Foamfrax Provides Fast, Effective Furnace Lining Maintenance Solution for Nucor Hickman

Until recently, anchored and bonded ceramic fiber module systems were considered state-of-the-art for refits and repairs in the metalproducing industry. However, Foamfrax insulation, a new, gunnable foam/fiber insulation developed by Unifrax Corp. provides exceptional fuel and energy savings, fast installation, and overall cost savings. The benefits of the Foamfrax insulation system make it an important innovation in high temperature technology for furnace lining maintenance.

In order to evaluate this new foam/fiber product in a field trial, Unifrax Corp., in cooperation with one of its Foamfrax distributors, F.S. Sperry Co., applied Foamfrax insulation over an existing ceramic fiber module lining in a continuous roller hearth furnace at Nucor Steel in Hickman, AR.

Foamfrax insulation system

Foamfrax is a three-component system of specially conditioned bulk ceramic or soluble fibers, an inorganic binder, and an organic foaming binder. The installation process combines the bulk fiber material with the binders in a patented mixing mechanism creating a homogeneous foam/fiber mixture. The Foamfrax installation machinery propels this mixture through a feed hose and nozzle, then guns the material onto the target surface.

Foamfrax insulation can be installed at rates in excess of 1,000 board feet per hour, two to six times faster than traditional installation techniques. The time savings is even greater in cases of existing furnace linings that would otherwise require complete removal prior to a traditional installation. Unlike traditional construction techniques that often require five or more installers, a three-person installation crew is all that is required with this new technology.

Foamfrax insulation installs easily around apertures in the lining.

Foamfrax insulation is applied with minimal surface preparation.

The Foamfrax application system is specially designed to control airborne fiber levels. Unlike "sprayable fiber" technologies, which feed dry fiber and binder in separate streams that are partially combined once the product leaves the installation nozzle, the fiber in the Foamfrax system is completely coated with the foaming binder solution while in the mixing chamber, significantly reducing the potential for airborne fiber release into the surrounding environment. Limit switches installed on the binder mixing chamber prevent discharge of fiber prior to complete mixing with the foam binder.

In addition, a dust collection hood is placed on top of the fiber feed hopper to control further the release of airborne fiber. A vacuum drawn on the hood during operation keeps the bulk fiber chamber under negative pressure.

Measurable airborne fiber levels with the Foamfrax system may vary according to the specific application. Brian Bradley, engineering manager, furnace related products at Unifrax comments, "Average real-time exposures to airborne fiber levels with this technology are similar to or less than those experienced during conventional blanket or module installations. Also, because Foamfrax is installed much faster than conventional methods, the duration of exposure is significantly decreased."

System Characteristics

Foamfrax Insulation's interlocking network of fibers creates a strong, uniform monolithic structure that provides:

- Speed and ease of installation
- Low rebound during installation
- Low thermal conductivity
- Low thermal shrinkage
- Low heat storage
- Excellent thermal shock resistance
- Good chemical resistance

Nucor field trial

In August 2001, Unifrax's Bradley arranged a field trial with Taylor Curtis, hot mill production supervisor at Nucor Steel's Hickman mini-mill.

The application consisted of a 3-in. thick, 8 PCF Foamfrax Grade II fiber veneer over the existing ceramic-fiber module lining in a continuous roller-hearth furnace with an operating temperature of 2,150°F.

After six years of service, the ce-

The applied surface can be used immediately after installation.

ramic-fiber module lining had become severely fluxed and, as a result, the lining system had sustained some mass loss.

Due to this fluxing phenomena and shrinkage gaps in the lining, the furnace shell temperatures gradually increased over time. The repair options considered to lower the furnace shell temperature were either full lining replacement, or the addition of more insulation on the existing lining hotface. The Foamfrax insulation system was chosen to upgrade this unit because it could be quickly installed in three to four furnace sections during a 48-hr maintenance shutdown in the mill.

Prior to installation, the lining was thoroughly wetted with water to minimize airborne fiber generation and loose material was removed from the hotface surface. The glassy surface material that still maintained its physical integrity was kept in place. After this, the lining was wet with water once more and a 3-in. veneer of Foamfrax Grade II fiber was gunned onto the module surface. The completed Foamfrax lining added insulation thickness to the existing lining and filled any shrinkage voids on the surface of the modules. Care was taken during installation to work around burner areas and the removable roll bungs. Once in service, a noticeable reduction in furnace coldface temperature was observed.

Trial results

The lining upgrade on four sections of the continuous roller-hearth furnace was completed during the 48-hr maintenance shutdown and the furnace was immediately put back into service. The installation still remains intact after exposure to an operating temperature of 2,150°F.

Taylor Curtis comments, "The application of a Foamfrax Grade II fiber veneer over the existing ceramic-fiber module lining provided a significant decrease (approximately 50°F) in the outside steel casing temperature of our furnace. The net result was that our line now runs more efficiently while providing a consistent, uniformly heated product. The only other alternative for achieving similar results would have been a complete lining tear-out and replacement. This approach would have required a significant capital expenditure and prolonged furnace downtime. With the Foamfrax Insulation system, we can install three to four furnace sections during each of our 48-hour maintenance shutdowns, scheduled every six to eight weeks, with virtually no loss in production time."

The trial demonstrates that Foamfrax insulation is ideal for repairing/upgrading existing furnace linings or installing new full thickness linings in a fraction of the time required for conventional blanket or module linings. The system offers energy savings, installation speed, and lining performance for upgrades of existing fiber linings, linings over hard refractory, and furnace lining patches or refits.

According to Unifrax, the primary benefit of Foamfrax Insulation is that the end user realizes energy savings immediately after the product is installed and the furnace is put back into service. When installed as a lining upgrade or lining over existing refractory, Foamfrax has demonstrated a substantial improvement in thermal performance, saving thousands of dollars in energy costs. The typical payback period in terms of energy savings for an installation with this technology is less than six months. Applying several inches of Foamfrax over a partially deteriorated furnace lining can extend the furnace lining life and improve furnace efficiency. The new system can also be used as a hot face veneer or full thickness lining in kilns and furnaces operating at temperatures up to 2450°F.

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