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某简易垃圾填埋场渗滤液在场底天然土层迁移模拟与长期预测

Numerical simulation and prediction of migration of leachate into natural soil strata under a simple MSW dump

中文关键词：简易垃圾填埋场 有机污染物 渗滤液水位 迁移 对流作用 阻滞因子 长期预测

英文关键词：simple waste dump COD leachate head migration advection retard factor long-term prediction

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中文摘要：

为了解我国早期建设的简易填埋堆场底部天然土层中污染物迁移状况,作者以安徽某填埋场为例,在前期现场勘查、取样和室内测试工作基础上建立了三维有限元分析模型,对宏量有机污染物COD在土层中的迁移状况进行了模拟分析.通过拟合求参获得COD在该场底土层中扩散系数、机械弥散系数和阻滞因子等运移参数的合理取值,在此基础上开展了污染物长期迁移模拟和预测.模拟与分析结果表明,在该场地土层条件和高渗滤液水头条件下,土层的渗透系数和水力梯度对COD迁移深度或水平距离影响最为显著,阻滞因子的影响也不可忽略,而机械弥散系数和分子扩散系数的影响很小.在垃圾堆体中心部位及8 m高渗滤液水头作用下,100年后渗滤液中COD迁移深度达5.4 m,进入深部低渗透性的老粘土层1.4 m.由于垃圾堆体边坡区域下伏土层中水力梯度比较大,100年后COD迁移深度比堆体中心部位的大1.6 m,达到7.0 m.在水平方向上,COD在浅层渗透系数较大的耕植土中水平迁移距离最大,100年后达48.5 m,在深部老粘土层中100年后水平迁移距离为18 m.长期预测结果表明该填埋场深部低渗透性的老粘土层对污染物具有较好的阻隔效果.

英文摘要：

In order to investigate soil contamination under a simple municipal solid waste dump in Anhui, China, 3D finite element models were set up to simulate the migration of COD into the natural soil strata under the waste dump.The simulation was carried out on the basis of previous field and laboratory studies.The model parameters of COD, including retard factor, diffusion and dispersion coefficients, were obtained by back analyses of field investigation results.Long-term simulation was carried out to predict the migration of COD into the soil strata.The simulation results show that advection is the predominant mechanism controlling the migration of COD into the soil strata under this dump with a high leachate head; the effect of retard factor can not be neglected; and the role of dispersion is relatively insignificant.For the central part of the dump with 8 m of leachate head, the migration depth of COD is 5.4 m after 100 years, reaching 1.4 m deep into the relatively impermeable clay layer.For the sloping part of the dump, the hydraulic gradient in the soil strata is relatively large, and the migration depth of COD after 100 years, being 7.0 m, is 1.6 m greater than that for the central part.In the horizontal direction, the migration distance of COD in the shallow relatively permeable soil layer reaches 48.5 m, being greater than that in the deep relatively impermeable clay layer (i.e., 18.1 m).The long-term simulation results indicate that the deep relatively impermeable clay layer is an effective barrier for hindering the migration of contaminants.

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