DANTE Solutions is Returning to the Office

- DANTE Solutions is pleased to announce that we have done our part by becoming fully vaccinated against COVID-19 and will be transitioning back to the office during the month of June. Customers will see no interruptions in service or support while we get back to the office.

Quick News:

- Justin Sims gave a virtual presentation at the 2nd International Conference on Quenching and Distortion Engineering on April 28, 2021. The publication, titled "Reducing Distortion during Quenching of Steel Components using a Controlled Cooling Method", discussed a novel approach to distortion control for high hardenability steels using a controlled cooling method. The publication outlined the theory behind the process, termed "DANTE Controlled Gas Quenching (DCGQ)", used simulation to show the improvements of DCGQ over conventional gas quenching, and briefly discussed results from physical testing conducted using a prototype DCGQ unit.

- Congratulations to Jason Meyer, for completing his Masters of Science in Mechanical Engineering from Cleveland State University. Jason completed his graduate degree with a 4.0 cumulative GPA, while raising a family and interning at DANTE Solutions, assisting with consulting projects, marketing, and software testing and training. He looks forward to having more time to pursue his interests in materials science, aerospace and stress analysis with DANTE Solutions in the coming years.

- DANTE Solutions is pleased to be working with the Army CCDC AvMC on a project concerning the high temperature tempering of high alloy steels. Ferrium C64 will be used for the project, but knowledge can be applied to other alloys. This project aims to develop a model to predict carbide formation during secondary hardening in order to minimize tempering furnace times and optimize the mechanical properties of the final parts for different applications. Sample coupons are currently being machined and carburization, hardening, and snap tempering processes are expect to begin this month to prepare the coupons for testing.

Task 2.1.3: Coupon Testing and Data Analysis

- Tempering process
  - Dilatometry tests
  - Vacuum furnace process
- Characterization
  - Hardness and microstructure
  - Residual stresses
- Data analysis

Task 2.1.4: Model Development

- Implement high temperature tempering model into current DANTE frame
- Tempering model parameter fitting
  - Precipitate solutionizing, precipitation and growth
  - Hardness and strength model using precipitate (carbides) condition
- Validation
  - Hardness and residual stress (dilatometry strain)

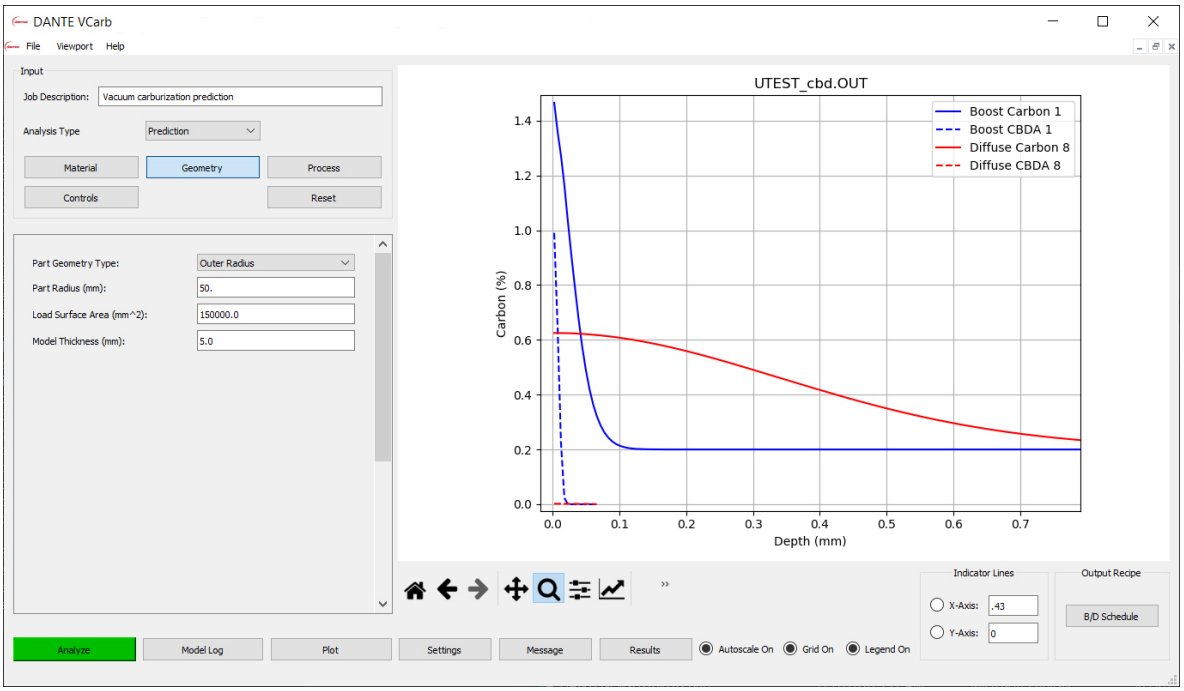
- The 2021 HTS Technical Conference and Expo, scheduled for September 14-16th in St. Louis, Missouri will be a face-to-face event. The event is co-located with IMAT2021 and AGMA's Motion & Power Technology Expo. DANTE Solutions will be one of the 200 or so heat treat companies represented at the Expo, while presenting several papers on our heat treating work. We hope to see you there! Come visit and see what's new at Booth 1720.

