The Use of Particulate Emission Monitors to Support Arrestment Plant Operation and Upkeep

The operation of filtration type arrestment plant can be optimised by the effective use of Particulate Emission Monitors (eg Filter Leak Monitors and Filter Performance Monitors). Particulate Emission Monitors are installed throughout the broad spectrum of industrial processes to satisfy regulations (IPPC, Part B Guidance Notes, WID and LCPD) for emission limit enforcement. In addition, where processes are controlled with arrestment plant, these instruments also serve to provide feedback on the operation and performance of the arrestment plant itself. Specifically after filtration plant (bag-filter type), appropriate instruments may be used to reduce running costs and minimise emissions.

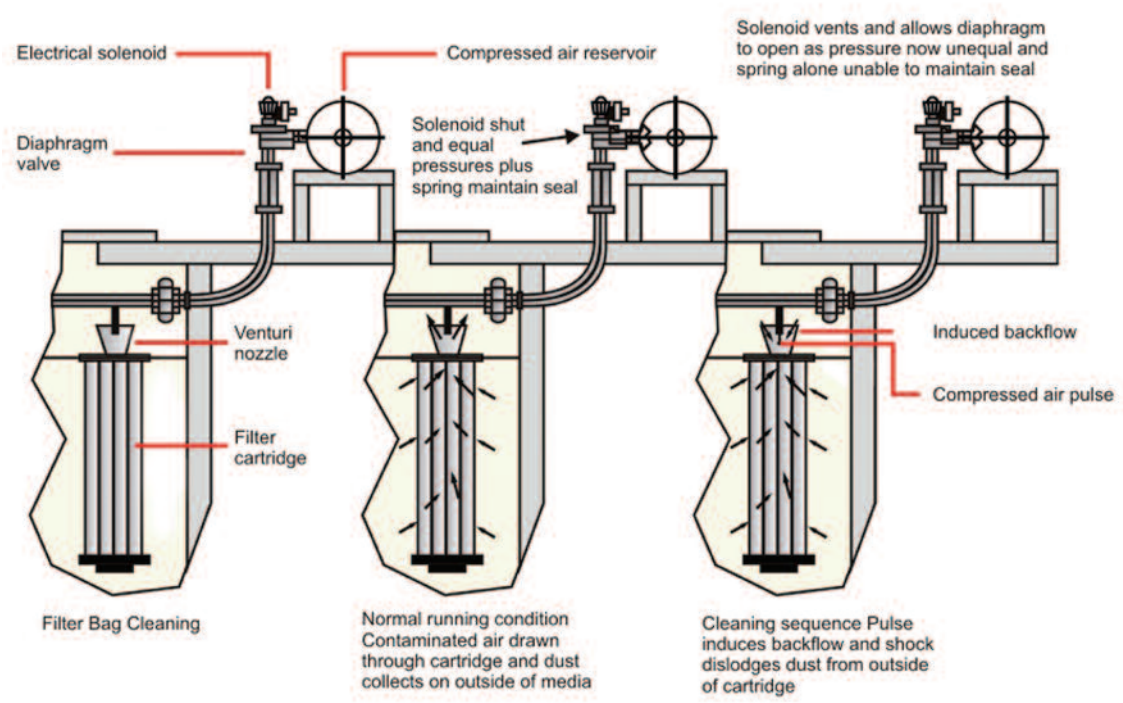
Cement Mill 45,000 m³/hr (25,000 CFM) 1.2m Stack

Battery Industry 27,000 m³/hr (15,000 CFM) 800mm Stack

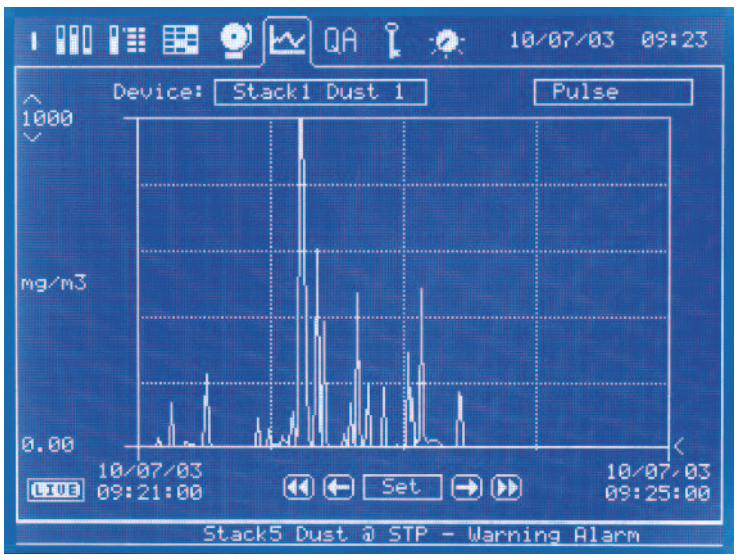
Example filtration plant fitted to different processes

