Updated DANTE Software Solutions are Here!

Welcome to the DANTE Family!

- DANTE Solutions would like to welcome eCon Engineering as our newest representative. Located in Hungary, eCon Engineering was founded in 2002 and now employs over 80 engineers. They have 20 years of experience solving industrial problems using finite element analysis. eCon Engineering offers software sales, training, and support.
- DANTE Solutions would also like to welcome the following companies from all over the world to our expanding number of DANTE software users:
    - Bell Flight (USA), Knorr Bremse (Hungary) , University of Akron (USA), Virginia Polytechnic Institute and State University (Virginia Tech; USA)

Quick News:

- Jason Meyer gave a presentation at the ASM International Akron Chapter meeting on October 20th. His presentation detailed the work he performed with Brian Kohut (Cleveland State University graduate student) for the Strong Bar Competition, held at Heat Treat 21 in St. Louis. Although they placed near the bottom of entries, they learned many valuable lessons about heat treat specifications and were happy to share them with the Akron Chapter of ASM International. Pictured, from left to right: Joe Powell, Brian Kohut, Lou Cseko Jr., Steve Powell, Jason Meyer, and Lynn Ferguson.
- Charlie Li continues to teach the next generation of engineers at Cleveland State University by introducing undergraduate mechanical engineering students to the fascinating world of materials and manufacturing processes in the class Engineering Materials & Manufacturing Processes (MCE-276).
- Justin Sims will present at the next meeting for the Cleveland Chapter of ASM International on November 16th. The talk, titled "Simulating Heat Treatment of Steel Parts", will explore the data required for heat treatment modeling. Included are the material data requirements for diffusion, thermal, mechanical, and phase transformation models used in heat treatment simulation, along with examples to explain why certain data is critical to model accuracy. The importance of thermal boundary conditions will also be discussed.
- DANTE Solutions is proud to be working with the Cleveland Chapter of ASM International to bring our heat treat simulation software to their new Data Ecosystem. Initially, the DANTE utilities will be available to help users evaluate, design, and optimize heat treatment processes. A few examples include recipe determination/optimization for gas and low pressure carburization and determining the cooling rate required to achieve a desired microstructure or hardness.

dante°

Since 1982 we have provided engineering services to the metalworking industries, and for over 30 years we have focused on thermal processing. Our range of services has expanded to include several software products, with our DANTE° software being the premier package in the world for modeling heat treatment of ferrous parts. In recognition of this, we re-branded ourselves as Dante Solutions, Inc. in January, 2014.

While we use computer analysis tools for most of our work, we are much more than analysts using computer software tools. Our staff includes experts in mechanical and metallurgical engineering. Let us help you improve your heat treatment and deformation processes, use new materials, and develop new products.

Software Highlights

DANTE UTILITIES

DANTE, our flagship software, provides part designers, process engineers, and metallurgists the ability to peer into the black box surrounding their heat treatment processes and design an optimum process, or troubleshoot an existing process, with limited experimental verification. While DANTE is an extraordinarily powerful design and analysis tool, heat treat shops looking for specific features in DANTE but who can't justify the investment in learning and utilizing a new software, we offer our DANTE Utilities.

The DANTE Utilities are standalone (no third-party FE solver required) software solutions, which utilize the models, algorithms, and material database used by the DANTE software. Our developers have created user-friendly interfaces that make setting up and reviewing the results intuitive and straight forward. There are three types of Utilities:

Process Design and Prediction

- **GCarb**: Used to design the time needed in a gas carburization process to reach a desired case depth by specifying the carbon potential. GCarb can also predict the carbon profile in terms of depth for a user specified gas carburization schedule.
- **VCarb**: Used to design the Boost/Diffuse schedules of a low pressure (vacuum) carburization process according to the specified case depth and surface carbon. VCarb can also predict the carbon profile in terms of depth for a user specified Boost/Diffuse schedule.
- **MatSim**: Powerful utility that predicts temperature, hardness, volume fractions of phases, and strain for any heating/quenching process. Heating/quenching schedules can be supplied as time-temperature tabular data or rate-temperature-time tabular data.
- **GNitro**: Used to design the time needed in a gas nitriding process to reach a desired case depth by specifying the nitrogen potential. GNitro can also predict the nitogen profile in terms of depth for a user specified gas nitriding schedule.

