Environmental risk assessment on soil and groundwater contamination measure

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The issue of the soil and groundwater contamination, it is not because the existence of the contaminated soil or groundwater in the environment. The problem is that the contaminants in the environment can cause possible adverse effects to the human health or the living environment, i.e. there is environmental risk. In this paper, based on the concept of the Risk-Based Corrective Action (RBCA), which was developed in the United States, soil and groundwater contamination countermeasures are discussed focused on reducing the environmental risk on the site.

The example site is that the soil and the groundwater are contaminated by the trichloroethylene (TCE), TCE infiltrated into the sand aquifer, which exists below the ground from GL-5m to GL-10m. Planar distribution of the TCE source is 3mx3m. The hydraulic conductivity of the aquifer is 2.5E-3 cm/s and the dynamic gradient of the groundwater flow is 0.005. The average TCE concentration in the groundwater at the source is assumed to be 100 mg/l (about 1/10 of the saturated concentration of TCE in water). The receptor of the environmental risk is the residents that using groundwater as portable water, this actual point of exposure (POE) is about 300 m away at the groundwater down-gradient from the source. The potential POE is supposed to be the down-gradient boundary of the plant, where resident may use groundwater as portable water in the future and the distance from the source to this boundary is 100m.

After RBCA Tire 2 risk assessment considering lateral transport and attenuation of the contaminant, risks to either the actual receptor or the potential receptor exceed the target risk of carcinogens, 1E-5, which indicates remediation measures need to be taken on this site.

The first evaluated case 1 is targeted to ensuring the risks to the residents at the actual POE and/or potential POE are lower than the target risk. Evaluations are performed to decide the reduction targets of the TCE concentrations in the groundwater at the source. Target concentrations are evaluated respectively by considering the risk to the actual receptor and potential receptor. However, though the risk caused by the source contaminant of TCE can be controlled at this stage, it is possible for cis-DCE to exceed its target risk at POEs because of the natural anaerobic degradation.

In case 2, BIOCHLOR, which can calculate a sequential first-order decay of the dissolved contaminants, is used to evaluate the concentration of the TCE degradation product cis-DCE, and the target TCE concentration at the source is set up to ensure that environmental risks caused by TCE and cis-DCE will meet their target risks respectively. The result of this example is that, when TCE concentration at the source is lower than the target concentration with considering the potential receptor risk in case1, cis-DCE at down-gradient POEs will not exceed its target risk. However, if TCE concentration at the source is just treated to meet the target concentration with considering actual receptor risk in case 1, risk caused by the daughter product of the cis-DCE possibly exceeds its target risk. Under such condition, further reduction of the TCE concentration at the source area is necessary.

As a summary, countermeasures to the soil and groundwater contamination and their implementation can be evaluated on environmental risk assessment. The risk reduction of the countermeasures can be quantitatively evaluated. However, to perform such risk assessment, it is important to develop a simple but representative model of the subsurface environment where transport of the contaminants occurs, and also it is essential to decide the related physical, chemical and biological parameters.