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Used Equipment Suits Chemical Processing Applications

Large inventory includes machinery and equipment for all stages of production

FEDERAL EQUIPMENT Company buys and sells machinery for chemical manufacturing and processing. The company's inventory includes equipment for raw material unloading, through processing equipment, to finished product loading and packaging.

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Chemical manufacturing (commodity or specialty-batch chemical production) generally requires equipment for heat transfer (heat exchangers, dryers, evaporators, humidity and temperature control units); distillation (columns, towers, stills, and reactors); mass separation (centrifuges and filters); and mixing (mixers, blenders, fluid beds).



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Food-Grade Hoses Handle High-Static Applications

Hose design helps dissipate static charges to ground

KURIYAMA OF America's new line of Tigerflex Voltbuster food-grade material-handling hoses have been designed for high-static applications such as the transfer of powders, pellets and other granular materials.

The hose's design helps dissipate static charges to ground, helping prevent static build-up and reducing the potential for dangerous electrostatic discharges. They have been constructed with static dissipative plastic materials, allowing for the free flow of static to the hose's embedded grounding wire. The light-weight design of the hoses can help reduce injuries related to heavier metal hoses.

The "Volt Series" hose-tube construction includes abrasion-resistant food-grade polyurethane to ensure the purity of transferred materials. In addition, the grounding wire has been encapsulated in a rigid PVC helix on the exterior of the hose, eliminating the risk of contaminating the transferred materials. The VLT-SD Series is constructed the same, but has an FDA polyester fabric reinforcement to handle both suction and higher pressure discharge applications. New 2- and 8-in. ID sizes have been recently added to this product line.



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Prevent Problems with Fine Particles

Sampling is crucial and demands particular care

By Tom Blackwood, Contributing Editor

ONE OF the biggest problems encountered in solids processing is sampling particulate solids containing fine particles. Individual particles may differ in chemical composition as well as in physical size and shape. While many vendors offer equipment to address these issues, somehow designers of a process often ignore or forget about this aspect of process control.

There are legitimate reasons to minimize sample ports: contamination concerns and, maybe, cost. Sometimes, no sample is needed because of downstream processing. However, when sampling is necessary, obtaining a representative sample can be a problem for materials with wide particle-size distributions. The quantity required for a representative sample may become unreasonable. In addition, after taking a sample, subsequent handling and processing can compromise the sample integrity.

THIEF SAMPLER TROUBLE

One of the most-common ways to sample is via a thief sampler. The use of this device generally is required because sampling methods weren't built into the process design.

Unfortunately, it also is the most-abused sampling method, especially when materials contain fine particles. In such cases, it frequently gives the wrong results. For instance, we used to go to great lengths to maintain the correct particle-size distribution during manufacture. Nevertheless, a customer using a thief sampler on material in a newly arrived bulk delivery truck rejected the shipment.

Part of the problem was the way we loaded the truck from a silo. The other was having short delivery distances. At the end of a loading cycle, the chute was shaken to dislodge the final solids. Unfortunately, this freed a large fraction of fine particles that then dropped onto the top of the solids in the truck; so grab samples taken by the customer contained an excess of fine particles. Even though our silo was designed for mass flow, some of the fines collected on the chute due to electrostatic and cohesive forces. By placing a very small high-speed blender between the silo and truck nozzles, we could minimize the accumulation of fines — so that, even using a thief sampler, the customer got consistent results. It's interesting to note that trucks traveling longer distances never had this problem due to the sifting that took place during transport. We should have anticipated that the shorter distance would exacerbate the problem.

BLENDER BLUNDER

Feeding a process with multiple ingredients that widely differ in particle-size distribution presents a similar set of problems. How do you blend 1/8-in. particles with 100- μ ones — or should you even try? Unless you plan to coat the large particles, don't try!

An extrusion process in which seven chemicals were used to produce a pellet product exemplifies the problems that can arise. Loss-in-weight feeders provided the components to the extruder in the correct ratio. The process also included a blender — because during process development one had been used to mix the feed to the extruder in batch mode. The design team kept this blender in the flowsheet partly to provide a sampling point. In all of the batch studies, the blender effectively fluidized the mixture and emptied completely. The designers thought, "a blender is a blender," and chose a different type for the continuous process. Unfortunately, fines accumulated along the shell of the blender and occasionally would slough off, upsetting the composition out of the extruder. Removing the blender restored a consistent extruder product. Sometimes, simpler is better — and, yes, there are significant differences in blender design.

These examples show how complex the handling of fine solids can be, especially if you don't follow the particles' path and behavior.

