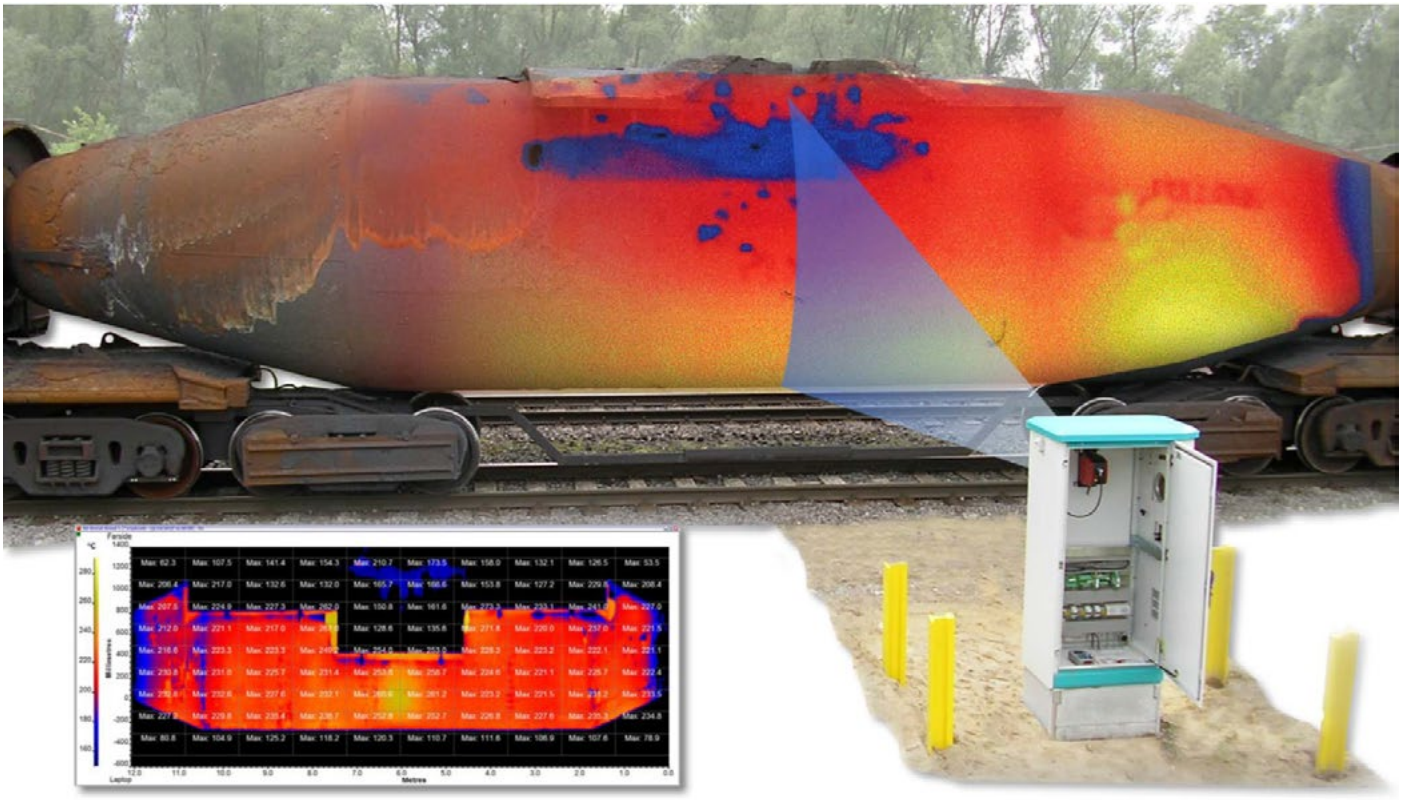


AVOIDANCE OF MOLTEN METAL BREAKOUTS
TORPEDO CAR MONITORING

INTRODUCTION

The escape or breakout of molten metal is a highly important safety consideration in all metal manufacturing industries, particularly steelmaking.

The extremely high temperatures involved make any breakout of molten metal extremely hazardous. However, if the metal mixes with water, it can instantly vaporize the water, causing a potentially explosive reaction.

Temperature measurement systems can provide a warning of when breakouts are likely to occur. Hotspots on the outside of ladles indicate the early stages of a damaged or thinning refractory lining. By detecting these hotspots on the surface of torpedo cars, they can identify points where the refractory lining is at its weakest.

TORPEDO CARS

Typically, integrated steel mills use torpedo cars on rails to transport molten metal form the blast furnace to the steelworks. Each car has a torpedo-shaped ladle that can carry up to 250 tons of liquid metal.

The ladle is lined with refractory brick to keep the contents in a liquid state and to protect the outer steel shell of the torpedo car against failure.

It is important to monitor the shell temperatures using the same method each time the car passes the monitoring location. In this way, a history of hotspot progression can be developed.

There is a temptation for steel manufacturers to allow the refractory linings to thin, thus increasing the volume of iron that can be carried. However, this increases the risk of failure.

Constant and repeatable thermal mapping of the shell allows early detection of areas that need repair.

