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

by

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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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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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