and the electric actuator manufacturer for guidance. Improper torque settings and/or position settings are commonplace when field personnel unfamiliar with the operation of the valve or actuator adjust these settings. This typically results in poor valve performance or valve damage.

Operation

It is normal for dust or fine powder to escape the beds, especially following new construction or the reworking of a drying tower that involved the change out of desiccant. Valves designed for this service, especially the rising stem ball valves mentioned earlier, will handle normal dust and carry over without issue.

Once a plant is past the construction and start-up phases and has been in operation for a period of time, the most common cause of damage to valve sealing surfaces is molecular sieve desiccant escaping the screens and finding their way into the valves.

If the desiccant escapes the tower, it can find its way between the valve sealing surfaces. This may result in damage to the closure members when the valve closes on this material, yielding the base material supporting the hard facing. No valve trim is designed to adequately handle this foreign material. The solution is proper installation of the molecular sieve desiccant and ceramic balls that make up the components in the drying tower and proper installation of the screens.

Figure 4 is a picture of molecular sieve desiccant that escaped the tower and was found in a gas outlet valve.

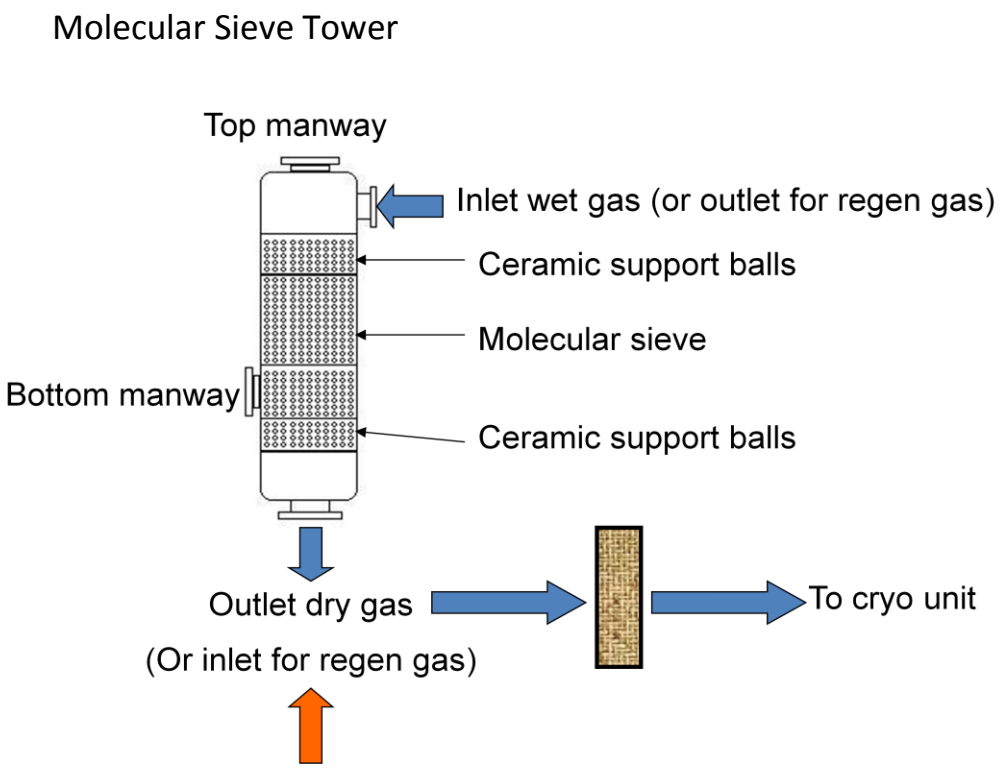
Figure 4

Figure 5 shows typical seat damage caused by molecular sieve desiccant.

Figure 5

It is common practice to use a special wire mesh screen at the bottom of each tower to trap particulate that escapes the beds. The size of these screens are designed for the size of the desiccant balls used and are quite effective in trapping material that gets past the ceramic balls in the drying tower. Problems arise when the size of the particulate and the screen size do not match. A good example of this is a system designed for desiccant supplied in 1/16" balls or pellets. As long as the pellets maintain their original size and shape all is well. But because of outside influences (liquids in the gas supply, incorrect selection of desiccant, mechanical damage caused by improper loading procedures, etc.) the desiccant can break down into smaller pieces and these pieces escape the screens and get into the outlet valves. Figure 6 is a representation of a typical molecular sieve tower.

Figure 6



Once seat damage has occurred and seat leakage begins to cause concerns in the efficiency of the unit, a common practice for well intentioned operators is to attempt to get the valves to "seal tighter." This attempt usually means increasing the closing air pressure on the instrument regulator. This results in more closing force being applied to the valve and may result in a temporary improvement in sealing. In the long run, however, this results in additional damage to valve internal components and only makes the problem worse.

