Primary Aluminum Production:

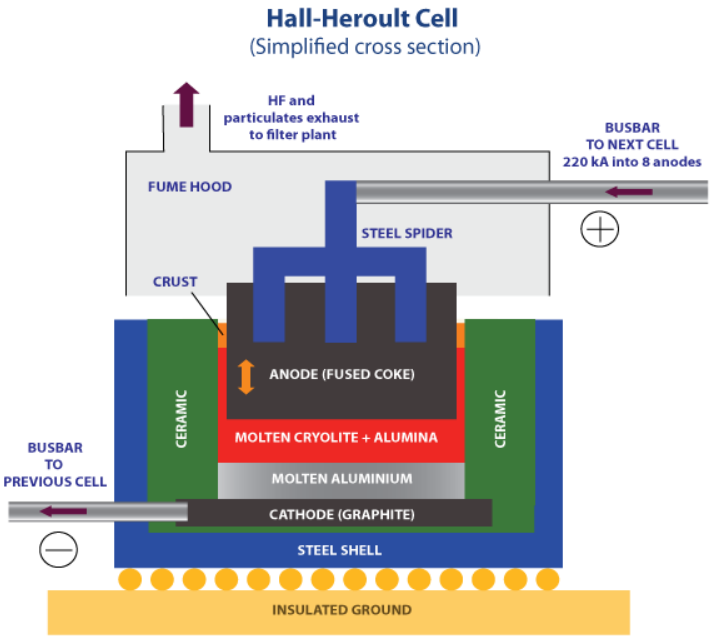
Triboelectric Technology Yields Savings and EPA Compliance

Triboelectric Technology

A primary aluminum production plant, located in the southern United States, has invested more than $40 million for advanced environmental technologies during the past decade. Auburn's emission monitoring equipment plays an important role assuring control of fugitive dust emissions at this and other plants operated by the Company. The subject of this case study employs more than 600 people and produces 200,000 tons of aluminum annually. This report highlights the challenges and solutions to reduce toxic dust emissions at this primary aluminum smelter.

Aluminum Production Processes and Dust Control

Aluminum manufacturing, while producing one of the most valuable non-ferrous metals, also yields significant quantities of fugitive particulate matter—dust, containing toxic absorbed chemicals. Sophisticated dust containment systems (fabric filter dust collectors) and collector efficiency monitors are essential to protect the workforce and surrounding environment.



Smelting Process

Primary aluminum reduction is the process of extracting aluminum from aluminum oxide (alumina) with an electrolytic method known as the Hall-Héroult process. Alumina is dissolved in a sodium fluoride bath and the solution electrolyzed to drive off oxygen and to obtain pure aluminum metal. Hydrogen fluoride (HF) is injected through a fluidized bed of alumina to render the alumina soluble and conductive. Unused, excess HF is absorbed into particulates and recycled for further processing.

Environmental Issues

During this electrolytic process the fluoride absorbed particulates, if not properly contained, will escape into the atmosphere posing a significant health hazard and making waste of a valuable resource. These particulates are toxic and can etch glass if emitted into the atmosphere. When fabric filter dust collectors fail, if the cause is not immediately corrected, significant environmental damage can occur, in addition to the loss of valuable, recyclable fluorine.

Carbon Anode Production

The availability of carbon anodes is a major requirement for this alumina reduction process. About 0.5 tons of carbon is used to produce every ton of aluminum. Modern smelters use prebaked anodes, which consist of solid carbon blocks with an electrically conductive rod (e.g. copper) inserted and bonded in position. These carbon blocks are consumed during the electrolytic process.

Environmental Issues

Carbon anode production is a pitch baking, electrode forming process, producing significant quantities of polycyclic aromatic hydrocarbon emissions (PAHs) and absorbed in particulate matter. To minimize PAHs, efficient dust collecting equipment is critical for the entrapment of these noxious products of combustion.