- In the first case, the supplier of the product should have considered the short transport distance along with the tendency of the product to have a trailing dust cloud. Many integrating samplers that could have provided a composite sample to be sent with the truck are available; using one would have eliminated the need for a thief sample at the customer.
- The second case shows one of the hazards of converting a process from batch to continuous, and demonstrates that you have to trust your process design (i.e., the loss-in-weight feeders) to provide the correct mix.

Always remember that fine particles have a tendency not to follow the path of the other particles and to be more susceptible to segregation. ●



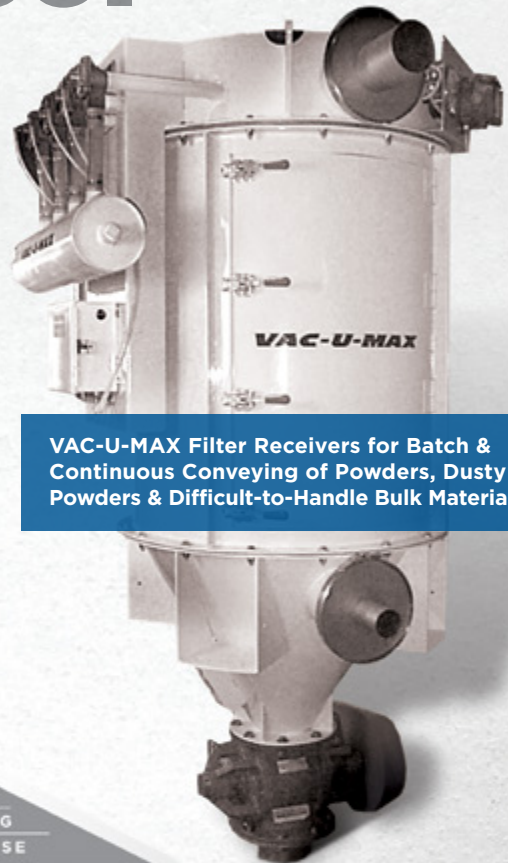
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Don't Err About Fluidization

Consider its under-appreciated advantages and broader utility

By Tom Blackwood, Contributing Editor

ANYONE WHO knows me will say: “He’s crazy about fluidization.” That’s the absolute truth. The heat transfer is greater, the mixing can be better if you’re careful, and fluidization often provides the lowest cost option for processing. One of our plant’s operators observed that the only thing his product didn’t stick to was air, so he became a fan of fluidized beds. Not all products are well-suited for this type of operation, though. Attrition and segregation of the product may pose concerns. However, you can design around these limitations or even turn them to your advantage. Here are some examples:

- A granular product having some fine particles was being loaded into drums, which was an easily contained operation. However, when the lid was removed, the excess fines created a dust and handling problem. Fluidizing the product as it was loaded enabled stripping off the fine particles, eliminating the problem.
- Coal fed to a calciner produced an emission of fine particles that would be very expensive to collect at 2,000°F. Rather than install emission controls, the site added a fluidized bed that removed the coal fines before the calciner. This worked well because larger coal particles have less inorganic chemicals than the fines.
- Fine crystals that form in solution often are more reactive than grown crystals that are ground down to the desired size — and thus frequently command a much higher price. So, eliminating the grinding operation, using a fluidized bed and segregating the finer particles during the drying process can boost profits.

Attrition often is cited as a reason not to use a fluid bed. However, particle-particle impact is much more damaging than impact between a particle and a gas or even a particle and a wall. In one study of a cyclone, we found most attrition occurred when the cyclone was removed and the solids discharged directly into the bin. One of the major concerns of designers of fluid beds is maintaining adequate fluidization of the bed; so they use too high a velocity, which can impact attrition. To compensate, they don’t provide enough pressure drop at the fluidization grid to prevent larger solids from settling

on the grid, which in a dryer can cause fires or burn the product. Note I said pressure drop, not velocity. High pressure drop ensures uniform distribution of the gas, whereas high velocity may increase particle-particle impact and attrition.

Pneumatic conveying systems, including so-called dense-phase ones, count on fluidization to transport particulate solids. Clearly, dilute-phase systems rely on fluidization — most of their operational problems stem from not maintaining fluidization all along the line. In these systems, we not only are fluidizing the particles but also are accelerating them to some velocity below the gas velocity. Gas velocity is increased at the feed point to help in this process but the effort is wasted if the travel distance before an elbow or diverter isn’t sufficient. Also, we know that putting two elbows close together is a well-known recipe for defluidization, which increases the solids/air ratio and pressure drop. In dense-phase systems, fluidization is less obvious with the typical dune or even plug flow. Some particulate solids need some sort of gas bypass to refluidize and maintain motion down the pipe.

