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Removal of volatile, organic iodines from vented containment gas streams by wet-scrubbing during severe nuclear accidents

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During severe nuclear accidents several hazardous and radiotoxic gaseous fission products can be released and constitute a threat to the environment.

Significant amounts of the radiotoxic fission product iodine, mainly as particular caesium iodide and gaseous elemental iodine, are released into the containment and coolant system assuming a core melt down accident. The distribution of iodine species in the containment follows a series of complex processes. Considerable amounts of gaseous iodine will dissolve in the water pools, condensing steam or water sprays and be converted into non-volatile species such as iodide and iodate ions.

Remaining gaseous elemental iodine can react in numerous complex reactions with volatile organic substances like hydrocarbons released from organic materials such as cable isolations to form iodo-organics. Thus highly volatile airborne organic iodine species like methyl iodide and ethyl iodide can be formed from e.g. the reaction of methane with iodine.

In e.g. Swedish light water reactors gaseous iodine species in excess gas streams being vented from the containment in case of a pressure increase are scrubbed off with an alkaline sodium thiosulfate solution. The removal efficiency for volatile iodo-organics is about 20 times lower than for elemental iodine. Those species of the isotope I-131 have a high potential to cause biological harm to humans by bioaccumulation when getting released to the environment due to their long enough half-life of app. 8 days.

In response to improve the removal efficiency a modified scrubber solution has been developed containing nucleophilic organic compounds to achieve a rapid break of the organic iodines into non-volatile inorganic iodides maintaining in the scrubbing solution.

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