15 Tips for Selecting the Best Bag Leak Detection System

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Introduction

We understand. You don't think of bag leak detection system selection as a career "make or break" decision. In fact, as business decisions go, choosing a broken bag monitoring platform seems pretty mundane. And therefore it's often relegated to last minute, casual comparison of seemingly similar products – an administrative selection as a subset of a compliance obligation.

It's time for that to change!

Now, we admit that we're bag leak detection "geeks." We live, breath and eat triboelectric technology. We turn our lights on every day, thinking about the nuances and technical mysteries of probes and sensors. While that expertise has never resulted in a steady stream of party invitations, it does mean that we understand the "ins and outs" of detection better than most.

And increasingly we find new generations of EH&S engineers are eagerly seeking more detailed and complete information on all aspects of environmental monitoring and compliance – tasks for which they are made responsible but often without deep institutional support or substantial education.

We're thrilled to be a resource, and excited to support in-depth inquiries into bag leak detection, and rigorous exploration of how this seemingly innocuous decision may broadly impact manufacturing operations in ways well beyond traditional compliance.

Why is Leak Detection Important?

Tip # 1
Treat your BLDS selection as a business investment rather than a compliance detail.

Traditionally the answer has been simple – compliance.

That's not sexy, cerebral or carefully aligned with corporate growth objectives – but it's real and compelling. And it's also evolving.

The confluence of four trends has gradually shifted the consideration of bag leak detection from a simple "check the box" component of mandated compliance to an opportunity/need to contribute meaningfully to operational efficiency and larger corporate goals. These include:

1. Increased capability of the technology
2. Corporate Social Responsibility and philosophical commitment to doing well by doing good
3. Tightening corporate budgets and rigorous justification requirements for ROI
4. Fewer people doing more work (and the resulting need for automation and efficiency)

But realizing the ancillary benefits and unlocking the value of BLDS requires an understanding of what distinguishes one bag leak detector from another, and further; selecting the right tool for a specific set of application parameters.

Bottom line? This isn't simply a technology (or even less a compliance) decision. It really is legitimately a business decision. And understanding the business implications helps to set the context for the discussion of technical specs, features and benefits.

Savings & Efficiency

Bag leak detection is a cost. It comes straight off the bottom line and can't reasonably be argued to contribute any top line revenue. However, properly selected triboelectric bag leak detection monitors can absolutely reduce compliance & operations/maintenance costs. The predictable, demonstrable and measurable reduction in costs allow a clear and compelling ROI to be calculated for implementing and/or upgrading an existing BLDS.

Common savings can be broadly categorized as follows:

- **Maintenance** – companies staff their maintenance departments for routine operations. Emergency issues tax that staffing and attention directed to events is attention diverted from operational maintenance. Related costs include overtime, contract support, special equipment and supplies, and even the impact of other work that goes undone. These are sometimes hard to quantify, and frequently discounted as 'outliers' which can't be reasonably budgeted.

  Less abstract yet huge potential savings, however, exist with bags themselves. First, when a small leak develops in one bag, escaping particles abrade, and therefore degrade nearby bags. A single failure, therefore, typically results in multiple failures; but rapid detection and isolation normally allows the failed bag to be replaced before damage occurs to its neighbors. Second, scheduled replacements are typically performed according to a calendar. A manufacturer's spec suggests a lifespan of one year, for instance, as a reasonable maximum

Tip # 2
select a system that supports your maintenance team – not one that adds new tasks to their plate.

period after which disruptive failures may occur. But that estimate embodies inherently contradictory objectives. Bag manufacturers must be recognized as reliable (although they also can't commit to a lifespan longer than realistic and therefore suffer excessive failures) and they must be competitive in terms of performance, lifespan and price. But simultaneously they must sell more bags. Therefore the published lifespan of bags is probably no longer than it must be to satisfy commercial requirements. Depending on operating variables, bags might perform quite satisfactorily for much longer than advertised.

