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High Performance Pumps

Claudia Proeger and Kenny Thomson, Sulzer Pumps, Switzerland/USA, detail the history and the development of process pump retrofit kits for the hydrocarbon processing industry, which can reduce maintenance costs and increase service lifetime.

Hydrocarbon extraction plants, refineries, petrochemical and gas plants all operate sophisticated production processes that require reliable pumping solutions.

The hydrocarbon processing industry is one of the core business segments within Sulzer Pumps, and is subdivided into synfuels, refining, gas processing and petrochemicals, each requiring specialty applications. The company has a variety of pumping solutions, and all pumps are engineered in line with the latest standards issued by API, ISO and ANSI in order to ensure reliable and safe operation.

Reducing maintenance costs

The petroleum industry uses thousands of pumps in refining and petroleum plants. The most frequently used or 'workhorse of the industry' is the single stage end suction, overhung impeller, process pump. This pump is found in a great many units (hydrocracking, amine, and desulfurisers to name but a few) in the plant and operates 24/7 in systems of varying flows (up to 15 000 gpm), heads (up to 1000 ft) and temperatures (up to 800 °F).

The end suction process pump design has evolved over the years. Significant changes occurred with the successive introductions of API 610 7th, 8th and 9th Editions. To comply with these standards various modifications were required for pumps:

- Increased shaft stiffness (L^3/D^4).
- Improved bearing lubrication and cooling.
- Larger radial and thrust bearings.
- API 682 compliant seal chamber.
- Bearing housing isolators.
- Elimination of tail brackets.

These changes have improved bearing and mechanical seal life, resulting in increased reliability and a better Mean Time Between Repair (MTBR).

Retrofit kits

In the mid 1990s, Sulzer's research into design improvements and enhancements for increased reliability, combined with more stringent industry standards, resulted in the upgrade retrofit kit (CAPR) targeted at the company's CAP end suction process pump line. This pump allowed customers to replace the 'power end' of old CAP pumps with the superior design features of the CAPR, without having to modify or change the 'wet end' (impeller and casing), resulting in no costly piping or base changes. Eventually, the CAPR capabilities were extended so that any end suction process pump (irrespective of OEM) in a facility could be changed to accommodate the improved CAPR power train design features. Often, competitor pumps are referred to as 'Brand X' type. Consequently, in the late 1990s Sulzer introduced CAPX (Figure 1), which allowed the upgrade conversion of any end suction, overhung propeller, process pump.

Proper pump operation

While the CAPR and CAPX have advanced design features and can improve end suction pump reliability it is important to recognise that retrofit kits should not be viewed as a 'fix' for all problems. Although the retrofit kits have reduced shaft deflection and incorporate larger bearings resulting in longer seal and bearing life, it is critical that the pump and the complete system is evaluated to ascertain the 'root cause' of the specific problem. Examples of operation problems, which can cause premature bearing and seal life, are discussed below.

Low and/or high flows

A centrifugal pump should be operated as close to the best efficiency point (BEP) as possible. Operation at extremely low or high flows can result in high radial and thrust loads with corresponding high vibration and should be avoided if possible.

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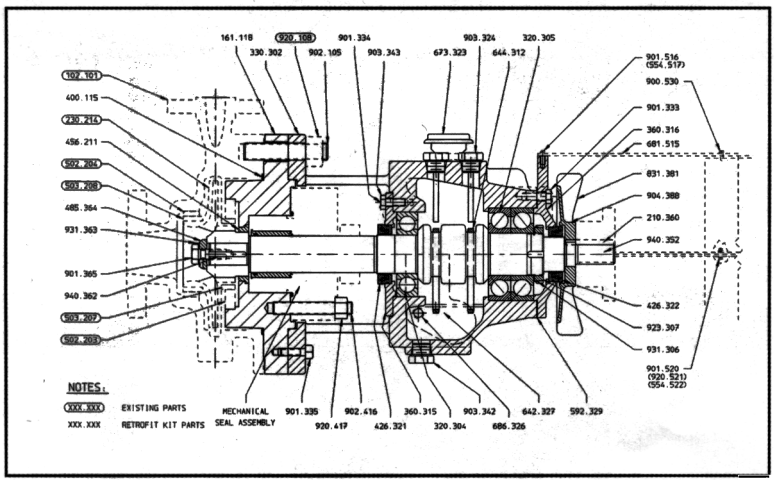

Figure 1. Cross section of Sulzer's CAPX retrofit kit.

Insufficient net positive suction head (NPSH)

Adequate NPSH is critical for good pump operation. When site available NPSH falls below pump NPSH required, cavitation will occur. This will effect pump performance, increase vibration and can cause mechanical damage to the impeller and case.

