Spring, 2015

Volume 13, No. 2

DEFORM™ News

Training:

- April 21-24, 2015: DEFORM training will be conducted at the SFTC office in Columbus, Ohio.
- June 16-19, 2015: DEFORM training will be conducted at the SFTC office in Columbus, Ohio.
- August 11-14, 2015: DEFORM training will be conducted at the SFTC office in Columbus, Ohio.

Events:

- April 28 and 29, 2015: The Spring 2015 DEFORM User Group Meeting will be held at Hilton Marco Island Beach Resort in Marco Island, Florida.
- August 18-19, 2015: The annual Die Stress Analysis Workshop will be held at the SFTC office in Columbus, Ohio. Professor Joe Domblesky, from Marquette University, will co-instruct this very popular workshop.
- August 20, 2015: A one-day training class on the DEFORM setup details related to die stress analyses will be offered. This first time offering will be held after the Die Stress Analysis Workshop. This training workshop will cover die stress analysis setup and simulation options from a DEFORM user perspective.

Design Environment for FORMing

Furnace Modeling

Among the developments introduced in DEFORM Version 11 is the ability to simulate batch furnace heating. It is an application-specific tool to study thermal response when furnace heating one or more objects. The Multiple Operation (MO) wizard simplifies the setup of heating models, including staggered loading and fixtures.

Traditional furnace heating simulations assume a user defined (generally fixed) environment temperature at any specific time, based on a defined thermal schedule. This requires an assumption that the environment is not influenced by the furnace contents. In reality, a hot furnace will cool off after loading a large load of cold billets. The new model accounts for detailed furnace properties, including the impact of part load on the temperature and energy consumption.

Energy costs are a significant factor in forging and heat treatment processes. Companies with furnaces have an opportunity to reduce energy use through process improvement. The batch furnace model provides a tool to optimize load patterns and thermal schedules. In addition to reducing energy consumption, avoiding quality issues can be expected.

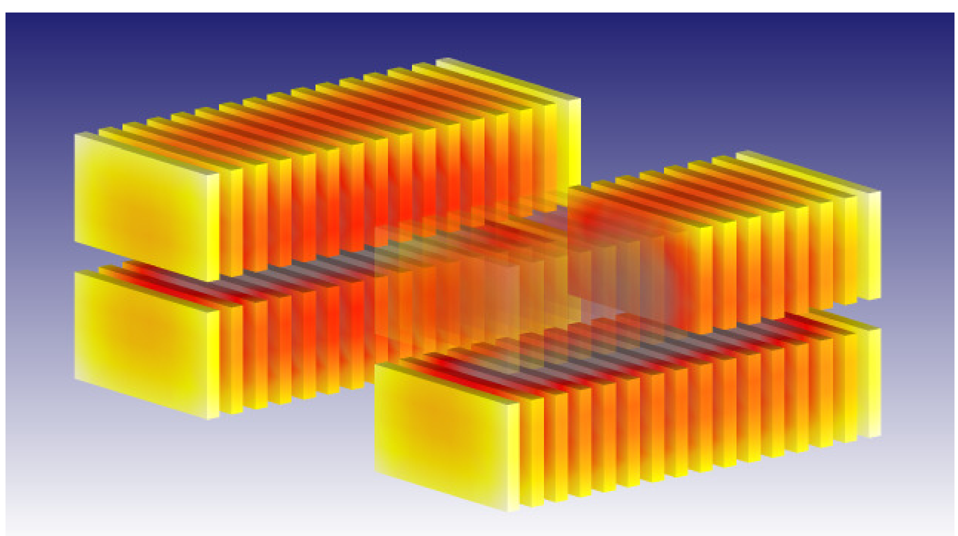
Furnace response depends on the size of the load to be heated. Large loads or billets can impose a substantial energy drain on the furnace. This may have a profound impact on furnace efficiently and heating times.

The GUI provides the following unique capabilities:

- Load pattern
- Furnace properties
- PID control response
- Forced convection estimation
- Energy balance calculations
- Energy consumption prediction

The easy-to-use preprocessor supports the definition of furnace dimensions, wall details, cooling system and recirculation fans. Gas or electric furnaces are supported. A PID control input permits model tuning to accurately reproduce the furnace response.

Energy balance calculations are used to predict the furnace energy consumption. Adding a load of cold parts to a hot furnace draws thermal energy from the furnace environment to the parts. As this reduces the environment temperature, furnace PID controls act to recover the furnace back to the defined schedule.

