Summer, 2017

Volume 15, No. 2

DEFORM News

Training:

- October 17-20, 2017: SFTC will host DEFORM training at our office in Columbus, Ohio.

- December 5-8, 2017: SFTC will host DEFORM training at our office in Columbus, Ohio.

- February 13-16, 2018 (tentative): SFTC is planning to host DEFORM training at our office in Columbus, Ohio. The remainder of the 2018 schedule will be released before the end of the year.

Events:

- November 7-8, 2017: The DEFORM User Group Meeting will be conducted in Columbus, Ohio. (Tentative)

- August, 2018: The 22nd annual Die Stress Workshop will be hosted by SFTC, in conjunction with Marquette University, at our office in Columbus, Ohio. The exact timing will be released by the end of the year.

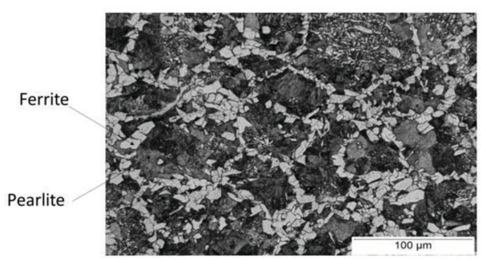
DEFORM®

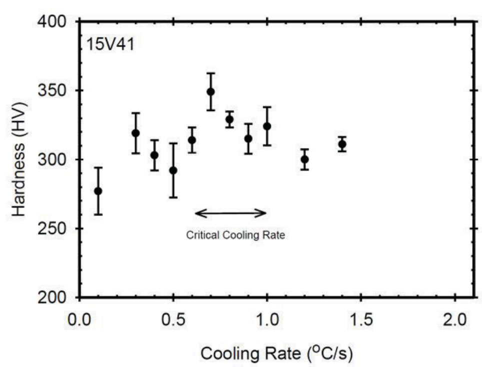
Design Environment for FORMing

Microalloy Cooling Rate

Typically, steel forgings are heat treated to produce the optimum strength versus ductility for a given chemistry and application. Microalloy steels use a precisely controlled cooling rate, after forging, to achieve comparable mechanical properties at a lower manufacturing cost. Identifying an optimum cooling rate for each alloy would allow manufacturers to select ideal cooling fans for any new forging, minimizing trials.

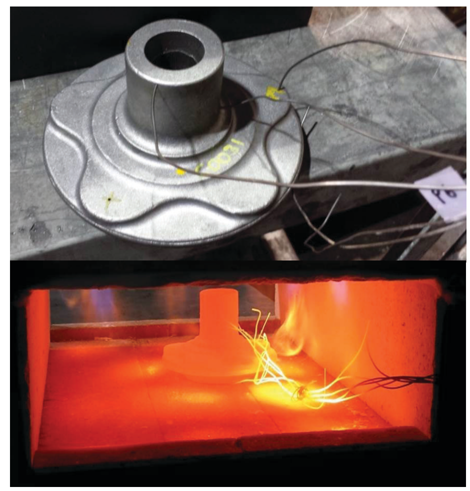
In 2014, a FIERF poject was awarded to Professor Chet Van Tyne at Colorado School of Mines (CSM) to characterize optimum cooling rates for three common alloys. Samples of each alloy were cooled on a Gleeble, at a range of cooling rates, with hardness measured for each sample. The optimum cooling rate to achieve maximum hardness (strength) was the output, along with the microstructure.





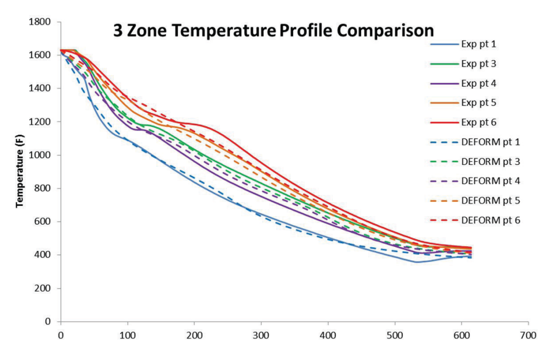
The CSM project provided excellent information, subject to industrial trials. SFTC and HHI/MPG Forging (since acquired by American Axle) funded a subsequent project to test this work on automotive forgings produced at Jernberg, in Chicago.

In order to simulate the cooling rate after forging, the convection coefficient was required for a given fan and conveyor. This could be determined by CFD modelling, which is tedious and time consuming. In this case, we used the Inverse HTC module in DEFORM to 'extract' this date from a thermocouled test part, as shown below. The heat transfer coefficients were



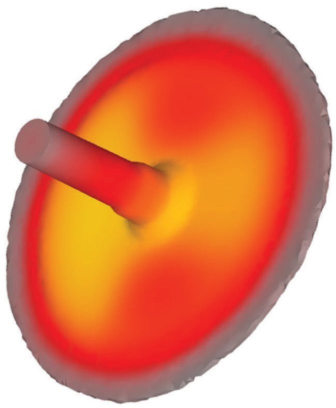
determined in regions on the top, bottom and sides. This represented surfaces with direct airflow from the fan, the back side where the air was blocked and an intermediate region.