Piping strain

Excessive piping strain can impose an undesirable load on pump flanges. In some instances of badly supported pipework, the pump casing has been distorted such that the internal close running clearance components have touched, causing damage.

Summary

This should not be considered the complete list of problems that can occur and adversely effect seal and bearing life. However, they can be viewed as examples of where the 'root' cause of the problem may not be the 'old' power train of an existing pump but rather the system it is operating under. Fitting the CAPR or CAPX upgrade kit may help the situation, but it will not completely cure the overall problem. Sulzer offers assistance with the evaluation and makes suggestions for the retrofit kit as well as system improvements to rectify the problem and obtain significantly improved MTBR for the pump.

Figure 2. 'Brand X' end suction pump, as received at Sulzer's service centre.

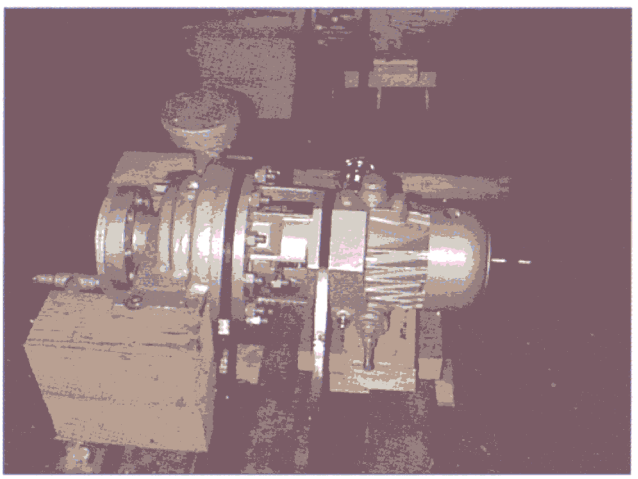

Figure 3. 'CAPX' end suction pump, as it leaves Sulzer's service centre.

Casestudy

A refinery in the USA's Pacific Northwest had been experiencing difficulties with two of its process pumps (Figure 2) for a number of years. Senior refinery maintenance personnel had termed them 'bad actors' for the following reasons:

- Bearing failures.
- Alignment problems.
- Seal failures.
- Difficult impeller adjustment.

Although neither of the process pumps was of a Sulzer design, the customer chose to work with the company to rectify the problems.

The scope of work was to:

- Upgrade the pumps to API 610 8th Edition.
- Supply new CAPX retrofits.
- Supply new baseplates, couplings and mechanical seals.
- Modify impeller/wearplate arrangement.
- Rebuild the pumps.

A limited time was available to complete this project. When working with 'Brand X' pumps it is vital to get the dimensions of the critical components. However, once these are obtained, design and manufacture of the necessary parts is swift. A quick engineering response is assured due to the company's proprietary computer program that evaluates and generates the necessary 'engineered' drawings (seal chamber, shaft, etc.) that interface with the power train components (bearing housing, etc) and customers 'wet end' components (casing, impeller). The speed of the drawing generation combined with stocking of key pre-machined components means that process pumps retrofit upgrade kits can be supplied in good time. The quick turnaround (Figure 3) and the notable performance of the CAPX process pump in operation were pleasing to the refinery maintenance personnel. All requirements were successfully met and significant improvements in reliability and MTBR have been noted in the two years of installed operation.

Support service

Through a worldwide network of over 50 service centres Sulzer provides a full range of services for pumps and other associated equipment, ranging from supplying spare parts to solutions to optimise equipment performance throughout its lifecycle. Services include eBusiness solutions, quick spare parts deliveries, field services, repairs, retrofits and long term contracts.

The Heart of Your Process

SULZER

Pumping solutions and services. This is our business. Sulzer offers you innovative pumping solutions to improve the vital processes within your specific business area. We work with you to ensure that all your pumping needs are met – and surpassed. Our global sales and service network covers over 100 locations on all 5 continents. So wherever your business is located, we are there to provide you with the knowledge and expertise of our business.

- Basic research and product development
- Application analysis and adapting the pump to fit your needs
- Manufacturing, packaging, testing
- Installation, training and optimizing pump operation
- Complete portfolio of after sales products and support services

Sulzer Pumps is a specialist in the following application areas:
oil & gas • hydrocarbon processing • power generation • pulp & paper • water & wastewater • sugar • metals • fertilizers

Sulzer Pumps, Sulzer Pumps Ltd., tel. +41 (0)52 262 3904, hpi.pumps@sulzer.com, www.sulzerpumps.com