Software Highlights

VCARB AND GCARB UPDATES

DANTE Solutions, Inc. is excited to announce updates to the VCarb and GCarb utilities which can be used for recipe design and predicting given carburization recipes for vacuum carburization (VCarb) and gas carburization (GCarb) processes.

The most notable update includes the ability to use the DANTE material database for design and analysis. This change allows the user to use one of the many materials already defined in the DANTE database, or any user-defined materials that have been developed, further expanding the capabilities of DANTE analysis.



Using the DANTE material database opens the ability to use the carbide formation and dissolution models present in the full DANTE package, which are paramount in high-carbon gradient processes like vacuum carburization.

Another important inclusion is the addition of the geometry tab, which allows the user to better define an inside (concave) or outside (convex) curvature to the point being analyzed, which will alter the profile and concentrations of carbon in the case.

Lastly, in VCarb, a load surface area input was added to help predict the amount of carburization gasses consumed by the parts in the furnace. Coupled with gas and furnace efficiencies in the controls tab, the user can estimate the amount of gas used by the process and apply that to costs for accounting purposes.

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.

For more information, contact us: support@dante-solutions.com

Project Highlights

Improving Temperature Uniformity by Simultaneous Cooling During Induction Tempering

Objective:

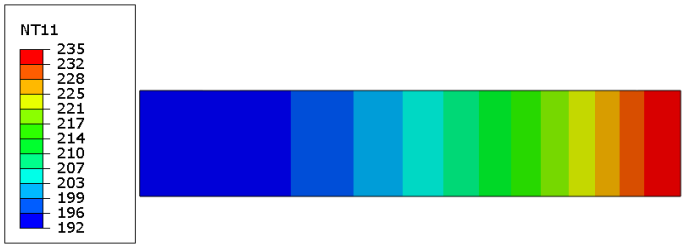
- This study focuses on the shape and magnitude of the thermal gradient present in a 50 mm (2 inch) diameter bar when subjected to induction tempering, with and without cooling the surface while tempering.

Geometry & Model Description:

- Material: AISI 4140
- 50 mm diameter
- Model is an axisymmetric section of an infinitely long cylinder
- Induction heating process modeled by applying a Joule heating profile to a penetration depth of 3.6 mm (0.142 inch)
- Same frequency (depth) was used for both models
- Spray type cooling was selected to mimic existing induction/quench technology
- Power increased on spray model to reach tempering temperatures

Results: Temper Only

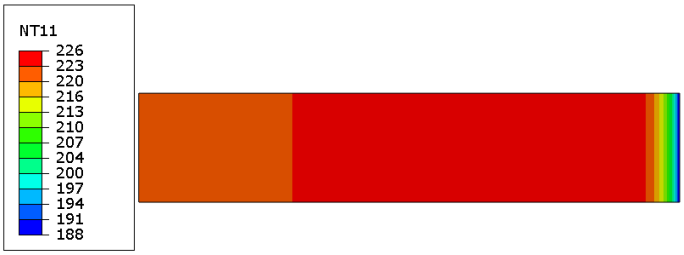
- For the temper-only model, the cross-sectional temperature contour (below) shows a difference of 40°C, spread out from surface to core



- This temperature profile will result in softer martensite at the surface, due to the higher local temperature that exists there

Results: Simultaneous Temper and Quench

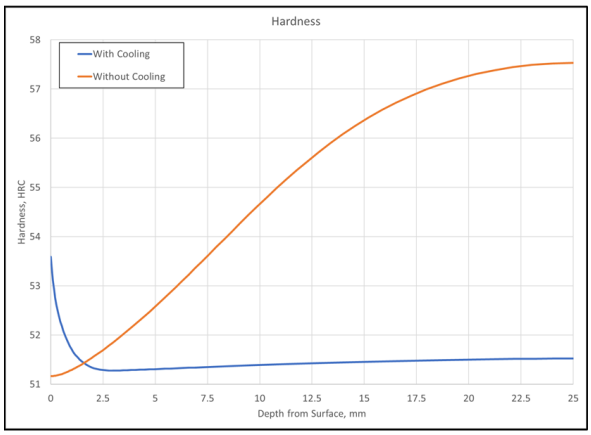
- The temperature contour of the simultaneous cooling model (below) maintains a gradient of 40°C, but is confined to the ~2.5mm surface depth.



- The sub-surface to core temperature is much more uniform than heating alone, which leads to more uniform properties.
- This temperature profile will result in harder martensite on the surface relative to the sub-surface and core, possibly improving fatigue performance and wear resistance.

Results: Hardness Profiles

- The plot displays the contrast in hardness vs depth profiles of the two models
- The cooling model (blue line) follows a softening profile from surface to core, while the temper-only model (orange line) is inverted with an overall hardening from surface to core



Conclusion

- DANTE was used to successfully evaluate and show that cooling while induction tempering can result in improved hardness uniformity
- DANTE can be used to further optimize the power, frequency, and quench rate to reach desired case-core requirements