Ladle and ladle base

Thermography at Iron and Steel Works:

Krupp Mannesmann ironworks use FLIR Systems ThermaCAM™ P series to inspect, maintain and observe production processes

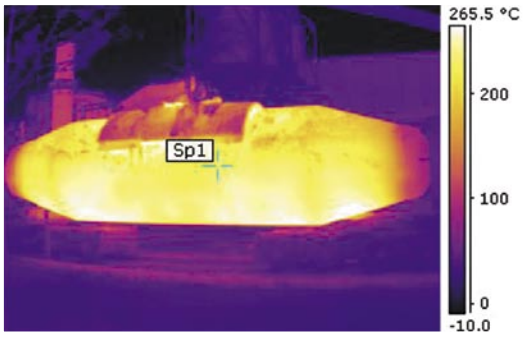
Infrared thermography is a vital tool to inspect, control and optimize metallugic production processes and installations. As contactless and reliable tools, thermal cameras provide temperature readings across an entire surface area instead of just at a few single points. In addition, thermal cameras allow workers to spot potential problems faster, safer and easier and avert unscheduled shutdowns and failures.

Hüttenwerke Krupp Mannesmann GmbH (HKM), located in Duisburg, Germany, is a leading European steel, metal plate and piping producer. The plant has been set up and developed by the Siemens, Krupp and Mannesmann industrial dynasties and is owned by their successor companies. At present, HKM has a workforce of 3,500 and an annual output exceeding 5 million tons.

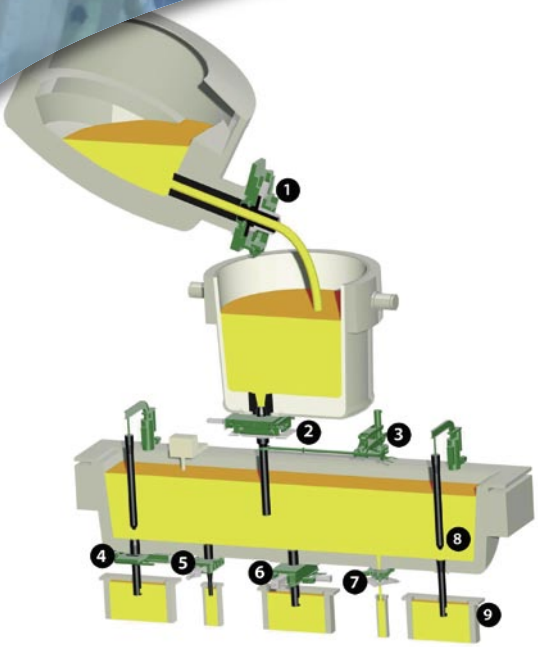
HKM manufactures pig iron and steel. The plant specialises in semi-finished production in the form of an extensive range of continuously cast slabs and rounds. HKM also operates a coke plant and a sintering plant, a factory where iron-bearing particles are formed into pellets or pulverized to be charged again into the blast furnace.

Making steel

Liquid steel, the production of which starts in a converter or an electric furnace, is tapped into a ladle through a furnace gate. Further refinement and chemistry of molten steel required to produce a high-grade steel takes place exclusively in the ladle. This 'ladle metallurgy' is also called secondary metallurgy. After passing the ladle's secondary metallurgy process, the ladle's content is sent to a continuous casting machine through a ladle slide gate valve. Then the hot steel is casted from the tundish to the continuous casting machine molds, channeled through tundish slide gate valves which assure an accurate level control of the molds for the steel.

