DEFEAT THE DUST

John Rennockl, Parker Hannifin, discusses upgrade and improvement options for dust collectors.

Introduction

Pulse jet dust collectors have been around for over 30 years, and today, the majority of dust collectors are using the pulse jet system for filter cleaning. This cleaning technology has evolved and improved since its beginnings so that newer dust collectors typically have more efficient and sophisticated cleaning systems than previous generations.

When older dust collectors – especially collectors that vent process equipment are pushed to their limits or beyond – the cleaning systems often struggle to keep up with the demands. The result is bottlenecks, process upsets, and maintenance headaches. What is the solution?

The solution could be a simple adjustment to the cleaning controller or a replacement of the entire dust collector, depending mostly on one or more of the following factors:

- Cause of collector problem.
- Budget.
- Time constraints.
- Space and layout constraints.
- Environmental regulations.
- Existing equipment condition.
- Required and anticipated future capacity.

The first step towards a viable solution is to conduct a complete analysis of the dust collector and vented system. On larger ventilation systems, Parker Hannifin typically performs a STEP audit, whereas on a small collector, a findings and recommendations report might suffice. These technical reports seek the cause of the problem and determine if other issues are impacting the collector.

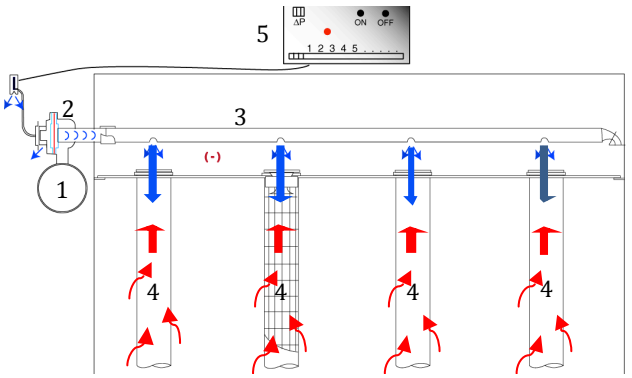

Figure 1. Airflows during pulse jet cleaning.

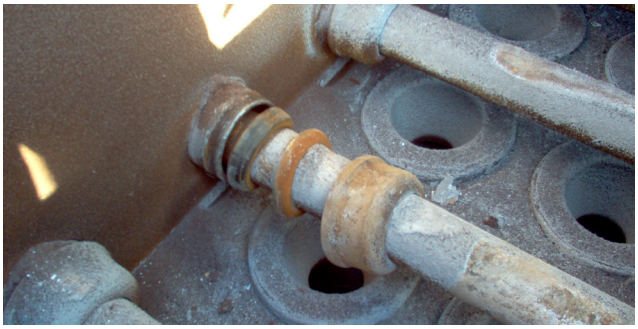

Figure 2. Undersized original blow pipes to be removed and pipe nipples will be cut out.

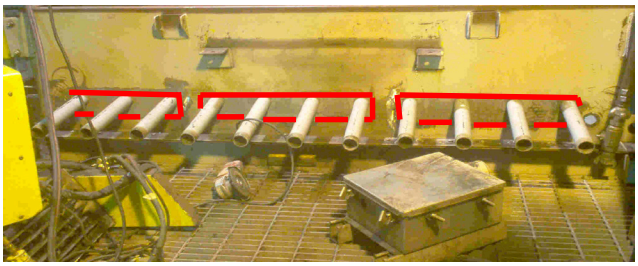

Figure 3. New pipe nipple sections welded into place.

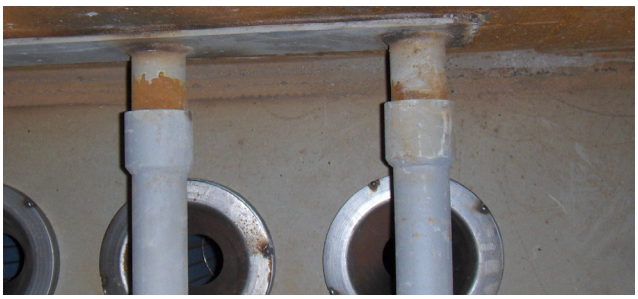

Figure 4. New nipple plate and new style blowpipes.

Figure 5. Pin with safety snap securing the end of new blow pipe.

If the report concludes that the cleaning system is inefficient and the problem is resolved by upgrading the collector with more powerful pulse valves, larger blowpipes, and a new cleaning controller, a relatively quick payback on the investment can be realised.

Determining efficiency

Figure 1 shows a typical pulse jet cleaning system. Most dust collectors clean the filer bags online. This means that at the same time that a row of filter bags is cleaned with a shot of compressed air, filtered process gases are flowing contrary to the compressed air and into the clean air plenum through the top of the filter bags. In a typical dust collector, filter bags are cleaned in the following manner:

- Compressed air from the header (Figure 1.1) is released through a pulse valve into a blowpipe (Figure 2).
- The blowpipe (Figure 1.3) is centered over a row of filter bags (Figure 1.4) and contains a small hole above each bag.
- Compressed air exits through the holes in the blowpipe (blue arrows) and shoots into the filter bags below the blowpipe.
- The air burst injected into the filter bag shakes the bag and blows some of the dust off the outside of the filter bag. The operation of the pulse valves is controlled by the cleaning controller (Figure 1.5).

