Laserprofile Measurement in the Steel Industry

LaCam® - Mobile

Fixed installation for:

Converters
Ladles
EAFs

Mobile version for converters and ladles

Torpedo Tadles

Open Die Forging
Motivation of Laser Measurement in Ladles

Why Laserscanner for Hot Ladles?

- Increase of safety in a steelplant
- Reduction of refractory and maintenance cost
- Optimization of process and logistics
- Increase of yield
Examples of Current Laser-Ladle Inspection

If the mouth of the ladle is “clean” and no skull is built up you can have good results from the entire Ladle-Refractory lining although the lasercaner is in front of the ladle mouth. But hidden areas cannot be measured and leads to a remaining risk.
The method of immersing a lasercanner into a hot confined space was already introduced with the LaCam®-Torpedo which measures inside the hot torpedo ladle.

Patented measurement method was further developed to measure ladle refractory lining in hot condition directly after tapping from inside the ladle.
Measurement Procedure

Positioning-Scan on outer ladle shell

Bottom-Scan from outside

Centerposition-Scan 360° inside ladle
Examples of LaCam LI-Explorer Applications

Ladle in Vertical Position

Klick on picture to run animation clip

Ladle in Horizontal Position
Versatile 2D and 3D Result presentation for Ladle Application

Ladle Refractory Thickness-, Wear- and Wearspeed- Measurement

Sectional and Horizontal 2D Cut

Wall

Examples of 3D presentation

Trend and Tendency Analysis

Bottom
Evaluation and presentation of the results
Measurement from outside vs. inside

Refractory thickness measurement with laserhead position outside (A) and inside (B). Not measured areas in the slagzone are white spots (A). Fully measured slagzone (B) shows dangerous thin lining in red.
Pyrometric Temperature Measurement

Simultaneously to the lining thickness the system measures the surface temperature of the lining with a high density of data collection (one measure point per laser shot). With this additional temperature profile information the system provides non-uniform temperature distribution of the ladle-lining and hot spots.
Performed data processing is a special 2D peak finding algorithm which has some similarities to image processing functions. In a combined evaluation of brick thickness-, surface temperature and Laser Echo Amplitude a gap or crack in the lining can be determined.
3D - Gap contour plot of ladle / view from outside w/o steel shell and cut in half from inside

Ladle wall with gaplines (red) and gap values
3D - Gap contour plot and Temp. plot of ladle bottom result in automatic detection of extreme points
Taphole Condition and Sandfilling

Detection of “Open slider”, Debris above slider, optimum amount of sand mass, optimum sand filling by controlled x-y-position, optimum sand profile shape

Tap Holes before sand filling

Tap Holes after sand filling
Bathlevel Determination and Freeboard

Bathlevel determination based on exact profile and volume calculation and input from steel- and slag mass.
Cooling and Control Unit

- IPC COMPUTER
- PLC Control unit
- Service monitor and keyboard
- Space for customer specific solutions
Cooling and Control Unit
User friendly solution and easy to maintain

- Operation mode
- Service mode

- 20l water reservoir
- Selector Cooling/Auto filling
- High power pump
- Heat exchanger Incl. fan
Conclusion

By immersion the laserscanner into the ladle you achieve better results by means of

- Higher measurement accuracy in all areas - covering 100% of the ladle surface
- Scanning areas e.g. slagzones which are often hidden if you are using laserscanner from outside
- Very high resolution scan due to small laserbeam and better viewing angle
- Detection of gaps and cracks due to combination of thickness measurement and surface temperature
- Additional advantages like taphole analysis and controlled sandfilling
- Precise determination of bathlevel and freeboard
SCANTROL® - Intelligent Control Module between Laser Wear Measurement System LaCam® and Automatic Spraying Manipulator
System overview Scantrol for Ladle (example)
Planning in realisation of the complete system
Control Flow SCANTROL®

Start of Operation

Measuring Sequence

Coordinates for Manipulator

Gunning Sequence

Optimisation Strategy

Visualisation

Controlling by Operator

End of Operation
Scantrol® mask: Wall Areas
Controlling by Operator

- Operator can adjust the optimisation strategy parameters:
  - gunning time (optional)
  - quantity of material
  - degree of lining rebuilding

- Operator can decide whether to start the gunning sequence either:
  - immediately,
  - later on,
  - or whether to cancel the gunning sequence
Coordinates for Manipulator

The gunning areas calculated by the optimisation strategy are transformed into control commands which can be interpreted by the manipulator.