Material Characterization: Prediction Tools

- **TTTGen**: Used to generate TTT and CCT curves from materials in the DANTE database. Also used to check parameters of user created materials.
- **CHTGen**: Used to generate continuous heating curves, to view the austenite transformation behavior.
- **Jominy Predictor**: Used to predict the hardness and microstructural profiles of a Jominy bar.
- **DI Predictor**: Used to predict the critical diameter of a steel alloy.

Material Characterization: Fitting Tools

- **TTTFit**: Used to fit diffusive phase transformation kinetics to the DANTE material model using TTT curves. Data can be entered manually or generated from a third-party software, such as JMatPro. **Transformation strains cannot be fit using this utility and the martensitic phase transformation kinetics.**
- **DilotFit**: Used to fit diffusive and martensitic phase transformation kinetics to the DANTE model using dilatometry experimental data. **Transformation strains are captured with dilatometry data.**
- **MecFit**: Used to fit mechanical properties of each phase to the DANTE model from tension/ compression tests.
- **HTCFit**: Used to fit heat transfer coefficients from time-temperature data.

Project Highlights

Strong Bar Competition

For those unable to make the Akron Chapter meeting, an overview of Jason and Brian's presentation is provided. Link to conference posters .

Strong Bar Rules:

Student teams will heat treat steel bar to achieve the highest combination of bending strength and bend deflection

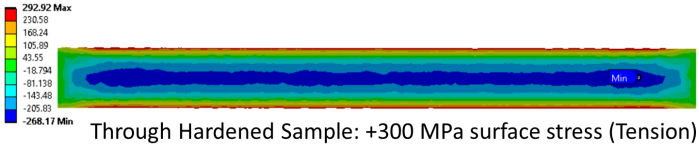
- Pre-machined cylindrical pieces of 4140 steel will be provided by the ASM HTS
- Teams will heat treat the specimen according to their best choice
- Specimens will be tested in bending by Instron
- A 0.5 mm deep circumferential notch will be machined prior to testing

Process Design:

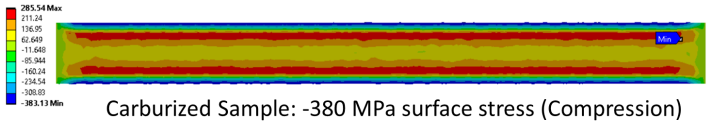
- Carburization was included due to the added strength and to induce a near-surface residual compressive stress. This was decided after initial modeling studies with DANTE indicated high surface residual tension for a through hardened sample.
- DANTE's GCarb utility was used to determine the gas carburization processing time and carbon potential required to achieve an effective case depth of 1.5 mm and a surface hardness of 60HRC, after tempering at 165° C.
- DANTE was used to model the entire heat treatment process; gas carburization, austenitize in a salt bath, water quench, and temper, to ensure preferable hardness and residual stress profiles.
- The heat treatment of the bars was conducted at Akron Steel Treating (big thanks to Joe Powell)

Results: Heat Treatment

- Optical microscopy and microhardness measurements were performed by Jason and Brian at a lab located on the Cleveland State University campus.
- Micrographs and hardness confirmed the designed specifications were met by the performed heat treatment



Through Hardened Sample: +300 MPa surface stress (Tension)



Carburized Sample: -380 MPa surface stress (Compression)

Results: Physical Testing

- Bend test performed at Heat Treat 21 by MTS (Instron backed out sometime before the show)
- Notch was not cut into the coupon; significant since the ECD was designed with the understanding the tested surface would be 0.5 mm below the heat treated surface (without a notch the surface was too brittle for bending)

Conclusions: Post Test Analysis

- 3-point bend model was executed with the residual stress predicted by DANTE used as an initial condition
- From the model, strong possibility the crack initiated subsurface at the case-core interface, where the high tensile stress field exists
  - Residual tensile stress of approximately 250 MPa at 1.75 mm depth
- Two increments from the bending simulation where the bar is believed to fail is shown below. Possible subsurface failure with tensile stresses in excess of 900 MPa, and then a high tension zone right to the surface