13.2 MELTER TECHNOLOGIES FOR VITRIFICATION

Melters for vitrification have to address not only the required throughputs but also material performance at elevated temperature (1000-1200 °C) and in contact with highly corrosive molten glass environment. Vitrification plants in India have been using the liquid fed metallic pot induction heated melters. The inherent limitations with these melters have been limited throughput and short melter life. Joule heated ceramic melters are being inducted in view of their higher throughput, better operational flexibility & prolonged life. Based on their performance, Joule heated ceramic melters could replace existing metallic melters in a phased manner. Advanced melters adopting cold crucible technology are also under study as a viable alternative to attain high temperature availability, compactness and ease out decommissioning problems associated with ceramic melters.

- Advanced Vitrification System – Joule Heated Ceramic Melter

One of the achievements made in technology upgradation was the setting up of a Joule-heated Ceramic Melter-based Advanced Vitrification System (AVS) in the existing process cells of SSSF, Tarapur.

The Joule Melter Technology is essentially a single step process of direct resistance heating where immobilisation of HLW in a borosilicate glass matrix is achieved in a refractory-lined melter. The Joule Heated Ceramic Melter (JHCM) process exploits the high temperature behaviour of glass whereby it becomes an electrical conductor at elevated temperatures and favourable changes in its viscosity near the pour point helps in product withdrawal and shut off. The distinct features of the AVS are increased throughput, availability of higher furnace temperature and minimum dependence on operator skills.

Retrofitting of JHCM in the existing cell blocks was a challenge to associated systems without affecting the regular operation and maintenance of the plant. An additional limitation was suitably locating melter cell equipment like off-gas scrubber, condenser, condensate collection feed tanks and piping inside the melter cell in such a way that the remote operations envisaged could be carried out smoothly.

A well-planned strategy for final decontamination, decommissioning and dismantling of JHCM was also to be addressed. Keeping in view the free space required for the reach of the remote handling gadgets during operation, layout for remote handling was carried out very carefully with lot of innovations.

JHCM has a throughput of 25 LPH with its external dimensions 1.5 x 1.5 x 1.8 meters. The main refractory is high corrosion-resistant Alumina-Zirconia-Silica refractory backed up with layers
Waste Management: High Level Waste Management

of insulating materials encased in a stainless steel box on suitable structural supports. The melter cavity has a hold up volume of 125 liters which is sufficient to provide a mean residence time of around 25 hours at the normal glass production rate of 1.5 Kg/hour. The plant is now complete in all respects. Initial trials have shown the system to be robust and promising. Full-scale operation is expected to be taken up soon.

- **Development of Cold crucible Induction Melter**

Cold crucible induction melting (CCIM) is emerging as an attractive technology for the vitrification of high level liquid waste. The cold crucible induction melting technology offers flexibility in treating various wastes, susceptibility to various wasteforms with better waste loading and enhanced melter life. Its compact design is advantageous as in-cell equipment. Developmental efforts are in progress at the Back-End Technology Development Division for establishing this technology.

**Laboratory and Bench Scale Studies**

The cold crucible is manufactured from contiguous segments forming a cylindrical volume, but separated by a thin layer of electrically insulating material. The number and the shape of the segments and the insulating gap between them must be optimized to minimize the power dissipation by the induced currents in the crucible while ensuring sufficient cooling of the crucible.

Detailed study has been carried out to decide the geometry and configuration of the segmented crucible. A laboratory scale segmented crucible of 500 mm diameter was employed to test the selected geometry and configuration. Subsequent to the successful demonstration of the laboratory scale unit, a bench scale cold crucible induction melter of 200 mm diameter was designed and tested to establish bottom glass pouring.

**Engineering scale facility**

An engineering scale facility is being set-up to establish the cold crucible technology employing a liquid-fed melter with a throughput of 15 LPH. The industrial scale melter is under construction and will be used to establish melter start-up procedure and melter operational stability. The crucible has an inside diameter of 500 mm with a glass holding capacity of 65 L. An induction heating power supply of 350 kW, 200 kHz will be employed to meet the total energy requirements.

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