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ABSTRACT

DYNAMIC MODELING AND EVOLUTIONARY OPTIMIZATION OF A BIOFILTER FOR BIODEGRADATION OF AMMONIA AND HYDROGEN SULPHIDE

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Detoxification of industrial emissions well below the threshold limit is highly important to eradicate the hazardous effect of the same on humans and environment. Vapour phase biofiltration is a microbial process for the purification of industrial emissions and is one of the best competitive alternatives to the existing physico-chemical and thermal methods. In the biofilter, suitable microbial consortia are embedded on appropriate bedding material and polluted gas is passed through the bed so that microbial consortia could degrade pollutants *[Crit. Rev. Biotechnol. 25,53, 2005].* The microbial process consists of biologically catalysed oxidation reactions at ambient temperatures with increased yields of products like CO_2 and H_2O that require no further treatment or products requiring minimal treatment. The design of a bio-filter relies on low-pressure drop and uniform fluid flow pattern across the bed due to the high surface volume ratio. The bio-filters could be applied for the treatment of variety of industrial emissions if the detailed information concerning the design, operational variables, maintenance procedures and complex microbial processes are well understood.

In this study, a mathematical model for biodegradation of ammonia (NH_3) and hydrogen sulphide (H_2S) is developed and optimized using the recently emerging evolutionary computation that is used to solve real world problems *[Chem. Eng. J. 113, 205,2005].* Proteobacteria, firmicutes and acinetobacteria are used for biodegradation of NH_3 and H_2S in the polluted gaseous mixture with nitrite, nitrate, sulphate and sulfide as metabolites. The parameters of bio-filter like film transfer coefficient, bio-film diffusivity, bio-film thickness, maximum specific biomass growth rate, yield coefficient, initial active biomass concentration, the height of packing material and incoming airflow velocity were optimized, and operating conditions are established *[J. Chem. pharm. res. 7,763,2015].* Simulation results indicate NH_3 removal efficiency of 90-99% with nitrifying and anaerobic ammonia oxidizing bacteria, H_2S removal efficiency of 98-100% with sulphur oxidizing bacteria. These are in good agreement with the experimental results and demonstrated at pilot scale, which helps in the design and operation of biofilters for controlling odorous and hazardous air emissions.

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