DECONTAMINATION OF ^{14}C-CONTAMINATED SPENT ACTIVATED CHARCOAL GENERATED FROM AIR CLEANING UNITS IN NUCLEAR POWER PLANT

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Abstract - An experimental study was performed to decontaminate ^{14}C-contaminated spent activated charcoal generated from air cleaning units in nuclear power plants below the clearance level concentration (1Bq/g). It is known that the decontamination of ^{14}C-contaminated spent activated charcoal is very difficult because the ^{14}C radionuclide is absorbed physically and/or chemically on the extensive surface in pores of granular activated charcoal in a form of organic/inorganic compounds such as CO2, C_nH_{n+2} (Ref. 1). A heating method with microwave under reduced pressure was selected for desorption of ^{14}C on the basis of the thermal behavior of ^{14}C containing organic/inorganic materials identified through a thermal characteristics such as thermal gravimetric analysis(TGA), Pyrolysis GC/MS analysis.

I. INTRODUCTION

Spent activated charcoal is constantly generated by the replacement of charcoal filters according to performance degradation with the operation of NPPs. The annual amount of generation is expected to keep growing as the replacement cycle is shortening under strict regulation in Korea. Therefore, a cost-effective decontamination technology on site is required to reduce the radioactive waste disposal cost by disposing ^{14}C-contaminated spent activated charcoal as clearance level waste.

II. EXPERIMENTAL

Each sample of 200 mL of spent activated charcoal was heated simply by 2.45 GHz 3kW microwave in the vacuum chamber at various temperatures from 200℃ to 800℃ in increment of 100 under the constant reduced pressure of about 400 mmHgA for 60 minutes; the pressure was controlled by PLC/HMI with a pressure transducer and a pneumatic vacuum valve. The gases such as vapor, organic and inorganic compounds generated in the chamber by heating was vented through a discharge line by a diaphragm vacuum pump. ^{14}C radionuclide concentration of the sample after completion of heating decreased in logarithm function according to the increase of the heating temperature.

III. RESULTS AND DISCUSSION

The result of experiment showed that the desorption rate of ^{14}C containing materials increased in logarithm function according to the increase of the heating temperature like as the Fig. 1. The desorption rate was about 74% at the heating temperature of 300℃ and about 91% at a higher temperatures than 600℃. According to this experiment result, it can be presumed that ^{14}C-contaminated spent activated charcoal less than 2 Bq/g may be disposed as a clearance level waste after being heated simply at the temperature of 300℃ for 60minutes without chemical pre-treatment or grinding, while ^{14}C-contaminated spent activated charcoal more than 2 Bq/g but less than 10Bq/g may be also disposed as a clearance level waste after being heated simply at the temperature of 600℃ for 60 minutes.

IV. CONCLUSIONS

It is expected that the disposal cost of ^{14}C-contaminated spent activated charcoal generated from air cleaning units in Korean NPPs can be reduced dramatically by heating the charcoal simply up to 600℃ with microwave under the reduced pressure of 400 mmHgA because the ^{14}C radionuclide concentrations of 85 % of the spent activated charcoal samples taken in Korean NPPs was less than 10 Bq/g.

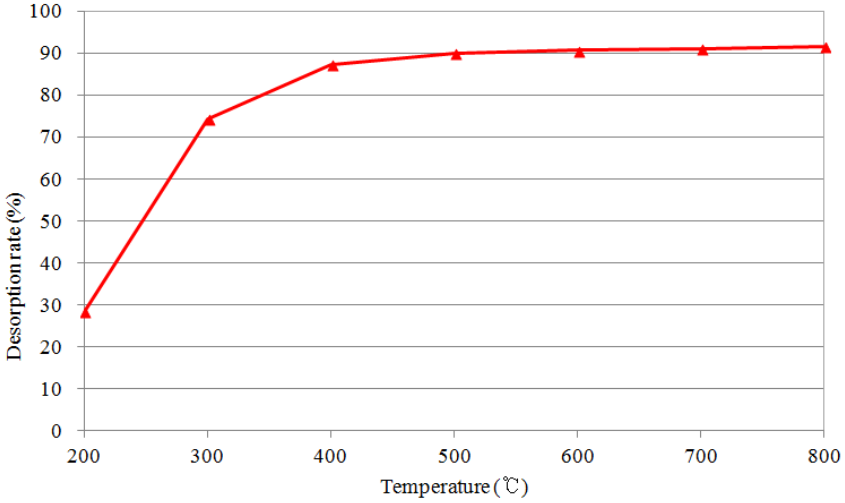

Fig.1. Correlation between temperature and desorption rate

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