

6 - 2 Manufacturing and Design of Thin Wall Dipole Chambers at HIMM

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The dipole chamber is one of crucial components of HIMM(heavy ion medical machine) and has to fulfil many different requirements. The main reason for using thin wall in the dipole chamber is to reduce heating due to eddy currents.

The fast ramping model is adopted in the magnetic field of synchrotron and the magnets shall be ramped with 1.6 T/s. Due to the fast field variation, eddy current effects will be rather intense in the dipole chambers. This leads to a unwanted heating up of the chamber wall. In order to keep the heat load at an acceptable level, the wall thickness of the dipole vacuum chambers is limited to 1 mm only. This low thickness, in turn, requires a proper stabilization of the thin-walled vacuum chamber.

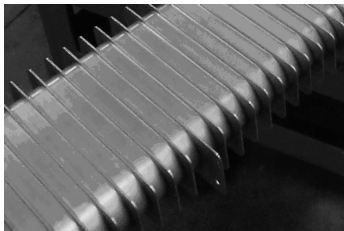


Fig. 1 The vacuum chamber with strength ribs.

The thin wall dipole chamber is made of austenitic stainless steel. It consists of the runway beam tube with thickness of 1 mm and support ribs with height of 5 mm(see Fig. 1). In order to satisfy safety in the machine operation time, the finite element analysis is used for estimating the mechanical stability and strength. The simulation results show that the vacuum chamber can withstand the atmosphere pressure (Figs. 2 and 3).

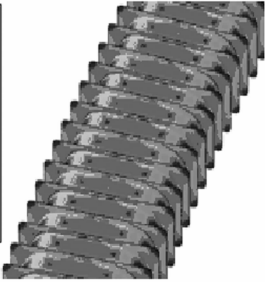
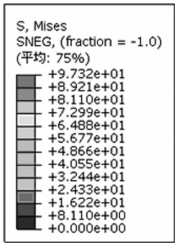


Fig. 2 Mises equivalent stress distribution.

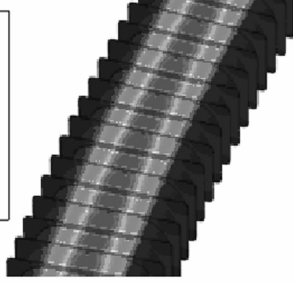
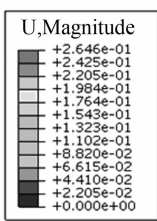


Fig. 3 Mises equivalent strain distribution.

The thin wall chamber with ribs is 45° arc with radius of 4000 mm. It is very long for thin wall chamber of stainless-steel. Moreover, the braze-welding is practically limited by vacuum brazing furnace. In order to reduce the manufacture difficulty, the curve vacuum chamber is welded together with five straight sections and the increase of cross-section dimension for eliminating the differences between arc and chord are adopted. The dipole chamber is self-made. Through the efforts of all members in vacuum group, the shaping process of thin wall tube, the brazing process of reinforcing rib and the segmented was finished, while welding process has been achieved gradually. The first prototype has been completed. The leakage and the deformation of the prototype can satisfy the design requirements. The prototype is the first special-shaped thin wall chamber in China up to now. At the moment, the other chambers have been produced in batches.