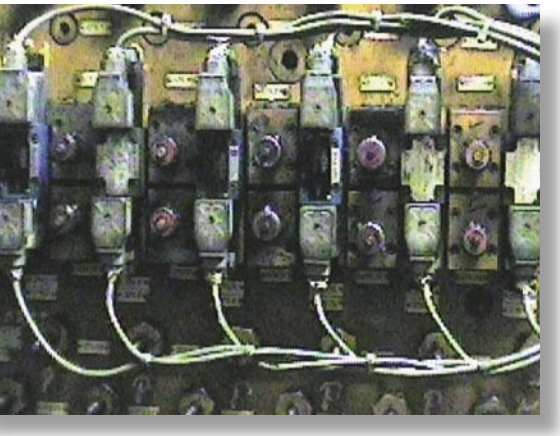


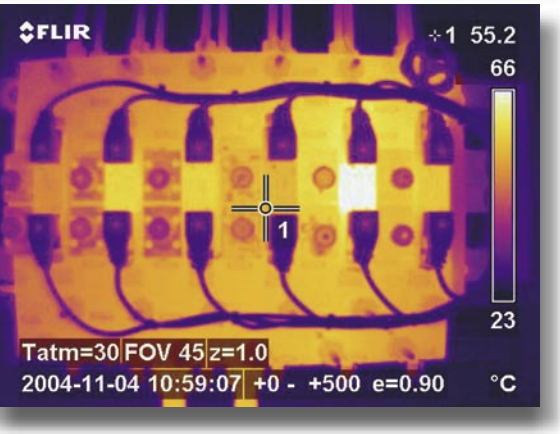
Torpedo laddle in infrared



Continuous casting systems

1. furnace and furnace gate
2. ladle and ladle gate
3. tundish and sliding gates
4. Tube changer with stopper
5. Tundish sliding gate
6. Tundish sliding gate with tube changer
7. Calibrated nozzle changer
8. Stopper control systems
9. Mold level control





Defective control module (second from right)

A multitude of tasks for the P-series ThermaCAM™

„Temperature tracking through the use of infrared thermography has proven invaluable within our industry", says Dirk Ehrlich, a technician at HKM's Energy Management Department. Ehrlich and his colleagues measure and calculate parameters such as heat and gas development, energy flows, or dust concentration which are needed to determine and eventually to optimise and reduce the plant's energy output. „And" he adds," infrared cameras enable a faster inspection in critical, inaccessible or potentially hazardous environments".

During the casting, an infrared camera is used to monitor the heat load on engines, gears, and other elements as well as the proper functioning of the cooling of the rollers. Risks are at hand: the proper functioning of the plant can be endangered by rollers, which are in direct contact with 1,000 °C hot molten steel rounds as well as structural casting plant elements which are directly exposed to heat radiation.

Semi-finished steel slabs produced in the continuous casting plants are usually cooled down in stacks. For the onward transportation of the slabs (for example, to the hot-mill strip to be rolled into coiled sheet and plat products) specific temperature limits need to be maintained. Thermography hardware and software allows to compare the actual temperature with the computed, pre-scheduled temperature at various points to optimise the process. At a sintering plant, iron-bearing particles are formed into pellets or pulverized to be charged again into the blast furnace. The sinter, which is still hot after the production process, is transported via a conveyor belt to the sinter coolers. Thermography is particularly useful to determine the average temperature distribution of the sinter in order to assess the heat load on the sinter cooler.

Inspecting refractory lining defects

Refractory materials are needed, among others, to prevent fire development during the casting process. They are exchanged after a few hours of operation. Their quality and performance are vital to a clean, safe and streamlined production process.

"We regularly inspect the tank lid of a vacuum chamber after a steel melting operation, to check the heat load of the lid" says Ralf Ponczeck, another team member of HKM's Energy Management Department.

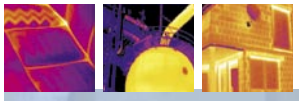
The surface of the two pig iron mixers, each with a capacity of 2,000 tonnes, is regularly checked for partial temperature overshoots, to identify as early as possible any damage which has occurred in the refractory lining. Also checked on their refractory level are so-called torpedo ladles. They are used to conveying the liquid pig iron from the blast furnaces to the oxygen steel works. Here too, thermographic imaging enables clear conclusions to be drawn about the state of the inner refractory lining.

The team also inspects the functioning of the converters' floor flushers. As flushing takes place via the floor using inert gases, the openings need to remain clear. The heat distribution can be captured by an infrared image. "Due to the high thermal radiation in this and similar measurements, we use a a telephoto lens to protect the ThermaCAM. This also makes it easier to film more remote objects, such as hot pipe routes", says Alfred Lichtweg, Energy Management Department team member.

Other current time- and money-saving applications are checking pipelines for deposit build-up or inspecting machinery which keep the steel product fabrication steps going. HKM also makes use of infrared thermography to optimise its production processes: alternative refractory linings, for example have been extensively tested at the plant with infrared cameras as they allow an accurate observation of temperature cycles across entire surface areas.

A FLIR Systems ThermaCAM P-series is are a very useful tool to reach, access, and inspect hot and hazardous areas typical for the metallurgic industry. And it helps to keep a vital and strategically important industry sector going: "After all," says Dirk Ehrlich, "there's something from HKM in every made-in-Germany truck or car: 12 percent to be exactly."

This story was based on an article authored by Dirk Ehrlich of HKM and free-lance journalist Frank Liebelt, Frankfurt, Germany



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