

# Survey on Hot Isostatic Pressing Technique for development of Tokamak components

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Hot Isostatic Press (HIP) equipment is basically an electric furnace which is contained in a pressure vessel. In HIP, the component is subjected to elevated temperature (generally over 1000 degree centigrade) and pressure (generally over 1000 bar) which results in fully isotropic material properties. As per 2012 estimate, approximately 1000 HIP systems have been installed worldwide. Around 50% of these HIP installations were for R&D applications. HIP is used to eliminate pores (and remove casting defects), consolidation of powder and diffusion bonding of dissimilar metals or alloys. The components are often of net shape or near net shape. HIP eliminates inspectibility issues, enables new alloy system and enhances weldability. HIP improves fatigue properties, creep properties, ductility and impact strength. It provides an alternate supply route for long lead time components. Hot Isostatic Pressing of Austenitic Stainless Steel Powders for pressure retaining applications is reported in The American Society of Mechanical Engineers (ASME) proceedings.

The technology has developed over the last 20 years and HIP can now produce twice as much product using the same type of machine as they could twenty years ago. The capability of producing full dense near net shape product can be utilized for multilayered plasma facing components fabrication. Joining of various dissimilar materials is possible, such as tungsten to copper joining, Copper to copper alloy, SS to CuCrZr material etc. using HIP. The fabricated joints are reported to be satisfactory. Many fusion components are also fabricated through powder metallurgy route using HIP technique.

In this paper, we have performed a survey on applications of HIP in various R&D in fusion community. Some offshore applications, interesting applications in science projects and application for additive manufactured components etc. shall also be discussed.

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