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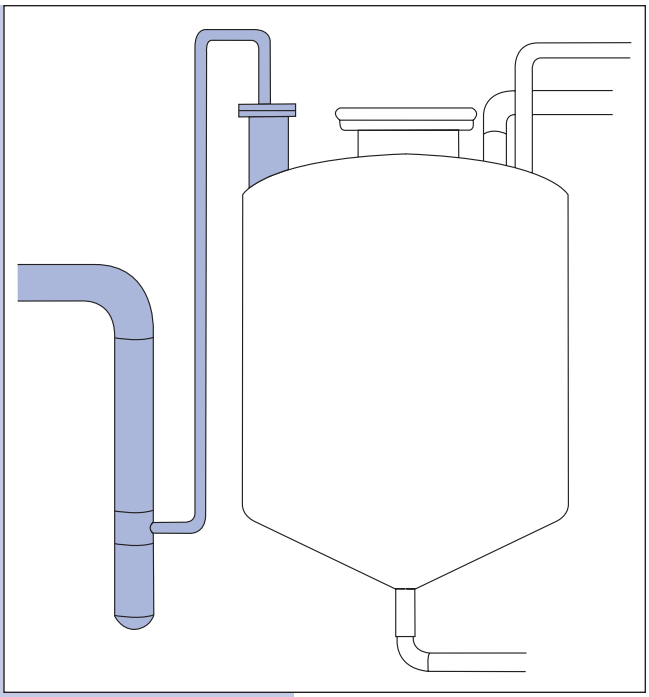
Chemical Industry Application Notes

Engineering to help you optimize nozzle applications

Piping for tank washing: Hints from the experts



This tank washing piping (shaded blue) will give no end of headaches with mixed pipe sizes, sections that won't drain, a dead leg and a long spud. These should be cleaned up for better operation.

At some point, manual tank washing gets to be a chore. Even when you're using an effective nozzle just for the purpose (such as a Lechler ACCUClean or Whirling Nozzle) the process of opening the cover, making the hose connection and climbing up the ladder can get old.

The real advantage for tank washing is the ability to leave the nozzle mounted in place so the whole process can be done with the turn of a valve. Systems that use this technology are called CIP for "clean in place" and use combinations of tank washing nozzles, cleaning solution storage tanks, cleaning solution injectors and controls to automate the process completely. The dairy industry developed the approach given their need for very thorough and consistent sanitation of all their process equipment. Pharmaceutical manufacturers soon followed for the same reasons.

While you may not need to build a complete CIP system, there are some tips you can learn from these designers that will make your job easier for simple permanent installations:

- **Size the tank washer properly.** For most cleaning, the rule is 0.2 to 0.5 gallons per minute per square foot of interior surface.
- **Avoid interior shadows.** Make sure you have enough tank washers positioned throughout the interior that will clean around internal obstructions such as mixing vanes.
- **Avoid piping dead legs.** This is good advice at any time, but especially with cleaning systems. Otherwise product can be contaminated with cleaning solutions.
- **Keep tank spuds short.** Long spuds are no better than dead legs and are difficult to clean.
- **Make sure gravity will drain everything.** Once the cleaning sequence is finished, the whole system should drain easily on its own. That means properly pitched piping.

- **Watch out for pipe T's.** T's that point down can accumulate sediment. T's that point up can trap gas. It's best to point them horizontally.
- **Keep the solution moving.** Cleaning solutions should move through pipes quickly, 4 to 5 feet per second, to ensure that nothing can settle out and air cannot be trapped.
- **Keep the solution clean.** Your tank washing nozzle should not be the "system strainer." With its orifices, it can trap any debris in the line which will hurt its effectiveness. Make sure you have a more effective way to do that.

These suggestions are just the beginning, but they should give you some ideas. Automated cleaning set-ups are not difficult to configure, don't have to cost a lot of money and can save a huge amount of time and effort.

Lather, rinse, repeat: Tank washing sequence

While it's more complex than washing your hair, a thorough tank cleaning sequence is not difficult to configure following these basic steps:

Pre-Rinse—Begin with low grade or "used" water to rinse the interior, washing out the heaviest soil.

Alkali Wash—Use a mild solution such as 1% sodium hydroxide or TSP. This will remove most types of deposits.

Second Rinse—Follow with cleaner water to rinse out the alkali. This water can be used next time for the pre-rinse.

Acid Wash—A mild acid wash will neutralize any alkalinity and remove mineral deposits.

Final Rinse—Use your cleanest water as the final step.

This approach is not suitable for every application, but should be a good start. It conserves water by using each batch three times.

Scrubbers: Maintaining effectiveness and operating life

Anywhere a gas stream needs to be cleaned, there's a good chance that you'll find a scrubber doing the work. Scrubbers do all sorts of jobs:

- Capture gaseous pollutants
- Remove particulates
- Cool gasses
- React liquids and gasses

When scrubbers are new and designed for their specific purpose, they can be sized accurately and will perform well in their application. However, in most plants, after a while, few things are doing exactly what they were designed for. Processes change. Throughput goes up and down. Soon the scrubber is working differently than it was originally, which often means not as well.