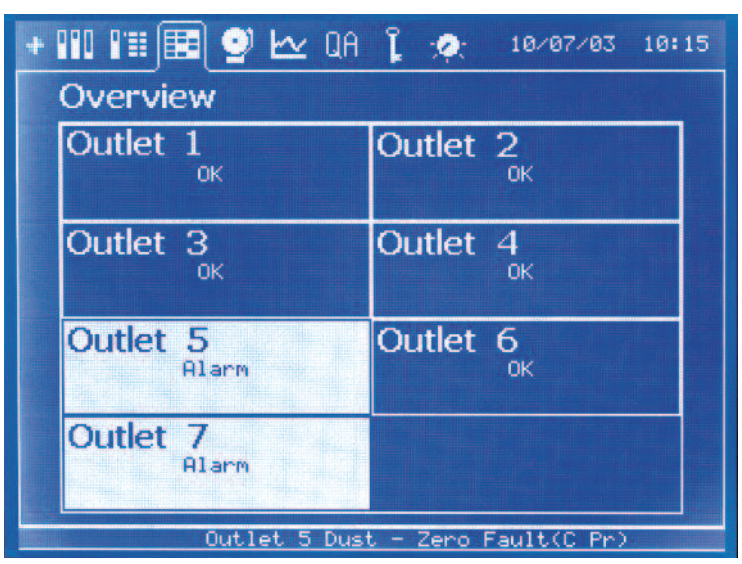
Bagfilters and cartridge filters, as their names imply, use bags or cartridges of various media types to filter out particulate from the exhaust stream. Filter bags are typically provided in various dimensions and are fitted over a metal cylindrical cage. Hanging vertically in rows within the arrestment plant, filtration occurs when air passes through the outside of the bags into the middle of the cylinder and then up into the clean air plenum. Particulate is collected on the outside of the bag where it may form a "cake", which provides even more efficient filtration. Periodically the "cake" must be removed from the bag so that the pressure drop across the bags does not obstruct the air flow through the filter media.

In most current filter plant, cake removal or cleaning of the filter media is carried out using a reverse jet pulse of air applied to the top of the cylinder which inflates the media. On inflation, the particulate "cake" is cracked, the filter material's pores are opened and the particulate falls to the bottom of the filter plant hopper where it is collected. After the air pulse is removed, the filter media recovers to its original shape and resumes filtration. During the cleaning process there is a small discharge of particulate, which shall be referred to as a 'pulse', when the particulate in the filter (in addition to the "cake") has been dislodged. The cleaning mechanism in such filtration plant typically occurs sequentially within a defined time period (e.g. 30 seconds) between the cleaning of each row.

