Case Study: Energy Conservation through WDS® system in Steel Ladles

Introduction

In the face of heightened carbon footprint awareness and rising energy and raw material costs today, more efficient use of advanced thermal insulation materials is especially pertinent in energy-intensive industries such as iron and steel. Microporous possesses the lowest thermal conductivity among all other types of insulating materials, even below that of still air. As such, it is used when extreme insulating properties are required in the narrowest of spaces.

Background

Trials were conducted at a cluster market at Jalna where Thermo Mechanically Treated (TMT) bars were manufactured from the scrap. Scrap along with sponge iron were melted in induction furnaces of 15 to 55 tons in capacity at various plants. Metals are melted at 1640-1655°C, depending on the usual practice of each plant. At all tested sites, the hot face lining is made of silica ramming mass followed by 70% alumina safety brick and ceramic fibre board.

Refractory	Lining Pattern
Silica ramming mass	150-250 mm
Safety brick	50-125 mm
Ceramic fibre board	13 & 20 mm

Proposal

Requirements for ladles in iron and steel industry:

- Minimise power consumption in maintaining melt temperature during ladle travelling, holding and casting - insulation plays a critical role to reduce heat loss of the melt
- High level of corrosion resistance to liquid steel at the front of the unit; most of these high quality refractory materials possess high thermal conductivity levels as well
- High energy-efficiency and durability - outer shell of steel ladles has to withstand up to 400°C over a prolonged period without deforming
- Maintain intermediate temperature within the continuous use temperature with the use of an optimum insulation lining

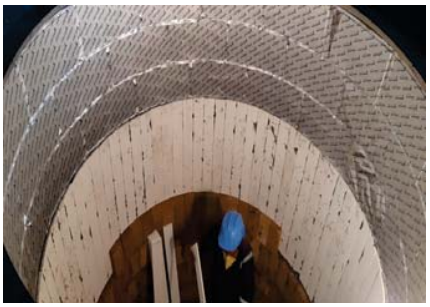
First, an assessment was conducted on the health condition of existing ladles. Based on experience, high quality refractory materials can be insulated with WDS system without compromising durability. In the table on the next page, it shows how the performance of the proposed lining compares with that of the traditional lining originally used by the customer. With WDS, it is possible to reduce the shell temperature to as low as 80-100°C, with significantly less heat loss.

Solution

	EXISTING LINING		PROPOSAL	
	With whole lining	**After 60 mm of Hot face**	**With whole lining**	**After 60 mm of Hot face**
Design	Silica ramming mass: 230 mm 70% Alumina brick: 100 mm **Lining thickness: 330 mm**	Silica ramming mass: 170 mm 70% Alumina brick: 100 mm **Lining thickness: 270 mm**	Silica ramming mass: 210 mm 70% Alumina brick: 100 mm Insulating board: 13 mm WDS System: 7 mm **Lining thickness: 330 mm**	Silica ramming mass: 150 mm 70% Alumina brick:100 mm Insulating board: 13 mm WDS System: 7 mm **Lining thickness: 270 mm**
Actual Measurement	Heat loss: 5.485 KW/m^2	Heat loss: 6.777 KW/m^2	Heat loss: 2.913 KW/m^2	Heat loss: 3.275 KW/m^2
	Cold face temperature:268°C	Cold face temperature:297°C	Cold face temperature:195°C	Cold face temperature:207°C
	Temperature reduction with proposed system		**73°C**	**90°C**
	Key benefit		**Less heat loss with lower cold face temperature**	

Installed System





Design, engineering, supply and application of proposed system for optimal performance

Post-Performance Review

A post-performance review via thermography and actual power consumption data analysis and correlation was then carried out.

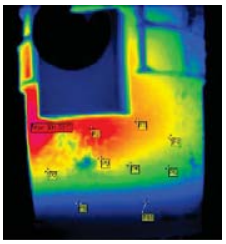
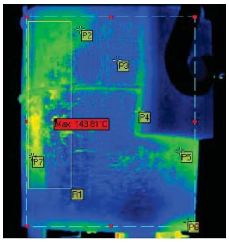
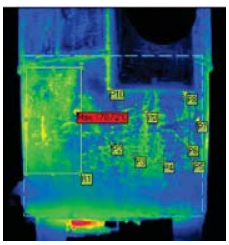
Case 1: Steel ladles lined with safety bricks and silica ramming mass

Case 2: Steel ladles lined with WDS system with SS 800 board introduced

Test Stage 1: With IR camera thermography

Test Stage 2: Drop in temperature of the metal from tapping till casting to correlate performance of WDS system

Case 1 : No insulation, 45th heat | Case 2: WDS+SS 800 Board, 15th heat | Case 2: WDS+SS 800 Board, 87th heat

Note: Two-stage data collections are done when ladle was empty, after fully loaded, before casting at CCM.

Conclusion & Value Proposition

The WDS-insulated steel ladle was compared with the un-insulated case for the last 3 months across different plants. An average of 15–20°C was reduced in the melting process of the induction furnace, which equates to saving 150–160 KW hr/heat. In a day, at least 12 heats are tapped from the induction furnace. In addition, holding time increases as the WDS-insulated ladle allows for a temperature drop of 1°C per minute as compared to >2°C per minute for the original ladle used.

About Us

We manufacture, design and install high performance thermal and passive fire protection insulation that reduces energy consumption and emissions in a variety of thermal processing and transportation applications.

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