§14. Development of Molten Salt Forced Convection Loop and High Heat Flux Cooling Techniques for Divertors

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It is clarified that heat-transfer enhancement in a FLiBe channel flow with a porous medium is effective in laminar flow. An averaged Nusselt number in the FLiBe channel flow with the porous medium is higher than that in a smooth pipe. Using materials of the porous medium with better thermal properties, the rate of enhancement becomes higher (Fig.1). Also, the larger enhancement can be obtained by increasing flow velocity. The averaged Nu number has a maximum value because the heat transfer in the radial direction becomes relatively small with the increase of the flow velocity (Fig.2). Therefore, it is concluded that the optimum value of the velocity will exist in the FLiBe channel flow with the porous medium.

On the other hands, a new concept of liquid wall divertor is proposed. That is composed of two flows, one is main flow and another is assistant inclined flow (Fig.3). Main flow is exposed directly to plasma and its surface is heated by high heat load. The assistant inclined flow with a velocity higher than the main flow is injected into the main flow to reduce the temperature rise in the heated main flow surface by mixing effect. The rate of relative temperature rise for different assistant velocities with no assistant flow are calculated (Fig.4).

The results show that the relative temperature increases behind the mixing region for FLiBe because of the strong temperature diffusion effect of the assistant flow. And the temperature of the mixing region decreases as the assistant flow velocity increases.

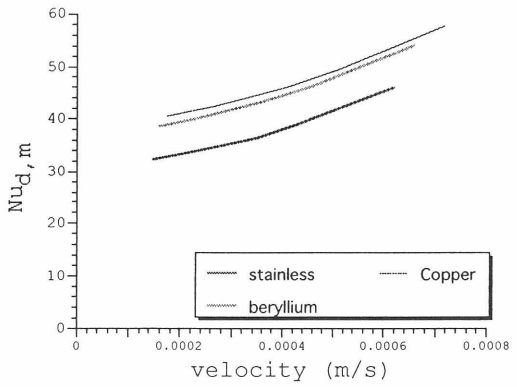

Fig.1 Averaged Nu number for several materials of porous medium

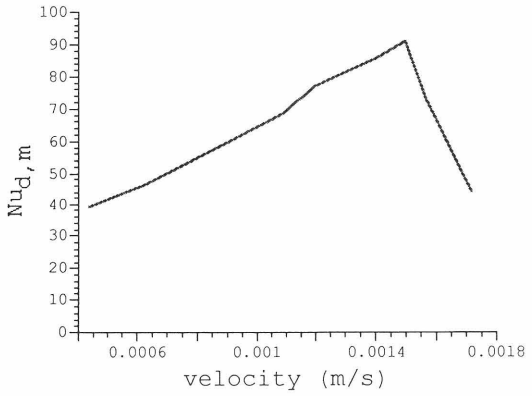

Fig.2 velocity v.s. averaged Nu number

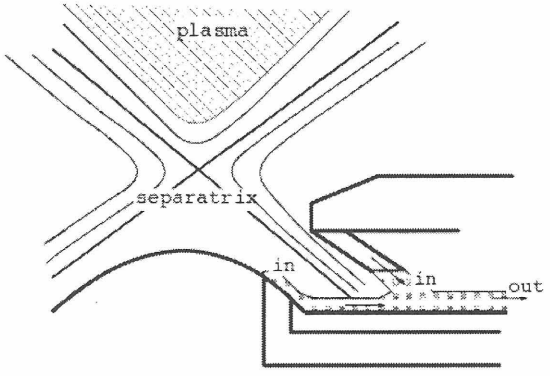

Fig.3 Schematic view of Liquid Metal Divertor

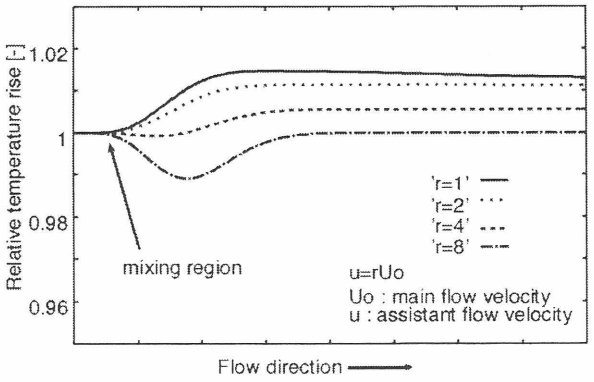

Fig.4 The rate of temperature rise