TRITIUM – TO ACIDIFY OR NOT TO ACIDIFY; DOES IT MATTER? - REVISITED

Thomas L. Rucker, Ph.D., Leidos Inc.

ruckert@leidos.com

C. Martin Johnson, Jr, Jennifer Nickerson,
US Army Test, Measurement, and Diagnostic Equipment Activity (USATA)

EPA Method 906.0, "Tritium in Drinking Water," dated 1980, states that the sample for tritium should be taken in its "natural state" and not acidified. However, EPA document "Technical Notes for EPA Method 906.0 – Tritium in Drinking Water" dated 2009, says this only indicated that "there is no need to stabilize the tritium in the sample" to keep it from precipitating and that "preserving samples with acid will not interfere with the technique and ... will produce valid results."

However, there is another concern about the effects of acidifying tritium water samples that may not have been considered in the EPA Technical Notes. It is known that tritium adsorbs onto hydrogenous material and will easily permeate into and possibly through the material through hydrogen exchanges.[1] The HTO will move much more rapidly into the bulk material than will HT. This is likely due in part to the auto-electrolysis of water forming hydrogen ions, H^+ and T^+, while HT is not ionized. As a result of this movement, plastics and rubbers exposed to tritium (especially as HTO) readily permeate the tritium through the bulk material and to the atmosphere through outgassing causing loss of tritium from the sample.

At a pH of 7, the H^+ concentration is 10^{-7} M; but at a pH of 2, it is increased to 10^{-2} M. Since the tritium will readily exchange with the H^+, the increased tritium ion concentration at lower pH will accelerate the migration of the tritium through plastic containers. This should be taken into consideration when choosing sample containers and holding times and may be a good reason to not acidify water samples to be analyzed for tritium.

In 2013, some preliminary results were presented for tests using polycarbonate and glass bottles. The final results did not show a significant loss of tritium in either acidified or non-acidified samples in either glass or polycarbonate for the first 180 days after preparation, the typical holding time used for tritium. However, some statistically significant loss of tritium was observed in the acidified polycarbonate bottles after 180 days. The experiment has been repeated using polyethylene bottles that were expected to more easily exchange tritium with hydrogen due to the higher hydrogen content. The results will be presented.

[1] *Primer on Tritium Safe Handling Practices*, DOE Handbook, DOE-HDBK-1079-94, December 1994.