Evolution of the fuel composition in the hybrid thorium reactor with neutrons fed from plasma held in a long magnetic trap

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An energy source based on the fuel cycle, in which only thorium is used, cannot operate without an additional source of neutrons. In this regard, studies on the neutron-physical characteristics of the thorium fuel loaded into the reactor, are needed. We have proposed a stand for this kind of experimental research, which consists of a subcritical assembly loaded with a thorium-plutonium fuel and a long magnetic trap with high-temperature plasma, which is located in the axial region of the assembly and serves as a source of additional neutrons [1]. A subcritical fuel assembly of a high-temperature gas-cooled reactor with a different composition of the loaded fuel, which sets the value of the effective neutron multiplication factor in the installation [2], is considered.

The report presents the results of computer simulation on the fuel evolution in the long (more than seven years) working cycle of such a hybrid nuclear fusion reactor. In the course of the simulation, the required percentage of thorium and plutonium in the composition of the initial fuel was determined, which should ensure the maintenance of acceptable parameters when the plant operates at such an interval of time. The installation modes at different levels of the neutron flux density emerging from the plasma column are considered, and a description of the evolution of the fuel composition in the operating cycle is obtained.

References

1. A.V. Arzhannikov, A.B. Anikeev, A.D. Beklemishev et al., “Subcritical Assembly with Thermonuclear Neutron Source as Device for Studies of Neutron-physical Characteristics of Thorium Fuel”. AIP Conference Proceedings 1771, 090004 (2016); doi: 10.1063/1.4964246.
2. I. Shamanin, S. Bedenko, Y. Chertkov, I. Gubaydulin et al., “Gas-Cooled Thorium Reactor with Fuel Block of the Unified Design”, Advances in Materials Science and Engineering, vol. 2015, Article ID 392721, 8 pages. (doi:10.1155/2015/392721)