Behavior of iodine aerosols

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1. Introduction

Iodine is a relatively high fission-yield product of spent fuel, and the monitoring of radionuclides is important in keeping a close watch on nuclear facilities, not only during their operation but also during their decommissioning. Volatile nuclides can readily interact with steam and water droplets in a nuclear reactor, and the contaminated aerosols formed can be exhausted in air during emergency venting or after nuclear power plant damage [1]. The released aerosols can further interact both homogeneously and heterogeneously with tropospheric particulate matter, such as smoke, sea salt aerosols, or cloud droplets.

2. Experimental

The methods to generate iodine species (such as I_2 and CH_3I) that are typically determined in contaminated exhaust air were properly chosen, and water droplets with constant particle sizes were generated and evaporated using the Model 3450 Vibrating Orifice Aerosol Generator (TSI Incorporated, USA) [2].

3. Results and discussion

Since iodine can be easily released into the environment and accumulated in the human body owing to its high volatility, an evaluation of the formation and behavior of the contaminated aerosols and a stabilization and determination technique of the aerosols are essential.

The generated volatile iodine gases were introduced into the water droplet to look into all aerosol related behavior, and several spectroscopic methods were applied to analyze the aerosols qualitatively and quantitatively. Moreover, for the efficiency testing of the sorbents [3], which are designed and synthesized in our laboratory for the localization of radioactive aerosols and volatile radionuclides, a capillary tube filled with a synthesized material was also added to a venting tube of the aerosol particle output. The experimental setup shown in Figure 1 was first tested using iodine gases with water droplets of well-characterized aerosol particles.

Even non-radioactive aerosols are charged, and radioactive aerosols have additional charges due to their radioactive decays [4]. The charged particles may be deposited in a drying column or flexible horses. Overall, the behavior of aerosols would differ depending on experimental parameters such as radioactivities, species, concentrations, sizes, flowing speed of gas and liquid, and it was understood from analysis of the collected iodine- aerosol output.

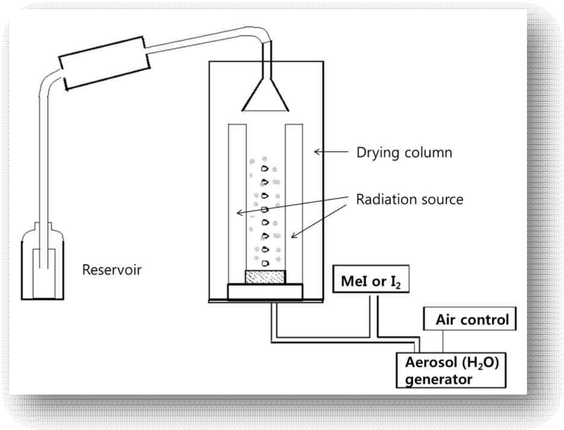

Figure 1: Schematic of set-up for a behavioral study of iodine aerosols.

Aerosol output of I_2-water particles can be collected in liquid phase, but additional filter system is required for CH_3I-water particles.

4. Summary

Iodine is responsible for the main short-term radiological impact on health through the ^{131}I isotope and its organic chemical form over long-term releases. However, iodine and the retention of gaseous organic iodine are seldom discussed owing to a lack of knowledge and experimental data. They are commonly known to move in gaseous or several types of aerosol forms. Therefore, to study how iodine-related aerosols are formed and act in the containment of a nuclear power plant and further in the environment, a lab-scale set-up including iodine generating and introducing equipment, a water droplet generator, and an aerosol collector or a sorbent testing tube was installed as a single system with a steady control.

Acknowledgements

This work was supported by the Nuclear Research and Development program of the National Research

Foundation of Korea (NRF) grant funded by the Ministry of Science, ICT, and Future Planning.

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