Decomposition of EDTA in a Simulated Radioactive Waste Solution By the Fenton Reaction

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1. Introduction

EDTA(ethylenediaminetetraacetic acid-2Na) is used as a decontamination agent in the nuclear industry. Although EDTA is a good decontamination agent, it creates a fast migration problem in an underground area when it forms a complex with a radionuclide. Therefore, EDTA must be decomposed of before a radioactive waste solution is stored at a disposal site.

In this study, decomposition characteristics of a high concentration of EDTA by the Fenton reaction is investigated.

2. Methods and Results

In this section, experimental procedures and the test results are described.

2.1 Methods

0.001 M of an EDTA solution was made by dissolving EDTA in the second distilled water. 30 vol % of a hydrogen peroxide solution was used, and the concentration of the Fe^{2+} ion was 0.001 M. All the chemicals used were from Junsei Chemical Co. Ltd.

The reflux condenser was installed in a 500ml flask. During the test, the solution was stirred for a maximum 2 hours. The solution pH was fixed at 3.5. The optimum experimental condition was determined by varying the H_2O_2 concentration, time, temperature and the Fe^{2+} ion concentration. The amount of decomposed EDTA was determined by the chelate back titration method.

2.2. Results

Fig.1. shows the plot of the decomposition percentage of EDTA against the amount of hydrogen peroxide at 25℃. As the amount of hydrogen peroxide was increased to 5 ml, the decomposed % of EDTA was increased. After that, there was no increase. The optimum amount of added hydrogen peroxide was 5ml at 25℃. Fig.2. shows the plot of the decomposition percentage of EDTA with respect to the amount of the additional ferrous ion at 25℃. As the amount ferrous increased, decomposition percentage of EDTA in the solution increased. However, there was no sharp change above 1 ml of the additional ferrous ion. Fig.3. shows the decomposition percentage of EDTA at various temperatures for 2 hours. At a given temperature, we can observe the ferrous ion effect on the decomposition of EDTA. The amount of decomposed EDTA is increased with the temperature. In the experimental range, the maximum decomposition of EDTA occurs at 90℃.

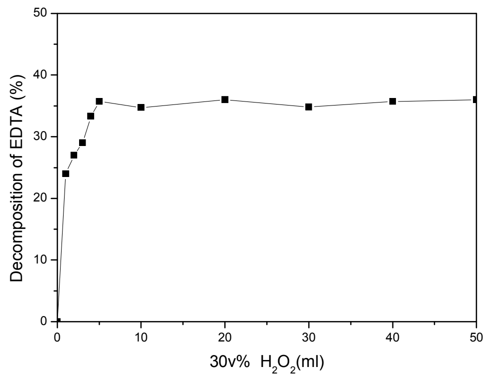

Fig.1. Decomposition percentage of EDTA against the addition of hydrogen peroxide at 25℃

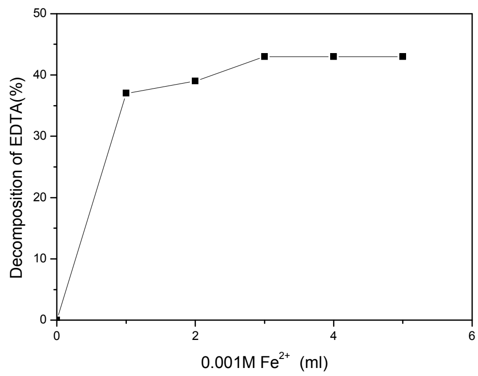

Fig.2. Decomposition percentage of EDTA with respect to the amount of the additional ferrous ion at 25℃

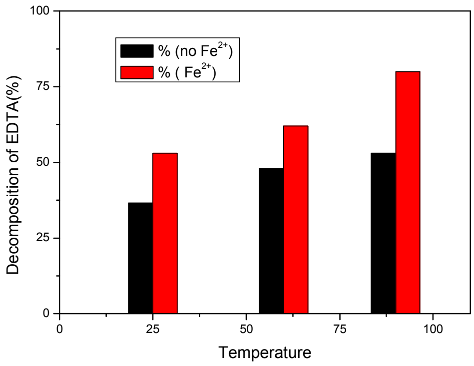

Fig.3. Decomposition percentage of EDTA at various temperatures.

3. Conclusion

We obtained the following optimum EDTA decomposition condition by experiments:

(1) The optimum amount of the hydrogen peroxide for a decomposition of 0.0001mole EDTA(100 ml of 0.001 M EDTA) was 5ml.

(2) At this condition, the optimum amount of 0.001M ferrous ion was 1ml. More than 30 % of the EDTA could be decomposed by the additional the ferrous ion.

(3) The decomposed % of EDTA was increased with the increase of temperature at a given time (after a 2 hours' experiment). By increasing the temperature, the decomposed rate of EATA increased rapidly.

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