Application Guide Series

Combustion Air Flow Monitoring

Benefits

- *Fuel cost savings*
- *Improve process stability*
- *Reduce operator interventions*
- *Increase equipment capacity*
- *Improve safety*
- *Reduce carbon footprint*
- *Improve sustainability*

Boiler Applications

- *Power*
- *Cogeneration*
- *HRSG (heat recovery steam)*
- *Biomass*
- *Recovery*

Process Equipment

- *Furnaces*
- *Smelters*
- *Incinerators*
- *Heat treating systems*
- *Heaters*
- *Ovens*
- *Kilns*
- *Flares*

Air Monitor
Precision Airflow Measurement
An ONICON Brand

1050 HOPPER AVE.
SANTA ROSA, CA 95403

(800) AIRFLOW
(707) 544-2706

www.airmonitor.com

Better Combustion Control Saves Money

Millions of dollars are wasted every day in combustion processes in the power and co-generation industries: in kilns, smelters, ovens and similar applications. Combustion losses are insidious because the processes operate normally while hiding operation inefficiencies. In the average process, operators and management can't easily identify the large amounts of fuel being wasted. An efficiency audit will reveal problems that raise operation costs.

Most combustion systems have mechanical controls set to overfeed combustion air by as much as 20%. Fuel costs and additional maintenance costs associated with blower or burner wear can add up to thousands of dollars wasted per day. However, there is a low cost remedy that can be implemented during a short downtime — upgrading combustion air flow meters or installing an instrumented control system.

The Problems

How can large combustion processes be modified so they operate more efficiently over a wide operating range with dirty gases that tend to plug and coat?

1) Dealing With Limited Straight Runs

Combustion processes generally consume a high volume of combustion air that travels to the burners through large ducts. To measure air velocity accurately, air flow meters require straight runs upstream and downstream to ensure the meter is reading a fully developed flow profile. Insufficient straight runs can adversely affect flow meter accuracy, process stability and combustion efficiency. Installation of sufficient straight run for flow measurement is typically not considered in the design of a system and multiple solutions are needed to accurately measure air flow.

2) Tighter Control in High Turndown Situations

Combustion system turndown and operational flexibility is often constrained by limitations of the control system. The performance of mechanical control systems is poor because mechanical linkages poorly control fuel-to-air ratios when operated over a wide range of firing rates. That's why they are set to overfeed combustion air. Instrumented control systems perform better at controlling fuel/air mixture if the flow meter is designed and installed correctly.

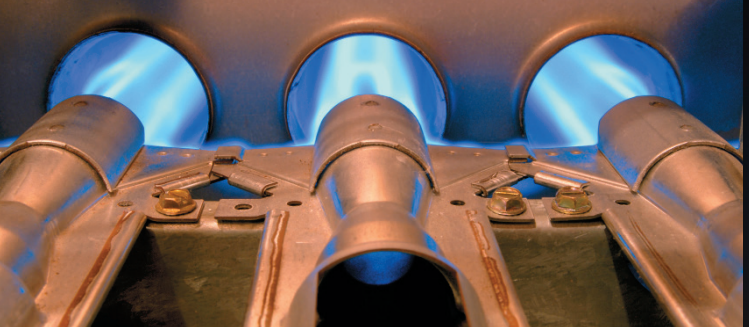
3) Reducing Plugging and Coating

Combustion air flow meters can become coated and plugged when particulates are present. This reduces flow meter accuracy and can potentially shut down the process.

4) Improving Efficiency and Environmental Compliance

Combustion processes require sufficient airflow for the efficient combustion of fuel. They also must comply with environmental regulations. Introducing excessive air reduces the efficiency of the combustion process, wastes fuel, and can dramatically increase operating costs. Mechanical combustion control systems do not provide a means to tune airflow for the ideal ratio. An instrumented system provides such a means but the ability to provide fuel savings is often limited by the performance of its air flow meter.

