Analysis of hydrocarbons of the JET divertor cryogenic pump at the end of the carbon wall campaign using a micro gas chromatograph

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For the operation of any fusion machine it is essential to know the gas composition at any step in the fuel cycle. The request will be mostly for impurities such as: He, N_2, O_2, CO, CO_2, CQ_4 (Q could be any hydrogen isotope) and higher hydrocarbons up to C9 (aliphatic or not).

For the design of the fuel cycle analytical system of ITER it is important to know the expected impurity species as well as their concentrations in particular those of higher hydrocarbons.

In JET the impurities from plasma operations are primarily pumped out and trapped by the cryo-panels of the divertor cryogenic pump at liquid helium temperature. After regeneration of the cryogenic pump (warming up), the released gases are analysed using either mass spectrometry or gas chromatography (GC). Both methods have their limitation as the present GC can only identify short chain molecules while mass spectrometry becomes more difficult when higher masses are involved as the variety of cracking patterns, in addition to the presence of deuterated and tritiated species, makes the interpretation of the spectra very difficult.

In this respect, the development of a new technique was essential. This paper describes the new Micro Gas Chromatograph (Micro GC) used, including a compression stage for the sample and the installation within the Analytical Laboratory of the JET Active Gas Handling System. The advantage of using a Micro GC is that not only can a wide range of hydrocarbons be measured but also the retention times range from a few seconds to a few minutes depending on the analysed compound. Indeed, preliminary tests have shown retention times of 26 sec., 38 sec. and 84 sec., for the ethane, propane, and butane respectively, rising to 4.5 min for decane. This new system enables the analysis of gases released during the regeneration of the JET divertor cryogenic pump. JET impurity analyses obtained using this tool will provide valuable information for ITER.