But most companies are loathe to 'gamble.' The operational cost of an event is so high, and the compliance implications often so dire, that it's considered 'cheap insurance' to change bags according to a schedule rather than as performance indicates. Therefore one of the huge proactive benefits of sophisticated BLDS is the ability to determine when bags must be replaced based on actual performance – not an arbitrary spec sheet and seasonal cycles. Proper triboelectric bag leak detection will provide the assurance that the bags are continuing to filter successfully, and give very early indications of minor incremental degradation in bag performance. This allows bag replacement to be scheduled (to avoid disruption to operations) at the point in real (vs. predicted) bag life when performance deteriorates. Often this can add an additional 6 – 12 months to bag life or longer.

Tip #3
choose a BLDS that will pay for itself by helping safely extend filter bag life.

Representative Bag Replacement Cost Savings Example

A typical baghouse containing 720 Bags (6” diameter & 12FT long) @ $15/ea requires an investment of $10,800 for replacement bags every 18 months based on the manufacturer’s suggested bag life of 1.5 years.

Labor cost to change 720 bags depends on the prevailing local wage rate. Let’s assume a national average $15/hour loaded. Removing the bags only through a roof door (not the cages) and replacing them would require approximately 32 man hours (2 men for 2 days each.) That’s a relatively small cost at $480.

Total cost = $10,800 (bags) + $480 (labor) = $11,280/18 months or $7,520/year.

Actual customer experience varies but often bags have lifespans of 1-3 years beyond the manufacturer’s stated maximum. Assuming a conservative additional 18 months, that translates to an annual cost of $3,760 – and an annual savings of 50% or $3,760.

And installing a bag leak detector at ≈$2,000 means that the ROI is roughly 6 to 7 months.

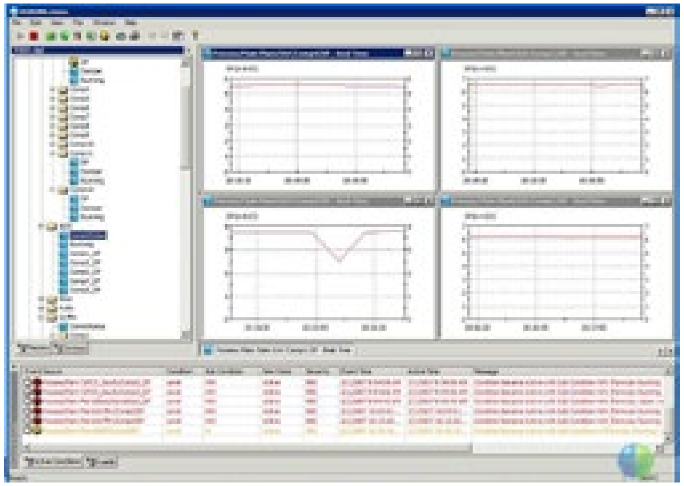
An amazing return!

- **Operations** – in general nothing good, or inexpensive, happens with a reactive approach. Plant shutdowns or simple production interruption is enormously expensive. That's where the differences in BLDS most often impact operations. The right system, implemented the right way, will provide an enormous quantity of valuable predictive information about dust collection system operations. Not only does the predictive capability of tribo BLDS enable scheduled, preemptive bag house maintenance, but additionally it largely precludes unexpected sudden events that often result in lost production time, plant shutdowns, compliance reporting and fines (or even lost product depending on the baghouse application.) Every factory is different, and there's no rule of thumb for the immediate and long term costs of production disruption – but it's never a minor expense.

- **Compliance** – this is often mistakenly considered as a red/green factor. And that potentially costs companies money because a proactive approach to the full range of compliance requirements can actually save companies large sums. For example, reducing the number of reportable events would reduce or eliminate fines, and further lessen the administrative burden associated with reporting and remediation. Sensitive, predictive monitoring technology can be set with early warning, non-reportable thresholds that accommodate preemptive action to avoid reportable events. Reporting itself is a generally accepted time-consuming burdensome element of compliance – but one which can generally be enormously streamlined through systems which integrate parametric monitoring, custom reporting, and integrated event reporting capabilities.

Tip #4

Demand that a bag leak detection system works to preempt shutdowns and disruption, not just trigger it.



Tip # 5
Compare the extended capabilities of BLDS to reduce the reporting burden and improve data logging.

Of course these savings don't just accrue automatically. Indeed the seemingly insignificant distinguishing attributes of different solutions directly impact their respective capability to deliver such savings.

