Application of autoclaves for the decontamination of fusion reactor materials from tritium

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The development of efficient procedures for the decontamination of fusion reactor materials from tritium is a subject of continuing interest for ITER. Within this framework a parametric study on the potential application of autoclaves for the decontamination of stainless steel waste was carried out. Essentially, tritium-loaded type SS316 stainless steel specimens were placed inside of an autoclave containing a defined amount of water and heated to temperatures in the range 393 – 473 K for extended periods of time. Water was added to “trap” released tritium. This is based on the fact that more than 99 % of bulk tritium is liberated from stainless steel as HTO. It could be shown that by and large released tritium is accumulated in the purposely introduced water. The achieved degree of decontamination was estimated from the tritium concentration in the water and tritium depth profiles in the stainless steel specimens. The latter were determined by chemical etching. Tritium in the surface layer of stainless steel remained essentially unaffected by the isochoric thermal treatment in the presence of moist air.

The time-dependence of the decontamination rate and the evolution of the tritium depth profile in the decontaminated Type SS316 stainless steel were simulated using a diffusion model and appropriate diffusion coefficients. The experimental results were in good agreement with theoretical predictions. Calculations showed that the decontamination of 5 mm thick Type SS316 requires temperatures exceeding 623 K when this is to be done in a reasonable length of time.

The utilization of autoclaves for the decontamination of Type SS316 stainless steel and of other fusion relevant materials under technically relevant conditions will be discussed.