Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20335

Change in airborne radioiodine distribution: a key issue for dose assessment

OLIVIER MASSON

IRSN - Nuclear Safety and Radioprotection Institute

Presenting Author: olivier.masson@irsn.fr

In the radioprotection domain, dose induced by the inhalation of radioiodine is determined through the distribution of iodine species between particulate, gaseous organic, and gaseous inorganic forms. Among them, molecular $^{131}I_2$ has the largest dose coefficient and leads to higher deposition and contamination of the environment than for gaseous inorganic and particulate iodine forms (subject to dry only deposition).

At short distance from a facility, i.e., where radioiodine concentrations will be of concern in case of a nuclear accident, the assessment of the contribution of the above-mentioned forms iodine remains highly uncertain. Conversely, at long distance from a release point, the iodine distribution observed after nuclear weapons testing or nuclear accidents is rather well balanced. This equilibrium (roughly 1/3, 1/3, 1/3 for particulate, gaseous organic and gaseous inorganic radioiodine) is also observed for stable iodine. We conclude that the change in the radioiodine distribution obeys to environmental parameters. Which ones? Given its high reactivity and short atmospheric lifetime, $^{131}I_2$ should not remain in such a high proportion long after a release or at several thousand km from the emission. The following mechanisms are likely to maintain the non-negligible contribution of $^{131}I_2$.

- Nighttime I_2 production (Saiz-Lopez 2016)
- Volatilization / resuspension from soil and from the marine environment after deposition?
- Temporary adsorption onto aerosol then volatilization (→ up to a 3-hour preservation from photolysis (Figueiredo 2021)?
- Interaction with droplets that would also hinder I_2 photolysis?

The kinetics of the transfer between gaseous and particulate radioiodine forms is not fully understood and experimental verifications are scarce. Field experimentation conducted by Wershofen and Aumann (1989) showed that theses kinetics are rapid and prone to affect the airborne radioiodine distribution at short and medium distances.

However, these authors did not consider the specific role of photolysis which may radically change the contribution of molecular iodine. Dedicated experiments will be conducted around the nuclear reprocessing plant of La Hague by the end of 2023.