MONITORING SOLUTION FOR TORPEDO CARS

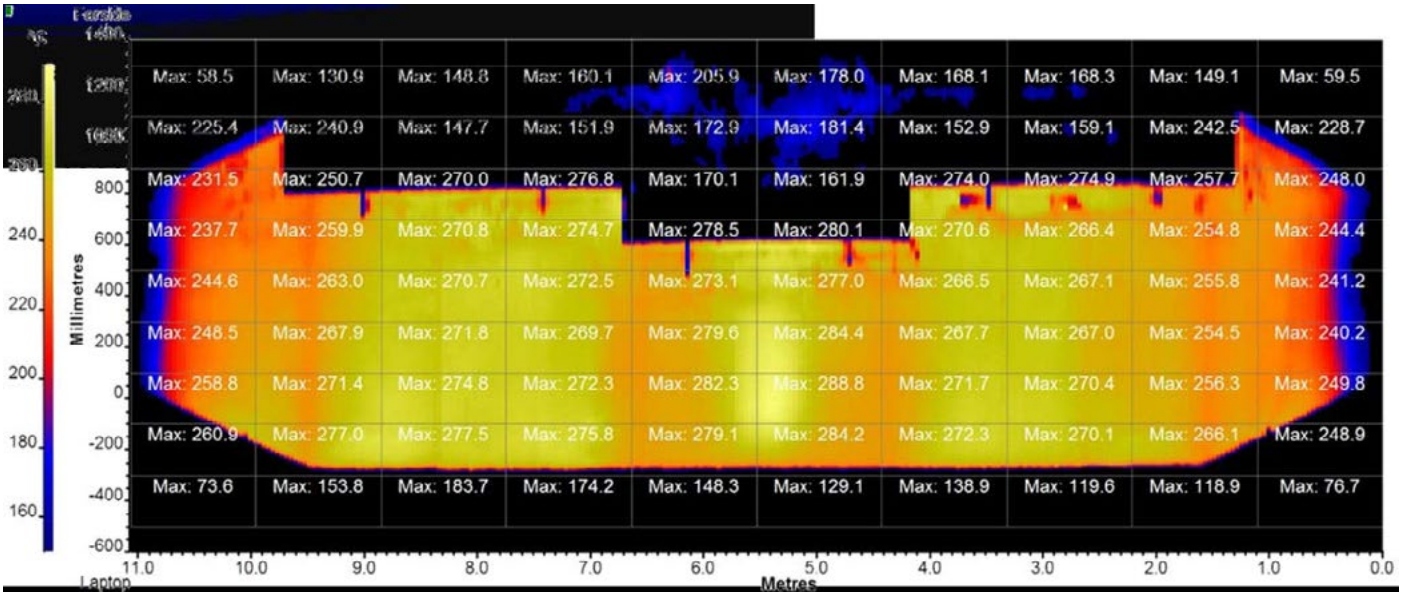
The optimal monitoring system uses scanners installed on each side of the track, producing highly detailed thermal images of each side of the car from a short distance, which usual thermal imagers cannot deliver. This enables the safety system to view very small surface details.

The scanners are housed in climate-controlled enclosures with air purges and electrical interfaces. Industry-standard fast ethernet provides rapid communication to the control room.

As each car passes a measurement station, ID tags on the car provide a unique car number and temperature data to the monitoring software. The direction of movement is also detected. The wide 80° vertical scan angle of the scanners and the 1,000 temperature points in each scan produce extremely high-resolution thermal images, providing comprehensive monitoring of the torpedo car. An image file is automatically saved for each side of every car. The complete view is then divided into a number of areas (50, for example).

For each area the maximum and average temperature is transferred to a historical database and stored images are accessible via PC on the company network. Data can also be transferred to the plant network for further analysis and storage.

Data obtained from a torpedo car can be presented in the form of a complete thermal image. Temperatures above the target region are indicated in red, and indicate an issue with the refractory lining.



TORPEDO CAR TAGGING

A SOFIS surface acoustic wave identification system is used for non-contact identification of ID tags located on mobile objects.

The SOFIS reading device has a computer controlled, high-frequency transmitter and receiver unit. It reads the tag number and direction of travel in the IDF tag and conveys this to the scan software.

The reading device is comprised of an evaluation unit and an integrated antenna designed for railway applications, and is accommodated in a robust housing.

The ID tag consists of a surface acoustic wave chip and antenna in a protective housing.

Both the tag and reader are highly resistant to vibration and shock, and are suitable for use in the track ballast or for installation on the vehicle body.

MAIN FEATURES AND BENEFITS

- Early detection of cracks in refractory helps avoid metal breakouts
- Early detection of changes in temperature profile
- Hotspot detection, analysis and tracking
- Increased plant safety by reducing and preventing breakouts
- Less risk to operators as manual field work is reduced by automatic inspection
- Easy-to-use fully automated solution
- Historical thermal image database
- Analysis of long-term trends
- Planned refractory relining maintenance schedule
- Automatic ladle/torpedo car detection and recognition

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