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Isotope removal and outgassing in JET-ILW

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Since 2011 JET tokamak is equipped with the ITER-Like Wall (ILW) consisting of tungsten (W) and W-coated plasma-facing components (PFC) in the divertor and beryllium (Be) PFC in the main chamber [1]. The most recent milestone achieved at JET-ILW is the second deuterium-tritium (DT) experimental campaign DTE2 (after DTE1 in 1997), in which the compatibility of the ITER material mix with high power fusion plasma operation was demonstrated. Tritium accounting, fuel retention and isotope removal are among fundamental scientific and technological questions addressed by DTE2. In particular, short-term and long-term fuel retention and outgassing (figure 1) were assessed for T and DT plasma operation and compared to available data for D plasmas [2]. After the DTE2, a sequence of fuel recovery methods (figure 2) allowed reducing the residual T content in D plasmas to about 0.1%, well below the requirement of 1% set by the maximum allowed fusion neutron production rates in the ensuing D campaign. The cleaning sequence comprised several days of baking the main chamber at 240ºC and at 320ºC superimposed with ion-cyclotron wall conditioning (ICWC) and glow discharger conditioning (GDC) cleaning cycles followed by plasma operation with raised inner strike point (RISP) configuration that was successfully tested earlier in JET-ILW for the D→H changeover [3] was applied to ensure tritium removal [4]. While ICWC and GDC interaction areas are limited mainly to the main chamber, RISP targeted the location of thick beryllium co-deposited layers in the inner divertor. These layers had been shown earlier to contribute significantly (~50%) to the long-term retention in JET-ILW [5]. RISP discharges with moderate NBI power allowed transient heating of co-deposited layers to temperatures above 1000ºC. Effective fuel removal was indirectly confirmed by an initial increase of the plasma tritium content, followed by very strong reduction of the isotopic content, as evidenced from neutron spectroscopy. In this contribution, a detailed analysis of tritium outgassing and removal is presented along with the overall post-DTE2 cleaning and modelling strategy.

References

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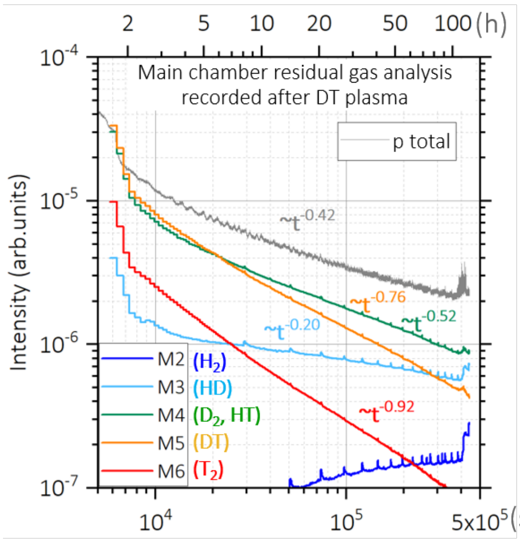

Figure 1. Quadrupole mass spectrometer signals: residual gas composition analysis after DT plasma

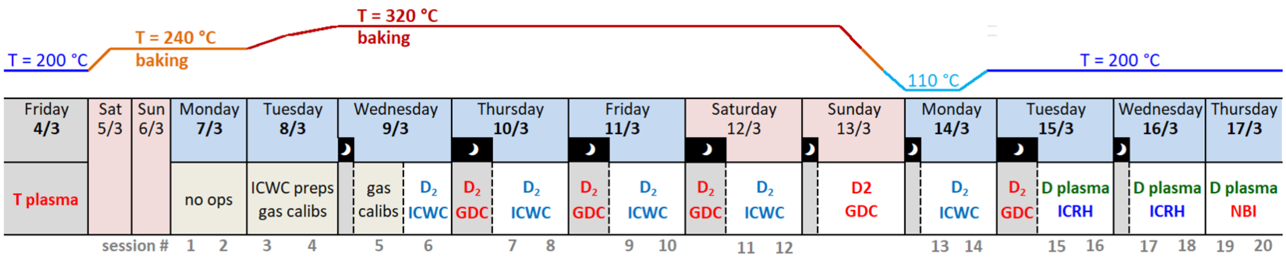

Figure 2. Post-DTE2 cleaning strategy and timeline.