Refractory Shotcrete Installations

by Robert J. Harmon

The overall process of refractory shotcrete installation is similar to that of commercial and residential concrete installations. There is the material (in our case, some grade of refractory product), a catalyst, the pump, a nozzle, and compressed air. The difference is in the purpose of the installation. The typical shotcrete installation is usually intended more for structural integrity and/or aesthetics. In contrast, refractory installation is for containment of the heat, molten metal, and chemical attack that occurs in these environments. Also, refractory shotcrete installations are usually done on a smaller scale than typical structural applications.

The shotcreting of refractories continues to evolve as a standard repair and rebuild practice in many industries. Product developments in equipment and materials have allowed for shotcreted refractories to be installed at much greater distances from the pump and with better overall installed properties than dry gunning and ramming plastics. Likewise, properly trained pump operators and nozzlemen techniques have allowed shotcreted refractories to replace the older, more traditional repair and rebuild methods.

The speed of installation is critical in the shotcrete process. The traditional practice of casting in-place with conventional castable refractories requires a great deal of formwork and set time, particularly in odd-shaped vessels. On the other hand, the shotcrete process allows for zero or limited forming and almost instant set. The technique of ramming refractory plastics into large areas, while requiring little or no forming, is a very slow and labor-intensive practice. Finally, conventional dry gunning of refractories is still a good practice in some situations, but the premixed wet process of shotcrete has better physical properties and installation rates. Wet-process shotcrete installation rates can range from 10 to 15 times greater than dry-process gunning. The shotcrete method has proven to be a valuable tool in reducing down time.

As in any industry, safety is of the utmost importance. The speed of installation when using the shotcrete process greatly reduces the amount of time employees must spend in areas where they may be exposed to unpleasant environments. The shotcrete process itself is also regularly reviewed and improved in an effort to reduce material handling by limiting motions that may create injury from lifting, twisting, tripping, and slipping. Shotcrete application is planned with an eye to eliminating hazardous working conditions.

The steel, glass, power generation, aluminum, and mineral processing industries have recognized the tangible benefits of using the shotcrete process.
Robert J. Harmon is the Manager of Shotcrete Application Systems for MINTEQ International Inc., a division of Minerals Technologies Inc. Harmon’s background is in mechanical design, and he has worked in the refractory industry for 21 years. His experience in refractories is represented on both the manufacturing and sales and marketing sides of the business. He has worked as a Production Supervisor at MINTEQ’s Dover, OH, facility and was a Production Manager at its Slippery Rock, PA, facility. Harmon has also held the positions of Customer Service Manager, Sales Representative, and Technical Support Manager over the years.

A combination of refractory and metallic anchors, as well as excellent material development, allows for overhead installations. Being able to install overhead can cut as much as 1 to 2 days off of a project schedule.

Material was pumped and installed over 250 ft (76 m) from the pump. This allowed all the equipment to remain at ground level and tucked out of the way of other operations. Past practice had been dry gunning; but because of the superior properties of the shotcreted material, the customer has improved vessel life by over 2 years.

This unit was lined in one shift. Specialized brick was not required due to the capabilities of the shotcrete technology. If the vessel were to be formed and cast with conventional or low cement castable, it would have taken a minimum of four shifts.

The compact mixer/pump system allows for a small footprint at setup. One furnace is repaired while work continues uninterrupted on the operating furnace.

This combination of refractory and metallic anchors, as well as excellent material development, allows for overhead installations. Being able to install overhead can cut as much as 1 to 2 days off of a project schedule. Material was pumped and installed over 250 ft (76 m) from the pump. This allowed all the equipment to remain at ground level and tucked out of the way of other operations. Past practice had been dry gunning; but because of the superior properties of the shotcreted material, the customer has improved vessel life by over 2 years.

This unit was lined in one shift. Specialized brick was not required due to the capabilities of the shotcrete technology. If the vessel were to be formed and cast with conventional or low cement castable, it would have taken a minimum of four shifts.

The compact mixer/pump system allows for a small footprint at setup. One furnace is repaired while work continues uninterrupted on the operating furnace.