Observed and Modelled Tritium (HTO and OBT) in the Wetland Ecosystem in Duke Swamp near a Nuclear Waste Management Area

S.B. Kim, S.L. Chouhan, P.A. Davis

Environmental Technology Branch, Chalk River Laboratories, Chalk River, Ontario, K0J 1J0, Canada

The great mobility of tritium as HTO implies that, under steady-state conditions, the T/H ratio (or equivalently the HTO concentration) is the same in all water compartments of the environment. This is the basis of the specific activity (SA) model, which underlies almost all environmental tritium models. SA concepts apply to OBT as well, since the OBT formed by a given plant process at a given time has a T/H ratio that reflects the ratio in the water that enters into that process.

There is no evidence in the empirical data that the bioaccumulation of tritium in aquatic and wetland plants will occur. OBT/HTO ratios less than one are found consistently in the laboratory where the HTO concentrations to which the plants are exposed can be held constant. These data suggest a value of 0.7 for the OBT/HTO ratio under equilibrium conditions in the laboratory. Theoretical considerations suggest that the value of the OBT/HTO ratio in plants is significantly different from one and, in most cases, greater than one. This is primarily due to the much longer residence time of OBT in plants as compared to HTO.

Duke Swamp, a relatively large wetland located on the site of Chalk River Laboratories (CRL), contains elevated levels of tritium due to releases from a nearby Nuclear Waste Management Area. The releases have been ongoing for many years and tritium concentrations in various parts of the ecosystem are likely to be in equilibrium. The observed HTO and OBT concentrations in plants and animals were compared with those predicted by IMPACT, the model used by the Canadian nuclear industry to calculate annual average doses due to routine releases. Generally, HTO concentrations are much higher than OBT concentrations. The IMPACT model over-predicted HTO and OBT concentrations in plants and animals by a factor of 3 or 4, on average.