Challenges

Problem

Before installing the Auburn triboelectric system, the facility relied on continuous opacity monitoring systems (COMS), requiring a seven member team of maintenance technicians to visually search for bag leaks. Opacity monitors only respond when particulate emissions become visible and cannot detect small leaks which can often continue for days before becoming visible. Since a single bag leak expands with time, the original tear or separation will grow, eventually damage neighboring filter bags. Until the emissions become visible prompting the operators to respond, cascading, multiple filter failures will occur.

In this case, with 18,000 filter bags in service, manually searching for bag leaks is tedious and costly. Tears were often not detected until several inches of dust covered the area, requiring hours of cleanup. Events like this require protective clothing and respirators and, at times, process interruption. Labor costs are excessive; permit compliance at risk; and technicians are not available for more critical needs.

Triboelectric vs. Opacity

A comparison of Auburn's electrostatic/triboelectric technology with COMS was conducted to determine how quickly each could quickly detect and locate dust emissions in a 17' diameter stack.

This test involved puncturing a 1/4" hole in one of the dust collector's 3600 filter bags. The potline dust collector chosen consisted of a 12 compartment shaker baghouse with 300 bags (8"dia x 22 ft) in each compartment, representing more than 165,000 sq ft of cloth area. Each pulse cleaning cycle requires about 50 minutes to pulse (clean) all 12 compartments.

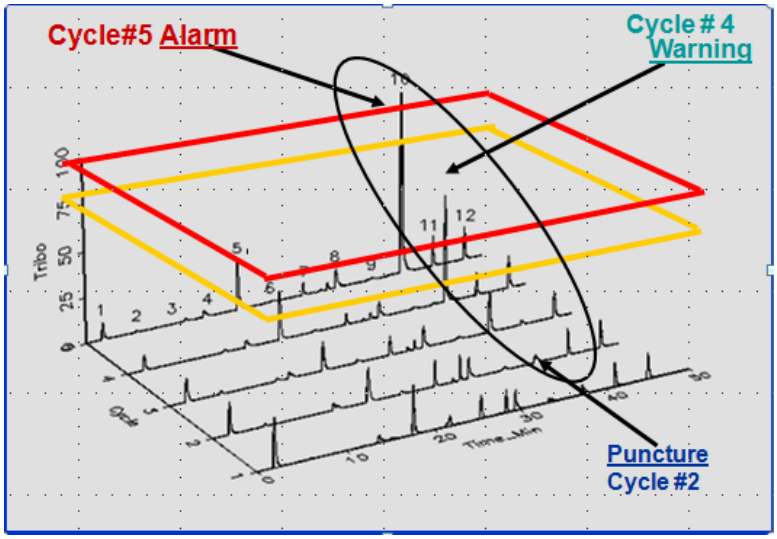


Figure 1

Small spikes represent elevated emissions during normal cleaning cycles and large spikes indicate leaks from torn bags. Auburn located a pencil-sized hole in seconds while the optical sensor was unable to detect a leak until a the tear measured 8 inches after two days.

The Auburn bag leak detector detected a minute amount of elevated dust emissions from the ¼" puncture after the first cleaning cycle. With a minimum detection range of 0.005 mg/m^3, the Auburn system was capable of detecting the event well in advance of visible emissions. The leak locator allowed the maintenance team to search only 300 bags in the failing compartment rather than tediously examining the condition of the entire 3600 filters in the dust collector. Technicians located the failing filter in less than an hour.

The optical device did not detect the event until *two days* later and only after the 1/4" diameter hole had enlarged to 8 inches. By that time, the amount of dust from the bag leak amounted to more than 60 cu ft, requiring 10 man/hours of clean up time.

It should be noted that no fugitive dust was emitted at the Auburn system test location.

Figure 2: Triboelectric vs. Optical Device Test Results

	Triboelectric	Optical Device
Estimated Time to:		
Detect Leak	Less than 1 Hour	2 Days
Locate Leak	Less than 1 Minute	2-3 Man Hours
Clean-up Leak	Less than 1 Man Hour	8-10 Man Hours
Estimated Size of:		
Hole Detected	¼"	8"
Dust Clean-up	2.6 Cubic Feet	60 Cubic Feet
Clean-up Tool	Shop Vacuum	Shovels

Results and Benefits

Since the test, Auburn triboelectric systems were installed on all potline, bake oven, anode forming units, and several material handling dust collectors, replacing the low sensitivity COMS and satisfying the need for more timely and accurate emissions data.

