I.3: New ultraclean controlled atmosphere brazing furnace

A vertical cold walled brazing furnace of effective hot box of diameter 500 mm ×height 1500 mm and with moveable bottom cover has been installed in fabrication lab of the hill side workshop (Fig. I.3.1). The furnace temperature can go up to 1200°C at the rate of 5°C/min and is designed to operate in hydrocarbon free high vacuum (1 x 10^{-6} mbar) as well as argon partial pressure (0.5 ± 0.05 mbar) modes for brazing. The furnace offers ultraclean atmosphere due to refractory metal hot zone and pumping system consisting of oil free vacuum pumps.

Fig. I.3.1: The furnace during the installation phase

The heating element is made of lanthanum doped molybdenum and has a double V grooved type construction. The inner shield is made of 0.38" thick lanthanum doped molybdenum and the second and third shields are made of melted quality pure molybdenum. The remaining two shields are made of type 304 stainless steel. The hot zone is divided into three zones. The empty furnace offers a temperature uniformity of ± 5°C at 800°C. The double walled jacketed furnace chamber is made of type 304 stainless steel.

The rough vacuum pumping system consists of a roots pump backed by a screw pump. The high vacuum pumping system offers duality of turbomolecular pump (TMP) and cryopump (CP). TMP has short start-up time and high compression ratio for gases of high molecular weight and is able to bring the vacuum to 10^{-6} mbar in less than 30 minutes; thus it helps in starting the brazing cycle in a very short span of time. CP takes a long start up time but is exceptionally good in removing water vapour. CP is ready to operate before the final soaking step and this helps in creating anoxygen deficient environment in the furnace just before brazing. Although, one CP is enough for most of the brazing jobs; two CPs are provided to offer redundancy. Simultaneous operation of two CPs may be needed only for large jobs. The inner side of the furnace chamber has UHV compatible weld designs and the wall is electropolished to reduce outgassing load.

The furnace is equipped with 15 sheathed 'N' type flexible thermocouples that can be easily inserted in the thermowells drilled in the pre-braze assembly to ensure an accurate temperature mapping of the braze locations.

The power supply unit has dry type transformers, flexible high current secondary cables, digital signal processor controlled thyristorsand brazed ceramic high current feedthroughs. The temperature control is through advanced algorithms, auto tuning and multiple PID loops. The instrumentation panel (Fig. I.3.2) and power panel are air-conditioned for reliability and long life. The operation is through HP Z-series workstation with SAS hard drive for reliability and 22" touchscreen monitor for user friendliness. A separate 15" touchscreen mimic panel has been provided for online status monitoring. The furnace is enclosed in a dust controlled environment that includes hutch with removable top cover.

Fig. I.3.2: Instrumentation Panel

A 100 kW air cooled water chiller, equipped with UL listed control panel, compressor, heat exchanger, condenser and fans, has been provided for heat removal. Two stainless steel water pumps provide the cold redundancy for water circulation. Water cooling system is integrated with furnace SCADA.

The installation of this uniquefurnace is a result of networking amongst four divisions of RRCAT and BARC (RMP, Mysore). The furnace was built by an Indian industry. The furnace configuration and specification for design and manufacturing were provided by RRCAT. A rigorous design review was conducted by a team of nine RRCAT engineers. The essence of product oriented approach of project management code PRINCE-2 was imbibed during the design and manufacturing phase. The continuous quality surveillance was ensured by the participation of third party inspectors along with team of RRCAT and RMPengineers.

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