地下水の塩素化有機物塗布ステージと分析の調査と評価を確認するために、異なるサンプリング方法
Evaluation of Different Groundwater Sampling Methods in the Investigation of Chlorinated Hydrocarbons in heterogeneous aquifers

CHEN YICHIEH[1]、*Dong Dong-Hsing [2]
YICHIEH CHEN[1], *Dong Dong Hsing [2]

1.霖昌工程有限公司、2.瑞昶科技股份有限公司
1.Geophysical Technology & Engineering Co., Ltd, 2.Apollo Technology Co., Ltd

Geological heterogeneity affects the diffusion of chlorinated hydrocarbons between high and low permeability strata in groundwater plumes. Because of the concentration gradient, solutes in the low permeability zone will back-diffuse into the high permeability zone, leading to the phenomena of “tailing” and “rebound”. However, these small but significant effects are often ignored, and the resulting mistaken mass transfer coefficient can cause erroneous assessments of the concentration distribution in low permeability zones. There are two parts to this study. One part is the correlation analysis of the concentrations obtained by the common sampling methods (micro-purge sampling and bailer sampling) for the chlorinated alkenes and chlorinated alkanes in 35 monitoring wells. The other part includes case studies to evaluate the use of three standard sampling methods (micro-purge sampling, bailer sampling and passive-diffusion bag sampling) for the analysis and comparison of heterogeneous aquifers.

Based on the results of three statistical hypothesis tests (t test, Z test and F test), there were no significant differences between bailer sampling and micro-purge sampling. The results thus show that both methods have a high correlation with regard to chlorinated alkenes and chlorinated alkanes (r=0.79~0.99), with the differences between them likely to be due to variations in the location depth and degree of disturbance. The major flow mechanism during bailer sampling and micro-purge sampling is influenced by advection, and the water that is obtained with both methods is mainly from the high permeability zones. Therefore, the correlations between these two sampling methods with regard to the measured concentrations were high. If the geological heterogeneity is more complex, or the high and low permeability zones show complicated inter-bedding, then bailer sampling and micro-purge sampling will erroneously estimate the actual contamination conditions, especially for the pollutants that have diffused into the low permeability zone. Due to the flow mechanism of diffusion, passive-diffusion bag sampling can better reflect the distribution of contaminants in both high and low permeability zones. To ensure the validity of the data, the sampling bags should be in place for at least 14 days, and the necessary precautions taken to prevent interference during this period of time.

Based on hydrogeology and geological heterogeneity, this study suggests that it is necessary to adopt comprehensive strategies, such as a combination of simple well investigations, monitoring well investigations (to examine sandy aquifers, gravelly aquifers, distinct inter-bedding, and so on), deep monitoring well investigations (with the water level or sampling depth exceeding 40 meters) and investigation evaluations (or remediation evaluations). With the use of appropriate sampling methods and investigation techniques, it is possible to reduce the probability of erroneous estimations, and determine the distribution of actual contamination in both high and low permeability zones, as well as the possible pollutant sources.

キーワード：塩素化炭化水素、地質異質、拡散、サンプリング方法、仮説検定
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