EFFECT OF ALKALI-OZONE PRETREATMENT ON SLUDGE REDUCTION POTENTIAL OF MEMBRANE BIOREACTOR TREATING DOMESTIC WASTEWATER

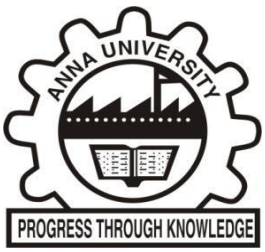
A THESIS

Submitted by

SURESH KARTHIK KUMAR M

in partial fulfillment of the requirements for the degreeof

DOCTOR OF PHILOSOPHY



FACULTY OF CIVIL ENGINEERING

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CHENNAI 600 025

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CERTIFICATE

This is to certify that all corrections and suggestions pointed out by the Indian /Foreign Examiner(s) are incorporated in the Thesis titled " EFFECT OF ALKALI-OZONE PRETREATMENT ON SLUDGE REDUCTION POTENTIAL OF MEMBRANE BIOREACTOR TREATING DOMESTIC WASTEWATER " submitted by Mr. Suresh Karthik Kumar.M

J. Rajesh
Signature of the Supervisor

Place : Tirunelveli

Date :

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Proceedings of the Ph.D. Viva-Voce Examination of Mr.Suresh Karthik Kumar.M held at 10:00 AM on 16.02.2018 in Department of Civil Engineering Regional campus of Anna University Tirunelveli

The Ph.D. Viva-Voce Examination of Mr.Suresh Karthik Kumar.M (Reg. No. 2010110102) on his/her Ph.D. Thesis Entitled " EFFECT OF ALKALI-OZONE PRETREATMENT ON SLUDGE REDUCTION POTENTIAL OF MEMBRANE BIOREACTOR TREATING DOMESTIC WASTEWATER " was conducted on **16.02.2018** at 10:00 AM in the Department of Civil Engineering Regional campus of Anna University Tirunelveli.

The following Members of the Oral Examination Board were present:

1.	Dr. K.N.Yogalakshmi,Assistant Professor,Centre for Environmental Science & Technology,Central University of Punjab ,Bathinda- 151001	Indian Examiner
2.	Dr. S.Chandran,Associate Professor,Department of Civil Engineering,Thiagarajar College of Engineering,Thiruparankundram Madurai 625015	Subject Expert
3.	Dr. Rajesh Banu.J,Assistant Professor, Department of Civil Engineering, Anna University Regional Centre Tirunelveli,Tirunelveli	Supervisor & Convenor

The research scholar, Mr. Suresh Karthik Kumar.M presented the salient features of his/~~her~~ Ph.D. work. This was followed by questions from the board members. The questions raised by the Foreign and Indian Examiners were also put to the scholar. The scholar answered the questions to the full satisfaction of the board members.

The corrections suggested by the Indian/Foreign examiner have been carried out and incorporated in the Thesis before the Oral examination.

Based on the scholars research work, his/her presentation and also the clarifications and answers by the scholar to the questions, the board recommends that Mr.Suresh Karthik Kumar.M be awarded Ph.D. degree in the **Faculty of Civil Engineering**.

16/2/2018

Indian Examiner

Subject Expert 16/02/18

J. Rajesh

Supervisor & Convenor

(J. RAJESH BANU)

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CHENNAI 600 025

CERTIFICATE

The research work embodied in the present Thesis entitled "**EFFECT OF ALKALI-OZONE PRETREATMENT ON SLUDGE REDUCTION POTENTIAL OF MEMBRANE BIOREACTOR TREATING DOMESTIC WASTEWATER**" has been carried out in the Department of Civil Engineering, Regional Centre of Anna University, Tirunelveli. The work reported herein is original and does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion or to any other scholar.

I understand the University's policy on plagiarism and declare that the thesis and publications are my own work, except where specifically acknowledged and has not been copied from other sources or been previously submitted for award or assessment.

SURESH KARTHIK KUMAR M
RESEARCH SCHOLAR

Dr. J. RAJESH BANU
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ABSTRACT

Due to the increase in industrialization and urbanization, huge quantity of water is being used. This in turn produces equivalent quantity of wastewater that needs to be treated before disposal .The treated wastewater needs to meet the disposal standards. Activated sludge process, commonly used treatment procedure produces a huge amount of sludge. This sludge demands a lump sum amount of money for its management. It is known that waste activated sludge is sewage sediment that hosts a heavy growth of microorganisms resulting from vigorous aeration.

Membrane Bioreactors (MBR) represent a newly developed wastewater treatment process in which solid liquid separation happens at aerobic basin itself. As the activated sludge is filtered by the physical barrier of a membrane, effluent does not contain suspended solids and the Mixed Liquor Suspended Solids (MLSS) level can be maintained very high (5000–30000 mg/L). Consequently, it is possible to operate the reactor with less aeration volume and high Sludge Retention Time (SRT). Membrane technology frequently known MBR when employed to treat wastewater generates lesser amount of sludge compared with Activated Sludge Process (ASP). Further the generation of sludge can be minimized by pretreating it before it is recycled back into the system (MBR).

Many experimental works is being carried over on MBR as well as pretreatment till date. The present study is about the effect of Alkaline-Ozone (AO) pretreatment on sludge reduction potential of MBR. A part of the biological solids was disintegrated by combined AO pretreatment. Recycling of the AO pretreated sludge at 1.5% Q (Q =12L/8hrs retention*3=36 L/day)

say 540mL in the Experimental MBR (E-MBR) for the subsequent biodegradation causes an excess sludge reduction of 37%.The excess sludge production in MBRs was constrained by the combined pretreatment method without any detoriation in the treated water quality and membrane performances. The optimized flow of ozone dosage was 0.09 g O_3 / g MLSS and alkali condition (1N of NaOH, pH 11) for combined Alkali-Ozone (AO) pretreatment on waste activated sludge. The above optimized condition of combined Alkali-Ozone (AO) pretreatment on waste activated sludge achieved 40% Chemical Oxygen Demand (COD) solubilization and 30% of Suspended Solids (SS) reduction. The COD removal of Control MBR (C-MBR) is in the range of 95 – 97 % and Experimental MBR (E-MBR) is in the range of 94 – 98 %after a stabilization period of 40 days. It can be concluded that the membrane separation plays an important role in providing an excellent and stable effluent quality

For day 0 to day 60 of operation, the solids concentrations in the Daily Sludge Production ($DSP_{day)}$ of both the MBRs were similar and varied in the range of 5 g/d. While from day 61 to day 120 of operation, there was a significant reduction in solid concentration in the DSP_{day} of 3.1g/d, and this indicates the role of combined Alkali-Ozone (AO) on waste activated sludge pretreatment. The average Yield observed ($Y_{obs)}$value for both MBRs was found to be 0.38 Kg MLSS/Kg COD for day 0 to day 60 of operation and the average Y_{obs} values for the E-MBR and C-MBR were found to be 0.24 Kg MLSS/Kg COD and 0.38 Kg MLSS/Kg COD, in day 61 to day 120 of operation. It was clearly evident that combined alkali-ozone pretreatment on waste activate sludge sample plays an important role in excess sludge reduction.The sludge reduction is increased by 37% by combined alkali-ozone pretreatment on waste activate sludge.