So before we jump into highlighting and comparing technical attributes let's quickly build a common language and understanding of triboelectric technology in general.

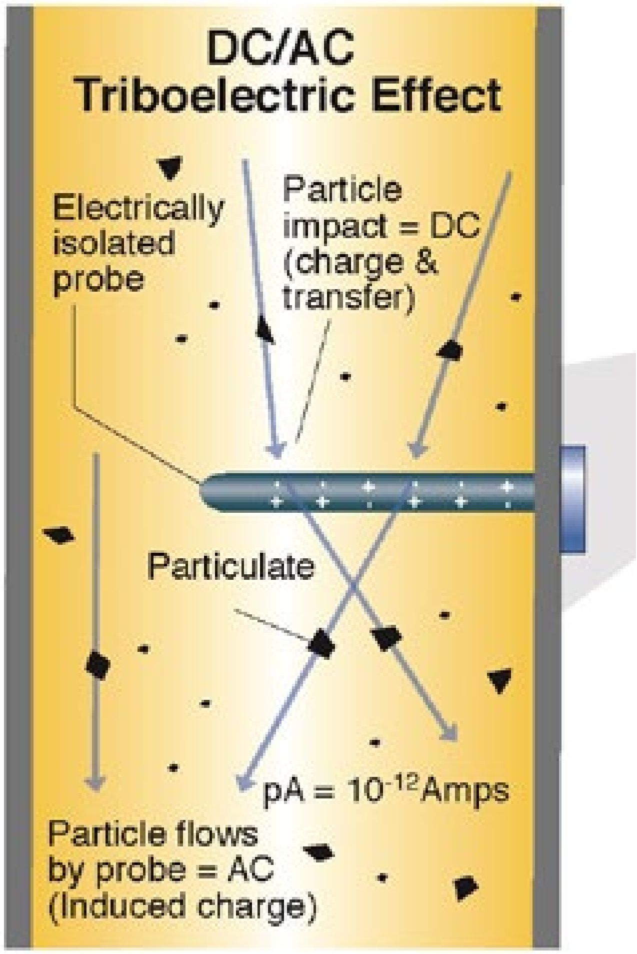
About Triboelectric Detection

When two materials are rubbed or collide together, a transfer of charge takes place from one material to the other. This is known as the triboelectric effect.

Principle of Operation

Various triboelectric mechanisms are at work in particulate flow streams.

1. Direct impact current – This is the transfer of charge between two dissimilar materials upon physical contact. This generally results in a fairly constant current of either positive or negative polarity (some particles impart a positive charge resulting in positive polarity on impact, some negative.) The triboelectric current is commonly referred to as Direct Current (DC) due to the relatively constant (not alternating) polarity, whether positive or negative.
2. Pre-charged particle discharge – In a few applications, particulate may accumulate very large amounts of charge before probe contact (e.g. particles exiting an electrostatic precipitator (ESP),) which will discharge to the probe surface



during contact. This is similar to the triboelectric effect, except it is of a much higher magnitude. The discharge is also a form of Direct Current.

3. Non-contact induced current – Particulates with some pre-existing charge passing near the probe can attract a mirror charge in the probe wall. If the concentration of the passing charged particulate is changing, then the mirror change in the probe wall will change in a similar fashion, resulting in an induced current. Since there is no direct contact or charge exchange, the average current for this mechanism is zero. The non-contact induced current is referred to as AC current, due to its "alternating" nature around zero.

Generally 80% of the triboelectric/electrostatic signal spectrum is represented by the first group (DC). Smaller percentages are associated with the second, and only about 20% of the available spectrum can be captured through the application of AC monitoring.

Understanding the nature of the particles, impacts and charges, a probe, electrically isolated and ground referenced, is inserted into a gas stream containing particles. The continual transfer of charge that takes place as each particle impinges on the probe generates a triboelectric current measured in pico amps.

Triboelectric measurement can be used for almost all materials and is suitable for use with particle sizes varying from a few millimeters to sub-micron. Today's most sensitive triboelectric measurement devices can detect baseline signals as low as 0.005 mg/m3.

