Dry Split Seal is the Perfect Deal

VIC LUNDBERG, process engineer, Quadna, a DXP company

Chemical attack is a destructive force in any high-tech manufacturing process. For TIMET’s Las Vegas, Nev.-based plant, the force was presenting itself during the high-temperature mixing of titanium tetrachloride (TiCl4), known in the industry as TiCL.

TIMET is the world's largest supplier of high-quality titanium metal products. With its unique combination of strength, light weight, corrosion resistance, and other metallurgical properties, the company’s titanium is used in hundreds of diverse aerospace, industrial, and emerging applications where no other metal is as reliable or economical.

The company sought out Quadna, a DXP company, to advise the best way to seal the shaft entry point in its high temperature mixing tanks where the TICL was batched. The aggressive chemical has a tendency to flash off and form into a potentially noxious vapor and toxic white cloud, making worker safety an issue. In addition, when the chemical comes into contact with water, it can become hazardous.

So, how to develop a more effective way to seal each tank? Two major challenges loomed. The first was to determine how to maintain a strong, positive seal. The seal design was of paramount importance, in addition to critical metallurgy issues. Previously, the system employed a double mechanical seal with a mineral oil barrier fluid that provided lubrication between the inboard and outboard faces. The customer had planned to use a split mechanical seal because if offered a quick replacement time. However, in order to enhance the operation, a dry seal was needed. The problem? No one made a dry running seal.

The second obstacle was the length of the shaft. The mixing operation uses a long, unsupported shaft, which created excessive run out at the mechanical seal. Quadna

recommended that DuPont Vespel CR6100 be installed as the bearing sleeve material. The additional sleeve would help the long shaft run true and minimize shaft run out at the mechanical seal.

The typical clearance for a steady bearing for a shaft of this diameter is .0020 side-to-side, for a total of 0.040” clearance. The Vespel sleeve bearing that was used had been machined for a total clearance of 0.007 to 0.010”. This reduction in clearance between the bearing and shaft was so dramatic, the Vespel sleeve bearing acted as a primary seal as well as minimizing shaft run out well below acceptable levels.

The reason the clearances could be reduced to this level had to do with the coefficient of thermal expansion (CTE). Dupont Vespel 6100 thermal growth is confined to the Z direction (along the shaft) while keeping the growth in the X and the Y directions extremely low. In addition to the unique CTE properties of the material, the Vespel is chemically inert to the TiCL4 and can operate without lubrication because of the very low coefficient of friction of this material.

Quadna redesigned the mixer stuffing box for a John Crane’s Type 3740D using the Vespel sleeve bearing, one of the first dry running beta split seals install by John Crane.

Final Analysis

During the final assembly of the bearing and split seal system, the Quadna team experienced a slight dimensional issue that prevented them from installing the John Crane seal. As a result, time was short and the mixer had to be placed back into service. Both Timet and Quadna were pleased to see that the Vespel sleeve bearing alone was sealing nearly 100 percent of the vapor. Quadna and plant officials decided to leave the unit without the split seal while the minor dimensional issue was addressed. At the first opportunity, the Quadna team installed the John Crane Type 3740D dry running split seals to ensure the vapor leakage would be completely contained.

The Vespel sleeve bearing demonstrated its effectiveness to reduce run out as a temporary seal. The team made the required dimensional modifications to the system and standardized all of the parts and components.

Several vessels in the plant that were experiencing problems similar to the first vessel received a John Crane Type 3740D dry running split seal in their mixers as well as Dupont Vespel 6100 sleeve bearings, resulting in the containment of all TiCl vapor. The split seal, which was installed during a very brief outage, operated without a hitch (a double seal would have required days versus hours to install). The cost of running the enhancements to the TIMET system reduced downtime and the requirements for complex seal support systems. The fact that mineral oil barrier fluid is not required with a split seal, as it is in double mechanical seal, was a major enhancement. This saved money, specialized seal support equipment to regulate flow and pressure to the seal, and reduced the amount of time required to replace mechanical seals in the future.

For all of the tanks, the combination of the John Crane Type 3740D dry running split seal and the Dupont Vespel, along with other modifications, resulted in total success. As a result of the work completed to date, Quadna team members are incorporating all of the new modifications as standard offerings for new mixers the company is purchasing for its plant. The combination of the dry running split seal and the Dupont Vespel steady bearings, along with other modifications, was the ultimate answer.

The assessment of the mixers' needs began in late 2010 and final installation on both tanks will be completed by the end of 2011.

For more information, please visit www.quadna.com *[1].*

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[1] http://www.quadna.com