Since 1975

Summer 2017

The Airflow Update

AIRFLOW SCIENCES CORPORATION

New Heat Transfer Test Laboratory

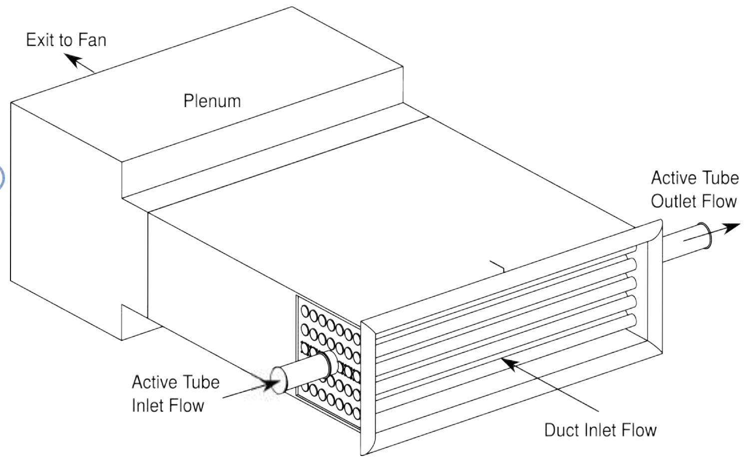

Figure 1: The Heat Transfer Test Laboratory schematic shows the location of the active tube within the tube bank.

The effectiveness of a shell-and-tube heat exchanger can be influenced by the amount of cooling air passing perpendicular to the tube banks, by the tube array configuration, and by the geometry of the tubes themselves. Flow modeling, with either Computational Fluid Dynamics (CFD) or a laboratory physical scale model, can be used to analyze and optimize the amount of heat transfer.

The Airflow Sciences Heat Transfer Test Laboratory is a new experimental test facility (Figure 1) created to evaluate the performance of heat exchangers. A reduced-scale physical model was fabricated specifically to quantify the heat transfer within individual tubes of a tube bank.

(continued on page 2)

New ASC Division

Azore Software was created to develop and market engineering software, specifically the flagship product Azore® CFD software. Azore was developed by Dr. Jeffrey Franklin, P.E. and has been used by ASC for flow and heat transfer simulations since 2007. Azore includes pre and post processing, HPC solver, and meshing with the Trelis™ software from csimsoft. More details can be found at www.AzoreCFD.com.

Flow Bench Capabilities

Airflow Sciences' Flow Bench was developed to provide higher controlled flow rates for use in assessing a customer's products or prototypes. The laboratory setup provides precise control of the rate of flow and meets specifications of *ANSI/AMCA Standard 210, Laboratory Methods of Testing Fans for Certified Aerodynamic Performance* and meets specifications of *ANSI/AMCA Standard 210, Laboratory Methods of Testing Fans for Certified Aerodynamic Performance*.

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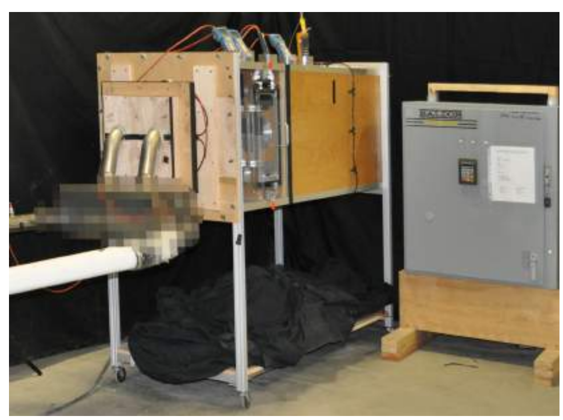

Staff News

Congratulations to **Matt Gentry** and **Craig Rood** who became part owners of Airflow Sciences Corporation.
2016 co-op student **Travis Burch** completed his Mechanical Engineering degree from the University of Michigan.
Kirsten and **Matt Gentry** (along with big sister Lily) welcome Colton to their family. Congratulations!
Best wishes to Sherah and **Kevin Linfield** as they begin their married life together.
Kim Charette has a new title of “grandma”, and loves spending time with Ethan.