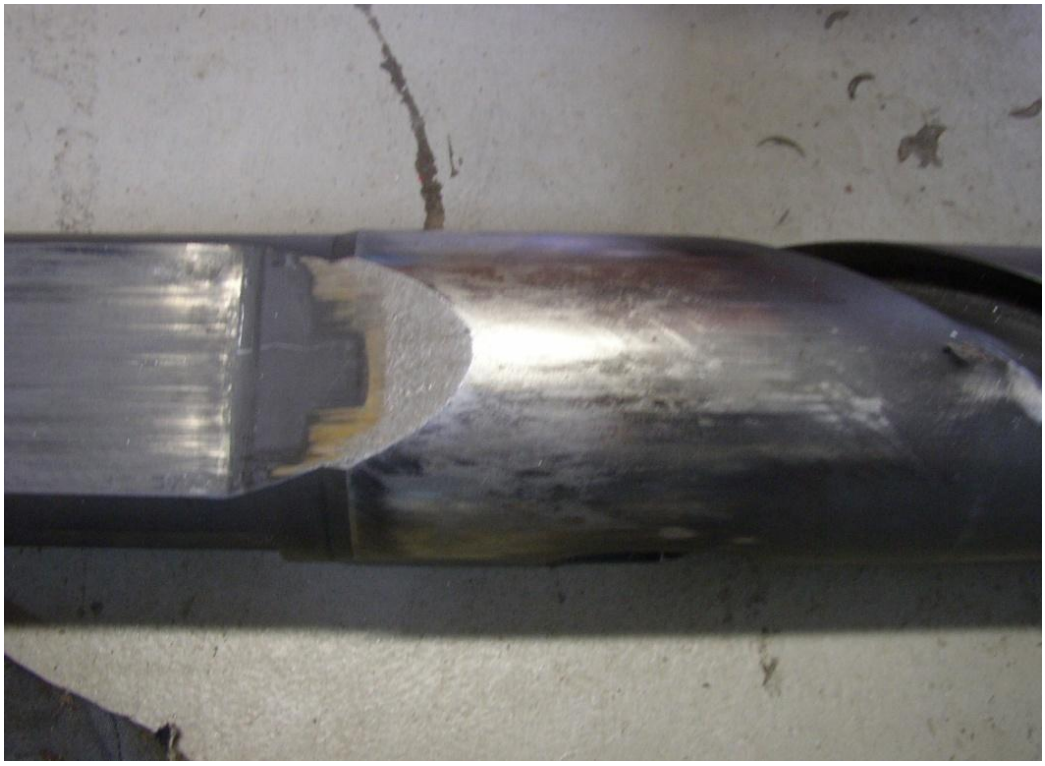
In some cases the air pressure is increased to such a high level the valve components exhibit adhesive wear and the valve can stick in the closed position. The result is an unplanned plant shutdown resulting in a loss of production. Increasing air pressure above the manufacturer's recommendations results in accelerated wear (best case) or complete failure of a key component (worst case). Simply keeping the desiccant in the tower enables the plant to avoid problems.

Figures 7-9 are pictures of typical component damage caused by excessive closing force.

Figure 7

Figure 8

Figure 9



Another common problem in the operation of switching valves is cycling the valves too fast. Most valve manufacturers recommend the minimum speed at which to operate the valve, meaning the valve should not cycle faster than the recommended operating time. Operating the valve faster than recommended causes accelerated wear on critical valve components and premature valve failure. The speed at which the valve actuator opens or closes should be controlled by the instrumentation (in pneumatic actuated valves). The most effective speed controls are adjustable valves placed in the exhaust ports of the three way or four way solenoid valves on the instrument panel. If the speed controls are placed in the supply line the actuator could "starve" for air resulting in jumping or erratic operation. Placing the speed control in the exhaust port eliminates this problem and will allow precise regulation of the valve operating speed. This simple, but often overlooked, detail can greatly extend valve operating life.

Re-pressuring and de-pressuring of the towers is dependent on many factors such as tower size, pressure, flow restrictors, etc., and most experts agree that de-pressuring of the tower should be gradual, no faster than a 50 psi change per minute.[3] Some form of flow control is necessary for the tower to gradually de-pressure and if this flow rate is not taken into consideration and the appropriate flow limiter installed at the time of plant design, high fluid velocities can occur when the de-pressuring valve opens. If this high flow rate is not taken into consideration at the design stage the de-pressuring valve is likely to be damaged. The solution is to consider the potential flow rates at the de-pressuring line and install the appropriate flow restricting devices. Changing trim materials in the valve does not solve this problem.