(Find Solutions to these problems on next page)



The Air Monitor Solution

Air Monitor products have been designed specifically to address these problems by improving the reliability of combustion air flow measurements with higher accuracy over a wide range of flow rates of dirty gas. This can effectively increase process reliability and uptime, reduce fuel expenditures, improve process stability, reduce operator interventions, increase equipment capacity, improve process safety, reduce carbon footprint, and improve sustainability.

1) Reducing Error from Limited Straight Runs

The Air Monitor Combustion Air Station integrates a flow conditioner with multiple strategically-located sensing points to measure combustion air over a wide range of flow rates. Accurate flow measurements can often be obtained within less than two diameters of straight duct.

2) High Turndown

Air Monitor transmitters provide accurate flow measurements at extremely low differential pressures. These transmitters are automatically zeroed to periodically eliminate signal drift from thermal, electronic, and mechanical sources. Air Monitor's AUTO-zero feature maintains accurate flow measurements while reducing calibration requirements and improving reliability.

3) Plugging and Coating

Plugging and coating can be mitigated by incorporating an Air Monitor AUTO-purge III that periodically clears the flow meter sensing ports with air. The AUTO-purge III ensures reliable flow meter operation when airborne particulate is present.

4) Creating High Efficiency

Air Monitor combustion air flow meters enable instrumented combustion air control systems to reduce the amount of excess air --- thereby reducing fuel requirements and fuel costs. See "What the Tech?"

What The Tech?

An efficient natural gas combustion system will consume ~100,000 ft3/hour of combustion air. Now consider a 10 million BTU/hour natural gas combustion system consuming ~120,000 ft3/hour of combustion air. Heating the extra 20,000 ft3/hour of combustion air from ambient to stack temperature (70°F to 570°F) represents a heat loss of ~750,000 BTU/hour or almost US$40,000 annually (where natural gas costs US$5.00 per million BTU). Depending on size, operation, and location, more closely controlling the air/fuel mixture can make the actual savings for combustion equipment much higher and speed up the ROI (typically within one year).

Controlling Air Flow to BLRBs

BLRBs (Black Liquor Recovery Boilers) use waste byproducts from paper mills to produce steam and electricity and can have three or more combustion air flow streams (Primary, Secondary, and Tertiary) --- some of which are preheated prior to entering the boiler. The wrong amount of combustion air in the wrong place can reduce boiler capacity, waste fuel, increase TRS and other environmental emissions, and coat and plug the boiler. Maintaining these air flows in the proper ratio is important to maximize capacity, ensure economical operation, reduce environmental impact, and minimize the number of shutdowns for cleaning.

The existing airfoil flow meters installed to measure the combustion air flows were found to exhibit poor accuracy and resulted in excessive environmental emissions. Investigation revealed that the airfoil flow meters installation had a limited upstream straight run and experienced plugging that affected the flow measurement and adversely impacted operation. The airfoils were also leaking due to thermal expansion from ambient temperature to full operational temperature and proved to be unreliable. The restriction created by the airfoils resulted in a significant permanent pressure loss. Air Monitor was invited to help solve these problems.

Air Monitor proposed installing a Combustion Airflow Measurement Station (CA Station) with integrated flow conditioner and multiple sensing locations to measure each combustion air flow. The proposed systems incorporated an integral high-pressure AUTO-purge to rid the probes of airborne particulate. An alternative was offered to monitor air distribution to each side of the Primary, Secondary, and Tertiary air belt ducts by installing smaller CA Stations after the total air ducts split.

In this application, since the customer already had modulating dampers after the duct split to control flow to each side of the combustion air belt ducts, they decided to install one CA Station and AUTO-purge for each side of each belt duct. The Air Monitor flow meters measured these streams more accurately and reliably, provided more information regarding mass flow distribution while providing significant economic payback by:

- Increasing black liquor firing rate closer to the rated capacity of the unit
- Reducing the number of multi-day shutdowns for cleaning
- Reducing the number and amount of fines for environmental emissions

The simple payback for this project was significantly less than one year.