Have you ever tried to coat a large particle with a fine powder? Mechanical devices frequently fail because of the clumping of the fine powder or lack of uniform coverage on the larger particles. The fluid bed coater often is a better option. It exposes the full surface of the larger particle to the gas that contains the fine particle. Any excess fines can be scrubbed off in the bed and returned for coating.

One of the more important aspects of fluidization is heat transfer. Not only is more surface area available but also convection is more effective than conduction. In addition, fouling of heat transfer surfaces is less of an issue, even when in-bed heat transfer surfaces are involved. By the way, in-bed heat transfer is an often-overlooked technology for high-solvent particulate. It allows use of much lower inlet gas temperatures, which can be especially valuable with heat-sensitive products. So the next time you want to move, dry or dedust a product, get a fluidizing device. ●



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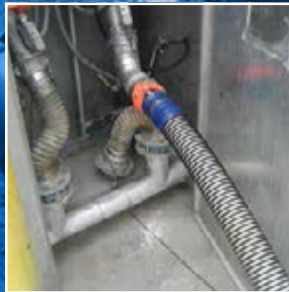
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Get the Most Out of Your Sterilization Process

Take a close look at two commonly used methods and their associated vacuum technology

By Phil Vibert, Tuthill Vacuum & Blower Systems

STERILIZATION IS defined by AAMI as “A process designed to destroy all viable forms of microbial life, including bacterial spores, to achieve an acceptable sterility assurance level.” The medical, healthcare, food and pharmaceutical (FDA recommendations) industries rely upon sterilization processing for many of their products.

Sterilization can be achieved by ex-

posing the products to a reactive agent or condition which destroys all forms of life such as high temperatures, steam, reactive gas/vapors such as ethylene oxide (EtO), hydrogen peroxide (H₂O₂), ozone (O₃), or formaldehyde (CH₂O), irradiation or gas plasma.

Each method offers certain advantages but when balancing cost, efficacy, environmental and product impact, the

two most commonly used methods are steam sterilization and ethylene oxide (EtO) sterilization.

STEAM STERILIZATION

Steam sterilization uses high temperature steam to destroy all living organisms. Steam penetrates and transfers heat to the organism much more efficiently and quickly than dry air. To be effective, the steam must contact the organism, which requires that it be able to penetrate within internal surfaces where they may be present. To efficiently do this, the atmospheric air, which might act as a barrier or cause inefficient heat transfer, must be evacuated before starting the steaming process (Figure 1). The steam efficiently conveys the heat at high temperatures to rupture and destroy cell membranes. The process depends upon the steam temperature (121-132°C), residence time to insure saturation of the material, humidity, pressure and layout of the products (importance of loading) within the autoclave.

The steam sterilization process consists of loading products within the chamber or autoclave, evacuating the atmospheric air down to a pressure of approximately 1.5–2-in. Hg A, and multiple steam cycles where the autoclave is backfilled with steam to el-

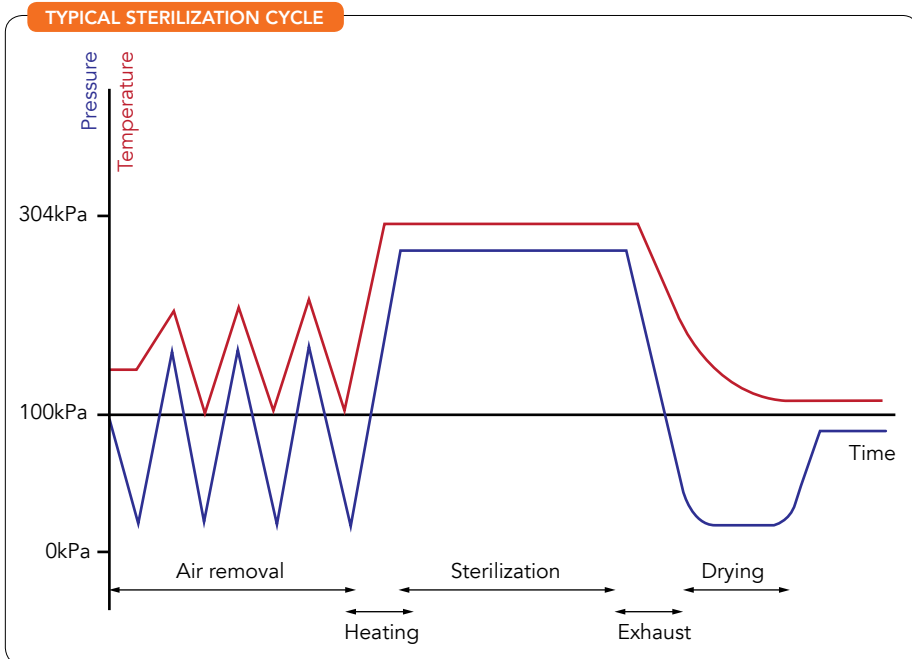


Figure 1. The effectiveness of the sterilization process relies on the repeatability of the evacuation/pressure pulsation process to remove air and ensure steam penetrates the product.