Turnarounds, Shutdowns, Repair, and Maintenance

Once the plant is operational and all of the construction and start-up bugs have been worked out, it is common for a dryer to operate continuously for an extended period of time, perhaps five years or more. Eventually the beds will require attention and a turnaround is scheduled. During this turnaround it makes economic sense to inspect and repair all equipment in the system so that the next run cycle can be long and trouble free.

To ensure proper operation of the unit, rebuilding of the beds must receive the same care and attention that was given at the time of construction. It is necessary to remove and replace the ceramic balls and desiccant and to inspect and replace the screens along with all of the packing. It is common for an operator to experience problems on start-up similar to those during initial plant start-up. Loading of the ceramic balls and desiccant is critical and the same care and attention to detail is critical to keep the ceramic balls and desiccant in the tower and out of the valves. While this may seem elementary, many operators are forced to re-learn these start-up lessons immediately following a turnaround.

It is a common practice, and highly recommended, to refurbish the switching valves during a turnaround. As mentioned earlier, these valves are critical to the operation of the system and have seen the same harsh operating conditions as the tower.

There are two schools of thought as to the extent of repairs performed during a turnaround. One is to inspect and replace only those components exhibiting damage or wear. This approach may make sense in cases where the service support and spare parts are easily accessible. Additional parts, if necessary, could be expedited and additional service personnel called in when needed. If this approach is chosen, care must be taken to ensure parts are available and can be acquired within the time frame. If the plant is isolated in a location where importation of parts is difficult and visas for service personnel are problematic, or the valve components are special (special material, size, pressure class, etc), this approach is less viable.

The alternate approach is to prepare to replace all components in the valve and have these parts on hand prior to shutdown. While this approach seems the most expensive alternative it may save money in the long run by avoiding costly delays. Both approaches have their merits; each operator must decide which is best for their operation.

In addition to the valves, consideration should also be given to the actuators. Whether electric or pneumatic, the actuator is the key component in the successful operation of the dryer. It is easy to focus on the repair of the tower and the valves and completely overlook the actuators. It is best to consult the actuator manufacturer for recommendations on the frequency of maintenance, or repair and recommended spare parts to keep on hand. Remember the actuator can stop the operation of your plant just as quickly as any other critical component.

It is also highly recommended that personnel chosen to conduct the repairs on valves and actuators be qualified to perform the task. Any company can claim to have the expertise to repair valves and actuators to factory specifications; few however have the factory training or necessary knowledge. Saving a few dollars here can cost many dollars later in the form of unplanned shutdowns or poor performance from the valves/actuators that were repaired. Let the buyer beware!

Proper routine or preventative maintenance is another way to extend valve life and/or eliminate that "call in the middle of the night." Valve and actuator manufacturers will have a recommended preventative maintenance schedule for their products and these schedules are based on the experience they have accumulated over the years. Following these recommendations can save much more than you pay and prove to be a valuable investment.

Conclusions

Extending the operating life on switching valves used in molecular sieve dehydration service is not rocket science; it is simply paying attention to some simple details.

1. Install the valves into a clean system.
2. Keep the molecular sieve desiccant and ceramic balls in the drying tower.
3. Maintain recommended air pressure on the actuator so the appropriate closing force is applied (and not exceeded).
4. Control the speed of operation to conform to manufacturer recommendations.
5. Ensure properly sized instrument piping is installed.
6. Follow the manufacturer's recommended preventative maintenance program.
7. Properly repair valves and actuators according to the manufacturer's recommended procedures.
8. Consult the valve and actuator manufacturer for the appropriate repair parts.

If these simple steps are followed, the life of your molecular sieve dehydration switching valve will be greatly extended and will improve performance.

[1] Ruskin, John. Common Law of Business

[2] Stellite is a trademarked name of the Deloro Stellite Company

[3] Gas Processors Suppliers Association. (2004) Engineering Data Book 12th Edition. (Volume 1 Section 1-15). Tulsa, OK. Gas Processors Suppliers Association

The Author

Mike Wood is currently the Business Development Manager focusing on the Gas Processing & LNG market for Orbit valves for Cameron International Corporation. He began his career with Orbit Valve Company in June 1974 and has held various management positions including posts in Venezuela and is credited with start-up Aftermarket operations in Point Lisas, Trinidad, Chengdu, China, and Edmonton, Alberta. He spent 15 years of his career in Orbit/Cameron's Aftermarket organization working closely with global customers in the areas of quality, design, and performance on valve-related challenges. He is highly regarded in the valve industry as a Rising Stem Ball Valve expert, particularly in the investigation and repair of valves in the oil/gas processing industry. With his combined 36+ years of valve, actuation and process experience, Mike provides a wealth of mechanical and automation solutions where customers use critical service valves in the gas processing industry.

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