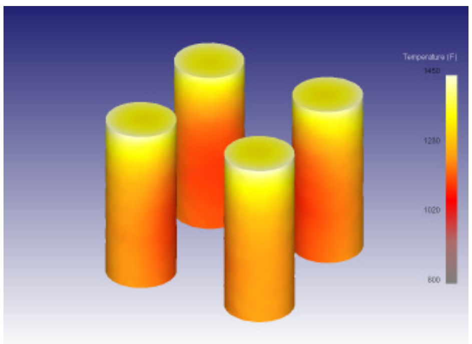


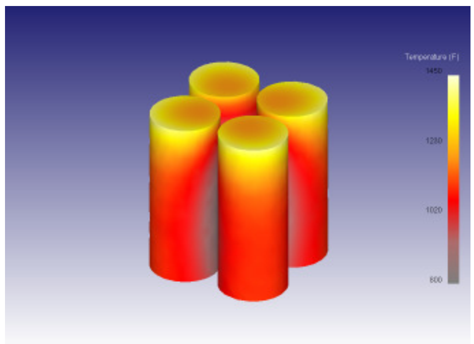
Temperature variation occurs across parts in a furnace layout. Local convection and radiation effects are dictated by layout pattern and spacing.

A comprehensive finite-element (FE) thermal analysis is implemented. Conduction within the parts, fixtures and furnace walls is included. Furnaces may be defined as free or forced convection. With forced convection, the module automatically estimates heat transfer coefficients due to the recirculation fan. Finally, radiation plays a dominant role when heating multiple objects. View factor calculations reveal object-to-object radiative behavior and shadowing effects.

The two examples shown below illustrate practical applications.

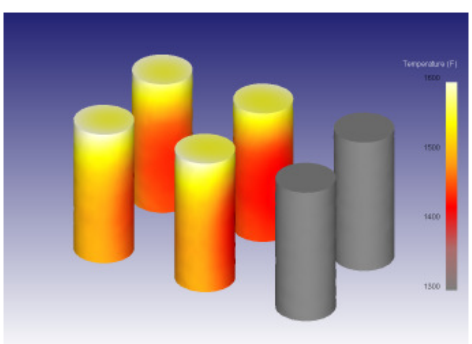
In the first example (below), a set of four billets is placed in a square load pattern under two different furnace heating scenarios. Parts are well spread out in the first scenario (left) and are closely grouped in the second scenario (right). The wide spacing allows for better forced convection around the billets, with less radiation shadowing. Thus, the widely-spaced billets heat up faster than the closely-grouped billets. Billet surfaces near the center of the pattern are being shadowed from the furnace wall by the billet on the opposite corner of the load pattern. The images show the temperature profile at a mid-point in the heating cycle. This type of study can be used to optimize workpiece arrangements within a furnace. In this case, the widely-spaced billets reached the target preheat temperature 45 minutes faster than the closely-grouped billets.

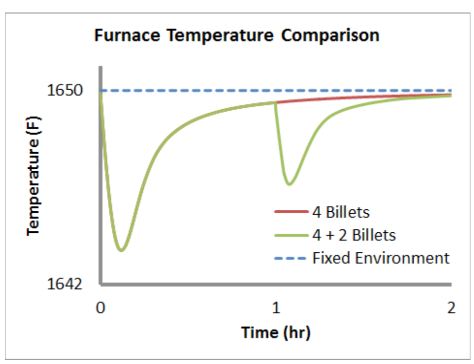




The second example (below, left) begins with the widely-spaced layout described above. Two room temperature billets are added to the furnace after one hour of heating. The six billet arrangement now takes a rectangular shape. As the billets heat, the middle two billets now heat slower than they did in the first example. This is due to the temperature loss in the furnace and the shadowing, from the furnace walls, by five other billets.

Furnace temperature was determined for the three scenarios (below, right). The blue dashed line shows the fixed environment temperature assumption made in a traditional heating simulation. The red line displays a single dip in furnace temperature, which occurred during the first widely-spaced billet example. The green line shows the furnace temperature response from the second example. It contains the initial dip plus a second dip from the two additional billets.





DEFORM V11.0.2 Release

DEFORM V11.0.2 was released in December, 2014. Improvements and enhancements include:

- Target volume calculation is available in FORMING EXPRESS 3D.
- Added features and controls were added the report generator.
- PIP (picture-in-picture) in the post-processor allows the user to view multiple database files.
- Quarter symmetry shape rolling rotation is now supported in ALE.
- Bug fixes and stability improvements were made throughout.
- Geometry reference point updating has been improved.
- MTS (multiple time step) coupled die stress analysis supports EP objects.
- Hyperelastic analyses with sub-stepping improves accuracy.
- Friction heating involving multiple deforming objects was enhanced.

New Features in V11.1

DEFORM V11.1 is being targeted for a mid-2015 release. Some of the new features include:

- Shape rolling, cutting and inverse HTC modules rewritten in new MO environment with numerous enhancements and bug fixes.
- Copy/mirror functionality is available in the MO environment.
- Enhanced PIP and multiple viewports will be implemented in the postprocessor.
- Brick remeshing improvements support more complex shapes.
- Rotational symmetry enhanced
- A dual mesh system was implemented to improve speed.
- Taguchi sampling, multiple simulation server support and CAD integration were added to DOE.

DEFORM V11.1 will contain the integrated 2D/3D and the F2/F3 GUI. These will be phased out and replaced by the Multiple Operations GUI over time.

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