TIPS FOR CLEANING AND SANITIZING PNEUMATIC CONVEYING LINES

To remove surface buildup and contamination from conveying lines, consider the piping system and cleaning methodologies.

By Jonathan Thorn, Executive Director, Process Technology

Pneumatic conveying is an effective form of moving dry materials in the pet food industry and other food markets. However, the long lengths of conveying pipe present a challenge when it comes to addressing cleanliness and sanitation.

While the closed nature of pneumatic conveying systems protects material from outside contamination, like debris, insects, etc., it is difficult to identify and protect against internal forms of contamination, such as build-up, microbial growth, etc. A plant HACCP or sanitation plan that does not address thousands of feet of pipe and dozens of elbows is incomplete and at risk for a recall.

At-risk materials

Deciding if a particular pneumatic conveying line should be cleaned at regular intervals involves identifying what materials pass through the pipeline, the inherent risk of contamination and where the conveying line is in the process. The analysis focuses on extrusion processes.

For conveying lines upstream from the extruder, assuming that a plant is using the proper kill step, the focus is on the worst offenders. Products that contain elevated moisture, exhibit cohesive properties or are known to carry pathogens from their origin can be considered at risk materials. Because these conveying lines are upstream of the extruder, we are primarily concerned with material build-up that can form large quantities of a biological contaminant. In this case, periodic mechanical cleaning is sufficient to mitigate the problem. See the mechanical cleaning methods section for more information.

Downstream of the extruder, although the material itself can be considered safe, we are primarily concerned about recontamination. As ambient air invades processing areas, contaminants available in the environment at harmless concentrations can plant and

Keeping piping systems clean can be a complex problem.

multiply where conditions are favorable. Pipelines in these areas carrying finished foods will be more likely to be mechanically cleaned at regular intervals followed by a sanitation step. See the sanitation options section for more information.

Conveying line variations

Piping used in a pneumatic conveying system can be comprised of piping components that vary by size and type. It is common to keep the pipe size and type constant across the length of a particular run. However, "stepping", increasing the pipe size, is used to control the velocity of material in some cases. Couplings play a large role in how piping segments (straights or elbows) transition to one another.

A properly installed ledgeless coupling will create a near seamless joint, while a poorly installed compression coupling results in large gaps between the pipe ends. The former will minimize contamination of stagnant material and facilitate mechanical cleaning. The latter promotes varying quantities of inactive product that can be difficult to remove by any means short of disassembly. Most piping systems experience variations from one of these extremes to the other throughout the line. However, a new piping system can be engineered to eliminate the risk of line contamination.

Finally, diverter valves and other ancillary piping components can have similar challenges. Although the primary flow of air and material may readily flow through the component, there may be recesses or dimensional changes that keep material from cleaning out completely. Non-uniform shapes also may limit the effectiveness of mechanical cleaning methods. Any existing piping system will need to be evaluated for consistency in piping diameter, quality of pipe joints and the potential effect of valves and piping components.

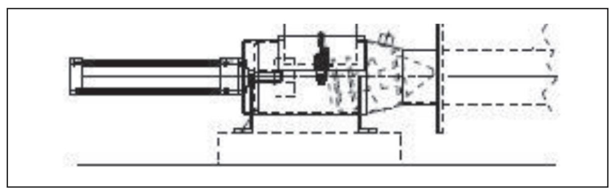
Mechanical cleaning methods

There are relatively few ways to gain access to the internal surface of a pipe to remove surface buildup and contamination, and each method has its challenges.

- Remove and manually clean – For very short conveying lines with a few manageable pieces this option is probably the most straightforward path.

- Scouring material – Running a secondary material through the conveying line, such as whole corn, salt, rice hulls, etc., to scour the inside surface of the pipe and remove contamination. Managing the quantity of scouring material required can be a challenge, unless it is used elsewhere in the process. It also is difficult to attack all surfaces because the material primarily follows the concentrated air path.

- Pigging – A surface contacting projectile is sent down the conveying line multiple times to remove surface contamination. The projectile uses a seal with the pipe surface to clean and drag it through the conveying line. If the dimensions of the flow path change (coupling gap, non-concentric diverter valve, etc.) the seal can be lost or the pig can become caught. The piping system should be engineered to properly process the pig. A launcher and retrieval system can optimize the pigging process.



Pig Launcher

Pigging projectile sample

- Spray washing/CIP – The entire pipeline is filled with a cleaning solution or a sprayer of the solution is sent through the conveying line. The primary obstacle is the addition of a liquid which must be completely removed and dried before the conveying line can be used again. Add to that the logistics of storing and creating the spray and flow and then remediation of the contaminated liquid.

