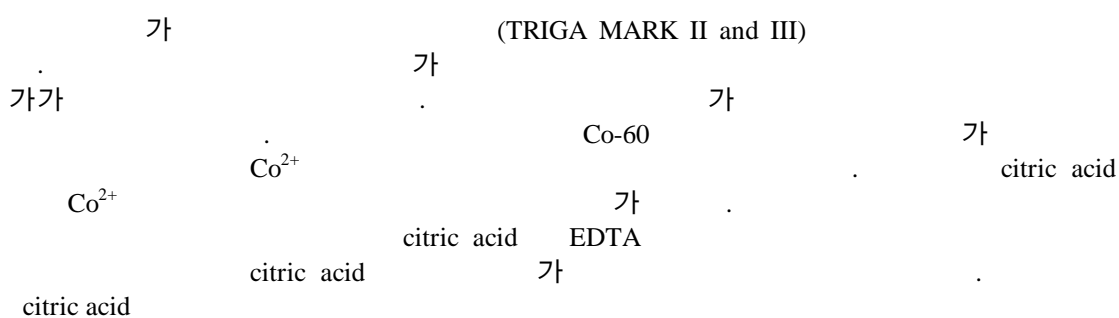


Decontamination of Soil from the Research Reactor Site

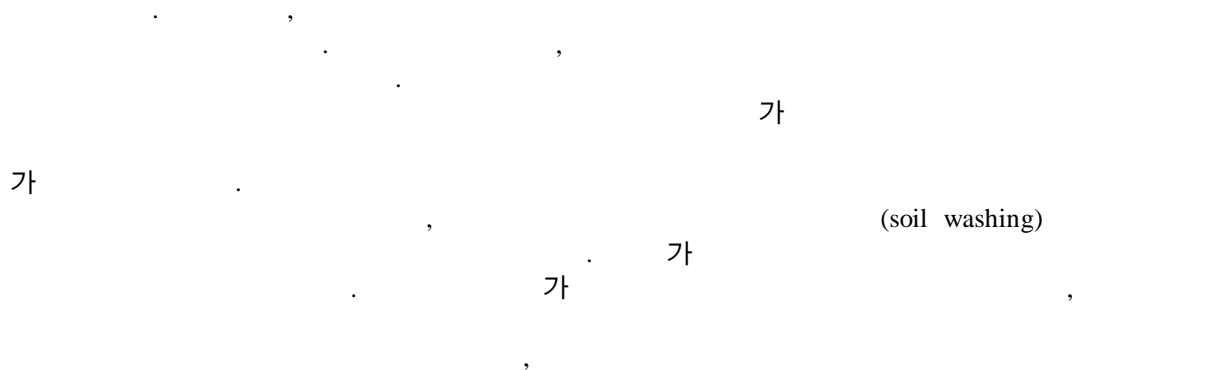
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Abstract

The two research reactors (TRIGA MARK II and III) in Korea are to be decommissioned in the near future. When the reactors are completely dismantled, the site may remain contaminated due to the long period of operation. We assume that the site is radioactively contaminated by Co-60. Soils gathered from the research reactor site were artificially contaminated with Co²⁺ ion. The desorption characteristics of Co²⁺ ion from the soil surface by citric acid solution were investigated. Decontamination performances of citric acid and EDTA on soil stored in the radioactive waste drums was examined. The feasibility test of recycling the citric acid was also performed. We concluded that the radioactive waste volume could be reduced significantly by soil washing with a citric acid solution.

1.



[1]. 가 가

가

EDTA, NTA[2], DTPA, oxalic acid citric acid

[3].

가

, citric acid

Co²⁺

citric
가

EDTA

citric acid

2.

가. Co²⁺

TRIGA MARK III

2mm(10 mesh)

pH 5

1 M sodium acetate

20 % hydrogen peroxide

[4]. X- (Model; SIEMENS SRS 303)

Si,

Al, K, Na

100 g

0.01M Co²⁺

250 ml

25 °C , pH 5.4

48

(25 °C).