Analyzing scrubber problems has to start with an understanding of what is going on inside. A scrubber simply provides an interface where liquid and gas can interact. That means the liquid has to be broken up into droplets to increase the amount of surface area available. Heat transfer, particulate capture and chemical reaction rates are all a function of surface area. Liquid surface area is a function of the number and size of the droplets.

Our first issue discussed droplet formation and size in more detail. (If you didn't receive a copy, please ask us for one.) This is a key aspect of scrubber analysis. However, in general, here are a few common problems with possible solutions:

My reaction is incomplete with unreacted feedstocks. For the sake of analysis, a pollutant can be considered a feedstock, along with the reagent that you are injecting to neutralize it. Assuming your stoichiometry is correct (You might check that first. The liquid to gas ratio has to be correct to start.) the three main things you should check are—

1. **Available surface area.** The first thing to check is the nozzle configuration. If you are generating droplets that are too large, there will not be enough surface area for a complete reaction. You might need to choose a nozzle that will generate smaller droplets. We can certainly help you with that selection.
2. **Residence time is too short.** If the gas velocity through the scrubber is too high, there simply may not be enough time for the reaction to take place. You may be able to compensate for that with more surface area (smaller droplets) but it could be that the vessel has just become too small for the throughput.
3. **Poor gas or liquid distribution.** Never assume that either gas or liquid are distributed evenly enough for them to interface completely. Poor duct design and nozzle placement can keep the gas and liquid effectively separated even though the vessel size is adequate.

Unfortunately, these usually all exist to some extent in a given scrubber. The key is to try and figure out which has the most influence. We can help you with that.

Too much liquid is carried into or through my mist eliminator. This is a case of too much of a good thing. We'll assume first that you don't want to replace your ME. So, your droplets are too small for the gas velocity. You need to change one or the other, or maybe both. If your scrubber is performing adequately in its primary function, you may be able to back off on the degree of atomization. This can probably be done without changing all the nozzles and is easier than changing the gas velocity. However, if the scrubber is not performing well in other respects, you are probably trying to fix the wrong problem first.

My nozzles clog. Assuming you are filtering your liquid as much as practical (or if you are using a slurry the particles are uniform and well mixed) the first place to look are the nozzles and piping. Nozzles all depend on some sort of choke point to regulate the flow. Some designs, especially older ones, are particularly clog prone because the choke point is smaller than it really needs to be. Many designs are now available that offer less restricted flow paths which stay open longer. We can help you evaluate your present nozzles and suggest other possibilities. Piping can also be an issue. If there are areas where liquid velocities are low, sediment can accumulate into a mass. If this breaks free, it can form a chunk much larger than would be possible otherwise.

My nozzles wear out too fast. Some scrubbing reagents can be abrasive and the environment can be corrosive. These work together to shorten the life of nozzles and piping. We've also seen cases where the nozzles and piping are worn from the outside because of poor placement. If an abrasive spray is directed against nearby piping or the vessel wall, it can cause serious problems. Nozzle material choice for this application is a careful balance of abrasion resistance, corrosion resistance and cost. We can help you examine your particular requirement and see which factors are the most critical.

These suggestions are only the beginning. As you can see, there are many variables that need to be balanced carefully to achieve the desired result. One or two that are not optimized can cause a serious decline in your scrubbing effectiveness and increase operating costs. If you want to examine this in greater detail, we have two articles we can send with more information on scrubbers and liquid/gas reactions.

Breakthrough in mist eliminator cleaning

Washing mist eliminator panels is one application that nobody seems to like. Without effective cleaning, scrubbers can clog, ducts can corrode and the whole operation can grind to a halt. Nozzles for this application can be a problem. They frequently clog, have to be made from expensive materials for corrosion resistance and are difficult to mount in tight spaces. Lechler has solved all that with our vaneless full cone nozzles in PVDF (Kynar®). This nozzle is perfect for ME washing because:

- PVDF material provides excellent corrosion resistance and high temperature limits.
- Vaneless design is very clog resistant for operation with poor quality water.
- Tangential inlet allows mounting with tight head space.
- Injection molded construction is inexpensive with uniform performance.
- True full cone distribution gives full cleaning even with wide spray angles.

One by one, scrubber operators are discovering the advantages of this configuration and making the change. Ask for more information on available sizes.

Injection molded PVDF is perfect for nozzles, combining long operating life with low cost.

Kynar® is a registered trademark of Elf-Atochem.

Do you want future issues of this newsletter?

You probably don't think about nozzles every day. Unless you work for a company like ours, there are other things on your mind. But, when the topic comes up, you need to know where to turn for help. These papers will contain technical information, application tips and ideas for nozzle applications specifically for the chemical and pharmaceutical industries.

If you want future issues (four each year) and our most current catalog information, fax this page back to us with the YES box checked. If there is someone else who might like it, send his or her name too. Make sure we can read your address label.

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