Advancing air cannon operation

Jeff Shelton, Dracyon, reviews the most common points of failure for air cannons and explains how these can be overcome.

Many air cannon OEMs manufacture solid air cannons and most firing assemblies) are well-designed. The key to a good air cannon installation is putting the customers' needs first. Current air cannons at existing plants can and should be reused whenever possible. This is the Dracyon ethos.

Those air cannons, however, often have the following issues:

- They are not protected from the harsh operating environment.
- They often do not have enough air volume (70 l is just not enough).

Figure 1. Installation errors are a leading cause of air cannon failure.

Figure 2. Air cannons should not be pointed upward. This allows easy access for material to enter air cannon and cause failure.

Figure 3. Air cannons often fail because of heat. Installations like this increase the heat and failure rate of any air cannon.

- They are not equipped with proper nozzles. The Fan Jet or Smart Nozzle are not the correct nozzles for all applications.
- They are not easily accessible for safe maintenance.

Protection from the harsh environment

If left unprotected, air cannons will fail primarily due to the harsh environment. It is worth noting that air cannon failure in many cases is not due to the duty cycle but due to the manner in which they have been installed. Figure 1 demonstrates the consequences of inadequate protection. This is the number one reason for failure.

There are multiple common installation errors which lead to the failure shown in Figure 1. This includes plants installing their air cannons facing upward, and mounting the air cannon so that it is exposed to the high temperatures of the cement production process. These are very big mistakes as material will enter the reservoir tank and erode the internals.

Another common mistake is installing the air cannons too close to the application. This is a major blunder for three reasons. Firstly, the heat from the application will cause the air cannon to fail as the reservoir tank is not capable of withstanding such temperatures. Secondly, it places maintenance personnel at risk – working in this hot environment with hot metal is dangerous and must be avoided. Thirdly, as the temperature rises, the density of the air decreases and the blast force reduces by as much as almost 20%.

Lack of volume

Sometimes bigger is better. The more cleaning energy available, the better and farther the air cannon will clean. More energy is therefore an advantage.

The greater the cleaning energy the longer the impulse time during cleaning. This not only improves the cleaning of hard-to-clean material but also extends the cleaning distance which often determines the success of an air cannon.

Power from an air cannon is a function of many items, one of which is cleaning energy. Cleaning energy comes from the air stored in the air cannon tank. For example, a 150 l tank has

more than two times greater cleaning energy than a 70 l tank at the same pressure. While some applications do exist for 70 l air cannons, most require far more cleaning energy.

Dracyon conducted an experiment to demonstrate the beneficial impact of increased volume. Two air cannons, one with a 70 l volume and one with 300 l, were tasked with moving 50 lb of sand.

As Table 1 shows, the 70 l air cannon was discharged four times and did not remove all 50 lb of sand. In comparison, the Big Blue moved all 50 lb of sand with one blast.

Volume is clearly a crucial factor for powerful air cannon cleaning. Many air cannon applications fail because they simply do not have enough power. Upgrading to a 150 l or 300 l reservoir tank is a simple way of cleaning more effectively. Pressure is also key because the higher the pressure, the greater the peak force.

Nozzles

The force generated by nozzle design is critical to a successful air cannon installation. Many air cannon producers have solid air cannon designs, but their nozzles designs must be questioned. Multiple trials (lab and field testing) have proven the difference of Dracyon nozzles over fan jet nozzles, smart nozzles, and straight pipe.

These nozzles are not only new technology but a new concept. Cleaning depth often determines the success of any air cannon, and nozzle design must enable the penetration of different applications so that cleaning is possible.

Whenever possible, Dracyon recommends the use of the existing air cannons to resolve the build-up problems in a plant. Replacing outdated nozzles with advanced nozzles is a straightforward way of improving the air cannon cleaning performance.

Access for safe maintenance

As discussed earlier, air cannons must be protected from the harsh operating environment, or they will fail. If safe, easy maintenance is not possible, air cannons cannot be adequately protected from these conditions. Clearly, these air cannons must be accessible for maintenance. It does not matter how powerful an air cannon is if it is not working.

Therefore, when installing an air cannon, maintenance must be kept in mind. Figure 6, for example, shows air cannons that are inaccessible for maintenance. When the cannons fail, they cannot be recovered.

