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ORAL PRESENTATION - Decomposition of boric acid solutions and evolution of gases under mixed thermal and fast neutrons and gamma radiation

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Usually radiolytic gases (such as oxygen and hydrogen molecules) are not detected in cooling system of a research reactor even under room-temperature irradiation conditions. However, the presence of certain amounts of boric acid, which is known as a water soluble thermal neutron absorber, produces an evolution of gases in significant quantity in the reactor at room temperature. To study the radiolysis of the cooling water, we irradiated several water samples containing natural, 10B-enriched, and mixed boric acid in the ranges of 0 to 2000 ppm for the function of 10B concentration.

The boric acid concentration increased the extent of water decomposition compared to the absence of boric acid because of the nuclear effect from 10B(n,α)7Li, which is due to the radiation issued from a 10B reaction with thermal neutrons. It is well known that the products of water radiolysis are molecular (H2, O2, H2O2) and radical (H, OH, e-aq, HO2) species, and that high linear energy transfer (LET) radiation of 10B(n,α)7Li produces more molecular species than radical ones. The high LET radiation of alpha rays, produced from the addition of boric acid in water, inhibits the recombination mechanisms of radicals and stops the chain reaction.

The radiolysis of a boric acid solution under mixed thermal and fast neutrons and gamma radiation was examined quantitatively and qualitatively using a inductively coupled plasma mass (ICP-MS) spectrometer for measuring the 10B and 11B concentration ratio; a flameless atomic absorption (AA) spectrometer for the concentration of a product, 7Li,; a gas mass (Gas-MS) spectrometer for the measurement of H2, O2, and H2O concentrations; and titration methods for the H2O2 concentration. The total amounts of produced gases will be discussed with a comparison of the theoretical calculation values.

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