Tip # 6

Don't settle for a system that only captures a portion of the available spectrum.

Triboelectricity can be used to monitor particulate emissions in the outlet duct of any dust collector including baghouses, cartridge collectors, HEPA filters, drum filters, cyclones, multiclones and ESPs.

Specific applications for leak detection are predicated on the fact that all dust collectors leak to some degree. The constant particulate material leakage establishes the signal baseline. Because the current (pA) is directly proportional to the mass concentration of the particulate under somewhat constant conditions, triboelectric measurement devices are able to detect slight gradual changes in particulate concentration indicating the onset of a filter bag leak or instantaneous changes indicating broken bags.

Therefore triboelectric measurement is generally used in bag leak detectors to indicate relative changes in particular concentrations. However, since the triboelectric current is proportional to the mass concentration of the particulate, it can also be used as a quantitative monitor. The triboelectric signal must be correlated with a stack test (e.g. Method 5) to provide quantitative monitoring in lbs/hr; mg/m3, or other specific value.

Evolution of Triboelectric Technology

Like all technologies, triboelectricity has evolved substantially from it's original incarnation 35 years ago. Early on it was "cool" technology looking for a substantive application. Early analog circuits tended to drift and required periodic calibration. Devices couldn't be networked for easy collection of data and reporting purposes.

In fact originally, triboelectric found its use primarily as an

Tip # 7
Create a wish list for all monitoring capabilities to ensure that your BLDS partner identifies all required capabilities rather than just the simple or common ones.

> ***Frustrating legacy experience with stand-alone, analog and AC only triboelectric systems remain vivid memories for many engineering and maintenance personnel today, and often are the basis for skepticism about the predictive monitoring capability of newer, refined technology.***

alternative to expensive and maintenance intensive continuous optical monitoring (COM) for stack monitoring.

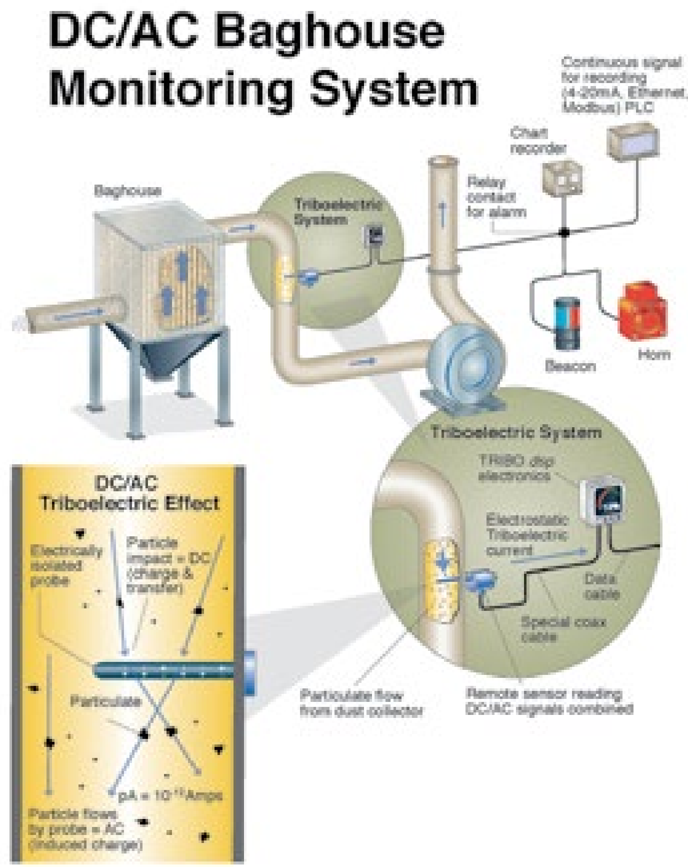
Traditionally triboelectric detection systems have been either induced current (AC only) or direct current (DC) based. The earliest triboelectric detection patents were actually for DC detection – it made sense to focus the technology on the strongest and most linear portion of the electrostatic signal, namely the DC signal.

Since those early patents essentially precluded detection access to the huge majority of signal range, AC based detection systems were developed as a competitive response. Manufacturers of those systems turned to a common marketing ploy - touting as unique, technical capability what was in fact a limitation for all but the very small (≈5%) number of applications (such as moist environments) where AC was indicated.

