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Plasma Torch Electrode Life Extension

DIAL has tripled the operating life of the Retech model RT 75-T plasma torch electrodes by carefully controlling the torch operating parameters. This was achieved with no loss of torch power or design modifications. Future research promises even greater extensions in plasma torch electrode life and operational reliability.

Plasma torch technology is a leading technology for vitrification of DOE's huge inventory of hazardous and radioactive wastes. A critical issue in the application of plasma torch technology is torch life; especially electrode life.

In current commercial use, torch electrodes are expendable materials, which can be replaced at frequent intervals. However, in radioactive waste processing, the costs and risks of electrode failure and replacement are much higher, thus creating safety and economic incentives which favor longer lasting electrodes.

Current electrode designs resemble a hollow cylinder, closed at one end and open at the other (see Figure 1). The arc attaches to the inside surface of this hollow cylinder, and exits through the open end. The outside of the cylinder is cooled with a continuous flow of water to remove the heat being transferred to the electrode by the arc. The plasma gas required to operate the torch is injected into the gap between the electrode and the nozzle.

This research effort has concentrated on increasing the electrode lifetime by controlling the operating parameters of the torch. The most important operating parameter to be controlled was the flow rate of gas through the torch. By varying this flow rate, the axial location of the arc attachment point can be moved. This strategy distributes the electrode wear axially, thus utilizing more of the electrode material before the wear in any one spot is sufficient to reach the cooling water and cause failure. To date, we have tripled electrode lifetimes compared to baseline operating conditions.

Future work promises to extend electrode life even further by exploring the effects of alloying electrode materials, and improving electrode heat transfer to the cooling water.

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