Edited by Julie Pierce

New Heat Transfer Test Laboratory (continued)

The Heat Transfer Test Laboratory includes:

- an arrangement of 35 tubes in either an inline or staggered array, with the center-most tube being the “active tube” and the remaining tubes providing appropriate flow characteristics within a tube bank (Figure 2)
- an air heater that supplies heated air (up to 600°F) to the active tube inlet (Figure 2)
- a large duct representing the shell-side flow through which ambient air is drawn by fans (Figure 3)
- a test probe with an array of thermocouples (Figure 4), capable of being traversed along the length of the active tube (Figure 5)
- thermocouples within the duct and at the inlet/outlet of the active tube.

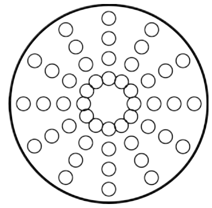

Figure 4: Thermocouple configuration

Figure 5: The active tube outlet view shows the traversing thermocouple probe, used to quantify the temperature distribution through the tube length.

Figure 2: An air heater provides hot air to the active tube (inlet view), located at the center of the tube bank array.

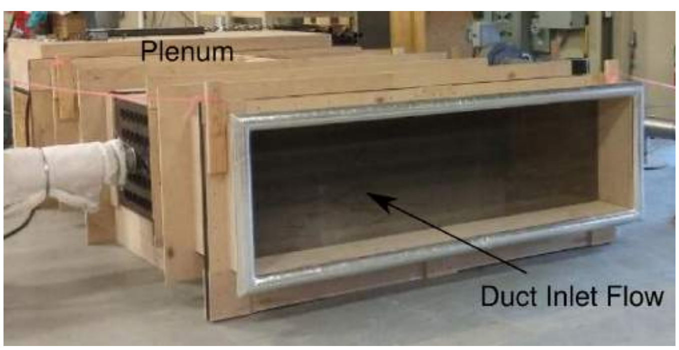

Figure 3: A large duct cross-section provides sufficient area to draw ambient air, necessary for simulating a large heat exchanger flow conditions.

The flow rate of the shell-side ambient air can be precisely set from 15 to 50 ft/s using VFD fans, while the heated air flowing through the active tube can be varied up to 80 ft/s. Although the thermal properties of only the active tube are measured, the remaining tubes are necessary to generate the correct flow distribution in the vicinity of the active tube. The thermocouples located within the duct and those on the traversing probe together can characterize the temperature profile inside the tube (Figure 6) and the heat transfer coefficient of the system. Pressure drop and velocity measurements complete the data collection to fully assess performance.

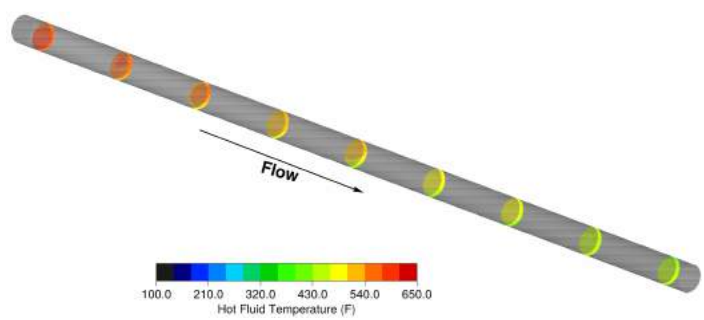

Figure 6: The temperature traverse data inside the active tube.

Upcoming 2017 Conferences/Exhibits

(complete list on website)

Come visit our booth, or hear a presentation.

Electric & Hybrid Vehicle Technology Expo
Novi, MI
September 12-14

Process Expo
Chicago, IL
September 19-22

North American Simulation Conference
Novi, MI
September 19-20

ASM Heat Treat Show
Columbus, OH
October 24-26

Power-Gen
Las Vegas, NV
December 5-7

Professional Development Hours
Call us to schedule a seminar at your or our facility

New Heat Transfer Test Laboratory (continued)

The Heat Transfer Test Laboratory was recently used to examine the effects of different tubular air heater tube designs. This included varied tube materials and geometry such as smooth tubes, rifled tubes, and spiral inserts to enhance heat transfer. The summary results of this testing, conducted for Corrosion Monitoring Services, Inc. (CMS) of St. Charles, IL, are shown in Figure 7.

