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Simulation and Prediction of Natural Restoration for Arsenic-Contaminated Site

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Contaminated soils typically possess self-healing capabilities, and the ecological concept of emphasizing natural restoration with supplementary artificial reinforcement has gained widespread acceptance. An investigation was conducted into the arsenic pollution status at an abandoned arsenic factory site in southern China. After identifying the spatial distribution characteristics of arsenic in the soil, indoor soil arsenic dissolution experiments were conducted under different conditions to obtain chemical kinetic parameters during desorption. A relationship model between desorption amount and time was established based on simulation results using Phreeqc. This model aims to predict the natural attenuation of soil arsenic based on natural restoration. The results indicate severe arsenic contamination in the original waste heap soil, with arsenic content reaching 181-283mg within 20cm below the surface in certain local areas. However, high concentrations of arsenic pollutants are mainly concentrated in the depth range of 30-60cm below the surface. This suggests that under the driving force of atmospheric precipitation, arsenic from the original waste heap infiltrates into the soil below the surface of 30-60cm. Due to the transformation of the soil from an oxidizing environment to a reducing environment, arsenic continuously accumulates, forming a relatively stable secondary pollution source that still poses a risk of groundwater contamination. The results of desorption simulation experiments using local normal rainfall and acid rain (pH=4.6) show that normal atmospheric precipitation can only desorb approximately 40.7% of the arsenic in the soil. It would take an additional 16.25 years to bring the arsenic concentration in the contaminated site to the second-level standard limit of soil environmental quality. Under acid rain conditions, the dissolution rate of arsenic can reach 65.4%, and considering the local annual acid rain rate, the arsenic concentration in the contaminated site can meet the second-level standard limit of soil environmental quality within 13.09 years.

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