

SOLID WASTE MANAGEMENT MODELING : EMPHASIS LANDFILLS

By

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CIRTIIFICATE

This is to certify that the thesis titled, “**Solid Waste Management Modeling : Emphasis Landfills**”, being submitted by Mr. Mohd. Junaid Khalil to Indian Institute of Technology, New Delhi, for the award of degree of Doctor of Philosophy is a record of bonafide research work carried out by him. He has worked under my guidance and supervision and has fulfilled the requirements for the submission of this thesis, which to my knowledge has reached the requisite standard.

The results contained in the thesis have not been submitted, in part or full , to any other university or institute for the award of any degree or diploma.

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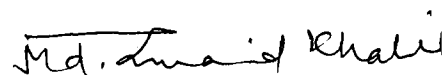
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ABSTRACT

The present work focuses on modeling of solid waste management. Special emphasis is given on landfills. Out of various issues concerning landfills three relevant issues are taken up for investigation in this research. Issues taken up for the study are.

- (i) Modeling and Simulation of Leachate Transport in the Landfills
- (ii) Modeling and Simulation of Methane Gas Migration in the Surrounding Area of a Landfill
- (iii) Modeling and Simulation of Oxygen Transport in the Landfill

Mathematical models for each of the above three studies have been made. These model for the above three situations are non linear partial differential equations (PDEs). For leachate transport model arising out of mass balances on COD and micro-organism in leachate are coupled PDEs. The solution of both PDEs depends on each other. The mathematical model is transformed into numerical model by discretisation . Backward Implicit Numerical Scheme is used for the solution. COD and micro-organism concentrations in leachate at various depths and at various times are predicted. Parametric studies on eleven (11) parameters

have been conducted. In this study it is found that out of these eleven parameters, the kinetic parameters (S_0 , C_m , k' , K_m , k_d , Y , μ_m) have a significant effect on COD and microbes concentrations.

Concentration profiles of microbes and COD obtained are compared with that of published experimental work and are found to be in close proximity with them. The concentration profiles obtained for COD in leachate resembles with that of hydrograph i.e. it has a rising limb, a peak and a recession limb. Likewise in concentration profile of microbes three phases can be identified. First phase in which microbes get acquainted with the environment. Second phase in which microbes multiply and grow. Third phase in which decaying of microbes starts.

For methane migration a study area of 16 m deep and 60 m long adjacent to the landfill is chosen. Transient two dimension model in space arising out of mass balance on methane is developed. The model developed along with the appropriate boundary conditions is solved by Alternating Direction Implicit (ADI) numerical scheme. In this study however, kinetics is not considered and only diffusive and convective transport is taken up. Concentration profiles of methane at various axial distances from landfill with varying time are obtained. Parametric studies on five parameters are carried out. The parameters are initial methane concentration, diffusivity in x direction, diffusivity in z direction, velocity of methane in x direction and velocity of methane in z direction. It is found that methane

concentration decreases with the increase in axial distance from landfill. However with the increase in time it is observed that methane concentration increases. The results obtained are compared with that of published experimental work.

For oxygen transport in landfill model . A transient one dimension in space model is developed. Model along with the appropriate boundary conditions are solved by Backward Implicit Numerical Scheme. Parametric studies on four parameters viz. effective diffusivity of oxygen, velocity of oxygen, kinetic rate constant and porosity of landfill is carried out. It is found that with increase in depth of landfill the oxygen concentration decreases. It is also observed that with the elapse of time oxygen concentration decreases at depths of landfill. The results obtained are compared with the published work and the two are in general agreement.

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