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Design of a Cryogenic Distillation Column for JET Water Detritiation System for Tritium Recovery

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A Water Detritiation System (WDS) is currently being designed and manufactured to be installed in the Active Gas Handling System (AGHS) of JET, currently the largest magnetic fusion experiment in the world. JET has been designed and built to study fusion operating conditions with the plasma fuelling done by means of a deuterium-tritium gas mixture.
AGHS is a plant designed and built to safely process gas mixtures and impurities containing tritium recovered from the JET torus exhaust gases. Tritium is removed from these gas mixtures and recycled. Tritium depleted gases are sent to Exhaust Detritiation System (EDS) for final tritium removal prior to discharge into the environment. In EDS, tritium and tritiated species are catalytically oxidized into water, this tritiated water is then adsorbed onto molecular sieve beds (MSB). After saturation the MSBs are heated and the water is desorbed and collected for tritium recovery. The WDS facility is designed to recover tritium from water with an average activity of 1.9GBq/l, and is able to process water with activities of 85 GBq/l and higher.
Tritiated water is filtered and supplied to the electrolyser where the water is converted into gaseous oxygen and tritiated hydrogen. The hydrogen stream is first purified by selective diffusion through membranes of palladium alloy and then is fed to two cryogenic distillation columns (CD). These operate in parallel or in series depending on the water activity. In the CD columns, hydrogen isotopes containing tritium are recovered as the bottom product and hydrogen, the top product, is safely discarded to a stack. The CD columns are foreseen to have a throughput between 200 and 300 mole/h of hydrogen isotopes vapour and they operate at approximately ˜21.2K and 105 kPa. The design of the CD columns will be presented in this work.

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