§45. Reduction of Helium Ash by Selective Helium Pumping

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In a fusion reactor of helical or tokamak type, the helium ash concentration has to be less than about 10 % to lengthen the burning time period or to avoid the enlargement of such device size. The helium ash can be removed by the divertor. Since it is predicted that the ash concentration can not be reduced to such level by the divertor alone, the additional pumping for the helium ash is required[1].

It is known that several metals such as Ni, V and Mo can selectively trap the helium ion. For nickel metal, the maximum capacity to selectively trap the helium was observed to be $2x10^{16}$ He/cm^2 at the temperature of 500 ^oC[2]. If such metal is placed in the vicinity of the divertor, the helium ash concentration may be largely reduced[1].

Based on the particle balance of helium, the helium ash concentration was calculated as a function of fraction of He returning core plasma (Fig.1). In this figure, it is seen that the ash concentration becomes to be less than 10 % if the helium recycling rate can be reduced from 0.9 to 0.8 by the selective pumping of nickel placed in the vicinity of the divertor.

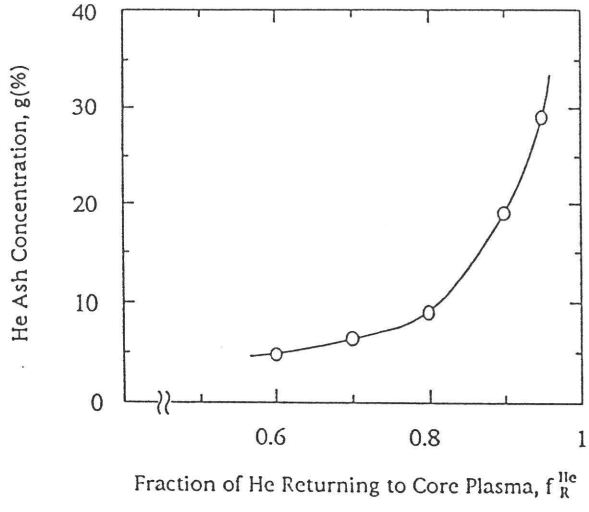

Fig.1. Ratio of helium ash concentration versus recycling ratio of helium.

Since the helium can multiply collide with the nickel plate in the divertor region, the helium can be largely trapped in the metal. So that the recycling rate of helium into core plasma can be considerably reduced. Then, this new concept largely contributes to the reduction of the helium ash concentration. The maximum capacity of selective pumping is limited, so periodic replenishing of nickel is required.

References

1) Hino, T. et. al, To be appeared in Fusion Engineering and Design (1994)
2)Yanagihara, H., Hino, T. et al, Proceedings of 11th PSI Conference, P.165, Mito, May 1994.