§10. Experiment on Large High Pumping Speed Cryosorption Pump for NBI

T. Kuroda, Y. Oka, O. Kaneko, Y. Takeiri, K. Tsumori, T. Kawamoto, M. Terashima, H. Morimoto, (ULVAC CRYOGENICS, INCORPORATED), T. Okuyama, Y. Suzuki, (Toshiba CO.)

A large pumping speed cryosorption pump for NBI has been developed and usefulness of it was demonstrated by an application to NBI of JIPP T-II Tokamak1). In order to make a further application of cryosorption pump, we have examined a prototype cryosorption pump unit for actual negative ion based NBI of Large Helical Device, in which a large high pumping speed with the capability of more than 1000m^3/s is required.

An engineering model has been manufactured and tested for design study of the cryosorption pump. A schematic diagram of engineering model is shown in Fig. 1. The model consists of two modules, each of which is divided into four units to easily manufacture and construct the model. Two cryopanels are enclosed by a radiation shield box. The model consists of an 80K louver blind baffle, a 15K cryosorption panel and an 80K radiation shield. Activated charcoal is used as an adsorber. A louver blind type baffles have large transparency for hydrogen to maximize the pumping speed for hydrogen gas by using Monte Carlo simulation. The dimension of the module is 16.6cm in width, 29cm in depth and 200cm in height. Each module has a refrigerator on the top of the module and a compressor to cool down the panel at a temperature of 13K. The baffles are cooled at a temperature of 80K with liquid nitrogen.

The temperatures distribution in the pump is measured. The temperatures on the top, the bottom and the edge of the radiation shield arrived at about 80K in one hour. The tempareture of the second stage of the refrigerator shows almost same time evolution for both two refrigerators. The temperature of the edge of the cryopanel goes down more slowly than the temperature of other parts of the pump and it attained 13K at the same time with the temperature of the second stage of the refrigerator.

Fig. 2 shows the pumping speed of the cryosorption pump model as a function of the pressure where solid triangles shows the pumping speed for a pulse gas feed of 15sec, while open triangles are the speed for a steady state gas feeding and the solid line is the design value of the model. The experimental value of the pumping speed is higher than the design value.

The experimental results show that the capability of the model satisfies the design value and the design principle is reasnable for the design of a prototype pumping system.

1) Y. Oka et al. Fusion Eng. Des. 31 (1996) p.89

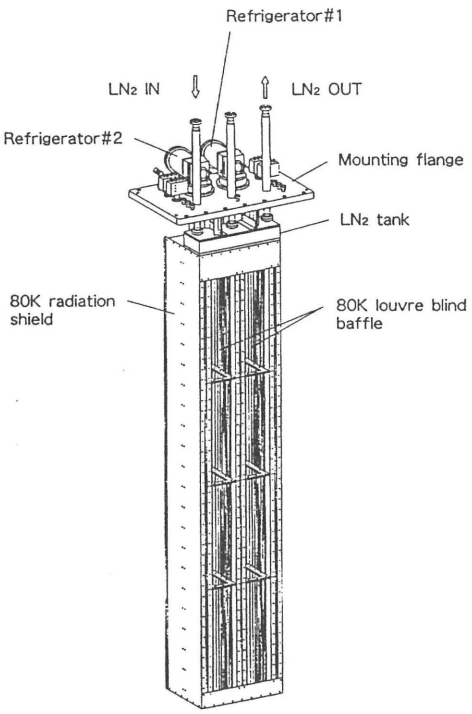

Fig.1 A schematical drawing of a engineering model of a prototype cryosorption pump

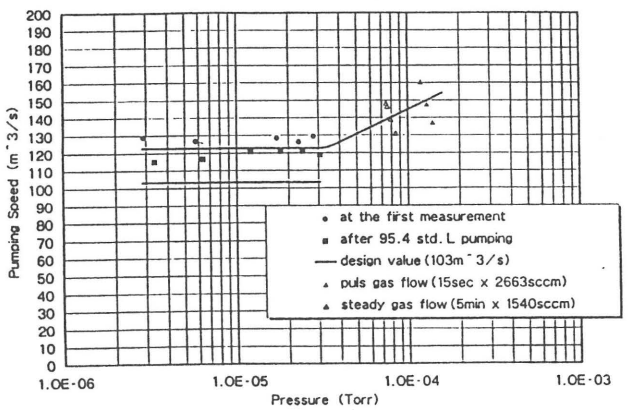

Fig.2 Pumping speed of the engineerig model