Selective C-14 Stripping Method From Waste Resin Generated From HWR via Microwave Treatment

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Inorganic and organic ion exchange materials were generally applied to liquid processes in nuclear reactor. In the case of heavy-water reactor (HWR), zeolite, active carbon, anion resin, and cation resin were used to treat liquid processes such as reactor primary coolant cleanup and liquid radioactive waste management system. Then, used ion exchangers were stored at storage tanks. Various kinds of nuclides were adsorbed in ion exchange materials. Especially, C-14, long half-life nuclide, was highly concentrated in anion resin, and waste resin was treated as intermediated level radioactive waste (ILW).

In KOREA, 4 units of heavy-water reactor are operated and a lot of spent resins are generated. Until now, 580 m^3 of waste resins were generated from Wolsung HWR unit 1 and 2 and stored at storage tank (storage tank capacity of Wolsung HWR unit 1 and 2: 986 m^3). Enormous cost will be expected to dispose this radioactive waste if there is no process treating this waste.

Conventional process to treat radioactive wastes is not suitable for treating spent resin. To solve this problem, various kinds of processes were developed such as acid stripping, PLO process, activity stripping, thermal treatment, and etc. In this study, new process using microwave, is suggested. Basic properties of anion and cation were characterized by using surrogate waste resin. Removal efficiency of C-14 via microwave method was evaluated with active waste resin generated from Wolsung HWR.

Surrogate waste resin was synthesized by using anion resin absorbed HCO_3^- ion. Surrogate waste resin was treated by microwave under different time condition from 1 min to 30 min. Treated surrogate waste resin was characterized by C NMR to confirm a stripping of adsorbed HCO_3^- without damage of main chain in resin. After 20 min microwave treatment, ammonium functional group was perfectly changed to amine group. It is means that of adsorbed HCO_3^- was removed. Additionally, main chain and benzene group were detected at even 30 min treated sample.

Surrogate C-14 nuclide was perfectly removed from waste anion resin without damage of resin.

Active waste resin was treated under 1 kW microwave condition with and without additional DI water. More than 94% of C-14 from active waste resin were desorbed.

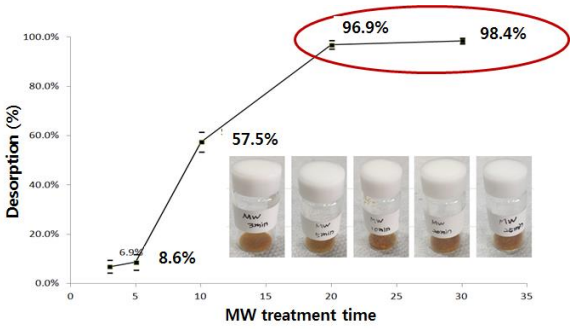

Fig. 1. Desorption efficiency of microwave treatment with surrogate waste resin.

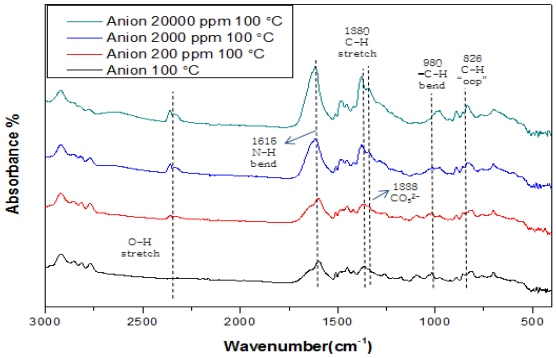

Fig. 2. IR results of surrogated anion resin treated by microwave.

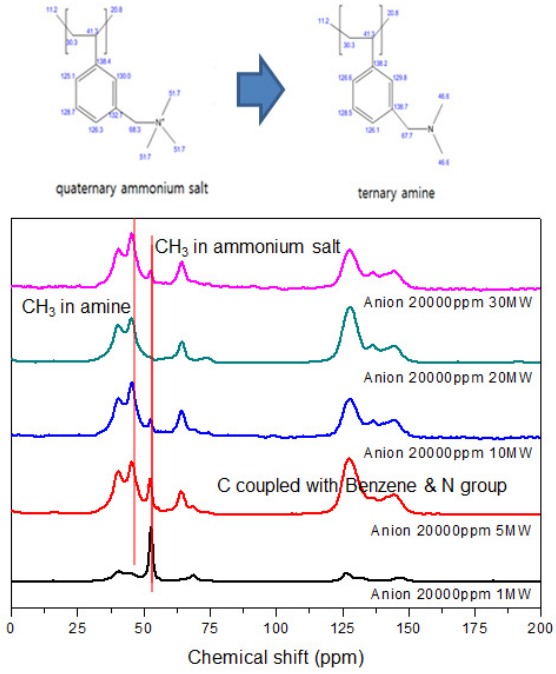

Fig. 3. C NMR results of surrogated anion resin treated by microwave.

REFERENCES

[1] Technical Reports Series no. 408, Application of ion exchange processes for the treatment of radioactive waste and management of spent ion exchangers, IAEA, Vienna, 2002.

[2] M. Matsuda, K. Funabashi, T. Nishi, H. Yusa, M. Kikuchi, “Decomposition of ion exchange resins by pyrolysis”, Nuclear Technology, 75 (1986), 187-192.