The Airflow Update
AIRFLOW SCIENCES CORPORATION
Summer 1999

Reducing Particulate Emissions

ASC's field testing group has been quite active lately, performing measurements on a wide range of equipment including pet food dryers, coal pulverizers, electrostatic precipitators (ESPs), and forging ovens.

Since particulate emissions are a major concern at most industrial facilities, many plants are seeking to optimize their particulate capture equipment in a cost-effective manner. Whether the system involves ESPs, filter bags, or inertial separators, the capture efficiency can be significantly influenced by the flow patterns within the system.

In a recent test at a coal-fired electric power plant, the goal was to examine flow patterns within an ESP (Figure 1) and develop design improvements to enhance ash particle capture.

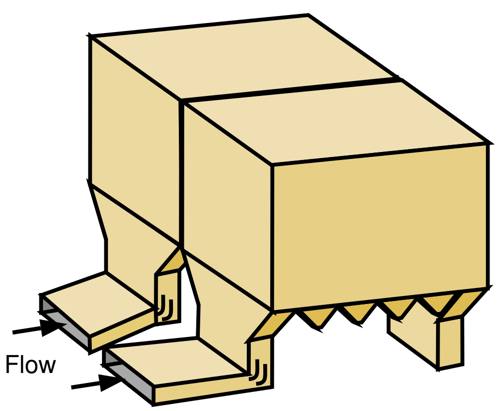

Figure 1. ESP Geometry

The customer had several concerns:

- ESP performance was marginal, with opacity (a measure of particulate emissions) running 16-19%.
- Operating so close to their 20% opacity limit occasionally forced the plant to curtail output.
- ESP performance was noted to degrade over time, requiring the unit to shut down every 50-60 days to wash the ESP.

ESP Performance -- Before and After Modifications

	Before	After
Inlet Flow Uniformity (RMS Deviation from Avg. Velocity)	27.8%	11.9%
Full Load Opacity	16-19%	<10%
Unit Derates Due to Opacity	~10 MW	none
ESP Wash Frequency	50-60 Days	350 days

ASC's engineers utilized specially designed testing equipment (Figure 2) to measure the flow patterns through the ESP under air-only operation. The velocity profile entering the ESP was severely out of industry uniformity standards. Through an iterative process, several geometry modifications were installed and evaluated.

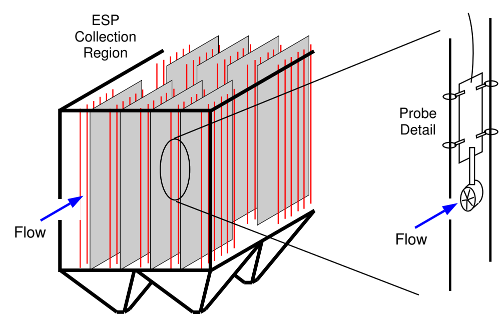

Figure 2. Velocity Testing Equipment

A final design was developed that significantly improved the flow distribution. After the unit came back online, the ESP operated at less than 10% opacity. More importantly, the ESP operated for a full year without any washes.

The Inside Story

Quite a bit has changed at ASC since our last newsletter. Three new members to the engineering team in 1999 have increased our capabilities and availability. This summer, we'll double our office and lab space at the Michigan headquarters and establish Airflow Sciences Corporation of North Carolina. With our existing Regional Offices in California and Florida, we will be better able to provide all the services our customers require.

Our research and development group has been busy working on both simulation software and testing hardware for a variety of analyses. Latest topics include pet food drying, coal pulverization, combustion/NOx modeling, droplet evaporation, and UV radiation modeling.

The two examples discussed in this newsletter provide some results from recent projects in the Power Generation and Food Processing Industries. If you have any flow, heat transfer, or mass transfer issues you're dealing with, feel free to give us a call at 734-464-8900.

Spray Dryer Performance Enhancement

In a recent application of its flow analysis capabilities, ASC investigated the conditions in a spray dryer used by a dairy product manufacturer. In the existing design of the dryer, severe product build-up occured in the exit ducting. A costly conditioning agent was required to prevent product buildup and eventual blockage in the lower elbow.

