

Behavior of Radiolytic Gas in Zeolite Bed under Gamma-ray Irradiation

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Mixtures of zeolite IE96 and artificial seawater (ASW) were poured in cylindrical tubes, and irradiated by Co-60 gamma-rays. In the case of a zeolite bed which was fully immersed in ASW, the zeolite bed level increased slightly(1.8%) and an ASW phase formed onto the bed. The ASW level increased with the irradiation dose. In the case of a partial immersion, which simulates a drained zeolite vessel, the zeolite bed level was un-changed (0.0%).

Keywords: gamma-ray, irradiation, zeolite, radiolysis, gas

1. Introduction

We have evaluated secondary wastes generated from water treatment system at Fukushima Daiichi Nuclear Power Station for their safe storage. Recently we observed radiolytic gas generation and retention in a carbonate slurry and the rise of water level during Co-60 gamma-ray irradiation [1]. In this study, we investigated gas retention and volume change in zeolite beds during Co-60 gamma-ray irradiation.

2. Experimental

The UOP zeolite IE96, supplied for Cs adsorption vessels (SARRYTM), was mixed with ASW containing 20,000 ppm Cl⁻ (Akuamarin; Yashima Co.). The mixture was poured into a quartz tube (diameter 40mm, height 500mm), and the ASW volume was adjusted to two levels; (1) top of zeolite bed (full case) and (2) a quarter bed (1/4 case). Two tubes were irradiated by Co-60 gamma-ray at 7.2 kGy/h for 27 h. This dose rate was evaluated using a PMMA dosimeter (Radix W; Radie Industry Co., Ltd.).

3. Results and Discussion

Fig.1 shows the changes in ASW and zeolite bed levels during 27 h irradiation, and the appearance after the irradiation. In full case, the ASW level rose from 402 mm to 438 mm (rise ratio, 9.0%) and the zeolite level rose from 398 to 405 mm (rise ratio, 1.8%). Larger bubbles (dia. >10 mm) were observed in higher zeolite layer but change in zeolite bed levels was slight. The volume of ASW phase formed on the zeolite bed increased with irradiation time. Observed

$G(\text{H}_2)$ was calculated to 4.6×10^{-8} mol/J from data; rise of 21 mm of ASW level and dose of 36 kGy. It was almost as same as $G(\text{H}_2)$ of ASW [2]. These results suggest that the hydrogen gas bubble generated in the zeolite bed extruded water from the bed. In 1/4 case, the zeolite level was un-changed (rise ratio, 0.0%), and visible bubbles (dia. > 1 mm) and/or new voids between zeolite particles were not observed in zeolite bed. We could not confirmed the ASW level rise in zeolite bed by visual inspection. It was suggested that the drained zeolite bed could suppress the expansion of the immersed bed and absorb the extruded water in the voids. Additional experiments need for this hypothesis.

References

- [1] T.Motooka, R.Nagaishi, I.Yamagishi, Proceedings of Annual Meetings of Atomic Energy Society of Japan 2016, 2I20 (2016) [in Japanese]
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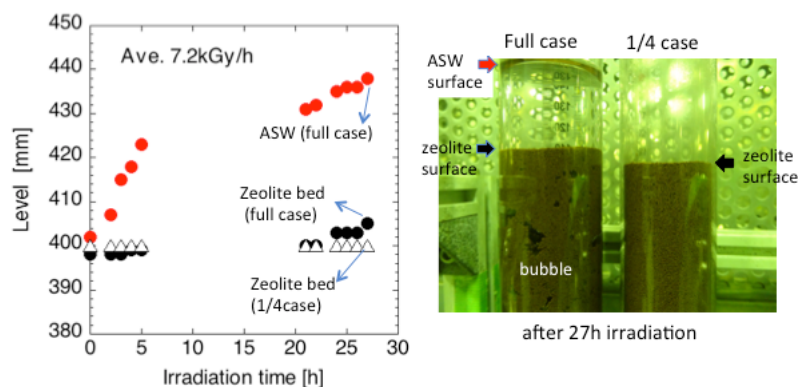


Fig.1 Changes in ASW and zeolite bed levels during irradiation, and the appearance after 27h irradiation.