To achieve satisfactory bag cleaning, the gas velocity of the compressed air (blue arrows) travelling from the blow pipes down into the filter bags, has to be substantially greater than the speed of the filtered gases (straight red arrows) exiting the filter bags.

The velocity of the filtered gases increases when gas volume through a dust collector increases. Since the filtered gases exiting the filter bags oppose the compressed air shot during bag cleaning, any increase in gas volume slows the burst of compressed air into the filter bag.

If the increase is such that the velocity of the filtered gases (straight red arrows) equals the velocity of the compressed air shot into the filter bags (blue arrows), little cleaning takes place and cleaning efficiency is basically zero. In this case, cleaning energy needs to be increased. A change in filtered dust characteristics, such as stickier dust, might also require increased cleaning energy.

Sometimes the header pressure can be increased so that the pulse valves deliver more compressed air to the filter bags. However, if the pulse valves are already operating at its pressure limit, the only alternatives are either to reduce airflow through the dust collector or to upgrade the cleaning system with pulse valves that deliver more compressed air volume. Many process dust collectors with ¾ in. pulse valves are good candidates for an upgrade. Upgrading a ¾ in. single diaphragm pulse valve to a 1 ½ in. double diaphragm valve triples the cleaning energy and efficiency.

Assuming that the analysis finds the air-to-cloth ratio, can velocity, and other design criteria acceptable, upgrading the cleaning system is relatively simple.

Figure 6. New header and pulse valves.

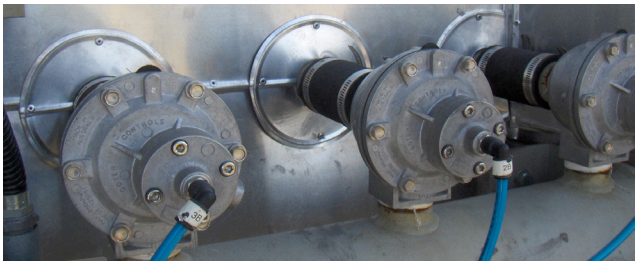

Figure 7. New pulse valves connected with flex couplings to pipe nipples.

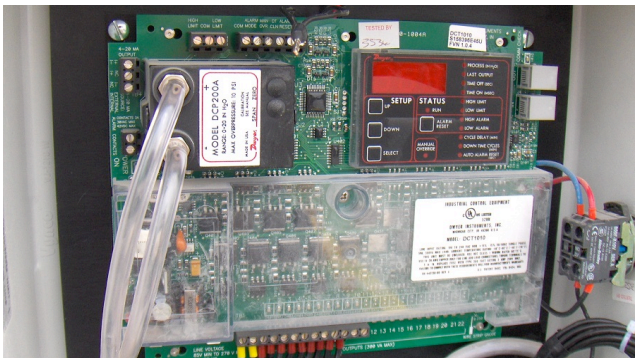

Figure 8. New controller for pulse valves.

Figure 9. New controller enclosures and header and valve assemblies.

The upgrade

The upgrade includes the following steps:

- Removing the undersized pulse valves, blowpipes, and compressed air header(s).
- Removing part of the wall sections that contain the pipe nipples connecting the pulse valves to the blowpipes. Figure 2 shows the pipe nipples with a typical, older-style threaded blow pipe connection. In a short time the threads become corroded or dirty and removing or installing the blowpipes becomes difficult. This problem is eliminated with the new quick-release blowpipes that do not require tools for removal or installation.
- Alignment and installation of new nipple plates and blowpipe support brackets. Figure 3 shows the new nipple plates (outlined red) installed in the openings where the old nipple plates had been cut out.
- Installation of quick-release blowpipes.
- Figure 4 shows how the new blowpipes are connected to the nipple plate with a slip fitting. At the opposite end, the blowpipe is secured using a pin (Figure 5).
- Installation of new compressed air header(s), pulse and solenoid valves, compressed air filter, and a pressure regulator.
- The compressed air header is typically delivered with the pulse valves already mounted. The header and pulse valves can be installed directly outside the nipple plate, as shown in Figure 7, or up to 6 ft removed (Figure 6), as required for service access.
- Installation and wiring of new cleaning controller.

Unless the dust collector already has an updated cleaning controller, it is recommended to install a new controller (Figure 8). New controllers typically come with advanced cleaning options, a built-in differential pressure gauge, and a transmitter for remote monitoring and remote control of the cleaning system. More advanced control systems incorporate broken bag detectors and software that automatically determines the row of a leaking filter bag and stops cleaning that row.

The advantages of upgrading the cleaning system compared to replacing the collector are cost and time savings. A small dust collector can be modified in two days whereas a more significant process collector might require one or two weeks. Installations are often planned during an annual shutdown.

Should the initial review of the dust collector find that more extensive modifications are required, possible cost-effective options might include: changing tube sheets, increasing the filter area, increasing the collector height, or installing pleated filter elements.

About the author

John Rennockl is a Senior Application Engineer for Parker Hannifin.