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The Development of Treatment Process Technology for Uranium Electrokinetic Leachate

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1. Introduction

When electrokinetic treatment technology is applied toward the decontamination of uranium-contaminated soil, a great deal of leachate is generated. That is, about 4 to 5 drums of leachate are generated for the decontamination of one drum of radioactive soil using the electrokinetic equipment shown in Fig. 1. Therefore, the development of a treatment process for electrokinetic leachate is needed for a reduction of leachate waste volume. Optimal experimental conditions for precipitation and filtration were selected based on many experimental attempts.

1. Methods and Results

Fig. 1 shows the improved size of the electrokinetic equipment. A large volume of uranium electrokinetic leachate was generated during the electrokinetic decontamination experiment to remove uranium from radioactive soil.

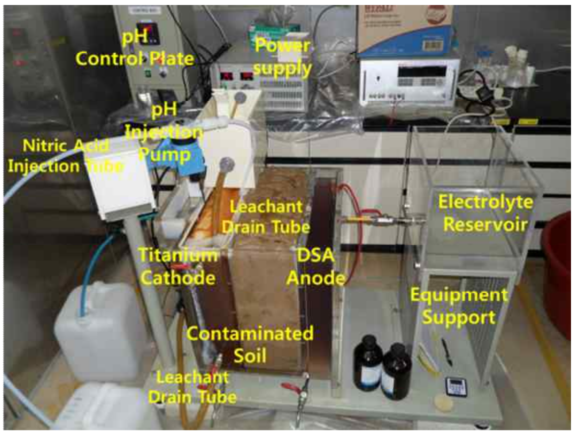

Fig.1 Electrokinetic equipment for soil decontamination

The main process in the treatment of generated leachate is considered to be precipitation and filtration. Sodium hydroxide, calcium chloride, and calcium hydroxide can be used as a precipitant. When sodium hydroxide is put into the uranium leachate, the precipitation time is shorter and the supernatant volume is larger, as shown in Fig. 2. Therefore, sodium hydroxide was selected as the precipitant.

Fig. 2 Precipitation experiment of uranium leachate with cohesive agent

Fig. 3 shows the concentrations of the main metals in uranium electrokinetic leachate generated during electrokinetic decontamination. The concentration of uranium in the generated leachate is 180 ppm. The concentrations of the other metals are 20 to 1,210 ppm.

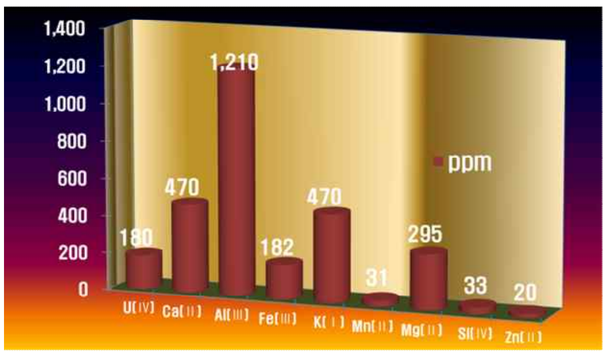

Fig.3 Concentrations of the main metals in uranium electrokinetic leachate

Sodium hydroxide is frequently used for the precipitation of metals in leachate. For an estimation of the removal efficiency of uranium from uranium leachate, sodium hydroxide is used as a precipitant and aluminum sulfate is used as a cohesive agent. Also, in order to increase the particle size of the precipitate, ferric hydroxide, magnetite, and poly acryl amide are used as a cohesion additive agent, and their cohesive capacity is estimated.

The size of the precipitate particle was documented using an SEM (Scanning Electron Microscope, JSM-5200). As the average particle size of the precipitate increases, the removal efficiency of uranium from the leachate precipitate though filtration also increases. Table 1 shows the change in cohesive particle size based on the chemical species at pH 9 and 0.2g/100ml alum. The results of the above filtration experiments show that a mixture of NaOH+alum+0.15g magnetite is an optimal precipitant for filtration due to its bigger particle formation.

Table 1 Cohesive particle size changes based on the chemical species at pH 9 and 0.2g/100ml alum

Label number	Chemical species	Cohesion Size range(μm)	Cohesion Average size(μm)	Cohesion Shape	Precipitation ratio
1	$Ca(OH)_2$	none	0.5	Cakes	0.75(slow)
2	NaOH	100-200	150	spear shaped and sharp	0.75
3	NaOH+Magnetite0.15	300-500	350	sharp	0.75
4	NaOH+$Al_2(SO_4)_3$+Polymer0.1	300-500	350	polygon	none
5	NaOH+$Al_2(SO_4)_3$+Polymer0.2	300-500	400	polygon	none
6	NaOH+$Al_2(SO_4)_3$+Polymer0.3	500-700	500	polygon	none
7	NaOH+$Al_2(SO_4)_3$+Magnetite0.05	500-1000	550	sharp and polygon	0.7
8	NaOH+$Al_2(SO_4)_3$+Magnetite0.15	500-1000	600	sharp and polygon	0.7
9	NaOH+$Al_2(SO_4)_3$+Magnetite0.3	250-500	400	sharp and polygon	0.7
10	NaOH+$Al_2(SO_4)_3$+Ferrite0.05	300-500	350	sharp and polygon	0.7
11	NaOH+$Al_2(SO_4)_3$+Ferrite0.15	500-800	450	sharp and polygon	0.7
12	NaOH+$Al_2(SO_4)_3$+Ferrite0.3	500-1000	500	sharp and polygon	0.7

2. Conclusions

The concentration of uranium in generated uranium electrokinetic leachate was about 180 ppm and the concentrations of Mg(II), K(I), Fe(II), and Al(III) ions were high When sodium hydroxide was put into a uranium leachate as a precipitant, the precipitation time was shorter and the cohesive particle size bigger in comparison with calcium hydroxide and Calcium chloride.

Because bigger precipitate particles during filtration demonstrate a high removal efficiency for uranium, the average particle **s**izes of a precipitate with NaOH+alum+0.**1**5g magnetite is **6**00 µm, and the mixture of NaOH+alum+0.15g magnetite is more profitable than other chemical species, as shown in Table 1. Results of our precipitation experiments showed that a mixture of NaOH+alum+0.15g magnetite is an optimal precipitant for filtration.

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