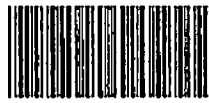


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博士論文

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溶質在土壤中流散之推估
Prediction on Solute Dispersion
in Soils

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摘要

混合取代用途甚廣，對於溶質流散、鹽分移動，採用流散方程式可預估的非常準確。問題是應用本項技術有三個先決條件要先滿足：第一是在試驗前，土壤中必須不含使用之追蹤物，故需事前淋洗，頗費時日。其次是預估流散係數必須另做一條無反應之突破曲線，故得再做一次輔助試驗。最後是預估有反應之突破曲線需加入交換方程式，而交換方程式之確立，尚需實驗求得。

本研究即嘗試利用數學推導及應用熱力學原理，處理以上三項先決條件，得以免除繁複之輔助試驗及測定。試驗結果顯示，三種土壤含原追蹤物之濃度不高，不淋洗亦可直接由突破曲線計算得流散係數，其公式為

$$D = \left(1 - \frac{B}{R}\right)^2 \frac{L}{\pi} \bar{v}$$

流散係數求得後，交換方程式中之K可應用熱力學原理計算，其公式：

$$\Delta \bar{G}^0 = \Delta \bar{H}^0 - T \Delta \bar{S}^0$$

及

$$\Delta \bar{G}^0 = -RT \ln K$$

至於另一參數c，可以電化學理論推測：

$$c = \exp\left(-\frac{zF\psi + \Phi}{RT}\right)$$

配合電腦程式模擬，即可充分描述溶質在土壤中之流散現象。

Summary

The miscible displacement technique has been applied in many fields of study. Solute dispersion through a porous medium can be accurately predicted by the dispersion equation. However, there are three requirements must be met while using this technique: (1) the porous medium should contain no tracer element, (2) it requires a nonreactive breakthrough curve for determining the dispersivity, D , and (3) it is necessary to establish an exchange function if there are interactions between the porous medium and the tracer. The miscible displacement technique is, therefore, a time consumed process. The application through mathematical and thermodynamic treatments is used in this research in order to simplify the process..

The result shows that three soils though contain a few tracer element can still predict the dispersivity, D , very well as follows

$$D = \left(1 - \frac{B}{R}\right)^2 \frac{L}{\pi} \bar{v}$$

Finally, thermodynamics and electrochemistry are used to find the parameters K , c in the exchange function by the following equatios:

$$\Delta \bar{G}^0 = \Delta \bar{H}^0 - T \Delta \bar{S}^0 ; \Delta \bar{G}^0 = -RT \ln K$$

and

$$c = \exp\left(-\frac{zF\psi + \Phi}{RT}\right)$$

which is needed to predict the solute dispersion phenomena in soils.