§6. Tritium Inventory in the Large Helical Device

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A series of discussion meetings on tritium issues has been organized for D-D experimentals by the large helical device.

1. Scopes of the Meeting

D-D experiments by the large helical device will produce tritium amounting to 12 Ci/year. A part of tritium will be removed by a tritium recovery system, but most tritium will be captured by the first wall, divertor plate, NBI armor and so on. The captured tritium should be removed to a level as low as possible before the maintenance operations of the LHD. To decontaminate relevant materials and/or equipments and to assure the safety of employees and the public from tritium hazards, it is essential to know tritium behavior in advance.

The aim of this discussion meeting is to evaluate tritium inventory distribution in the various materials/components of the LHD, loading to tritium removal devices, tritium outflow to room and/or environment, and to find problems to be solved before the beginning of the D-D experiments. Another subjects of this meeting is to analyze the present status of tritium-material interaction studies, data accumulation, and research and developments concerning on safe and economical tritium handling.

2. Meetings in this fiscal year

The first meeting was held on September 18, 1995 and the second January 19, 1996. The topics of the first meeting were tritium recycling at the first wall, tritium inventory distribution in a fuel recycling system, concept of an effective and economical multiple enclosure system, and oxidation in the environment. The subjects of the second meeting were tritium removing systems of large machines such as ITER, TFTR and JT-60U. Concerning the large machines, problems on tritium behavior in the environment was also discussed for protecting employees and the public from tritium hazards.

3. Summaries of the meetings

In comparison with hydrogen recycling on metallic first walls, it is rather difficult to understand the phenomena occurring on carbonaceous first walls of large tokamak machines. This is partly due to the lack of data of low energy particles, which concerns much with the co-deposition of hydrogen with light impurities emitted from the first wall. Tritium recycling and inventory on/in the first wall are also important for designing the fuel recycling system of the coming experimental reactor. Concerning the recycling system, the dynamic response should be investigated in more detail against various accidental scenarios. It was also pointed out that much improvement on various unit processes is required to develop more efficient, small sized and economical recycling systems, although the present day technology enables to handle tritium amounting about 100 mol/hr.

Several different tritium removing systems have to be designed for the experimental reactor, depending on their duties. Although the present day technology has established promising tritium removal systems for ITER, they appear to large, expensive and complex. It was reported that the use of permeation membranes is attractive for solving such problems. On the other hand, however, it was pointed out that the development of dry systems not forming HTO is desirable, because the above mentioned systems are essentially HT oxidizers and dryers of HTO, which is about 25,000 times more hazardous than HT.

Dry tritium such as HT is easily oxidized to form HTO by micro organisms in the environment. Their activities differ from each other. Namely, HTO concentration in the air is site-dependent owing to different micro-organism inhabitants. This means that tritium release experiments are invaluable to assess the effective dose of the public at the site.

It is worthwhile to note that LHD is a model machine to investigate tritium behavior in larger and more complex D-T burning experimental machines such as ITER.