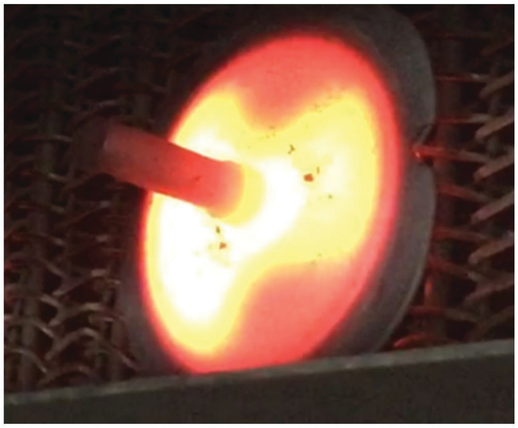
The comparison between measured (with thermocouples) and simulated test results showed an excellent correlation, as shown below. This gave confidence that the model and convection coefficients were accurate enough to predict internal cooling rates. The plan was that a known cooling rate would match a measured hardness at a location on the production forging.



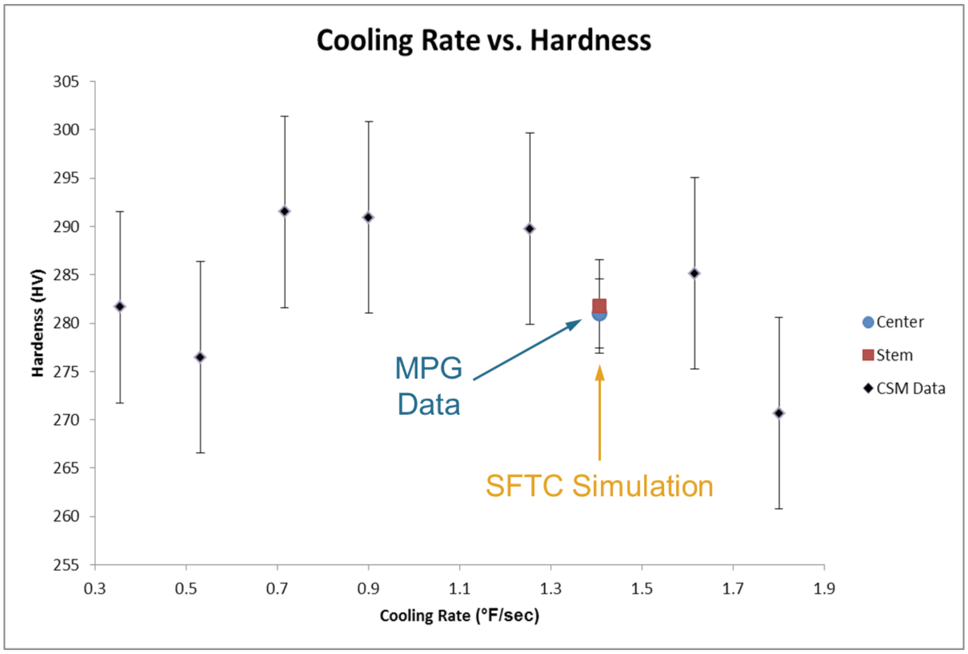
Microalloy Cooling Rate (continued)

The team selected an automotive component, forged from 15V30M material to validate the modelling procedure. Jernberg engineers simulated the process, with special attention paid to the temperature through the process. As shown below, the profile between the model and production parts match. Pyrometer measurements were used to ensure that the surface temperatures were accurate in the model.





After the simulations were completed, the cooling rate between critical temperatures for various test sample regions were extracted from the model. The results were very encouraging, with hardness in the middle of the range reported in the Colorado School of Mines report. Hardness was used as a proxy for tensile tests, due to a known relationship.



This collaborative project was a success, with excellent correlation. While only three materials were characterized and one tested against production data, the production results matched the lab tests. Additional validation will be required to understand how robust this approach is. This project was presented at the Forging Industry Technical Conference in 2016 by Nick Lindeke of Jernberg.

For more information on how DEFORM can be used to optimize your microalloy cooling rates, contact sales or support at SFTC.

DEFORM V11.2 Release

DEFORM V11.2 is being released in early fall, 2017. Important improvements include:

Enhancements

- A process control utility has been developed.
- The status of DEFORM services are available in DEFORM Setup.
- Installing and managing DEFORM services and updates has been significantly improved.
- Web based simulation monitoring is avialable on PCs.
- Simulation queue priorities can be managed by users.
- MO system performance has been improved for large 3D models.
- Mechanical press models have been enhanced in **Forming Express**.
- MO simulations can be stopped in the simulation queue.
- MO project archival database purging has been implemented.
- DOE output options include purging databases after DOE study completion.
- Point tracking has been enhanced for trimmed objects.
- FLOWNET tracking has been developed for ALE simulations, including extrusion and shape rolling.
- A backward tracking function for region of interest has been included.
- Volume tracking for 3D forgings with flash has been included.
- Anisotropic friction is available.
- A hydraulic press model with a power limit and speed as a function of stroke is included.

Bug Fixes

- Fracture element deletion in 2D
- Thickness based element deletion
- 3D view factor calculation
- Temperature substepping

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