMICAL ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY, DELHI
NEW DELHI - 110029
DECEMBER 1979

DEDICATED TO MY PARENTS



CERTIFICATE

This is to certify that the thesis entitled "Studies on Urea Hydrolysis Using Immobilized Whole Microbial Cells", submitted by V.Kannan has been prepared under my supervision in conformity with rules and regulations of the Indian Institute of Technology, Delhi. The research and results presented in the thesis have not been submitted for any degree in any other University.


(T.K.Ghose)

ACKNOWLEDGEMENTS

Most heartily, I wish to thank and express my sincere gratitude to my guide and mentor Prof. Tarun K.Ghose for his able guidance, encouragement and the perfection he imparted during the course of this research. His vast knowledge, dedication and in-exhaustible store of energy was a constant source of inspiration throughout.

My appreciation and thanks are due to Dr. Subhash Chand, Mr. R.K.Sachdev, Mr. P.S.Vishnoi, Dr. Vikram Sahai and other colleagues for the healthy discussions, fruitful suggestions and cooperation at the time of need extended by them right through the thesis preparation. I also acknowledge with sincerity the par-excellence technical service rendered by Mr. Subrata Sen Ray, Mr. Vinay K. Ghosh and Miss S.Jayanthi and highly cooperative assistance by Mr. G.N.Sharma.

The excellent facilities, provided by Swiss Federal Institute of Technology, Zurich, under Indo-Swiss Collaboration in Biochemical Engineering, which has contributed a good deal in the present investigation is also acknowledged with utmost gratefulness.

Mr. R.N.Shukla's excellent typing of this thesis is highly appreciated and duly acknowledged.

- iii -

Finally I take this opportunity to thank one and all connected with the preparation of this thesis either directly or indirectly.

(V.KANNAN)

CONTENTS

		<u>Page No.</u>
	Certificate ...	i
	Acknowledgements ...	ii
	Contents ...	iv
	List of Tables ...	v
	List of Figures ...	vi
	List of Photographs ...	viii
 <u>CHAPTER - 1</u>		
1.1	Introduction ...	1
1.2	Objectives ...	9
1.3	Literature Review ...	11
 <u>CHAPTER - 2</u>		
2.1	Materials and Methods ...	51
2.2	Experimental procedures ...	57
 <u>CHAPTER - 3</u>		
	Theoretical Considerations ...	74
 <u>CHAPTER - 4</u>		
	Results and Discussions ...	91
 <u>CHAPTER - 5</u>		
	Summary and Conclusion ...	143
	Nomenclature ...	150
	References ...	153