"Airflow Sciences did an outstanding job in performing experimental testing to model thermal performance of our air heater tubing designs. They created the test fixture to be versatile and developed an in-depth analysis procedure to obtain the technical data our clients need to support selecting materials or design applications that will maximize service life and performance for their tubular air heaters. The results of their testing exceeded our expectations." – Alex Turner, President CMS

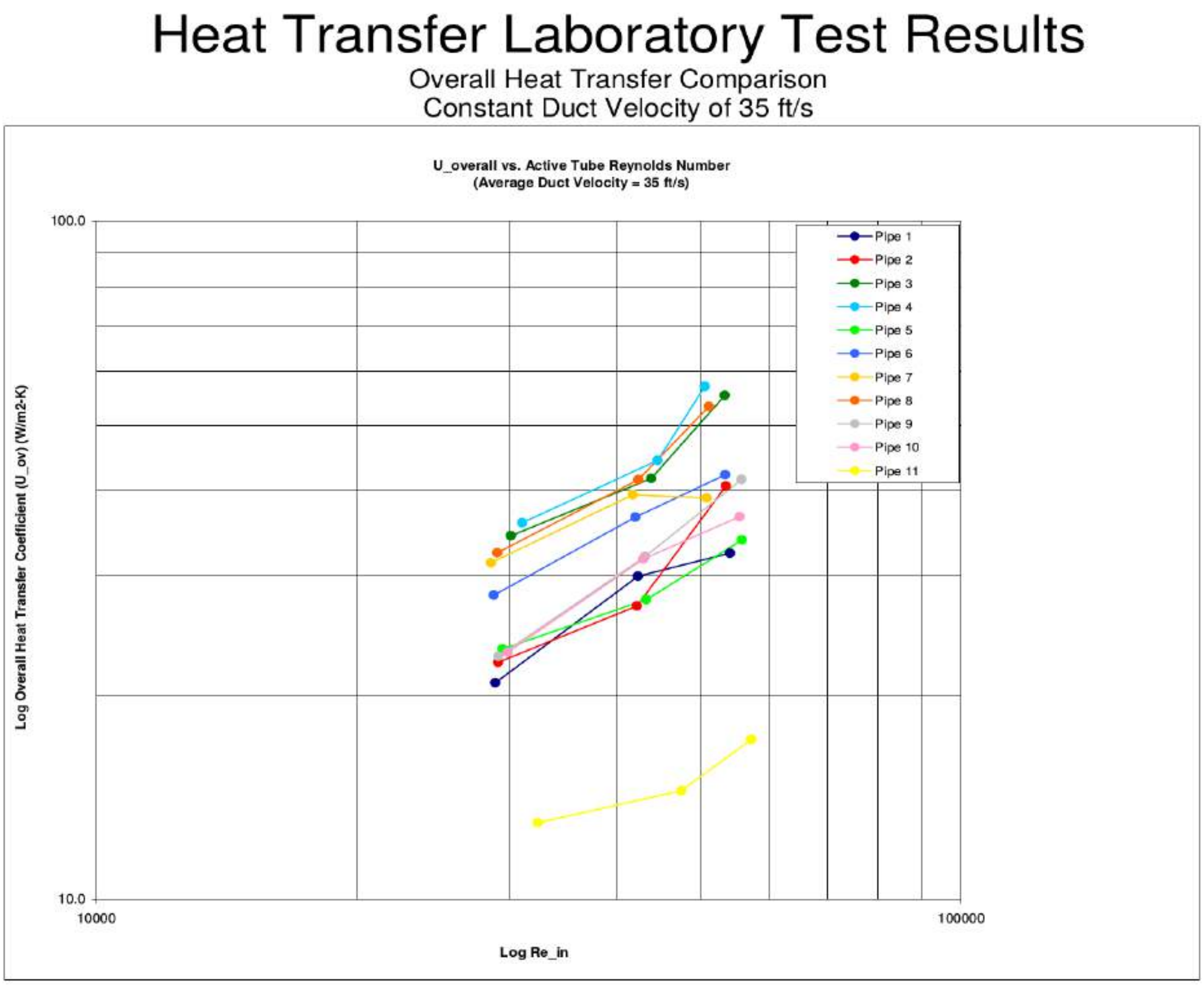

Figure 7: The heat transfer coefficients were calculated for different tubes. By comparing various configurations of material, surface features, and geometric inserts, the most effective air heater configuration was determined.

