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Progress Towards Achieving Large Pumping Speed for Exhaust from Fusion Grade Machines

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The exhaust from a fusion grade machine comprises mainly isotopes of hydrogen gas and helium as the main content. The challenge lies in pumping voluminous amount of exhaust gases of the order of 200-400 Pa.m3/s. At present, pumping such a large throughput of gas in a perpetual way is a topic of primary focus in the field of vacuum science. Important requirement is of establishing technology at effective cost. In the Indian program, a cryoadsorption Cryopump(MPCP-08) offering pumping speeds as high as 50,000 to 70,000 l/s for helium and 1,50,000 l/s for hydrogen with a 3.2m2 of sorbent panel area is developed at the Institute for Plasma Research (IPR), India. It took about 7 year with initially establishing experimental set ups required for validation of the sorbents and its properties. It also included successful development of hydroformed Cryopanels carrying liquid helium with leak tight welds as a spin off technology. First laboratory scale pump integrating the developed technologies was a Small Scale Cryopump (SSCP-01) with a pumping speed of 2,000 l/s for helium. Subsequently, Single Panel CryoPump (SPCP-01) with pumping speed 10,000 l/s for helium was followed by Multiple Panel CryoPump (MPCP-08).

Further works are in progress using different forms of activated carbon clothes, carbon fibers and tested at the various in house experimental facilities to maximize the adsorption capacity of the porous materials, improve its thermal conductivity and provide enormous pumping speed. This paper describes India's contribution in realizing the studies carried out towards exploring carbon materials to provide large pumping speed for fusion grade machines.

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