But that was then….and three decades of advances in the technology have produced vastly more sophisticated and capable systems. Today's technology boasts:

- Increased sensitivity
- Superior signal filtering
- Unified AC/DC systems for detection across 100% of the signal range for 100% of appropriate applications
- Integrated parametric monitoring
- Networked sensors and devices

Tip # 8
Demand a system which unifies AC & DC monitoring capability



- Centralized monitoring and data collection
- Easy integration with common factory automation systems
- Streamlined compliance reporting
- Enhanced compliance capabilities

As circuitry, signal processing, noise suppression and probe technologies have all improved substantially, some of the most dramatic improvements in Tribo technology have come in advances in networking multiple sensors, centralized monitoring and logging of data and the ability of BLDS to communicate with factory control systems to request/exchange various other parametric values. Collectively these vastly simplify the reporting process not only for compliance, but also for internal optimization.

In short, modern systems have progressed well beyond their early incarnation that merely "checked a compliance box." Today's systems, properly specified for an application, provide enormous breadth of data collection, monitoring and reporting capability not only in support of compliance, but enabling improvements in manufacturing efficiency and substantial reductions in cost.

Tip # 9
Remember, it's not just a detector. Evaluate BLDS as an integrated solution, including reporting and integration with existing control systems.

Tip # 10
Select a system from a supplier which takes time to understand your application in detail – and suggests capability enhancements based on application experience.

Implications of a Good/Bad Choice

Of course there is no "simple choice." Competing claims and glossy marketing information all tout industry-leading capability. And preconceptions, often based on experience with early generations of Triboelectric technology frequently figure in company lore – and influence the "safe choice." Therefore the engineer's most important task in selecting a system is often the most counterintuitive. Selecting the "right" system requires first disregarding the stats & specs that are typically central to such an analysis. The right choice today is predicated on the business factors and implications of the selection.

Too often companies create a firewall between business and technical responsibilities. Regrettably that overlooks the positive (and often unrecognized) positive business impacts that a simple BLDS can have.

Tip # 11
Select a system that offers substantial business benefit and savings – not just tech specs.

Tip # 12
Consider historical events and measure potential system capability by the ability to prevent recurrence.

Therefore engineers and others involved in choosing a leak detection system should take these steps during the evaluation process:

- Consolidate the history of events, shutdowns, fines and enforcement actions (cost, frequency, impacts and causes) to identify monitoring and detection capability enhancements that would reduce incidents going forward
- Understand how maintenance planning/scheduling/staffing is handled to ensure that the selection supports that process rather than complicates it
- Take an inventory of all current sensors and map how data is collected (people, hours, departments involved), logged and formatted into required reports. Look for opportunities to simplify your reporting.
- Reach out to operations early in your process and initiate the dialog about process improvements which the right choice would support. Get them excited.

Tip # 13
Choose a system that will let you simplify your reporting to match your manufacturing.

Procurement Challenges

Sometimes it's lonely to be the individual recommending a new approach. Everyone empathizes with the seeming safety of selecting the cheapest solution, or simply sticking with the status quo. But compliance excellence, operational efficiency and career reputations aren't built on "safe" solutions. Today's lean and demanding environments require innovative and inquisitive approaches. Nevertheless those approaches typically encounter some institutional resistance, and it is prudent therefore, to anticipate common impediments to implementation during the evaluation process. Anticipating challenges allows for a solid justification to be created proactively in support of the recommendation.

Common challenges include:

- Previous frustrations with earlier generations of triboelectric – "We tried that. It didn't work." Ever heard that sort of response from one of the old timers? Of course. We all have. But "getting it on the table" is an important step. Acknowledge that early generations of the technology (still commonly used by some manufacturers) had limitations; understand what technical attributes limited performance; consider which modern capabilities obviate those previous shortcomings.

Tip # 14
Accept that not everyone will be as excited about the best BLDS as you, and anticipate possible concerns.