10 g

0.05 M citric acid 250 ml

pH

HNO₃

NaOH

가

25 °C

shaking water bath

24

4000 rpm

10

0.2-

μm Whatman polyethylenesulfone

Co²⁺

(PERKIN ELMER, model; AAnalyst 300)

Co²⁺

(f)

$$f = (V \cdot C_{Co}) / (\cdot W_s) \quad (1)$$

(Co²⁺ , V (L), C_{Co} Co²⁺ (M), Co²⁺ / (g) W_s (g) . Distribution Ratio Rd

$$Rd = \frac{\text{Co}^{2+} \text{ ion concentration in soil}}{\text{Co}^{2+} \text{ ion concentration in solution}} = \frac{\text{ml}}{\text{g}} \quad (2)$$

1988

Co-60

가 60 mesh (0.25 mm) 10 mesh (2 mm)
 가 0.25mm 10 g 100 ml
 EDTA citric acid
 0.01 M 3
 Ge-detector (Canberra, Model GC 3019)) γ -spectroscopy (Multi-channel
 Analyzer(Canberra, Model 2024) 100,000
 1 Fe-59, I-131 Mn-54

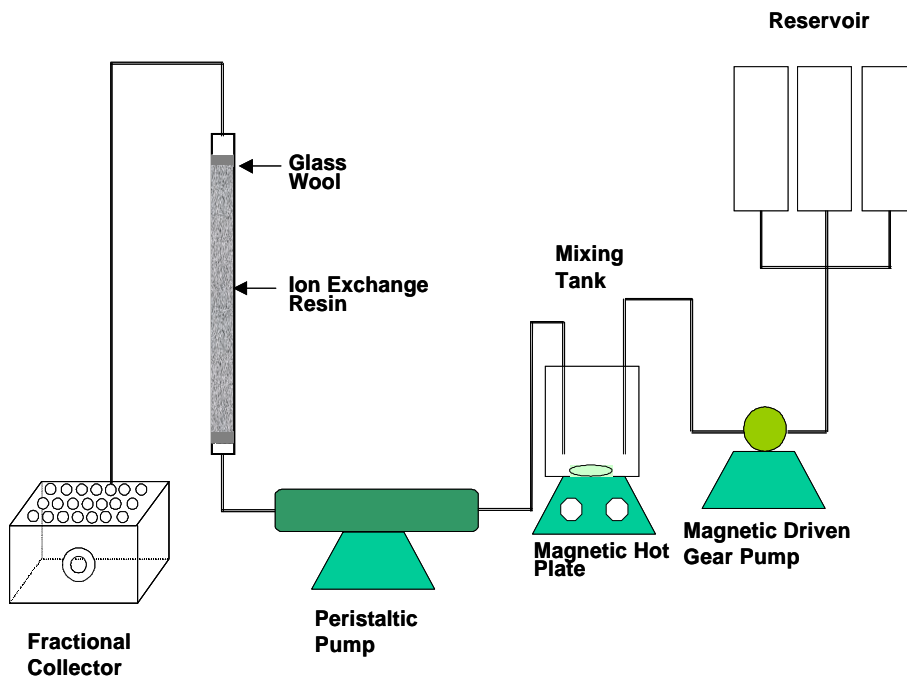
batch column test Batch
 citric acid 0.05 M, Co^{2+} 0.0006 M, Fe^{3+}
 0.004 M 90 mL IRN-77 0.3, 1.0, 3.0,
 6.0, 9.0 g 가 Co^{2+} , Fe^{3+} citric acid Column test
 swelling 4.1cc (Co^{2+} 2.7 X 10⁻⁴ M, Fe^{3+} 1.4 X10⁻³
 M, Ca^{2+} 1.2 X 10⁻³ M, Mg^{2+} 2.3 X 10⁻⁴ M 0.05 M citric acid) 1ml
 citric acid Column test
 1 (PERKIN ELMER, model; AAnalyst
 300) , citric acid US EPA dichromate reactor digestion
 citric acid

1.

Soil Particle Diameter	Radionuclide	Radioactivity (Bq/kg)
0.25 – 2 mm	Cs-134,137	60.3 ± 1.5
	Co-60	386.8 ± 4.7
	Cr-51	< 5.2
	Fe-59	< 3.1
	I-131	< 0.3
	Mn-54	< 1.5
	K-40	1314.0 ± 85.6
0.25 mm >	Cs-134,137	139.6 ± 6.2
	Co-60	1159.5 ± 7.8
	Cr-51	< 6.2
	Fe-59	< 4.7
	I-131	< 1.3
	Mn-54	< 3.1
	K-40	1272.6 ± 78.4

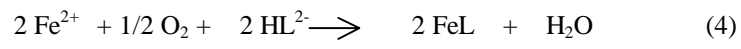
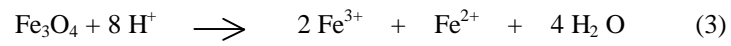
3.

