

EFFECT OF PROCESS PARAMETERS ON MICROBIAL COMMUNITY PROFILE IN A HIGH CELL DENSITY ANAEROBIC BIOREACTOR

by

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Submitted

in fulfillment of the requirements of the degree of

DOCTOR OF PHILOSOPHY

to the



**INDIAN INSTITUTE OF TECHNOLOGY DELHI
NEW DELHI – 110016, INDIA**

OCTOBER 2013

CERTIFICATE

This is to certify that the thesis entitled “**Effect of process parameters on microbial community profile in a high cell density anaerobic bioreactor**” being submitted by Ms. Kankana Kundu is worthy of consideration for the award of the degree of Doctor of Philosophy. The thesis has been prepared under my supervision and guidance in conformity with the rules and regulations of Indian Institute of Technology Delhi and is a record of the original bonafide research work. The results presented in this thesis have not been submitted in part or full to any other universities or institutes for the award of any other degree or diploma.

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ACKNOWLEDGEMENTS

A Ph.D. student life has never been easy walk but I certainly savoured this experience. During this period, beyond *The Almighty* I derived my inspiration from several sources and now at this moment I want to express my deepest gratitude to all those sources.

I am extremely grateful to my supervisors **Dr. T. R. Sreekrishnan** and **Dr. Shilpi Sharma** for their expert guidance and constant encouragement throughout my project. It would not have been possible at all to complete my thesis successfully without their continuous support and motivation. I am highly indebted to them for their patience and devoting their valuable time throughout my work.

I am very thankful to my SRC committee members Prof. Saroj Misra, Prof. G. P. Agarwal and Dr. Malini Balakrishnan for their valuable suggestions and encouragements during progress meetings and after.

I extend my gratitude toward laboratory support staffs Khan Sir, Kishan sir, Sharma sir, Dahiya sir and Mukesh Anand sir for their timely technical support and cooperation.

I would also like to acknowledge the authorities of Indian Institute of Technology, Delhi for the facilities provided, and All India Council of Technical Education, New Delhi for financial assistance through National Doctoral Fellowship to carry out my research work.

During Ph.D. I also got the opportunity to work at Leibniz-Institut für Agrartechnik Potsdam-Bornim E.V. (ATB), Germany and my indebted thanks to Dr. M. Klocke for giving me opportunity and administrative as well as research support without which it would have not been possible for me to do an extensive amount of work in short research stay. I would like to thank postdoc staff Ingo and Sarah over there for their support, which extended even after returning from Germany. I acknowledge the financial assistantship by German Academic Exchange service (DAAD) for my stay at ATB.

My heartfelt thanks to my seniors for guidance and a long list of ever-helping labmates, friends for their wholehearted support not just in academic activities but also throughout which made my stay in IIT a pleasant memory.

Now I would like to express my deep obligation to my parents, brother and other family members. Their consistent supports have always been the strong push for me.

Finally, an especially profound acknowledgement to my husband Ashish whose forbearance and supports have been invaluable.

Kankana Kundu

ABSTRACT

Lack of knowledge about the microbial consortia involved in wastewater treatment at different operating conditions, is a major cause for failure of anaerobic reactors during field applications. This study was an effort to bridge this gap by correlating the performance of hybrid anaerobic reactor, operating at different process conditions, with the structures of microbial communities, especially, archaea, involved.

The effects of different process conditions - operating temperature, organic loading rate, hydraulic retention time, different carbon sources, and hydrodynamic shear were studied. During variations in process parameters, consistent and reproducible changes observed in the DGGE fingerprinting patterns or relative abundance of methanogens strongly indicate that the structure of microbial communities is specific to the operating conditions of the reactors. More diverse community led to better performance of the reactor towards organic and hydraulic shocks suggesting functional redundancy conferred by higher diversity. Both denaturing gradient gel electrophoresis profile and relative abundance of different groups of methanogens, revealed that *Methanosaetaceae* is most affected by these induced perturbations.

The overall study established that variation in process conditions affect both archaea and bacteria, and a close relationship of microbial communities with reactor performance exist. Besides biochemical characteristics of the effluent, the structure of archaea, especially *Methanosaetaceae*, was found to be a reliable process efficiency indicator to predict system disturbances. Nevertheless, in case of complex wastewater (lipid-rich), bacterial profile should also be monitored to reflect the system status during disturbances. The knowledge derived from this study can be used for conceptualisation of a mechanistic model of the system by including kinetic properties of dominant species under a specific condition, which will help to predict the behaviour of the system for robust control in real field application.

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