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Q: What can we do to reduce wear in our pneumatic conveying system's elbows?

A: Ricky Patel, Lorenz Conveying Products, says:

Wear can be a problem in any pneumatic conveying system, especially those conveying abrasive materials, operating at high velocities, or doing both. Wear should be considered when a system is being designed, but it's often overlooked since a fitting designed for long wear may not always be the most efficient. Elbows and fittings should be selected based on the system's layout and geometries, which provide the necessary performance characteristics (desired pressure drop) while also providing the necessary wear characteristics and minimizing product degradation. These things are important to consider during the design phase because making wear-related changes to elbow geometries isn't always feasible after a system is in place.

Since layout changes aren't feasible in an existing system, any changes made to increase elbow life must work within the system's confines. The elbows are one area that can be especially problematic for wear because of the material's directional change. This means that any elbow replacement must match the original elbow's angle and its centerline radius. Luckily, there are several options that may provide longer elbow life. The easiest options to combat elbow wear are replacing it with an elbow made from a thicker material or changing the elbow to a more wear-resistant material.

The elbow replacement option will only work if there's a thicker or more resilient material available. For example, a 16-gauge aluminum elbow may be replaced with an 11-gauge stainless steel elbow for additional life. The downside here is that the change in thickness, either the outside diameter (OD) or the inside diameter (ID), will no longer match the existing pipe or tubing. This can introduce a slight flow restriction or create an area that may trap material (if the IDs don't align), or it can make joining the tubing together with couplings difficult (if ODs aren't aligned). To prevent these problems, a suitable elbow may be modified in various ways to prevent total failure from wear.

The elbow modification option for combating wear is adding material to the elbow only where the wear will occur. This can take a few different forms:

Open cavity is when the outside of a standard smooth flow elbow is boxed in with heavy gauge steel, which will provide high abrasion resistance. The elbow initially will perform as a standard elbow. As material wears through the main elbow, it will fill the open cavity and wear on itself. Eventually, the conveyed material will wear through the elbow's outside material, requiring elbow replacement. The advantage to the open cavity method is that it's a relatively low-cost option since it's based on using a standard elbow. Another option is to fabricate the elbow's outside surface to be fastened on with bolts (instead of being welded). This fabrication method allows for easier replacement once the conveyed material has worn through the elbow.

Therefore, the outside material's replacement can be completed without removing the entire elbow from the line.

Filled cavity is similar to open cavity, but the cavity created between the elbow and the outside wall is filled with concrete instead. The material must wear through the elbow first, then through the concrete, and then through the metal backing. This significantly increases the elbow's life but does so at the cost of introducing

concrete into the system. This elbow type is prone to trapping and can hold the conveyed material, which makes it unsuitable for applications where cross-contamination may be an issue.

Ceramic lining is when the inner surface of the smooth flow elbow is coated with a ceramic material, which provides a hard and smooth surface finish. This ceramic lining reduces the friction caused by what's being conveyed and, as a result, reduces wear.

Ceramic backing is when a hard ceramic is applied to the elbow's outside. When the conveyed material wears through the elbow's metal, the ceramic backing on the elbow's outside offers protection.

Flat back elbow offers a separate solution from those based on standard smooth flow elbows. This elbow has a square cross section, and it's fabricated from sheet steel with square-to-round transitions on either end. The back section and the transitions are typically fabricated from thick or abrasion-resistant steel with the back bolted to the main elbow, allowing it to be readily replaced. This is a good solution where cross-contamination may be a concern, and it won't trap and hold the conveyed material. It should be installed where the elbow is easily accessible so the backing can be easily replaced.

All these options add increased cost to a standard elbow and none will solve wear completely, but they can increase the elbow's lifespan. Wear is inevitable and parts will eventually fail due to wear no matter which option is initially installed. Therefore, wear must be managed appropriately by choosing an appropriate elbow and performing scheduled inspections or replacements in problematic areas.

When choosing an option, consider the elbow's replacement cost, including the labor, downtime, and material loss. The higher initial cost of a specialized wear-resistant elbow compared to a standard one may be offset if the items fail frequently and the replacement cost is high. However, in a case where elbows fail infrequently or the costs associated with failure are low, a standard elbow may be more cost-effective.

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