가. Co^{2+} 24 Co^{2+} Fe^{3+} 2
 25°C Co^{2+} Co^{2+} pH 가 가 가
 EDTA Co^{2+} [4] , Co^{2+} 가 가 가
 pH 가 Fe^{3+} 가 Fe^{3+} [5]
 Citric acid 가 Fe^{3+} 3
 pH



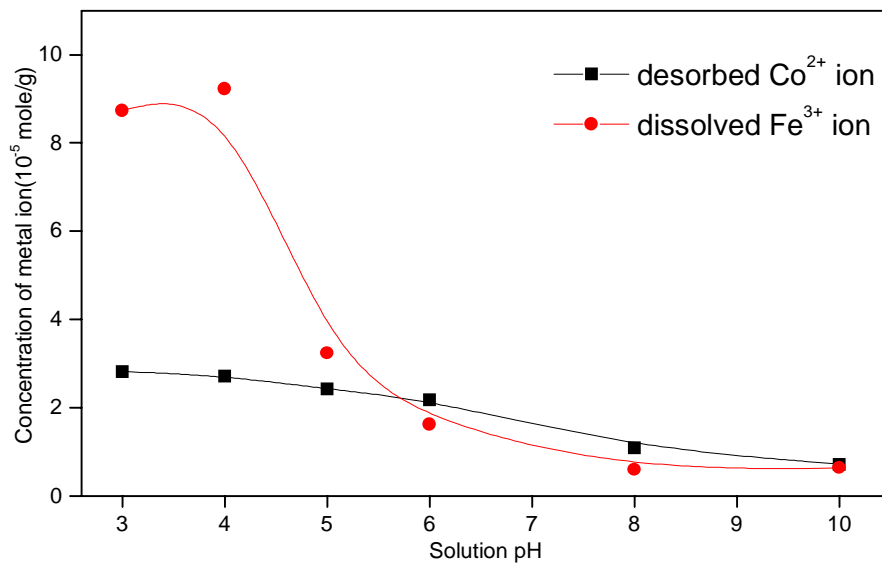
1.

citric acid 0.05 M Fe^{3+} 0.01M
 $\text{Fe}(\text{OH})_3$ Fe_3O_4 가
 FeL



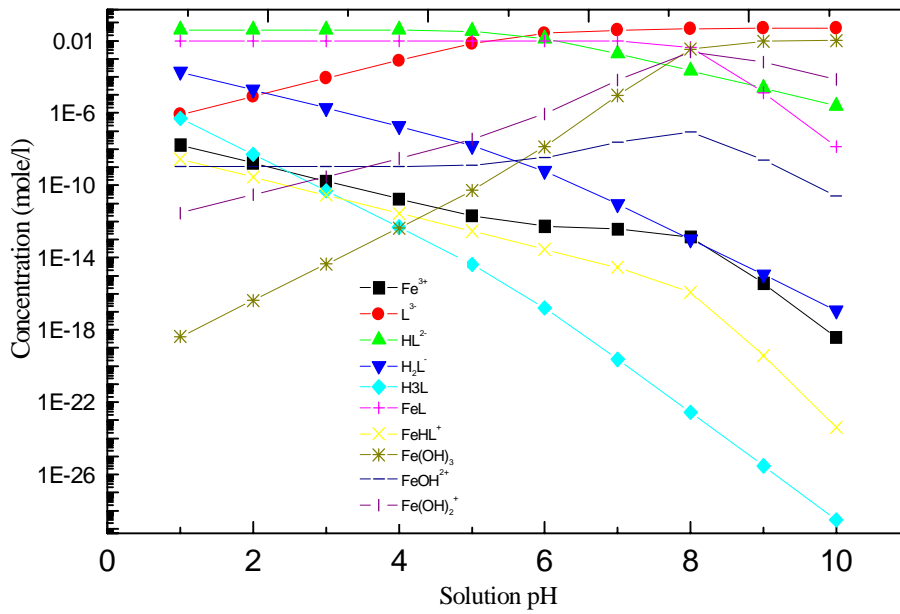
Citric acid

Co^{2+}



2.

