USE OF HEAVY WATER DETRITIATION AND DEPROTIZATION PLANT FOR HIGH CLEANING OF WATER WASTES FROM TRITIUM

I. A. Alekseev, S. D. Bondarenko, S. P. Karpov, K. A. Konoplev, V. D. Trenin, O. A. Fedorchenko, V. V. Uborsky[1)]

[1)] *JSC "DOL", Moskow*

Liquid tritium wastes with the great tritium concentration range ($10^{11} - 10^5$) Bq/kg can be formed and accumulated by operation of heavy and light water reactors, reprocessing nuclear fuel and operation thermonuclear reactor in a future. Therefore the development of efficient localization systems in order to prevent from the deleterious influence of tritium releases upon a man and enviroment is necessary . There are two main problems:
- maintaining safe tritium level (70 GBq/kg of water) in a cooling or/and moderator system of fission reactors and in light water coolant of thermonuclear reactors of the future;
- reprocessing various liquid wastes,containing tritium on the level of $10^5 - 10^9$ Bq/kg, with cleaning them from tritium up to permissible standards.

The first problem was solved in ILL at Grenoble [1] and at Darlington (Canada) [2] and is being solved in PNPI in Gatchina [3, 4] by creation of detritiation and deprotization plants, which allow to keep the tritium concentration on certain level (70 GBq/kg D_2O). At this plants tritium and also protium is extracted from heavy water flow on the isotopic exchange reaction in the "water vapour–deuterium" system, and then is concentrated by low temperature distillation of liquid hydrogen. This method is the only technological one of tritium concentration.

But this plant does not solve the high cleaning problem of water solutions from tritium, because the tritium and protium extraction from water is limited by equilibrium constant of the isotopic exchange reaction in the "water vapour–deuterium" system.

Chalk-River national laboratory had reported about the first at-tempt to create a technology which could be used for high cleaning of water solutions from tritium. The technology is founded on isotopic exchange in the "liquid water–hydrogen" system using wetproofed catalysts which have a possibility to carryout the single exchange act many times and like that to realize a high cleaning of a liquid flow from tritium in the exchange column. But in refs. [5, 6] no data about technology of the process is published. Development of the technology in detail is important because extraction and concentration of tritium is more expensive in comparision with heavy water production because of tritium radioactivity and much less of the separation factors of tritiumdeuterium modifications compared with protium-deuterium ones.

This problem is dealt with in Petersburg Nuclear Physics Institute (PNPI) together with JSC "DOL". The technology of contaminated by tritium water reprocessing has been offered using the reactor PIK detritiation plant. We believe that the following variants can be the most effective:
- electrolysis of water and low temperature hydrogen isotopes distillation using conversion of isotopic hydrogen forms. But this variant can be realized only in presence of a safe elektrolyser of great capacity;
- wetprooved catalyst isotopic exchange and low temperature hydrogen isotopes distillation using conversion of isotopic hydrogen forms.

We have no information about industrial scale realization of the above mentioned methods. It means that it is necessary to develope the technology of this processes in order to create a more economical plant with a closed technologycal cycle without the environmental contamination.

Now in PNPI together with JSC "DOL" using the existing column for hydrogen isotopes separation (diameter of the column 250 mm, gas loading up to 10 kMol) and its system is created in full scale variants next assemblies:
- electrolysis and isotopic exchange in "liquid water-hydrogen isotopes system" on the wetprooved catalyst;
- electrolysis and liquid hydrogen distillation;
- wetprooved catalytic exchange and liquid hydrogen distillation.

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