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能源和环境工程

地下水曝气过程中空气流场的数学模拟

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摘要 地下水曝气（AS）过程中空气流场的数学模拟是现场过程研究的必要手段。利用饱和度与相对渗透率、毛细压力间的关系建立了AS二维非稳态流场的数学模型，用有限元法模拟了复杂流场非稳态二维气相饱和度场、速度场和稳态压力场分布，结果显示气相饱和度随着曝气时间和距曝气井位置的不同而变化。在曝气5 h左右，流场区域稳定。由饱和度的分布确定了空气在地下水中流型为下部U形，上部水平。在本模拟条件下，单井AS的影响区半径为9 m，若修复大面积污染的地下水，宜采用多井曝气的方式，增大其影响区半径。

关键词 数学模拟 地下水曝气 流场 影响区半径

分类号

Mathematic simulation of air flow field in air sparging

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Abstract

Air sparging (AS) is an emerging remediation technique to remove petroleum contaminants from groundwater.The mathematic simulation of flow field is an important method to study the remediation process on-site during air sparging.A two-dimensional mathematical model of the non-steady state flow process was developed based on the AS momentum equation of saturation, relative permeability and capillary pressure.The equation was solved with the finite element method, and the distributions of saturation, velocity vectors and isobars were obtained.The results from simulation revealed that the distribution of air saturation varied with the operation time and the location of sparging well.The required time to form the steady fluid field was about 5 h.The radius of influence(ROI) was 9 m in this simulation condition.Multi-well sparging is recommended to increase the ROI, when remedying a wider area.

Key words mathematic simulation air sparging flow field ROI(radius of influence)

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