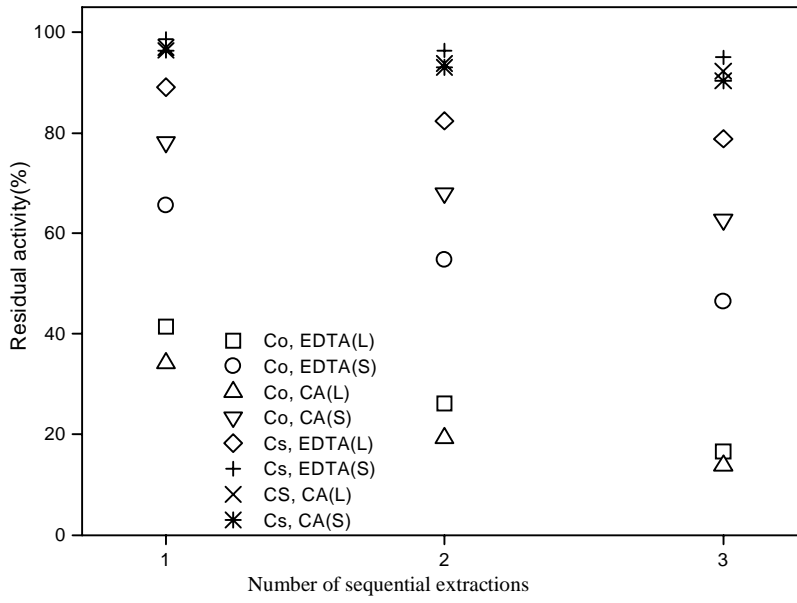
(25 °C, 24).



3. 0.05M citric acid ([Fe³⁺] = 0.01M, H₃L = citric acid, at 25⁰C)
 가

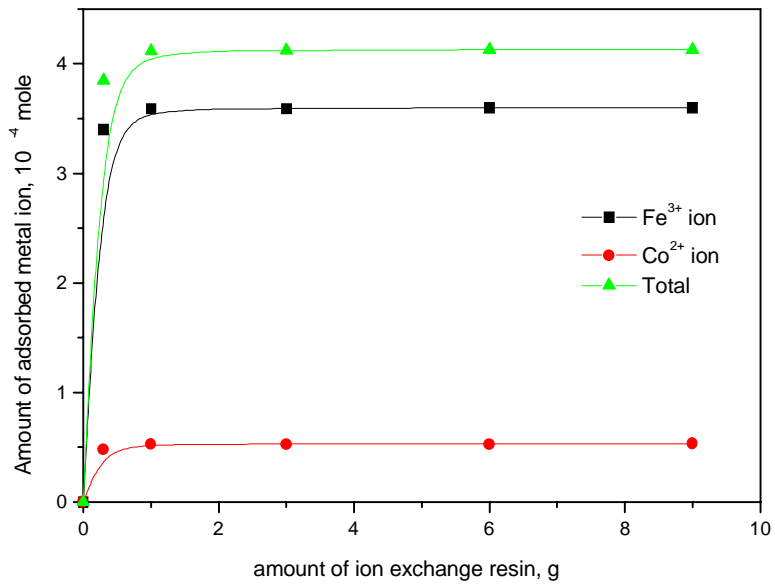
3

(Co-60, Cs-134, 137, Cs 가 가)
) Co EDTA Co (Cs (0.25 - 2mm) Cs
 citric acid EDTA citric acid 가 , TRIGA 3
 (0.25mm >)
 17 %
 0.4 Bq/g
 90 %
 EDTA Cs-134, 137 가 , citric acid



