SOUTHCORP CLEAN AIR SYSTEMS
EXTENDING YOUR CLEAN AIR OPTIONS

FILTER LEAK DISCRIMINATION

Introduction

This document outlines various methods of detecting and locating faulty filter bags within a large array, to minimise maintenance costs.

Background

Bag Filter Cleaning

Bag type air filter systems are commonly cleaned by a reverse jet pulse of air, which expands the filter bag, dislodging particulate accumulated on the outside, and allowing it to fall into a hopper below. During each cleaning operation, the pores in the bag(s) will be enlarged momentarily, allowing more and larger particles to pass through the filter media, resulting in a brief increase in particulate on the clean side. Dust density is greatest just after the high pressure air pulse passes each section of the bag as it is followed by a partial vacuum, and it may be followed a short time later by one or more additional brief pulses of high density pulses as the bag collapses onto it's frame, shaking off any dust adhering to the inside of the bag. If a bag has deteriorated, much more particulate will bypass the filter during this process, and the brief emission peak will be significantly higher and wider. Each such emission peak will be carried by the gas stream, and some time later will typically be detected by an emission monitor.

Broken Bag Detection

It is possible to maintain bag filter installations purely by periodic maintenance (ie, repair or replace all filter bags at fixed intervals). However this method inevitably leads to unnecessary maintenance costs, inappropriate emission levels or both. One or more emission monitors is therefore commonly applied to the output of the filter plant to indicate to the operator when a problem has developed, and therefore when maintenance is required. In the most basic form, an alarm is generated when the emission level exceeds a threshold, and the plant is then inspected and repaired at the next convenient time. This method (called Broken Bag Detection), is supported by a wide variety of simple emission monitors with either a built-in direct relay-contact output (often called Broken Bag Detectors), or a continuous output to an alarm system, PLC, SCADA system or PC + CONNECT software.

Manual Broken Bag Discrimination

Where the filter media are cleaned by a reverse pulse jet system, the high emission alarms will occur just after a faulty bag is cleaned, so maintenance personnel may monitor the pulse valves while operations personnel monitor the emission levels. If the two are in contact by telephone, radio, or even by key signalling of radio transceivers (where ambient noise prevents voice communications), it is readily possible to determine which valve pulsed before the high emissions were observed. It is then only necessary to inspect a small part of the plant to determine which filter bag has failed. This is Manual Broken Bag Discrimination

Parallel Valves

Sometimes, several valves are pulsed at once (by parallel connection of pilot or main valves). This is not generally recommended, because it means that some filter bags will inevitably be cleaned more often than they need to be, shortening their life. Further, if the parallel valves are in the same system (ie monitored by the same Emission Monitor), it is then impossible to distinguish between the filter plant areas covered by the parallel connected valves, and so less discrimination is possible, and finding a faulty bag will take longer.

Automatic Broken Bag Discrimination

If a PLC or programmable SCADA system is used to initiate the valve pulsing operations, or can reliably read the valve pulsing signals generated by a separate timer card or similar, then that system can also easily perform automatic Broken Bag Discrimination. Such a system need only recognise any emission alarm, identify the reverse jet pulse valve which fired most recently, and indicate that valve to the operator in a meaningful way. There are available a number of simple, stand-alone; hardware and software products which perform this function, but it can alternatively be implemented in an existing PLC or SCADA system with little effort.

Such BBD systems are usually endowed with a wealth of user-convenience features. They also perform adequately in many situations, but they are limited by their very simple internal operation.

PLC/SCADA Broken Bag Discrimination

In a PLC or other SCADA system, set up functions to perform a running average of the input signal over about 50% to 100% of the width of the emission pulse, and alarm the result. If the valve timing is generated externally, then that timing information must first be made available. As it is usually inconvenient to provide a separate inpute for each valve in the system (there may be 100 or more), the easiest method is for the timer system to toggle the state of a contact on every valve firing, and to toggle another contact when the reference valve (normally the first valve) fires. When the timer system cannot perform these functions, AXC1 and AXC2 perform a similar function. Once the valve timing is available internally, capture the current timing state state as each alarm occurs, and display it as appropriate (eg, for a 10X6-bag-row system, decoded to either a numeric 0-59 or 1-60, or one of 60 individual annunciators, or a 10X6 matrix of names with 10 LEDs along one edge, and 6 along the other.

Filter Leak Discrimination (FLD)

CONNECT software (v3.0 or later) includes a built-in optional next generation Row Leak Discrimination function. Unlike simple Broken Bag Detectors or Broken Bag Discriminators, CONNECT's Filter Leak Discriminator is based on signature analysis by pattern-recognition rather than simple level detection, so it can detect leaks well before they cause a problem. Because of this early warning, bag repair or replacement can be scheduled during normal maintenance periods for lowest cost, while still avoiding emission breaches and costly periodic replacement methods.

- Built into CONNECT PC software system (Windows 9x/NT/2000 compliant)
- Status indicator shows progress of cleaning system
- Unique user-configured message for each possible bag row leak to suit plant
- Message can be logged, flagged and displayed in event window
- Can output to PC speaker, soundcard speaker, external alarm relay
- Up to 250 bag rows per RLD system
- Up to 14 complete RLD systems per CONNECT network
- Automatically rejects high baseline emission level
- Automatically rejects high background emission noise and random events
- Requires one networked emission monitor per RLD system (eg EMS6 or EMP5+AXD1)
- Obtains valve timing from AXC1/2 current pulse detector (simple non-contact application)
- Future extension planned to include direct DDE connections to various timers.
- Future extension planned to include multiple networks per PC.

FLD Installation

Emission Monitor Installation

Set up one emission monitor (eg EMP5, EMP7 or EMS4 with AXD1 or AUD1 interface, or EMS6 alone) on each principal section of the plant, as close as possible to the filter bag outlets, yet conforming to minimum straight pipe length requirements. If there is a long transit time between the bags and the emission monitor, the emission pulse will lose definition and it will be more difficult to associate it with the pulse which caused it, so long transit times should be avoided. Configure the Modbus master (PLC, CONNECT or SCADA) and the emission monitor, and observe the shape of the emission peaks. Adjust the Scan Interval if possible to 10% (25% max) of the total width of the emission pulse (eg 250ms for a 2.5s emission pulse).

AXC1/AXC2 Installation

If timing information is not available directly from the timer system, then AXC1 (4-20mA) or AXC2 (Connect network) can be used to detect the valve timing and synchronisation. In this case, install the AXC1 or AXC2 near the timer card, then reposition the common return wire through one of windows, and the outgoing reference valve wire through the other.

Wire the AXC1 to a 4-20mA input on a PLC or Connect Access device (eg AXD1).

Wire the AXC2 directly to a Connect network.

In either case, configure the PLC or Connect to read and count the AXC1's output, and configure a Filter Leak Discriminator to use that data.