- Cost – When you propose a 'business solution' you're likely to encounter resistance. Compliance is often budgeted for begrudgingly and viewed simply as a drag on the bottom line. Incurring additional cost (as a complimentary system or more expensive version) will raise eyebrows. So be ready with a well-documented justification for savings across maintenance, operations and compliance responsibilities. Often it helps to coordinate with colleagues with those responsibilities in advance. Get them excited about savings and efficiencies that you can help deliver for them. And be realistic about the "all in" cost of implementation including software, customization, installation and downtime. Don't sacrifice credibility with an incomplete analysis.

- Existing Air Permits – In most cases implementing or updating a BLDS will not interfere with existing air permits. But double check and understand this in advance. Typically compliance components are identified by type (e.g. COM or triboelectric) at the discharge stack level. Adding compartment or module level monitoring, and or replacing one tribo system with another shouldn't constitute a substantive air permit challenge.

Tip # 15
Consider all costs and potential savings in a holistic analysis

- Brand familiarity – Sometimes corporate engineering, consultive engineers, 3rd party baghouse OEMs and internal maintenance departments will default to known systems from habit. Back in the day when maintenance had to regularly recalibrate tribo systems, a common procedure was sensible. But today that's irrelevant. "Set & forget" installation relieves maintenance departments of those burdens. Typically baghouse OEMs focus on individual component cost (rather than ongoing savings and efficiencies) and centralized engineering specifications often focus on administrative compliance at the expense of local requirements. Therefore it's important to empathize with each perspective – and understand how your recommendation will benefit the company holistically and substantially.

- Red/green mentality – prevalent in some companies is the perception that a BLDS, as a compliance component element, simply needs to alarm when a critical threshold is surpassed. Overcoming that upgrade challenge requires an understanding of the ancillary ways in which modern continuous monitoring technology supports broader business objectives.

Key Factors to Consider

Recapping the 15 key tips / factors to consider when evaluating a triboelectric bag leak detection system:

1. Treat BLDS selection as a business decision with investment implications, not simply a "check the box" technical compliance selection

2. Select a system that supports the maintenance team – not one that creates more work for them

3. Choose a bag leak detector that will pay for itself by helping you extend bag life…safely

4. Find a system that will help you avoid events, not just alarm when they occur

5. Move beyond comparison of devices and compare the broader capabilities for networking devices and simplifying reporting

6. Don't settle for a detection technology which only captures a portion of the triboelectric / electrostatic signal spectrum

7. Create a 'wish list' of all capabilities so that technology partners provide a complete solution – not a routine pro-forma design

8. Insist on unified DC/AC technology

9. Consider a system's ability to communicate with your existing plant operations control systems

10. Evaluate the supplier as rigorously as the technology – the right supplier will really be a 'partner' not merely a vendor

11. Select a system that delivers business value, not just compliance

12. Compare a system's capabilities against your historical events – pick something that would have worked, and will going forward

13. Carefully assess a system's inherent ability to streamline the burdens of reporting

14. Anticipate concerns that will arise internally among folks with other responsibilities and perspectives – and prepare a compelling case in support of your analysis

15. Calculate ALL costs and reasonable savings – don't overlook value or miss related expenses. Develop a Total Cost of Ownership comparison matrix

Selecting The Best System for Your Company and Application

Picking the best bag leak detection system isn't a high profile accomplishment that earns company awards and promotions. But it's an area where many companies can achieve substantial savings across maintenance, operational and compliance areas – and one which can often be implemented without disrupting existing air permits or requiring significant investment.

Understanding the detail of how a BLDS works and integrates into your requirements will allow you to compare solutions and select the best fit for your application. And while that takes a bit of work, it's far easier than dealing with the consequences of a hasty selection based on abstract technical features.

About Auburn Systems

Auburn Systems LLC designs, engineers and manufactures advanced electronics. Our specialty is developing and refining devices for particulate monitoring. We focus on bag leak detection for emission monitoring and solids flow monitoring for process control applications – particularly where accurate detection and monitoring saves our customers time and money. Regulatory compliance and process improvement are business challenges – not simple hardware tasks. Although we invented triboelectric monitoring, we don't just rely on our large assortment of patents. We measure our application success by the return which we enable our customers to realize. By accurately monitoring the triboelectric effect created by particles in a process, we actually help you do, what you do, better.

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