Contacting ASC

www.airflowsciences.com
asc@airflowsciences.com

Headquarters
12190 Hubbard Street
Livonia, MI 48150
phone: (734) 525-0300

Western Region Office
P.O. Box 22637
Carmel, CA 93922
phone: (831) 624-8700

India Representative
Sandeep Nigam
ABSR Engineers and Services Pvt Ltd
208, The Terminus BG-12 AA-1B
Kolkata -700156 West Bengal, India
phone: 91-94320-11579

Southeastern Region Office
1906 Arrowhead Dr NE
St. Petersburg, FL 33703
phone: (727) 526-9805

Taiwan Representative
Shih Lin (Stoney) Chen
Orient Total Enterprises
1st Floor, 74-7 Ging-Cherng Street
Pingtung, Taiwan 90061
phone: +886-(0) 8-7365491

Flow Bench Capabilities (continued)

The Flow Bench (Figure 1) incorporates 9 orifices / nozzles (inset of Figure 1), each with a calibrated opening of a different area. The nozzles can be in the open position individually or in combination, in order to change the surface area through which the air will pass, or considered another way, the amount of restriction. The attached fan has precise variable speed control for accurate data collection. By adjusting the number of open nozzles and/or the fan speed, the Flow Bench flow rate has a range from 1.5 – 2000 CFM. Different applications for the Flow Bench are presented.

The test setup for an automobile dual exhaust piping system is shown in Figure 1. The goal of this test is to measure the system pressure versus flow rate for a variety of exhaust configurations. Pressure probes were placed at both piping inlets and at the flow box inlet plenum in order to determine the pressure drop for the system. A similar test setup can be configured for other customers. In a product development or prototype stage, the pressure loss associated with the product may be an important performance parameter.

The focus of the next application is on exit velocity and air distribution for a commercial building HVAC grille. A manufacturer wanted performance metrics to assist in selecting an appropriate grille, including the shape and angles of the bars within the grille. The standard method of measuring the performance of HVAC grilles is defined in *ANSI/AHRAE 70-2006, Method of Testing the Performance of Air Outlets and Air Inlets*. The customized test fixture (Figure 2) included a plenum box in which the various grilles could be placed for evaluation. A partitioned test room was created (Figure 3) so that the

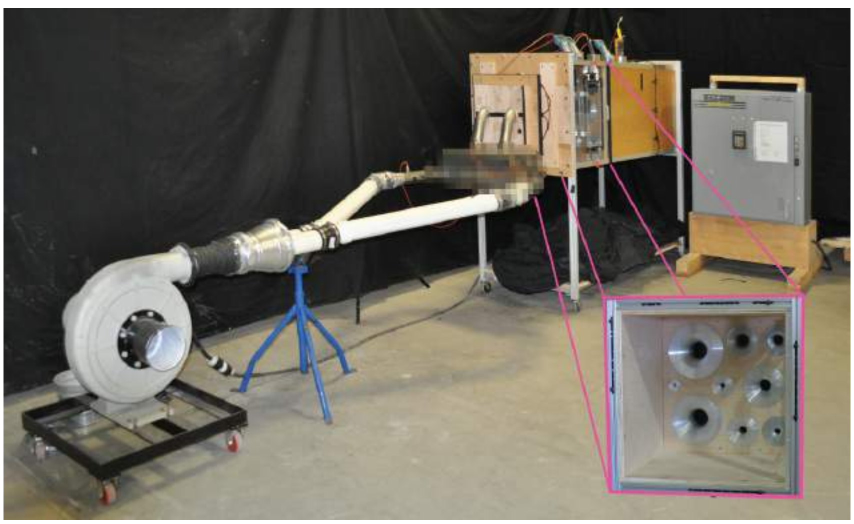

Figure 1: The test setup includes the centrifugal fan to control flow through the dual exhaust systems. The inset photo shows the 9 flow nozzles of various areas.

Figure 2: The various grilles were placed in this pressurized supply plenum, which included straighteners and perforated plates to ensure even flow at the register.

Figure 3: Curtains were installed beyond the furthest location of the movable probe stand to ensure accurate measurement of the throw distance from the grille.