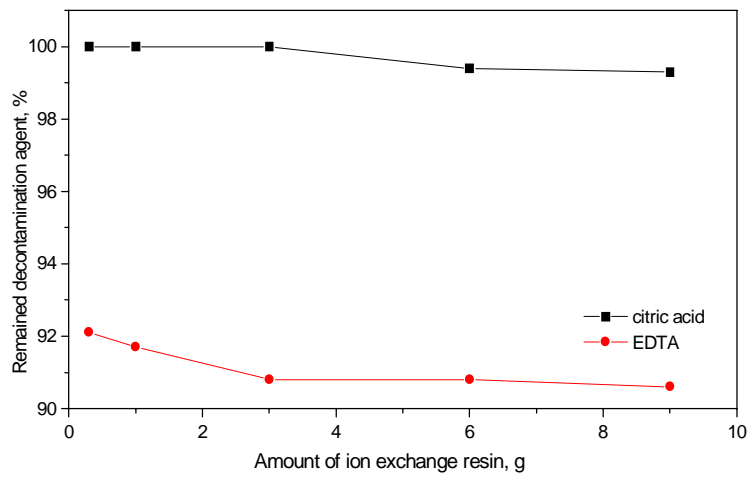
4. 3
 ([EDTA], [CA] = 0.01M, pH=4 at 25 °C).

Co²⁺ 0.0006 M, Fe³⁺ 0.004 M 가 0.05 M citric acid 90 ml
 가 가
 1g 5
 18 g 6
 batch
 acid 99.5 % free EDTA 90 % Citric EDTA EDTA
 citric acid
 citric acid



5.

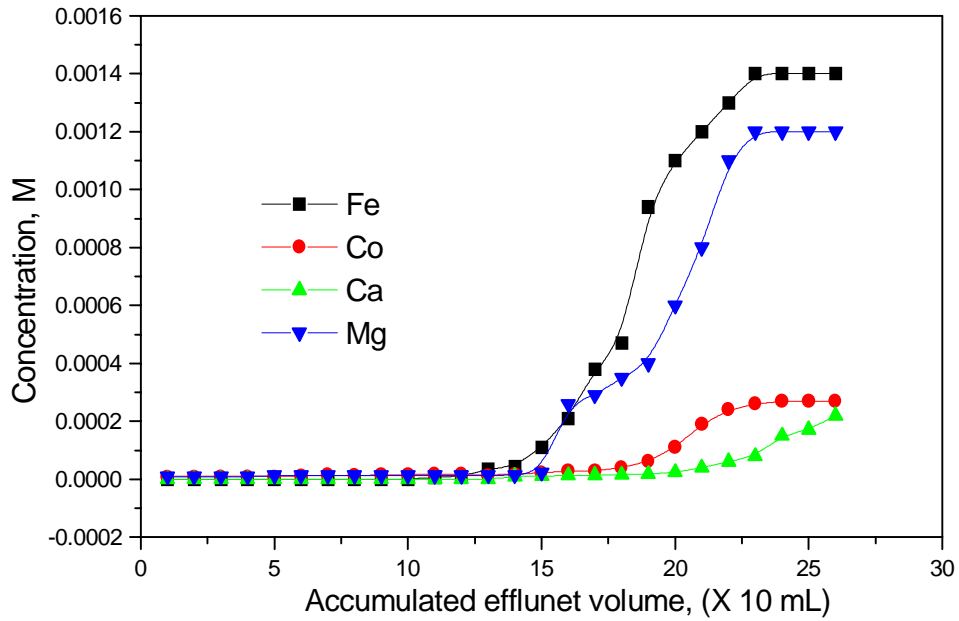
(0.05 M citric acid 90 ml).



6.

..

10^{-3} M, Ca^{2+} 4.1cc 가 Co^{2+} 2.7×10^{-4} M, Fe^{3+} 1.4
 10^{-3} M, Mg^{2+} 1.2 $\times 10^{-3}$ M, 2.3×10^{-4} M 0.05 M citric acid 7



7.

Co^{2+} , 180 mL 가 가 180 mL
 150 mL 40 ppm

4.

citric acid , citric acid EDTA

가

, citric acid 99.5 % 가

- [1] DOE , 100 Area Soil Washing Bench Scale Tests, DOE/RL-93-107, Washington(1994).
- [2] M. V. Hidalgo, N. E. Katz, A. J. G. Maroto and M. A. Blesa, “ The Dissolution of Magnetite by Nitroacetateferrate(II)”, *J. Chem. Soc., Faraday Trans. 1*. Vol. 84, No.1(1988).
- [3] AECL, The Thermodynamics of Metal Oxides in Water –Cooled Nuclear Reactors, AECL-4140, Manitoba(1973).
- [4] , , , , , “ EDTA Co^{2+} ”, , 16 , 3 (1999).
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