Many air cannon OEMs will supply a Thermal Safety Shield (TSS). Some plants seem to be under the impression that this shield will protect the air cannons from the harsh environment, but that is not the case. The TSS protects the worker when maintenance on the air cannon is required. These valves are not air tight and will leak. The introduction of false air on an individual basis may be believed not to be serious, but when all the air cannons on a tower are considered, the cost of this leakage (false air) can be as high as US$500 000 on an annual basis.

Figure 4. Bigger can be better. The air stored in an air tank is cleaning energy.

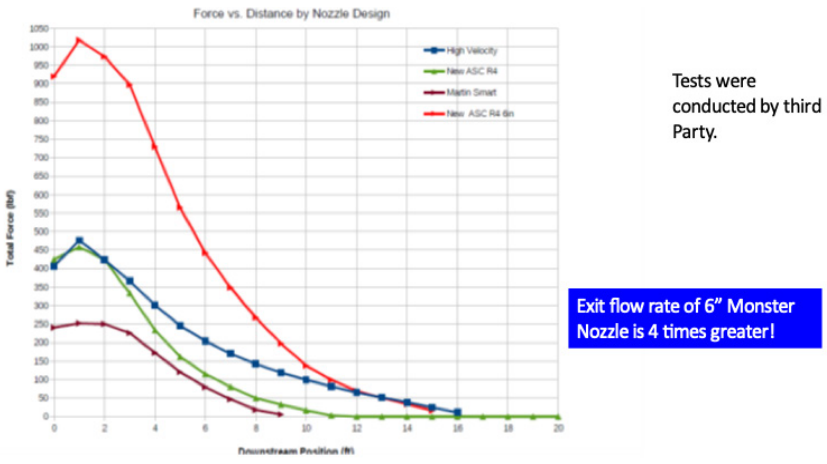

Figure 5. Advanced nozzle design comparison.

Figure 6. Air cannons that are inaccessible for maintenance fail and cannot be recovered.

Figure 7. Thermal Safety Shields leak air, allowing false air to enter the tower. Based on 100 air cannons on a tower, the cost of heating this false air is estimated to be as high as US$500 000 per year. Thermal Safety Shields do not protect the air cannon from the process. They protect the workers during maintenance. If you protect the air cannon from the process, maintenance decreases significantly.

Figure 8. Dracyon's Protector Valve (butterfly valve) can be used to combat the problem of false air.

Table 1. Results demonstrating the importance of increased volume.

	Volume (l)	Air pressure (bar)	Estimated firing pressure (bar)	Sand moved (lb)	Litres of air per pound of sand
First blast	70	7	7	13	0.185714286
Second blast	70	7	7	6	0.085714286
Big Blue	300	7	5.6	50	0.166666667
Big Blue	300	5.5	4.4	48	0.16
Big Blue	300	4	3.2	25	0.083333333

The solution to this problem is Dracyon's Protector Valve (butterfly valve), which is shown in Figure 8.

The butterfly valve is an automated valve which remains closed 99% of the time. To fire an air cannon, this valve must first be opened. It offers the following advantages:

- Better reliability. The valve protects the cannon from the harsh environment. This includes both heat and material which may enter the assembly. Cleaning efficiency is directly linked to air cannon reliability.
- Improved safety. When the TSS is closed, it protects the maintenance personnel. But opening and closing these TSS often places workers at risk. The Protector Valve, on the other hand, is automatic and is a much safer option. It also increases safety by protecting the air cannon and, thereby, reducing the need for maintenance.
- Increased efficiency. With this valve, there is no need to store air in the tank before discharge. This reduces the cost associated with leaking vast amounts of compressed air.

Conclusion

It is time for cement producers to demand more of their air cannon. For too long, small air cannons have been installed in compromised positions with outdated nozzles. When the air cannons need maintenance, they are inaccessible or unsafe for workers. Dracyon is addressing those problems by producing an air cannon with an advanced nozzle and protective valve. Dracyon will also install these air cannons with future maintenance in mind.

Air cannons are purchased to move material so that efficiency and production rates remain as high as possible. Install the right air cannon with enough cleaning energy with a nozzle designed to accommodate the material movement so that costly high pressure water washing or cardox are no longer needed. ■