- Dry ice conveying – Like the scouring material, dry ice is conveyed through the conveying line except that the extreme low temperature has a strong influence by cryogenically freezing deposits making them brittle and changing pipe dimensions through shrinkage. In terms of ice remediation, much of the dry ice sublimates and leaves with the convey gas while the remainder can be collected and disposed. The ability to interact with the entire inside pipe surface is still questionable and significant condensation issues arise with the external pipe surface from the cool metal.

Conveying dry ice through the piping can remove build up and deposits in the line

The above mechanical methods offer various advantages and obstacles depending on the attributes and condition of a conveying line. Fairly low-tech, pigging generally offers the greatest value, if the piping system can effectively pass the projectile. A new piping system would be engineered to effectively pass the projectile and include features to easily launch or retrieve the units. The simplicity of pigging offers additional advantages compared to storing and disposing of intermediate material, such as scouring or dry ice or addressing the liquid contamination.

Sanitation options

In critical processes, for example, finished product handling a simple mechanical cleaning may not be sufficient to guarantee the removal of all biological contaminants. A sanitation step may be required to create the needed production break required by a comprehensive HACCP plan. An important aspect of the sanitation step is validating that the process being used kills the biological contaminants when operated under the correct conditions. Sanitation options for conveying lines are relatively limited. Below are some current offerings:

- Antiseptic foam – A foaming agent is pumped down the conveying line. Validation would involve the number of injection points and pumping speed to guarantee surface coverage and the needed residence time. Foam residual removal is a concern so as not to affect the next batch of material.

- Heat – Elevating the temperature of the pipe surface to unsustainable levels is another way to kill contaminants. This can be done with heat tracing or by pumping hot air through the system. In either case, this method will struggle with heat loss to the environment and heat gradients, or hotter and cooler areas of the pipe. Validation involves a heating process for a particular pipe run in a particular environment that will sufficiently heat the entire pipe and selection of a temperature/duration to guarantee a kill.

- Gaseous – Adding an antiseptic gas, such as ozone or chlorine dioxide to a carrying air stream. The high concentration gas is mixed to desired levels, pumped through the pipeline and then captured and remediated at the end. Validation involves demonstrating that the gas concentration is distributed throughout the pipe and identifying concentration/duration of exposures that guarantees a kill.

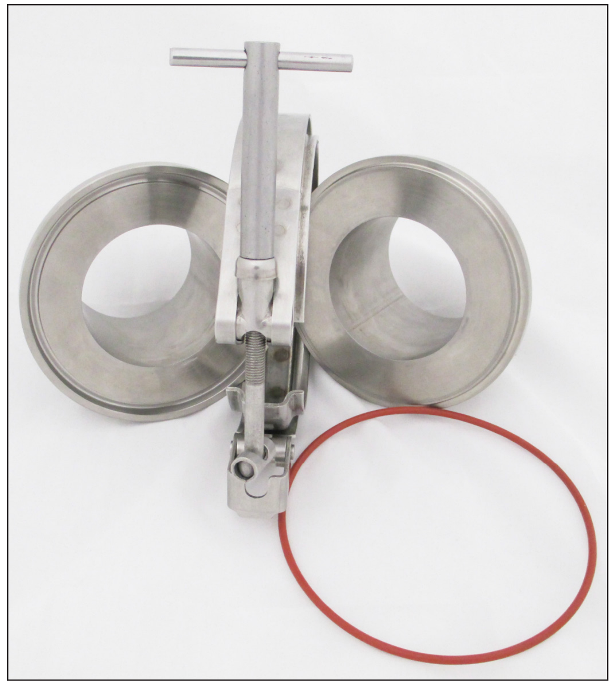
Of the sanitation methods, gaseous appears to be the most advantageous selection because of the ability to

Piping used to pump ozone through lines

System for generating Ozone into the convey line

easily inject, reach all internal surfaces and be removed from the piping system via an air flush. Ozone (O3) offers some unique advantages over other gas mediums, because it can be generated from atmospheric oxygen and returned to the atmosphere.

Although ozone could be emitted outdoors to naturally break back down into oxygen over time, a highly concentrated stream can be broken down with a simple catalyst



Ledgeless couplings eliminate gasket contact with product stream

and return room air at levels below normal ambient conditions. Significant work also has been done to validate the concentration of O3 and the required exposure time on pipelines, more so than other methodologies.

To execute an effective conveying line cleaning strategy, considerations for the characteristics of the convey piping system need to be accounted for as well as the features of the cleaning methodologies. For a best-in-class solution, an engineered piping system with ledgeless couplings or valves would be used with pigging and ozone for cleaning and sanitizing. ■

About the Author

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