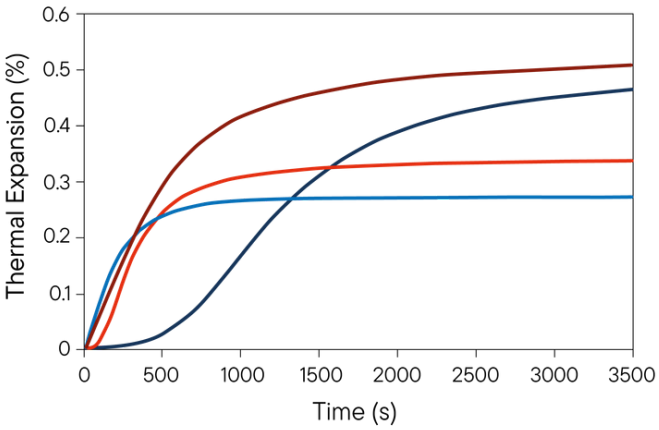
Thermal Expansion Behavior of Ultrasonically Treated Austempered Ductile Iron

Accelerated Ausferrite Transformation Analyzed by Quenching Dilatometry

Dilatometry enables the precise investigation of phase transformations and dimensional changes during controlled heat treatment processes. In this application example, the transformation behavior of conventionally solidified and ultrasonically treated austempered ductile iron (ADI) was investigated using the Linseis DIL L78 RITA Quenching Dilatometer. The measurement provides valuable insights into transformation kinetics and microstructure development.

Measurement Setup

- Instrument: Linseis DIL L78 RITA Quenching Dilatometer
- Sample: Austempered ductile iron (ADI), conventional and ultrasonically treated
- Austenitization temperature: 900 °C
- Austempering temperatures: 275 °C and 375 °C
- Measurement: Relative thermal expansion during isothermal transformation
- Application: Heat treatment optimization and phase transformation analysis



The dilatometric measurement reveals the transformation behavior of conventionally solidified and ultrasonically treated ADI materials. Key observations include:

- Significantly faster transformation kinetics after ultrasonic treatment
- Reduced incubation time before ausferrite formation
- Earlier stabilization of thermal expansion
- Strong influence of austempering temperature on transformation behavior

The results demonstrate the effectiveness of ultrasonic processing for accelerating phase transformations in ductile iron.

Interpretation

The observed behavior can be attributed to:

- Increased graphite nodule density
- Shorter carbon diffusion paths
- Enhanced nucleation of ausferrite
- Refined microstructure development

This results in:

- Faster heat treatment cycles
- Accelerated phase transformation
- Improved process efficiency
- Enhanced microstructural control

Industrial Relevance

Dilatometric measurements with the DIL L78 RITA are widely used for:

- Austempered ductile iron (ADI) development
- Heat treatment optimization
- Transformation kinetics analysis
- Foundry process development
- High-performance cast iron components
- Automotive and mechanical engineering applications

Conclusion

The measurements performed with the Linseis DIL L78 RITA demonstrate the capability of quenching dilatometry to characterize transformation kinetics in austempered ductile iron. The accelerated ausferrite formation observed after ultrasonic treatment highlights the potential for shorter processing times and improved microstructural control in advanced cast iron manufacturing.

Source:
Ahmed, M., Riedel, E., Bähr, R., Kovalko, M., Volochko, A., Nofal, A.
Ultrafine Ductile and Austempered Ductile Irons by Solidification in Ultrasonic Field.
International Journal of Metalcasting, 2021.
Adapted from dilatometry measurements performed using a Linseis DIL L78 RITA Quenching Dilatometer (incorrectly referred to as "L87/RITA" in the original publication).