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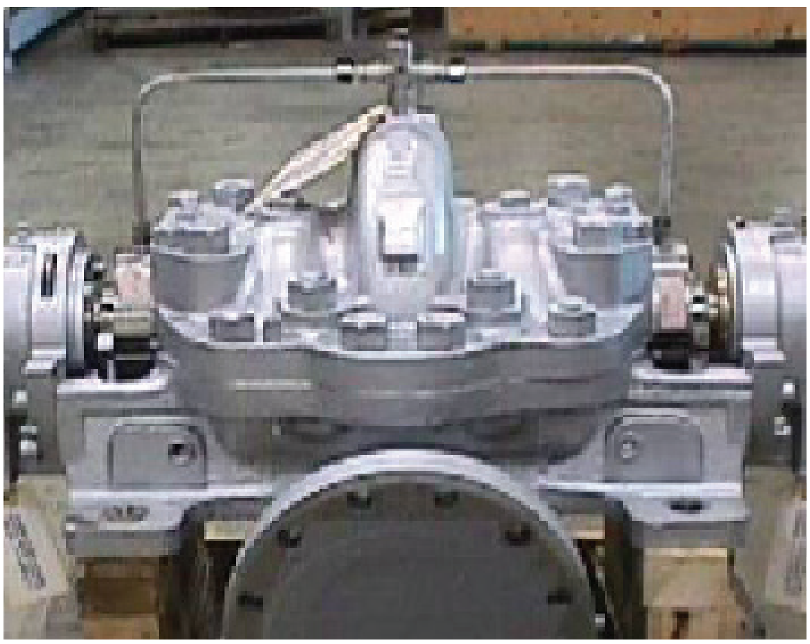
CELEROS FLOW TECHNOLOGY

CASE STUDY

PUMP DESIGN UPGRADE IMPROVES MTBR FOR PAPER MILL

- Causes of impeller and shaft damage investigated
- Operational safety margins restored
- Improved MTBR



Complete pump

CHALLENGE

A paper mill in the USA was experiencing reliability issues with a third party pump. They appointed ClydeUnion Pumps, part of Celeros Flow Technology, to investigate the cause and propose a solution.

CLYDEUNION® PUMPS

Industry: Industrial – paper mill

Region: Americas

Category: Mechanical design upgrade

API Type: BB2

ClydeUnion Pumps Aftermarket Technical Services team has experience across a range of services on critical rotating and reciprocating equipment to improve operational safety, reliability and efficiency. The mechanical upgrade of the Ingersoll-Rand 8 JVL pumps for the industrial market is one of our success stories documented in our library of case studies. These case studies highlight the requirement from the customer, how we achieved the goal and the process we followed to deliver the improvements.

Table 1 - Calculated Data

	1ST DRY NATURAL FREQUENCY, CPM	2ND DRY NATURAL FREQUENCY, CPM	SEPARATION MARGIN 1ST MARGIN	SEPARATION MARGIN 2ND MARGIN
Pump (as found)	2,988	8,638	-25 %	8 %
Pump (upgraded)	6,757	24,629	69 %	209 %

The new design was based on increasing the margin between the first natural frequency and the running speed. This was achieved by changing the shaft diameter, the distance between bearings, and the distance from the radial bearing and coupling. The throat bushing was also upgraded to graphalloy and installed with mechanical seals. With these changes, we were able the increase margins considerably (see table 2).

Table 2 - Actual Test Data

LOCATION + TEST CONDITION	NATURAL FREQUENCY(S), HZ	SEPARATION MARGIN	
Rotor dry with coupling hub + seals	107Hz, 347Hz	60 %	159 %
Rotor dry with coupling hub, but without seals	109Hz, 428Hz	63 %	219 %
Rotor dry without coupling hub or seals	120Hz, (second mode not tested)	79 %	

SOLUTION

ClydeUnion Pumps found that the pump's shaft was sheared under the impeller fit and there was a crack in the hub of the impeller at the keyway. The impeller wear rings were exhibiting 360° rubbing and some case damage had been caused by a combination of erosion and rubbing of the impeller.

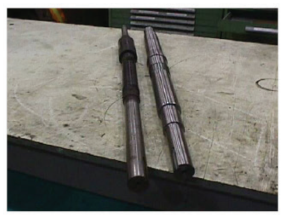
Analysis of the pump was undertaken to determine the cause of the broken shaft under the impeller. Calculations of the first and second dry natural frequencies were done on the original pump. The results showed that the pump's first and second dry natural frequencies were running quite close to the x 1 and x 2 running speed. Factoring in the effects of the worn packing and wear rings, it was clear that the pump was operating at critical speed.

The new design was based on increasing the margin between the first natural frequency and the running speed. ClydeUnion Pumps achieved this by changing the shaft diameter, the distance between bearings, and the distance from the radial bearing and coupling. The throat bushing was also upgraded to a graphite/metal alloy and installed with mechanical seals.

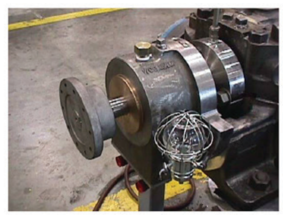
OUTCOMES

The upgrades resulted in a considerable increase in operating margins, verified by ring tests. The data shows that the upgraded pump will run smoother and with fewer mechanical problems, resulting in an extended Mean Time Between Repairs (MTBR).

Following this demonstration of our engineering and diagnostic expertise, the customer requested that ClydeUnion Pumps upgrade all three of their pumps.

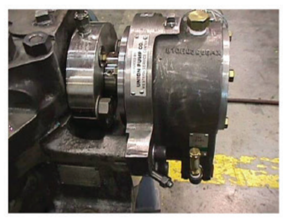


New shaft design



New bearing housings

New mechanical seals



New bearing housings

Aberdeen Service Center
P: +44 1224 756 100

Abu Dhabi Service Center
P: +971 02 4081900

Annecy Service Center
P: +49 405 220 2401

Baton Rouge Service Center
P: +1 225 778 3310

Battle Creek Service Center
P: +1 269 966 4782

Burlington Service Center
P: +1 905 315 3813

Calgary Service Center
P: +1 800 352 8294

Corpus Christi Center
P: +1 361 371 6519

Downey Service Center
P: +1 562 622 2371

Glasgow Service Center
P: +44 141 637 7141

Jenks Service Center
P: +1 281 217 6359

Odessa Service Center
P: +1 704 808 3780

Penistone Service Center
P: +44 1226 763 311

Singapore Service Center
P: +65 6513 9276

Zhengzhou Service Center
P: +86 371 8665 2391

E: cu.sales@celerosft.com
www.celerosft.com

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