

STUDIES ON DELIGNIFICATION  
AND ENZYMATIC HYDROLYSIS OF  
AGRICULTURAL RESIDUES

BY  
P.V. PANNIR SELVAM

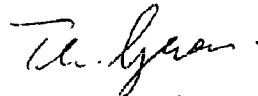
THESIS SUBMITTED TO THE INDIAN INSTITUTE OF TECHNOLOGY, DELHI  
FOR THE AWARD OF THE DEGREE OF  
DOCTOR OF PHILOSOPHY

BIOCHEMICAL ENGINEERING RESEARCH CENTRE  
INDIAN INSTITUTE OF TECHNOLOGY, DELHI  
NEW DELHI-110016

MAY 1983

CERTIFICATE

This is to certify that the thesis entitled studies on delignification and enzymatic hydrolysis of agricultural residues by Shri P.V.PANNIR SELVAM has been prepared under my supervision in conformity with the rules and regulations of the Indian Institute of Technology, Delhi. I further certify that the thesis has attained a standard required for Ph.D Degree of the Institute. The research report and the results presented in the thesis have not been submitted for any degree in any other university.



(T. K. Ghose)

## ACKNOWLEDGEMENT

I express my sincere gratitude to my research supervisor, Prof. Tarun K. Ghose, for his expert guidance, stimulating discussion, continued encouragement and keen interest through out the period of this investigation.

I am grateful to Drs. B. Pitumani, P. Ghose, K.B. Ramachandran, K.S. Gopalakrishnan, S.N. Mukopadhaya, V.S. Bisaria for their timely help and enthusiastic cooperation, valuable suggestions and also for other friends, Malik R.K., and V.V.P.S Moorthi Izauro for their willing, timely help. V.K. Ghose and Khan are to be thanked for their technical help. Appreciation is also extended to Miss Karla, for her skillful technical help for drawing of the figure and Mr. Rocha, who patiently typed this manuscript.

I also express my gratitude to Prof. J.O.B. Carioca and Harbans Lal, U.F.C., Fortaleza-Brazil, for their valuable suggestions, timely help, keen interest, to bring this manuscript, in earliest time.

*P.V. Pannir Selvam*

P.V. PANNIR SELVAM

CONTENTS

	<u>PAGE</u>
CHAPTER - 1 : INTRODUCTION	1
CHAPTER - 2 : OBJECTIVE	12
CHAPTER - 3 : LITERATURE SURVEY	14
CHAPTER - 4 : MATERIALS AND METHODS	34
CHAPTER - 5 : RESULTS AND DISCUSSION	49
5.1. EXPERIMENTAL APPROACH	49
5.2. CHEMICAL PRETREATMENT	55
5.3. MECHANO-CHEMICAL PRETREATMENT	74
5.4. THERMO-CHEMICAL PRETREATMENT-I	90
5.5. THERMO-CHEMICAL PRETREATMENT-II	103
5.6. COMPARATIVE EVALUATION OF PRETREATMENT	128
5.7. CATALYTIC ORGANOSOLVE PRETREATMENT	156
5.8. REACTION MECHANISM FOR DELIGNIFICATION PROCESS	176
5.9. ENZYMATIC HYDROLYSIS STUDIES	189
5.10. EVALUATION OF CATALYTIC ORGANOSOLVE PRETREATMENT	210
CHAPTER - 6 : SUMMARY AND CONCLUSIONS	225
APPENDIX:	
A - FACTORIAL DESIGN OF EXPERIMENTS	226
B - REGRESSION TECHNIQUES	241
C - EQUATIONS FOR REACTION ON LIGNOCELLULOSICS	247
D - ELECTRON MICROSCOPIC STUDIES	255
REFERENCES	258