The Airflow Update®

AIRFLOW SCIENCES CORPORATION

Winter 2008

Modeling Helps Ensure Effective ACI Mercury Capture

Many coal-fired power plants are now planning Activated Carbon Injection (ACI) systems in advance of the Clean Air Mercury Rule (CAMR) that will take effect in March 2010.

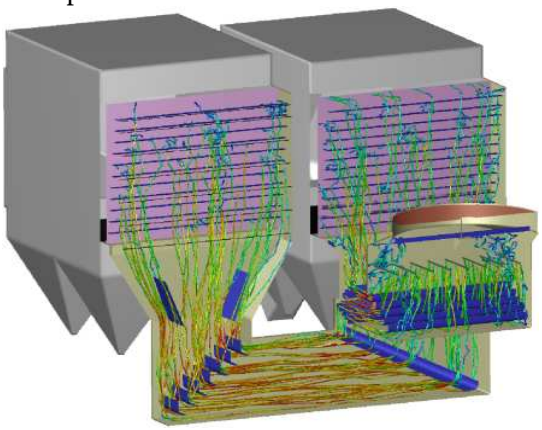
ACI systems remove mercury from the flue gas by injecting activated carbon into the stream upstream of either the baghouse or ESP. ACI systems are one of the most effective and cost-efficient mercury capture methods currently available, but the efficacy and expense of an individual system depends on several factors, including; injection lance design and placement, distribution of the sorbent, and the temperature and velocity of the flue gas that carries the sorbent.

Flow modeling during the design process is essential to developing a system that will meet regulations while keeping sorbent and maintenance costs to a minimum. CFD modeling can help:

- Ensure uniform sorbent distribution
- Maximize sorbent residence times
- Determine optimal sorbent feed rates
- Determine the optimum lance quantity, design, and location
- Optimize duct layout
- Ensure proper mixing within the flue gas stream for maximum adsorption and capture efficiency

A typical ACI flow modeling project begins with CFD modeling of the ductwork and flow leading to the system (usually starting at the economizer hopper for hot side injection or at the air heater for cold side configurations).

Several lance configurations and locations are then selected for numerical analysis. This helps ensure optimum configuration of the lances so that uniform distribution and mixing will occur at the target location. Configuration changes can include non-uniform injection port placement and/or diameter to reflect a non-uniform flow field. Lance placement is usually as far upstream as is practical given installation and operational considerations.



CFD model tracks the trajectory and velocity of carbon particles from the lances to the ESP.

In some cases the predicted flow field is sufficiently non-uniform that no lance placement and configuration can be found to provide adequate mercury reduction. Examples include high local temperatures that can lead to less mercury adsorption, or excessive local velocities that can push the gas through the sorbent too quickly—greatly reducing residence times. In these cases, ASC can determine flow control devices leading to a flow field that allows for an acceptable ACI system design.

ASC Projects Featured in *Forge* and *Power* Magazines

An article authored by Airflow Sciences' engineers **Andrew Banka, P.E.** and **Jeffrey Franklin, P.E.**, along with engineers from Deformation Controls Technology, Inc., was featured in the October issue of *FORGE* Magazine. The article explores the controlled cooling of just-forged parts.

Another ASC project was featured in the October issue of *Power* Magazine. ASC did both CFD and physical modeling of the ductwork for the WE Energies Pleasant Prairie Plant Project featured in the issue. Several ASC models are included in the article.

From the Editor

*There have been even more additions to the growing ASC staff. **Tiffany Lee**, **Daniel Tylutki,** and **Holly Skelton** have all recently joined our engineering staff, while **Neil Hesselgrave** has joined our laboratory department. We hope you have an opportunity to meet and work with them soon.*

*Another addition was made to the ASC family when engineer **Brian Dumont** and his wife, **Sandra**, welcomed baby **Renee Lynn** this September. Congratulations to the Dumont family!*

Edited by Kathleen Yanik

Intensive Quenching Study Presented at ASM Heat Treat Show

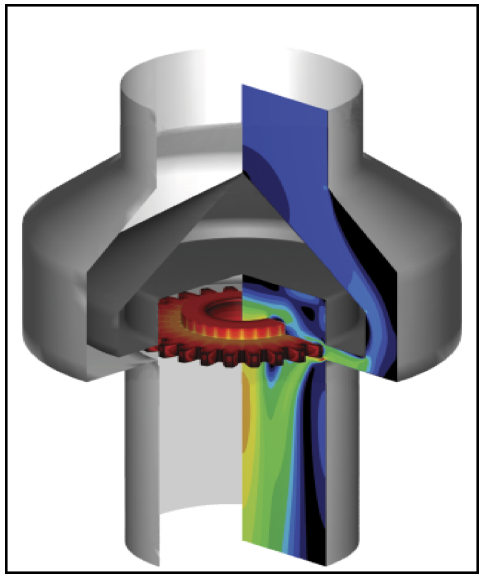
A paper, co-authored by ASC engineers **Andy Banka P.E.** and **Jeff Franklin P.E.,** along with engineers from Deformation Control Technology, Inc. and IQ Technologies, Inc., was presented at the recent ASM Heat Treating Society Conference & Exposition.

Applying CFD to Characterize Gear Response During the Intensive Quench Process presented a case study in which CFD modeling and DANTE® analyses are combined to assess an intensive quench fixture design. DANTE®, developed by Deformation Control Technology, Inc. (DCT), is a finite element based program used to predict phase transformation, residual stress, distortion, etc. for heat treating and other operations.

Intensive quenching uses plain water to create very high heat transfer rates that result in high surface compressive stresses, higher hardness and greater wear resistance. Since poor or uneven water flow can result in reduced hardness, distortion, or even cracking, design of the intensive quenching fixture is critical. CFD provides an effective way of evaluating the performance of the process and making improvements.

In order to increase the usefulness of CFD as a design tool for intensive quenching processes, ASC developed a method of predicting transient surface heat flux rates from steady-state results of two gear temperature conditions. Correlation of this methods against transient results for a 2D case showed excellent agreement.

The transient heat flux rates predicted with this method were provided to DCT for DANTE® analyses, which showed that the unequal flow conditions in the baseline quench fixture resulted in unequal treatment and distortion. Those predictions would not have been possible if a uniform heat transfer coefficient had been assumed, as is often done.



CFD model of a gear in an intensive quench fixture.

CFD and DANTE are both powerful tools that, when combined, can provide insight into complex quenching processes. If you have a heat treating or quenching issue, please contact one of Airflow Sciences' engineers. To request a copy of the complete paper, please contact the ASM Heat Treating Society (www.asminternational.org/heattreat).

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Airflow Events

We hope to see you at future trade shows:

- Nox/PCUG Conference (Feb, 4-7, Richmond, VA)
- SNAXPO 2008 (March 1-4, San Antonio, TX)
- Electric Power 2008 (May 6-8, Baltimore, MD)
- APC Roundtable & Expo (July 13-15, Savannah, GA)
- Coal Gen 2008 (August 13-15, Louisville, KY)
- Mega Symposium (August 25-28, Baltimore, MD)
- **Your Office:** Looking to host a seminar on modeling, fluid flows, or heat transfer?

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