The Problem

The high temperatures on the inside of a large, shower-cooled, blast furnace were not transferring to the exterior cooling water fast enough due to a very small insulating air void between the outside steel shell and the refractory liner.

The traditional solution was to replace the liner during a planned shutdown and in some cases, during an unscheduled shutdown.

The client had two objectives: first, to reduce the number of work stoppages, and second, to increase the campaign life of the furnace.

The Solution

Working closely with a chemical manufacturer, a grout material was developed from first principals that could withstand the high temperatures, travel into the small voids, and had heat transfer characteristics suitable for the application. Special equipment and procedures also had to be developed to meet installation conditions and other needs of the client.

Several formulations were tested on a special setup that allowed a visual observation of the flow characteristics of the material. The test bed is shown in Figure 1.

A system to weld on injection entry ports, under the constant water shower (Figure 2), on the exterior of the furnace was developed by working closely with the owner. The ports were permanently identified to facilitate accurate record keeping.

Figure 1: Injection Flow Tests
It was necessary to prepare a grout log for each grouting procedure. A computer-generated port location drawing was also provided to help the owner monitor performance.

Thermal couplers were used to identify hot spots and monitor the results of each grouting operation. Immediate improvements were recorded, and twelve months worth of records resulted in a computer-generated graph showing a gradual lowering of the interior temperature of the furnace. Shutdowns resulting from the loss of iron scull have been eliminated.

The success of the experimental development program has led to an annual contract to re-inject the grout nipples on a regular basis during scheduled shutdowns.

In the owner’s opinion, C3 Industrial was able to extend the blast furnace campaign life by at least five years. Plans to install additional grouting nipples during the next relining contract have been made.