Assessment of Impurity Concentration in the Helical Reactor FFHR

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Impurity accumulation in the core plasma of the Helical reactor, FFHR, is one of the crucial issues, since it can limit the operation time of reactor. There main concern in helical reactor is due to the large surface area, the lack of a neoclassical temperature screening effect and the large negative electric field. However, the stochastic edge and long connection length could mitigate the problem. In this paper we estimate the expected amount of impurity concentration in the bulk region of the FFHR. We have started by evaluating the sputtering of divertor plates, then the dynamics of impurities in the SOL region and, finally, the impurity distribution in the bulk plasma by using the Stellarator Impurity Transport code SIT [1]. This concentration has been eventually compared with the fatal levels, which prohibit ignition. The impurity yield due to sputtering was evaluated by averaging over the distribution function of incident ions, accelerated in the sheath. The incident ion flux was estimated using the confinement time and the average plasma density value, envisage for reactor. Impurity concentration in the SOL region has been evaluated by using the SOL transport model, which includes the balance of several forces (pressure, electric field, thermal and friction forces) determine the actual impurity localization along the magnetic field lines. For impurities in low charge state the electric field is dominate, whereas for high charge state the thermal and friction forces, being proportional to Z^2, mainly determine the localization [2]. The averaged over the SOL impurity distribution of each charge state was treated as a source term in the SIT impurity code for the bulk plasma.

Calculations in the bulk plasma show, that concentration intrinsic impurities, which could accumulate during the confinement time in the FFHR2m2 reactor, remain well below the fatal level, extinguishing reactor (see table):

	Be	C	Ne	Fe	W
Fatal fraction,%	0.14	0.07	0.025	0.0027	0.0007
Calculated fraction,%	0.08	0.057	0.089	0.0015	0.0005

[1] Yu.L.Igitkhanov et., al.Fusion Science and Technology 50, 268-275, (2006)

[2] Yu. Igitkhanov, Contribution Plasma Phys. 28 1988 4/5 477