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Flow Bench Capabilities (continued)

velocities at predetermined distances from the grille could be accurately collected with a movable velocity probe stand. The data were used to develop performance charts for their line of products.

Finally, the Flow Bench can be used to calibrate probes. Airflow Sciences technicians calibrate different probes, including S-type pitot probes, 3D velocity probes, vane and thermal anemometers, and Particulate Matter (PM) Emission cyclones, in a wind tunnel (Figure 4). However, when the calibration at low flow rates is critical, the Flow Bench is used in conjunction with the wind tunnel. Both laboratory facilities provide NIST traceable calibration reports.

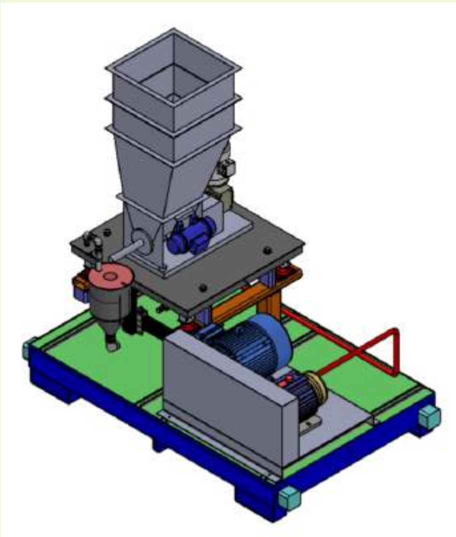
Do you have a product or prototype flow problem? The Flow Bench is an example of physical flow modeling, a less costly methodology than trial and error. Physical modeling is one tool used by Airflow Sciences to resolve flow problems; CFD modeling and field testing can be used independently or in conjunction.

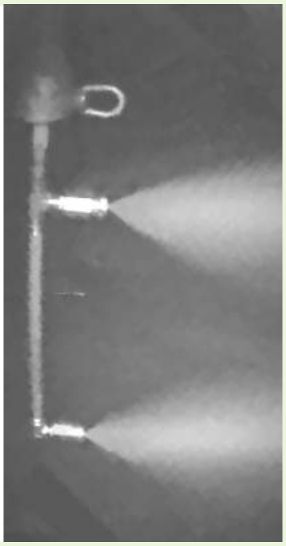
Figure 4: Both the Flow Bench and wind tunnel are used to calibrate a variety of velocity probes.

New Laboratory and Testing Services

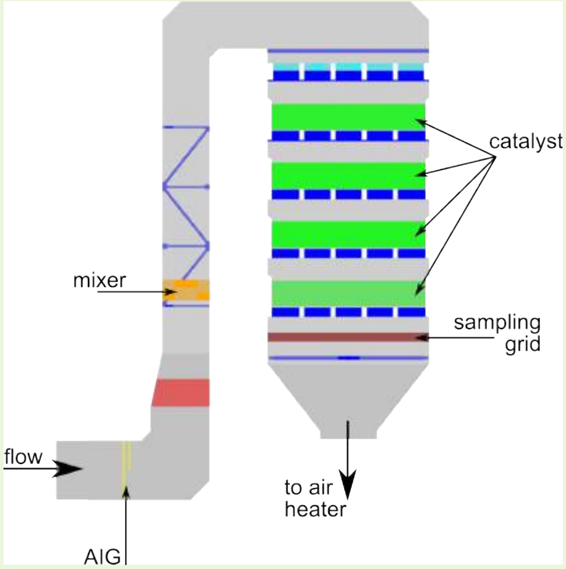
Unsure who provides accurate **Calibration Services** for the larger $PM_{2.5}$ or PM_{10} cyclone assemblies? The ASC wind tunnel is large enough to calibrate these probes and exceeds all specifications per EPA Method 2.

The **Particulate Matter (PM) Spiking System** (below, left) calibrates a Continuous Emissions Monitoring System (CEMS) by injecting a known amount of particulate matter (PM) (below, right) into either a wet or dry stack.





Contact Airflow Sciences for additional information about this equipment or testing services.



The **SCR DENOX Test Kit** optimizes the ammonia flow through an SCR (above) for more effective removal of NO_x, as well as lower NH_3 consumption.