To improve the design, ASC first examined what conditions must exist in order for the build-up to occur. A custom test fixture (Figure 3) was installed on the actual dryer. A slipstream of particle-laden flow from the actual dryer was drawn through the fixture which contained an impact plate. By altering flow velocity and plate angle, product build-up characteristics were quantified (Figure 4).

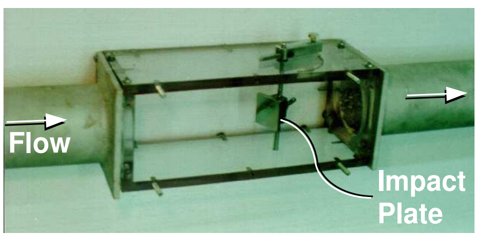

Figure 3. Test Fixture to Determine Particle Build-up Characteristics

A numerical flow model was then used to analyze the flow characteristics, including particle drying, within the device. Velocity patterns and particle streamlines for four particle sizes are shown in Figure 5.

The model predicts that the two largest particle sizes will impact the elbow at a speed and angle combination corresponding to "light" and "heavy" build-up according to the experimental data. Thus, the model results confirm that buildup will occur at the elbow.

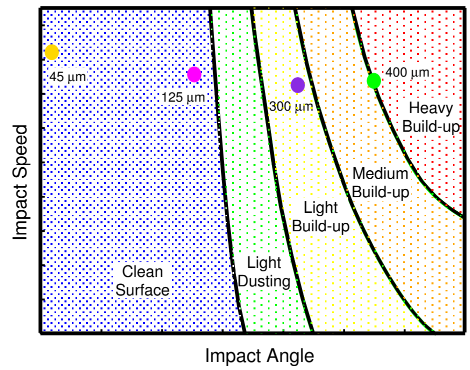

Figure 4. Experimental Build-up Testing Results

Continued efforts for this study are concentrating on using the numerical model to redesign the lower elbow. The primary goal is to eliminate the build-up under a range of operating conditions and eliminate the need for conditioner injection.

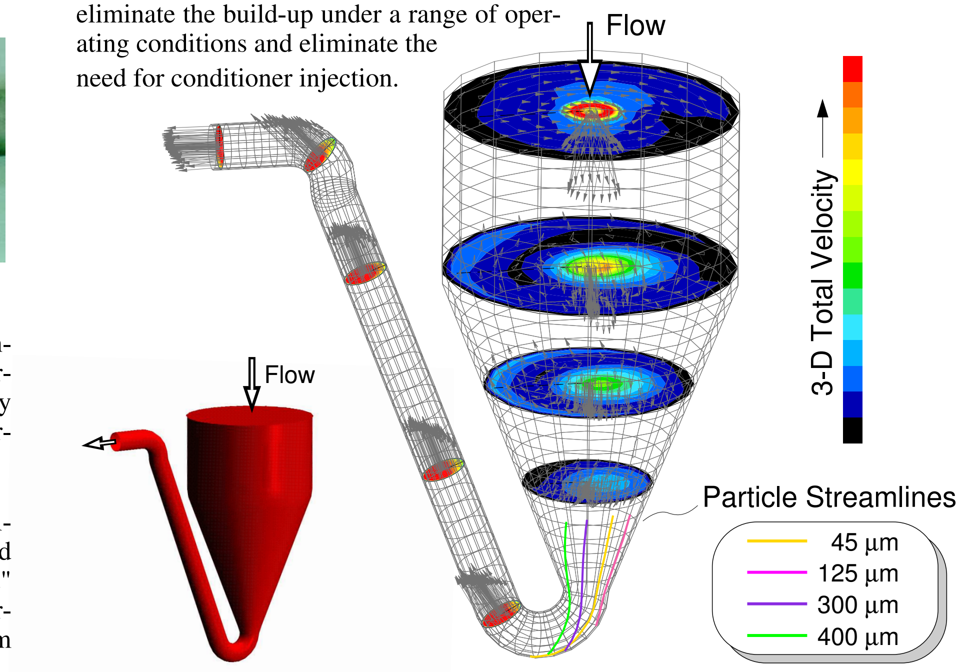

Figure 5. Spray Dryer Numerical Model Results

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