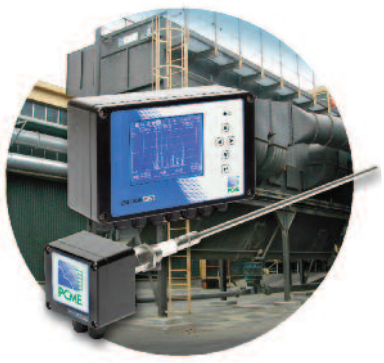


Reverse jet cleaning mechanism





Identification of failing filter media via particulate sensor control panel



Filter Performance Monitor: LEAK LOCATE 660

Filter Leak Monitor: LEAK ALERT 73

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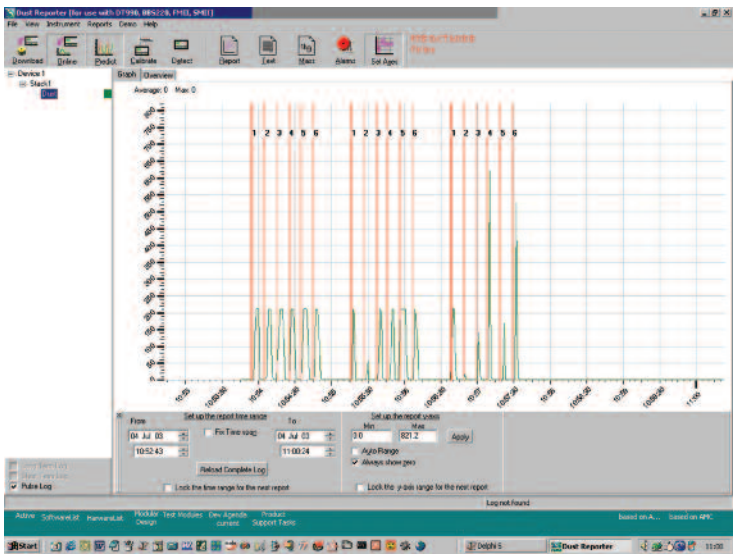
An appropriate particulate monitor fitted in the duct downstream of the filter plant can monitor the pulses of dust created by the cleaning process and discriminate this from the filter plant's particulate emission during routine operation. Consequently, the dust profile monitored by such an instrument includes periodic dust pulses resulting from the bag cleaning sequence. The magnitude of these dust peaks reflects the condition of the filter media being cleaned, with a failing or worn media generating a higher dust pulse emission peak than those operating efficiently. The cleaning pulse peaks present in the emission profile can be used to indicate the relative condition of the different rows of filter media and, therefore, isolate which row is failing ahead of catastrophic failure. Instruments designed to locate filter leaks can display this pulse profile on a graphical display and connected to the digital controller for the filtration plant's cleaning cycle so that the row being cleaned can be identified and marked alongside the appropriate dust peak.

Filtration plants that operate with periodic sequential cleaning cycles, require only the input pulse from the first row of the cleaning sequence, as the sequence of bag row cleaning is predictable and can be programmed into the instrument. Filtration plants that operate more complex cleaning sequences (eg clean on demand), require a connection to be made between the filter plant and the particulate sensor control unit for each row of filter media.

Using these techniques, failing bag rows can be easily identified but also the general condition of the filter plant can be compared over time and facilitate early warning of deteriorating operation and thus assist preventative maintenance.

Filter media leak location functionality can also be provided by PC software connected to appropriate particulate monitors. This enables maintenance staff to monitor the condition of filtration plant in a central location and efficiently monitor multiple filters simultaneously.



Automation with PC software

Filter Leak Monitors	
Instruments are used for monitoring changes in emissions from particulate arrestment plant (e.g. Electrofilters or Bagfilters) and provide a tool to minimise emissions from processes and monitor for arrestment plant malfunction (eg. leaking or failing filtration media).	•Approved Filter Leak Monitors (e.g. to MCERTS Class 3 requirements or TA Luft) where quality assurance features are required in addition to reliable measurement. Performance standard is similar to the ASTM standard D7392-07 for bag leak detectors which has relevance for MACT monitoring in the US. •Filter Leak Monitors which are not certified to any performance standard but still provide a variety of quality assurance and functionality options
Filter Performance Monitors	
In addition to providing leak monitoring capability for filtration-type arrestment plant, these more advanced instruments have the capability of monitoring the dynamic operation of the filter cleaning system and to diagnose the location of faulty media rows and compartments. Valuable information is therefore provided for maintenance teams in solving leakage problems and thus reducing bag replacements costs.	•Functionality is often combined with particulate measurement systems or may be added via a separate control unit to filter leak sensors hence permitting approved versions of these instruments •In large multi-compartment bag compartments, multi-sensor systems are used to monitor emissions from each compartment to diagnose the location of failed compartments

The benefits of leak location and failed filter media row identification are threefold:

- Leaking filter media are rapidly identified ahead of gross failure so that they may be replaced on a proactive and necessity basis only.
- Only faulty or leaking media need be replaced and thus those performing satisfactorily can be left in situ and their lifespan continued, when previously all filter media, regardless of condition, was replaced in a single event
- Following filter media replacement, a check can be made that all are properly fitted without seal problems.

To assist Plant Operators with the identification and selection of the appropriate level of Particulate Emission Monitor for their specific requirement, PCME have introduced product categories which reflect instrument monitoring capabilities: Filter Leak Monitors and Filter Performance Monitors. It is, therefore, much easier for a Plant Operator or Regulator to see which product category a specific instrument is intended to serve.

In conclusion, operational costs of filtration-type arrestment plant can be reduced by the installation of particulate emission monitors. By providing assistance in the identification of leaking bag rows before large scale emissions occur, diagnostic timescales and filter media replacement costs are decreased.