A DISSERTATION

Submitted in the partial fulfilment of the

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of

MASTER OF TECHNOLOGY

In

CHEMICAL ENGINEERING

(With Specialization in Industrial Pollution Abatement)

By

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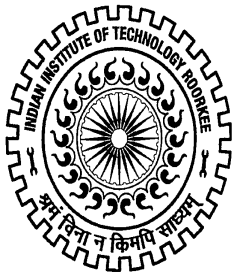

DEPARTMENT OF CHEMICAL ENGINEERING

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CANDIDATE'S DECLARATION

I hereby declare that the work, which is being presented in this dissertation report entitled **A DISSERTATION REPORT ON "REMOVAL OF HIGH FLUORIDE CONCENTRATION FROM INDUSTRIAL WASTE WATER: A COMPARISON BETWEEN ADSORPTIVE AND BIO REMOVAL"** in partial fulfilment of the requirements for the award of the degree of Master of Technology in Chemical Engineering with specialization in **Industrial Pollution Abatement (IPA),** and submitted in the Department of Chemical Engineering of Indian Institute of Technology Roorkee, India, under the supervision of **Prof. C.B.Majumder**, Department of Chemical Engineering, Indian Institute of Technology Roorkee India.

The matter embodied in this interim dissertation report has not been submitted by me for the award of any other degree of this or any other Institute/University.

Date:
Place: Roorkee (**AASH MOHAMMAD)**

CERTIFICATE

This is to certify that the above statement made by the candidate is correct to the best of my knowledge and belief.

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ABSTRACT

The aim of this research work is to design and develop a novel, cost effective strategy for fluoride removal from industrial waste water. This study investigates the feasibility of three low-cost biomass based adsorbents namely: banana peel, groundnut shell and sweet lemon peel for industrial waste water defluoridation at neutral PH range. Action of these adsorbents on fluoride was compared with commercially available adsorbents. It was found to be much better, high removal efficiency at higher concentration (20 mg/l) of fluoride in industrial waste water. The banana peel, groundnut shell and sweet lemon peel removed 94.34, 89.9 and 59.59 % respectively. Contact time for banana peel, groundnut shell, and sweet lemon peel are 60.0, 75.0, and 40 min respectively at doses of 14, 12 and 16 gm/l respectively. Mechanism of adsorption kinetics was found pseudo-second order reaction, and the mechanism of fluoride removal on adsorbents was found to be complex. The surface adsorption as well as intra-particle diffusion contributes to the rate-determining step.

Further study carried out for the comparison between the bio adsorptive removal process and Bio removal process (simultaneous adsorption and biodegradation/bio-accumulation). Generally organic compounds are biodegradable in our environment. But in the case of fluoride, it is an ionic form of atom, it would be accumulated by the bacteria. In our case, fluoride is mainly removed by simultaneous adsorption and bio-accumulation not by simultaneous adsorption and biodegradation. Bio removal study was done on sweet lemon peel because it has very low removal efficiency. Reason for choosing this adsorbent out of three is low removal efficiency so that we can find out the effect of micro-organism on the removal of fluoride easily. Actinobacter is a water living micro-organism which survives in waste water. Micro-organism (Actinobacter) is immobilized on the surface of sweet lemon peel. The size of micro-organism is greater than the pore size of adsorbent so that the removal of fluoride occurred due to the accumulation of fluoride by the bacteria. Adsorption and bio-accumulation process execute simultaneously but mainly fluoride is removed by the bioaccumulation. Active sites of the adsorbent are blocked due to immobilization of micro-organism on the surface of adsorbent.

Different optimizing parameters are studied like adsorbent dose, pH, initial concentration and contact time for bio-removal process. Removal efficiency of fluoride increased from 59.59 % to 94.47 % in optimum condition like contact time (87 h), pH 4.0 and dose 14 g/l for 20 mg/l initial concentration of fluoride. In simple adsorption process removal efficiency was 59.59 % at optimum time (60 min),optimum pH 4.0 and optimum dose 16 g/l. Adsorption isotherm parameters are well fitted for Freundlich whereas simple adsorption follow langmuir isotherm model. Adsorption kinetic model well fitted for pseudo second order for both process but the rate constant is less than the adsorption process. Kinetic result revealed that bio removal is a slower process. Bio-removal process increases the removal efficiency but it is very time consuming and costly as compared to the simple adsorption process.

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NOMENCLATURE

Symbol	Description
q_e	Adsorption capacity
q_t	Adsorption capacity at time ‘t’
C_o	Initial pollutant concentration
C**e**	Concentration of pollutants in solution at equilibrium
V	Volume of solution
M	Mass of adsorbent
K_F	Freundlich Isotherm constants
n	Adsorption affinity
K_m	Saturated monolayer adsorption capacity
K_L	Langmuir Isotherm constant
a, b	Langmuir Isotherm constant
K_1	Pseudo first order rate constant
K_2	Pseudo second order rate constant