STEAM STERILIZATION/VACUUM SYSTEM



Figure 2. This water-sealed liquid ring vacuum pump is designed to meet rigorous pumpdown times for air evacuation while handling the process gases and vapor heat loads.

evated pressures and temperatures and then re-evacuated and backfilled to ensure contact and sterilization, a drying cycle to remove all steam, and then proper bleed up to atmosphere, and product removal. The effectiveness of the steriliza-

tion process relies upon the repeatability of the evacuation/pressure pulsation process to remove air and ensure steam penetrates the product. The vacuum system must be able to perform effectively and reliably pumping down the autoclave whether containing air or steam.

STEAM STERILIZATION/VACUUM SYSTEM

The typical vacuum pump used is a water-sealed liquid ring vacuum pump with or without an inlet condenser (Figure 2). Pumping packages can be designed to help meet rigorous pumpdown times for air or steam evacuation while handling the process gases and vapor heat loads. Full sealant recovery systems are used to minimize waste water, but once-through or partial-sealant recovery systems can be provided if preferred.

ETHYLENE OXIDE STERILIZATION

The ethylene oxide (EtO) sterilization process is preferred for sterilizing temperature or moisture-sensitive products (Figure 3). It uses ethylene oxide gas which is toxic, flammable and carcinogenic to chemically attack, through an

