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Research Article

Modelling of reaction kinetics of lead in contaminated soils of Coimbatore district of Tamil Nadu, India

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Summary

The knowledge of kinetics of reaction is critically important for sound prediction of likely outcomes of remediation of contaminated soil. However, there is little information available on the sorption of Pb in soils receiving electroplating effluents and sewage water irrigated practices rich in Pb and other metals. Hence, this experiment was carried out to find out the Pb kinetics behaviour of contaminated soils of various soil types. Detailed investigations were carried out on the modeling on reaction kinetics of Pb in soils of contrasting character found in polluted soils of study area. The results revealed that, Pb required 22 hours to reach equilibrium for all soils irrespective of soil types and fitted well to zero order and second order kinetic equations for six soils under studied than did for first order, third order and parabolic equations.

Key words : Kinetic models, Pb sorption, Polluted soil

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Introduction

Automobile emissions and sewage irrigation are the major sources of lead pollution in the urban environment. Lead, a toxic heavy metal, is introduced into the environment mostly from petrol driven vehicles. Lead comes in the category of those trace elements, which are known to be toxic even when present in traces. Lead in the tetraethyl [$(CH_3CH_2)_4Pb$] form is used as an anti knock additive to gasoline to increase its octane number.

In India, lead concentration that forms a component of inorganic fraction in particulate matter exceed the WHO guidelines of 0.5 mg/m^3 in seven cities *viz*., Ahmedabad, Bombay, Calcutta, Delhi, Hyderabad, Kanpur and Kochi (NEERI, 1995). The health concerns with Pb - contaminated soils arise mostly from plant metal accumulation through soil particles and dust ingestions by humans, especially children (McBride and Bouldin, 1994). Lead poisoning remains one of the most common environmental hazards in spite of good body scientific knowledge on its toxicity and control measures. The clinical manifestations of lead poisoning in adults may present as chronic anemia, general malaise and easy fatigability, kidney failure and brain drainage.

In India, total volume of effluents discharged by the industries was estimated about 131 million gallons per day (Agarwal, 1996). In developing countries like India, over 95 per cent of urban sewage and electro plating effluent as well as bicycle industry effluents containing Pb wastes which are being discharged as untreated into rivers, bays, soil, water and air causes a major human health hazard. Land utilization becomes limited with the outlets of industrial and sewage wastes either directly by the effluents / wastes or by irrigation with polluted water. For better understanding of the dynamics of sorption process, a study of kinetics of these reactions in soil is required. The kinetics of Pb adsorption by soils appears to be slower than for the other ions.

Resources and Research Methods

Description of study area :

Coimbatore is located in the northwestern Tamil Nadu, close to Western Ghats, at 10° N latitude, 77° E longitude and 426.72 m above sea level and has an area of about 109.2 square kilometers. It is the second largest industrial center in Tamil