Sealed bearing prevents valves from malfunction

Bearing failures are the highest root cause of failure in Triple Offset Butterfly Valves (TOV). This issue is directly attributed to the need to have metal bearings with very tight tolerances when accepting the shaft diameter. Properly designed TOVs are metal to metal torque seated type of valves. Therefore, very little shaft deflection can be tolerated in order to properly torque the seal ring into the seat. Additionally, properly designed TOVs should have the bearings located as close as possible to the center line of the disc, which helps to deliver a rigid support of the shaft when torqueing into the seat.

Dave Buse, Daniel Zwick

In clean services, such as air or water, the chances of the bearings fouling are small. However, in the world of hundreds of petrochemical, power, and other applications there are many potential problems with bearing failures. Many of these problematic situations are obvious, such as Sulphur Tail Gas and Acid Gas services within refineries and gas processing plants. Sulphur in the gas state will have a phase change to a solid in temperatures below 145 F. If the gas phase sulphur is trapped in the bearing cavities and there is a drop in the temperature, the sulphur will become a solid. This causes bearing to shaft seizure, locking the disc in one position. When this situation occurs, the end user must apply a heat gun of some sort in order to unlock the valve. This procedure is not the best practice when operating a modern process facility. Most TOV manufacturers offer a welded on steam jacket (Figure 1) in order to use the steam’s latent heat to deliver heat to the bearing area. While this is good design practice, human error has negated this benefit when plant personnel simply turn off the steam to the jacket or unhook the connections to perform some maintenance and do not reconnect the steam to the fittings. In addition, every turnaround of a processing plant can be dangerous if media is still in the bearing cavity and that cavity has not the right temperature.

Other chemical applications such as butadiene and styrene have the same issues as described above, except when these chemicals become trapped and dormant it causes a phase change and popcorn, or

Fig. 1: TRI-CON valve with Steam jacket
not taken into effect the thermal coefficients of both bearing material and the tolerances accompanied by the cross sectional thickness then the bearing could lockup during quick changing thermal conditions.

TOV manufacturers have been keenly aware of this potential problem and in the early nineties some manufacturers introduced the Bearing Protection Ring, which has now become the industry standard (Figure 2). However, this feature has proven not to be the solution. A single ring of die-form graphoil installed into a groove in the ID of the bearing without a compressive load will flatten out and become quickly useless after a small amount of cycles under pressure. Graphoil has no memory. It might keep some of the heavy debris from entering the bearing cavity but will allow the process to enter. Other manufacturers offer a dual packing set with a lantern ring sandwiched between them, in addition to a flush port with grease fitting located on the bonnet to allow for flushing of the bearings. Certain manufacturers offer O-rings at the bottom of the bearing cavity. This design would be a good solution, but in the petro-chemical market Fire-Safe designs are mandatory, and an O-ring in the bearing cavity would not be considered Fire-Safe.

The company Zwick is one of the most respected manufacturers of metal seated Triple Offset Butterfly Valves, Series TRI-CON, in the world with more than 20 years of experience. Mr Hans Zwick, owner and managing director, developed a large range in the past. The Series TRI-CON is available in sizes 2” to 72” (Figure 3) and pressure classes from PN 10 to PN 160 or ASME Class 150-900. Mr Zwick also designed the very successful derivatives of the Series TRI-CON, the metal seated check valve, TRI-CHECK, and the Double-Block and Bleed version, TRI-BLOCK.
in this time. Besides this range, company Zwick is very strong in special applications with several customized features.

An example of efforts being made to find a solution to this issue is Hans Zwick’s mechanical design [Figure 4] that insures that both the ID and OD of the bearings are protected, and would also not violate the Fire-Safe design criteria. The design incorporates three rings of die-form graphoil packing ring at the very end of the bearing ID, and then three rings of the same on the OD, both are captured by machined edges and loaded by the packing load which keeps the graphoil rings from flattening out. This patented design is called the Sealed Bearing feature.

Besides the fact that this design prevents any media from entering into the bearing cavity, the advantageous design to minimize shaft deflection of Zwick’s standard bearings can be kept in the special design. Another plus is the fact that every standard Zwick valve can be upgraded with the Sealed Bearing design.

Besides the protection of the bearing in this design, it functions as an additional seal to the packing and minimizes fugitive emissions to a minimum which makes this bearing system also very attractive for applications in ethylene oxide or propylene oxide. The patented Sealed Bearing has been proven for more than 12 years in many applications such as butadiene, styrene, sulphur, sulphur tail gas, EO, PO, high viscosity applications like thermal oil and acid gas.

Valve World Expo
Hall 3, Stand A92

THE AUTHORS

DAVE BUSE
President Zwick Valves North America, LLC
77536 Deer Park, TX, USA
Tel.: +1 281 478 4701
davebuse@zwick-valves.com

DIPL.-ING.
DANIEL ZWICK
Technical Director
Zwick GmbH
58256 Ennepetal, Germany
Tel.: +49 2333 98565
d.zwick@zwick-gmbh.de

THE COMPANY

Zwick, established in 1977, is one of the leading manufacturers of metal seated triple offset butterfly valves and has more than 20 years of experience in this field. With its headquarter in Ennepetal, Germany, Zwick company manufactures all parts except standard parts inhouse in order to guarantee the best available quality on the market. From its facilities in Houston, the North American market benefits from the impressive inventory available in the US.

The Series TRI-CON is widely used in the energy, petrochemical, chemical industry, but also in special industries like oxygen applications. Besides the Series TRI-CON, Zwick offers its check valve TRI-CHECK in many applications like pump protection. Where redundant shutoff is required, Zwick offers its Double-Block and Bleed version, TRI-BLOCK, that incorporates two sealing barriers in just one body that additionally can be operated by just one actuator.