# DISINFECTION OF EFFLUENTS FROM UASB BASED SEWAGE TREATMENT PLANTS USING LIME AND FENTON'S REAGENT

By

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***Submitted***

**in fulfillment of the requirements of the degree of**

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# CERTIFICATE

This is to certify that the thesis entitled " **Disinfection of Effluents from UASB based Sewage Treatment Plants using Lime and Fenton's Reagent**" by **Anju Pant** submitted to the Indian Institute of Technology Delhi, India, for the award of the degree of Doctor of Philosophy in Civil Engineering Department is a record of bonafide research work carried out by him under my supervision and guidance. The thesis work, in my opinion, has reached the standard fulfilling the requirements for the Doctor of Philosophy Degree. The research report and results presented in this thesis have not been submitted in part or in full to any other University or Institute for the award of any degree or diploma.

Dated: 26·03·07

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**Dedicated to**

... My Late Parents &

Dearest Sisters

*...... their sacrifice and support made it happen*

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# ABSTRACT

The presence of pathogens – disease causing bacteria, viruses and other microorganisms, in the effluents discharged by the sewage treatment plants (STP) into the receiving water bodies can cause considerable threat to the public health. Worldwide, more than a billion cases of diarrhea are caused annually, by a number of different pathogens, including *Shigella, Salmonella, Escherichia coli, Campylobacter jejuni* and *Vibrio cholerae*. Generally, the treated or untreated wastewaters are directly discharged into the rivers or the other water bodies. In countries like India, rivers play a pivotal role in common man's life due to social, cultural and religious reasons, thus individuals at large are directly exposed to the prevailing river water quality.

In India, most of the sewage treatment plants are based on Upflow Anaerobic Sludge Blanket (UASB) process. It has been reported in the literature that the UASB based STPs are not efficient for the removal of pathogenic microorganisms. An appropriate disinfection process is required to remove the pathogenic microbes from the UASB effluent to ensure the protection of public health and to minimize the risk from chronic exposure to disinfection by-products (DBPs) prior to its disposal. The present work is focused on developing suitable processes which could be employed post UASB. A full-scale, UASB reactor based STP located in Noida, India, was selected for the present study.

The present study is focused to investigate the application of lime and Fenton's reagent based processes to treat UASB effluents. Both, indicators (fecal coliforms and fecal streptococci) and pathogens (*Salmonella* and *Shigella*) were selected as representative microorganisms for carrying out various inactivation studies. Wastewater samples brought from the 27 MLD NOIDA was used in all the investigations. Before carrying out the comprehensive disinfection investigations, the microbial profiling of the STP was carried out, besides selecting the best culture media which could provide maximum recovery of pathogens from the UASB effluents. A new protocol for the enumeration of microorganisms was also developed by modifying the existing protocol given in the Standard Methods.

Kinetics of inactivation of fecal coliforms, fecal streptococci, *Salmonella* and *Shigella* was studied using both lime and Fenton's reagent. Effect of dose of disinfectants was also evaluated. Besides, inactivation of micro-organisms, removal of other parameters like COD, $BOD_5$, TKN and turbidity was also carried out.

Lower doses of lime and Fenton's reagent were required at shorter contact times for the reduction of pathogenic microorganisms as compared to indicator microbes. The lime dose of 700 mg/L and Fenton's reagent dose of 150 mg/L as $H_2O_2$ were effective for the inactivation of both the indicators and the pathogens at a contact time of 60 minutes. Fecal streptococci were resistant to both lime and Fenton's reagent as compared to fecal coliforms, *Salmonella* and *Shigella.*

Various disinfection kinetic models were fitted to describe the disinfection kinetics. On the basis of survival curves obtained from the experimental data, the Chick and Selleck models were found to be the best to describe disinfection kinetics using lime for all the microorganisms, i.e., the fecal coliforms, fecal streptococci, *Salmonella* and *Shigella.* However, the best fit curve was obtained with Chick-Watson model for indicators and Hom model for pathogens using Fenton's reagent as disinfectant.

Both disinfectants, i.e., lime and Fenton's reagent, were able to meet the requisite microbial discharge standards (1000 fecal coliforms/100 mL) to safe guard the public health. Besides, the wastewater quality in terms of COD, $BOD_5$, TKN and turbidity is also improved using both lime and Fenton's reagent. The requisite volumetric ratio would be 1:2::lime:Fenton's reagent to make the pH neutral before the final discharge. The present study developed a cost effective disinfection process which can meet the required microbial discharge standards.

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