Pump Renovation Restores Balance

Vibration issues with a two-stage pump forced a major steel manufacturer to remove the pump from service. Due to incorrect weights welded on an impeller, a steel manufacturer called upon Hydro to repair and balance a two-stage pump.

Written by: Ken Babusiak (Hydro, Inc.)
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The pump was experiencing the vibration during the spring and summer months of 2016. The steel

company sent the pump to HydroAire's Chicago, IL facility in September of that year. HydroAire was able to determine the cause of the vibration and created a solution that got the pump back in operating condition. The pump was installed and back in service by February, 2017.

The initial testing and analysis deter-mined that the impeller had large weights welded onto it. The steel company was concerned for many reasons, especially because the staff knew that using weights was not the correct way to balance an impeller. This caused the steel manufacturer to question the manner in which the pump had previously been repaired.

The challenge

Based on experience repairing pumps that have vibration issues, HydroAire recommended removing the current impeller weights and using a different type of material. Since the bores had been oversized, HydroAire honed the bores and sized a new impeller shaft on the impeller lands. They then intermediately case flanged the bushing land accordingly. The service company further recommended welding and reclaiming the wear on the vane edges and machining the existing wear rings. The holes were re-tapped and the face dressed. Each impeller was balanced to ISO 1941 6.3 specification. The impeller retaining collar was sandblasted and machined in order to reclaim. The steel manufacturer was onsite to review HydroAire's proposal and to further inspect the pump. The weights on the impellers were kept intact because they were deemed 'acceptable'. However, they were positioned appropriately and tested further. Upon installation and startup in February 2017, the vibration results were found to be optimum.

Strict standards

As per HydroAire's engineering principles, the pump met high balancing standards, which include API 610, Hydro Engineering Standard HEDM-1027, and PCP #029, which states that material addition may be accomplished by welding or mechanical fastening. For material selection, the weight of the fastener and the loss of material in the holes or the weight of the weld mate-rial should be considered when

sizing the correction weight.

The area in question was reviewed for possible impact caused by the material addition and as a minimum, the following was considered: Firstly, the strength of the attachment method and associated component part at design conditions. Secondly, the degradation in mechanical properties due to welding as well as the corrosion properties of material added. Thirdly, the loss of material added due to abrasive pumpage. The engineering department was contacted prior to correction to see if there were any questions. Finally, threaded fasteners were employed so the balancing weights had a positive locking method. HydroAire's Component and Rotor Balancing Processes state that if balancing cannot be achieved by weight removal, then weight can be applied. This is methodology that many OEMs use as well, particularly when casting quality is not optimum due to core shift.

Balanced impellers

HydroAire has refurbished many similar pumps with similar vibration issues caused by incorrect impeller balancing. In 2014, the service company worked on a Byron Jackson 56 in RXL one-stage pump that was severely damaged, with many components requiring completely new manufacturing, including the suction bell, suction bell bearings, case bowl bearings, shaft and the impeller. The primary culprit of the extreme damage was a weight, which had torn loose from the impeller.

Results and conclusions

The impellers had properly positioned weights and were acceptable. The impellers and rotor were 'in balance' when the rotor left the shop on November 30, 2015. The rotor was check balanced when it came back on September 16, 2016, under SO 7123 and found to be in 'as left' condition.

The customer needed the pump repaired and returned urgently. HydroAir manufactured the damaged components including one new shaft coupling sleeve, two coupling locknuts and six split rings. The company also cleaned the components and indicated critical faces and diameters to ensure proper runout. At the custom-er's insistence, HydroAire removed the weights from the SO 7123 impellers, advising they would likely have to be re-applied to use the same impellers to achieve balance. That was exactly the outcome as the rotor was significantly out of balance by nearly 20 pounds. The weights were re-applied and the rotor balance was achieved. HydroAire returned the completed unit for installation and start-up and the unit now runs well without vibration.

Vibration was the root cause of the component damage and rotor imbalance was the cause of the vibration. HydroAire's assessment upon disassembly was that lake water, mud, and silt continuously built up over time. Centrifugal force then captured this debris and trapped the mud and silt. The company realized that the situation would only worsen over time. The impeller balance holes, designed to equalize pressure, having been clogged with debris, disrupted the hydraulic balance of the pump. This is a phenomenon HydroAire has seen before, especially where pumps are drawing water from lakes or rivers with heavy mud and silt beds. Kansas City Power & Light experienced similar problems with their CW pumps so HydroAire designed baffles and plates to stop the build-up of debris and protect against hydraulic imbalance.

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