

CASE STUDY

Polymer Wear Parts in BB5 Type Pump Upgraded to Ceramic Material to Withstand Transient Service Conditions

A Hot Hydrotreater Diesel pump (HPcp – BB5) in a refinery was showing a deterioration in performance over time. It had been fitted with polymer wear parts to a) run with tighter clearances thereby improving efficiency and b) eliminate risk of metal-to-metal galling in a critical service. Without warning a failure occurred leading to an escape of process fluid to the atmosphere. Sulzer, working with the owner, conducted a Root Cause Analysis (RCA) to identify the root cause and advise remedial action.



Remains of polymer wear parts after failure

The challenge

While it was clear that a mechanical seal failure had occurred, the RCA showed that the a high pressure polymer bushing had extruded from its retainer. Evidence from mating components revealed that the bushing had been extruding for some time prior to the failure, which caused overpressurisation of the mechanical seal and loss of pumped fluid to the environment. The failure mode was confirmed as a combination of collapse of the polymer insert in operation due to the applied differential pressure loading, coupled to transient conditions which were known to occur during pump changeovers.

The RCA identified a failure mode that, on further investigation, was found to be common in a number of less critical, but similar, hot water applications. The lower criticality of those had enabled the failure mode to go unnoticed.

Due to the nature and potential consequences of this failure the customer required a fix which would ensure:

- The safety of the site by eliminating the root cause
- No leakage of process fluid to the atmosphere
- Ensure that under transient conditions the parts would not fail again
- Bringing pump back to service as quick as possible

Following the RCA, the customer needed countermeasures advised by Sulzer to prevent a recurrence.

The solution

While various design improvements were considered which could improve the integrity of a polymer insert, the engineering decision was made to eliminate the risk entirely by changing the bushing to a material that would not distort under pressure whilst continuing to minimize risk of galling between rotor and stator parts in service.

The solution that was decided upon was a combination of solid ceramic, and thermally sprayed ceramic coatings. Solid zirconia ceramic parts were chosen for the high pressure stationary bushings with SUMEPUMP™ coatings applied to wear rings and all rotating parts. Both materials which were adopted would be able to withstand transient conditions without risk of distortion or extrusion.

The Sulzer difference

Customer and supplier partnership is one of Sulzer's core values and although the use of a different type of wear parts were utilized in the upgrade of the pump rotor, the collaboration between Sulzer, the customer and a 3rd party engineering firm shed light on the root cause and thus led to design changes to eliminate these causes. The changes were advised to polymer wear parts supplier to reduce the risk of failure of the part for future projects and these design changes have been integrated to the polymer wear part design and added to the suppliers product line.



Comparison of throttle bush before and after failure with heat effected zones

Customer benefit

Although polymer wear parts are commonly used in pumps, they exhibit very low mechanical properties and mean that they have to be very carefully engineered, especially in hot applications.

Experience clearly demonstrated that polymers were not the best choice for the application, with an ever present risk of extrusion in high pressure situations under transient conditions.

The use of ceramic parts and coatings ensures that wear parts remain stable even during transients without risk of catastrophic failure.

This upgrade of wear parts has now seen the pump running smoothly with no loss of performance since its upgrade in 2014.

Product data

General values of two types of materials used:

	Super duplex S32760	Zirconia ceramic	Polymer wear parts
Tensile strength (MPa)	750	450	120
Compressive strength (MPa)	-	1,990	87
Coefficient of thermal expansion 10-6/°C	11.1	10.2	5.6

As shown in the values above the coefficient of thermal expansion for the zirconia ceramic is closer of that to the steel carrier ring whilst also having higher material properties than the polymer parts.

Prime features of the new materials used:

Zirconia ceramic has a number of uses in centrifugal pumps in severe service and is used in many refining environments due to its wear and corrosion resistance, such as

- high mechanical strength
- excellent wear and abrasion resistance
- similar coefficient of expansion to chrome steels
- very low thermal conductivity
- good thermal shock resistance

SUMEPUMP™ coatings are well proven in high duty, high speed abrasive applications due to

- high hardness
- good wear resistance
- great anti-galling properties

Contact

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Applicable markets

Oil and gas, hydrocarbon processing

Applicable products

BB5 - back to back arrangement