Benefits realized from using Auburn's equipment:

- **Reduces Replacement Costs**

  Auburn TRIBO.*series* bag leak detectors quickly detect filter failures prompting maintenance before cascading filter bag damage and catastrophic compartment failures occur.

  At this plant, with 300 bags per compartment, the replacement cost of the entire compartment would be $31,600[1].

- **Extends Useful Filter Bag Life**

  Using Auburn's dust leak detector, dust collector performance is accurately and continuously monitored, assuring operators of overall collector efficiency. It has been reported that useful filter bag life has been extended to 6.5 to 7 years, well beyond the manufacturer's recommendation of 2-3 years. By extending filter bag use, each extra year results in a saving of $360,000[2].

- **Compliance Assurance**

  By installing Auburn triboelectric filter bag leak detectors, the facility is in full compliance with United States Environmental Protection Agency (USEPA) maximum achievable control technology (MACT) standards and Title V (CAM) compliance monitoring rule for primary aluminum processing.

[1] $100/bag, average replacement time 10 hours, for four 4 maintenance workers at $40 per hr
[2] 300 bags per compartment, with 12 compartments x $100 per filter bag

About Auburn Systems

Auburn invented and pioneered the use of triboelectric (TRIBO) technology to monitor and measure dust, powders, and bulk solids for **environmental** and **process control** applications. Auburn remains the leading supplier of bag leak detectors with more than 35,000 systems operating in the field at more than 5,000 diverse materials processing plants, world-wide, including: steel, cement, power generation, metallurgy, assorted foundries, food processing, pharmaceuticals, and more.

Auburn Advantages

What differentiates Auburn is the combination of superior innovative products with our well known customer care. Consensus in the field is unanimous: Auburn provides fast, effective, and unparalleled support to our end users.

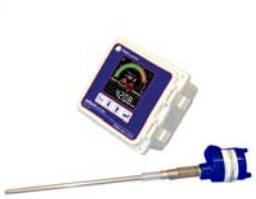
We continuously update and improve our products by utilizing the advances in today's cutting edge technology, while building upon our years of experience. Auburn's proprietary core technology, **TRIBO.*dsp***, unifies DC impaction (triboelectric) *and* AC induction electrostatic signals for superior accuracy, reliability, and repeatability. Unlike electrodynamic and AC induction-only monitors, which only use a portion of the triboelectric signal, TRIBO.*dsp* electrostatic particulate monitors provide high sensitivity and wide flexibility for harsh industrial environments.

Typical Applications

Dust Emissions Monitoring		Process Applications	
Bag Leak Detection	Fabric Filter Baghouses	Air Slide Flow Monitoring	Lime & Powder Injection
Cartridge Collectors	Dust Collector Maintenance	Catalyst Feed Injection	Activated Carbon Injection
Cyclone Overflow	Isolate Bag Leak Location	Cyclone Flow and Overflow	Pneumatic Conveying
EPA/MACT Compliance	Bin Vent/Nuisance Collectors	Flow/No Flow Detection	Screw Conveyor Flow
Indoor Fugitive Dust	Positive Pressure Baghouses	Fly Ash Handling Systems	Particle Flow Velocity
Spray/Fluid Bed Dryers	Title V/CAM Compliance	Gravity Feed Monitoring	Vacuum Systems

TRIBO.*guard* I 4001
Broken Bag Detector

TRIBO.*dsp* U3400
Two-wire Monitor



TRIBO.*dsp* U3600
Particulate Monitor

TRIBO.*dsp* U3800
Multi-channel Monitor

Industries Served

Agriculture	Battery	Food	Hazardous	Nutraceutical	Steel
Aluminum	Carbon Black	Foundry	Incineration	Paper	Tires/Rubber
Asphalt	Cement	Furniture	Metals	Pharmaceutical	Tobacco
Automotive	Chemical	Glass	Mineral	Power	Wood

For additional information or to request a quote, please contact us or visit ***www.auburnsys.com***.