摘　要

我國一般廢棄物衛生掩埋場設置規範中，規定掩埋場需要設置黏土或地工止水膜(geomembrane)等襯底系統，以阻隔掩埋場滲出水污染到周圍環境。地工止水膜是不透水的非極性物質，但有機溶劑可能藉由擴散作用浸透(permeation)地工止水膜；尤其國內許多事業廢棄物亦利用掩埋方式處理，其滲出水中之有機溶劑成分，對於地工止水膜之化學浸透性影響將不容忽視。

本研究使用 ASTM F739 標準測試方法(Standard Test Method)，探討垃圾滲出水中常含有的氯化碳氫化合物二氯甲烷、1,2-二氯乙烷、三氯甲烷、三氯乙烯及芳香族碳氫化合物苯、甲苯、乙基苯、苯乙烯等有機溶劑，在高密度聚乙烯(High Density Polyethylene，HDPE)地工止水膜之浸透現象。結果顯示穩定浸透速率，分別與有機溶劑之分子量($r=0.668$，$p<0.001$)及亨利常數($r=0.622$，$p=0.001$)有顯著相關。同時，利用 Fick's Law 建立之質傳模式，得到有機溶劑在 HDPE 的擴散係數(diffusion coefficient)及溶解度(solubility)，可適當地模擬浸透試驗數據。

最後，統計分析浸透試驗之擴散係數及溶解度，結果顯示其與有機溶劑的分子量和極性有顯著相關；並利用複迴歸分析，建立擴散係數及溶解度之經驗式。未來可利用此迴歸經驗式，預測有機溶劑在 HDPE 之擴

散係數與溶解度，進而模擬垃圾滲出水的浸透濃度，以評估垃圾衛生掩埋場的污染潛勢。

關鍵字：地工止水膜(geomembrane)、**浸透**(permeation)、ASTM F739 **標準測試方法**(ASTM F739 Standard Test Method)、**高密度聚乙烯**(High Density Polyethylene，HDPE)、**擴散係數**(diffusion coefficient)、**溶解度**(solubility)

ABSTRACT

Current waste disposal regulations require municipal and hazardous waste landfills to be lined with clay or geomembranes to prevent the transport of leachate from the landfill into the surrounding environment. Geomembranes are nonpolar materials and are impermeable to liquids. Organic solvents in the leachate may permeate the geomembrane by diffusion. Especially many industrial wastes in Taiwan are also treated by landfill. There are various composition of organic solvent released from the leachate and the influence of permeation and diffusion characteristics of geomembrane has taken on a greater important.

In this study, permeation experiments using the ASTM F739 method were conducted to investigate the permeation of eight neat organic solvents, such as dichloromethane, 1,2-dichloroethane, chloroform, trichloroethylene, benzene, toluene, styrene, ethyl benzene, through High Density Polyethylene (HDPE). The result of the steady state permeation rates was found that highly correlated to their molecular weight ($r=0.668$, $p<0.001$) and Henry's Law constants ($r=0.622$, $p=0.001$).

Moreover, the diffusion coefficients were estimated by a one-dimensional diffusion equation based on Fick's second law, and the solubilities of the solvents in HDPE were determined by the steady state permeation rates. The one-dimensional transient model was able to simulate the permeation concentrations and implied that equilibrium partition between organic solvent and HDPE geomembrane was not achieved during the initial permeation. The solubilities of organic solvents in the HDPE geomembranes obtained by immersion tests were not an appropriate boundary condition for permeation

simulation.

Finally, it was found that the diffusion coefficients and solubility of organic solvents were significantly correlated to their molecular weight and polarity. Used to multiple regressions to establish an empirical model for diffusion coefficients and solubility. These empirical models can be a basis to simulate the permeation of landfills leachate through HDPE geomembrane. This study will provide information on the extent of hydrocarbon permeations in HDPE geomembranes as applied in evaluation the potential pollution of landfills.

Keywords: geomembrane, permeation, high density polyethylene (HDPE), ASTM F739, diffusion coefficient, solubility

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