Metal release rate analyses in borated cooling water for DTT vacuum vessel

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The Divertor Tokamak Test facility (DTT) [1, 2] vacuum vessel (VV) is a toroidal chamber that ensures an enclosed vacuum environment for the plasma, a confinement barrier and temperature control. Water flows in the double-shell D-shaped VV cross-section structure made from stainless steel to operate at a set temperature. Beyond temperature control, the water cooling circuit needs to act as a neutron shielding media to protect the structures installed outside of the VV, namely the superconducting coils. The shielding function is achieved thanks to the addition of boric acid in the water. The requirement on the borated water for the DTT VV is to have 8000 ppm B solution highly enriched in ^{10}B (95% ^{10}B) as a shielding medium . Given the lack of water chemistry guidelines for fusion power plants, the water chemistry requirements from fission power plants were investigated. In this poster 316L general metal release rates in ultrapure water and concentrated borated water solutions were investigated experimentally and measured. Samples were exposed to ultrapure water and 8000 ppm B borated water at 80°C for 1 week each to quantify the amount of ions released in solution. Stainless Steel 316L general corrosion was studied considering the different water chemistries, ultrapure water vs borated water, and steels microstructures. DTT VV presents many welded joints so general corrosion of welding induced microstructure was here investigated compared to 316L base microstructure. The release of ions from general corrosion was found to be more influenced by water chemistry than microstructure.

Pressurized Water Reactors (PWRs) water chemistry guidelines teach that choosing an optimum water chemistry is key to ensure materials integrity of the cooling circuit.

References:

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