



NON-DESTRUCTIVE TESTING (NDT) SERVICES

ULTRASONIC INSPECTION IN METALLURGICAL FURNACES

Among various non-destructive testing (NDT) techniques, the ultrasonic testing (UT) pulse-echo is the most reliable and practical system for the accurate measurement of metal thickness, even under harsh operating conditions.

Cooling blocks in pyrometallurgical furnaces and blast furnaces are primarily made of copper or cast steel. The severe environment and the mechanical and chemical attacks cause deterioration of the cooling elements. Condition monitoring and periodical inspection of the cooling elements could prevent structural failure, a common factor in injuries, loss of time, and production.

Monitoring the thickness of the furnace coolers in operating furnaces, including plate coolers, finger coolers, waffle coolers, and cooling stave, is complicated for the following reasons:

- Copper or cast steel are attenuating mediums and tend to dissipate ultrasonic energy rapidly
- The coolers are relatively thick (150 mm to 500 mm)
- Cooling blocks could have very complicated shapes, such as dovetailed grooves, waffle coolers, copper fins, and internal Monel cooling circuits to carry cooling water
- The cooling circuits are either made of Monel or are drilled into the block and are closely spaced, making it difficult for ultrasonic waves to travel between them with reflection
- The speed of the UT waves is affected by the through-thickness temperature gradient in copper coolers.

Because of these complications, a systematic analysis and experimentation campaign was conducted to assess the impact of these parameters on the capability of UT testing to reliably monitor the cooling-block thickness while in operation.



Copper cooler field inspection

CONTACTS

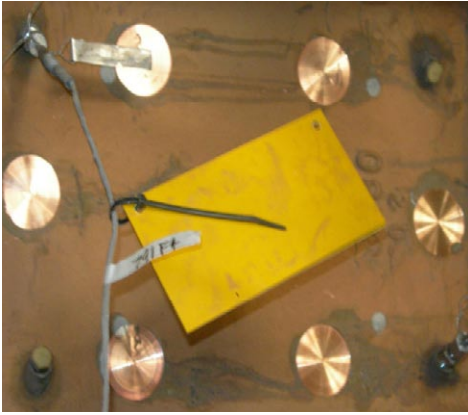
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Wave speed calculator for UT measurements in copper coolers



NON-DESTRUCTIVE TESTING (NDT) SERVICES CONTINUED



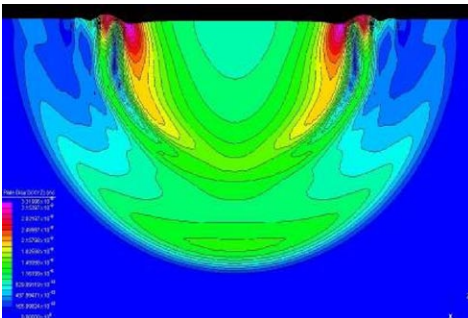
Permanent UT measurement stations on copper coolers

Hatch's NDT Group has developed a methodology for the accurate (average ± 2 mm) determination of cooling-block thicknesses in operating furnaces. Part of the development was selection of the UT pulsar/receiver, in combination with the right transducers. Another aspect of the development was a temperature-wave speed calculator that determines the UT wave speed in the material, such as copper coolers, when the hot face is at 200oC and the cold face is at 40oC.

With thousands of hours spent on cooler inspections in various countries around the globe, Hatch's NDT Group has the most experienced cooler inspection experts.

Hatch has provided NDT services for the following clients:

- Alcoa
- Anglo Platinum
- Antam
- Alouette
- Aluminerie Alouette
- ArcelorMittal Dofasco
- Bamangwato Concessions Ltd. (BCL)
- BHP Billiton
- Cerro Matoso
- Coru
- ENAMI
- Eramet
- Essar Global Algoma Steel
- Gerdau Acominos
- Iluka Resources
- Iron Ore Company of Canada (IOCC)
- ISPAT Inland Steel
- Lonmin Platinum
- Noranda
- Port Kembla Copper
- POSCO
- Pohang Steel Works
- Gwangyang Steel Works
- Queensland Alumina Ltd. (QAL)
- Rio Tinto
- QIT - Fer Et Titane Inc.
- Hismelt
- Kennecott Utah Copper Smelter
- Richards Bay Minerals
- Severstal (North America)
- Severstal (Russia)
- Stelco
- Sterlite
- Tenaris Siderar
- Vale Inco
- Western Mining Corporation (WMC)



The finite element model of stress-wave propagation in complex shaped elements