VAPOR PRESSURE VS TEMPERATURE WATER AND ETHYLENE OXIDE

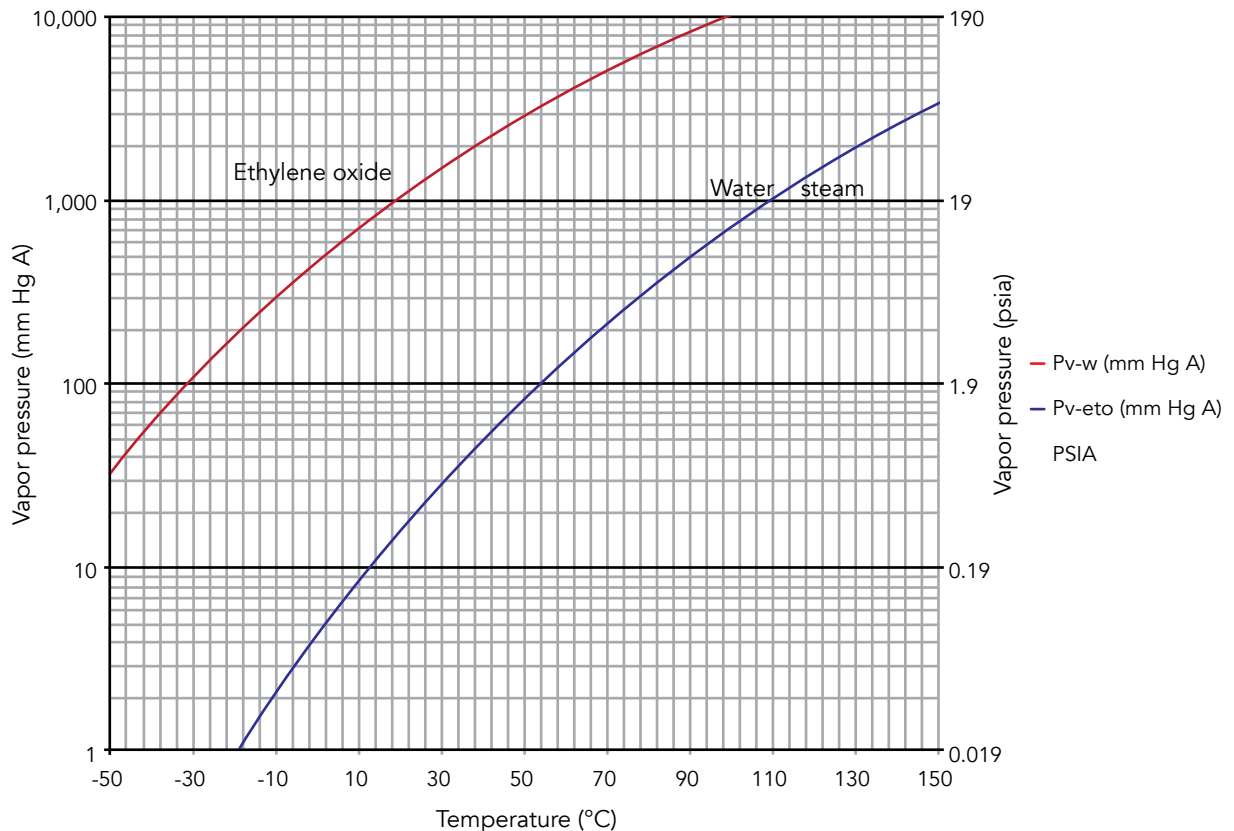


Figure 3. Ethylene oxide exhibits a substantially higher vapor pressure than water at a given temperature.



alkylation reaction, the DNA of the microorganisms. It is highly effective but requires careful handling because of its hazardous nature. EtO may be in 100% concentration or mixed with inert gas diluents such as nitrogen or CO₂. Its effectiveness depends upon the concentration, temperature, humidity and exposure time. Similar to steam sterilization, the atmospheric air must be removed to insure better penetration and contact with the organisms with the additional concern of reducing the air content below the EtO flammable limit of 3–100% in air.

The EtO sterilization process normally requires that the products be preconditioned in a controlled temperature and humidity environment whether outside or inside the chamber. The autoclave or chamber is then evacuated to approximately 1.5–2-in. Hg A. In some cases evacuation of the air is followed by inert gas (normally nitrogen) injections and re-evacuations to ensure air removal through dilution. A leak test also may be performed to check chamber leak integrity before introducing the EtO. Temperature and humidity are controlled depending upon the products being sterilized with maximum temperatures normally less than 60°C. The gaseous phase

EtO is injected into the chamber. Again, the EtO concentration and exposure time depends upon the product and ease of penetration and sterilization balanced against ease of cleanup of residual EtO. The EtO is then removed through successive evacuation and aeration processes.

ETO STERILIZATION/VACUUM SYSTEM

The typical vacuum system used is a water-sealed liquid ring vacuum pump. Because EtO is completely miscible with water, it can dissolve in the sealant water during discharge and outgas during exposure to the pump suction, reducing the net pumping capacity at lower pressures. In some cases, a booster/liquid ring may be used to enhance the low pressure pumping capacity, or a dry pump may be used, which avoids contact with a liquid.

Liquid ring, booster/liquid ring, gas ejector/liquid ring, or dry pump vacuum systems designed and manufactured to meet customer's expectations with the materials of construction can provide long and trouble-free service. ●

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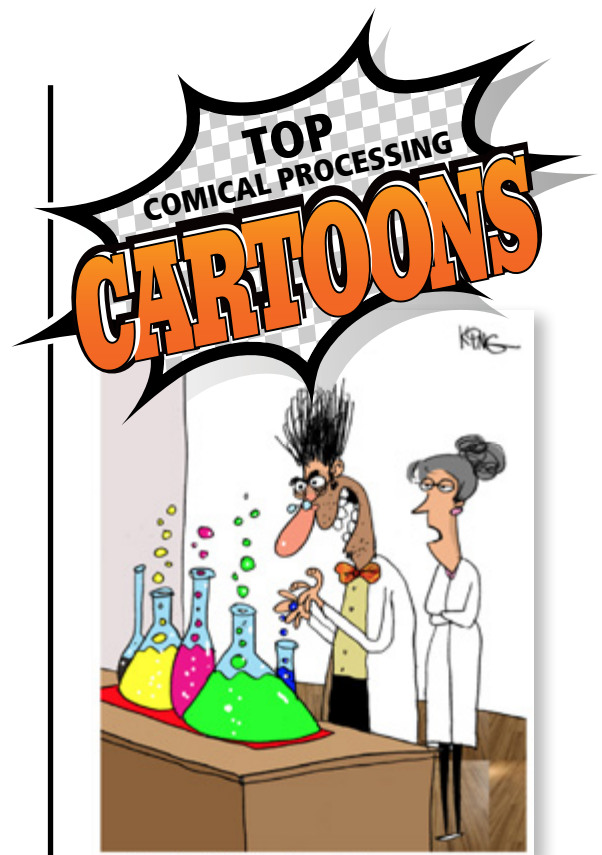
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