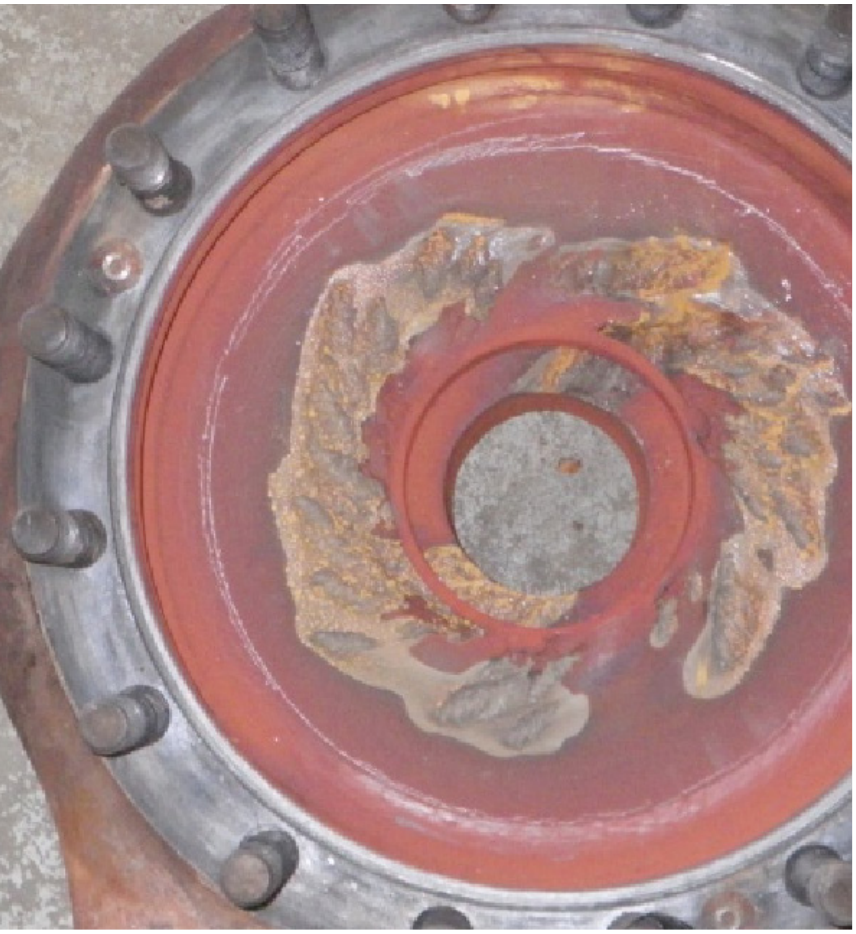
CASE STUDY
BOILER FEED WATER PUMP CORROSION



Boiler feed water conductivity

Industry:	Oil + Gas - downstream oil
Region:	Americas
Territory:	USA
Category:	Material upgrade
API Type:	OH2

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 root cause analysis and material upgrade of the boiler feed pump for the oil and gas 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.

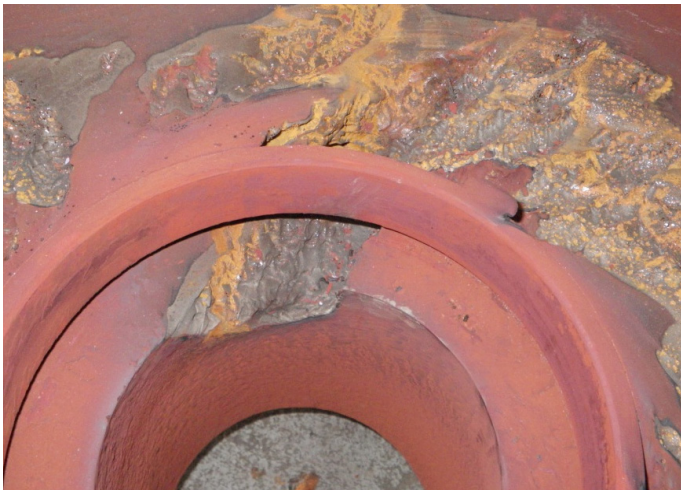
Image left: Damaged casing

Situation

A North American refinery was experiencing repeated failures of casings and casing covers on ClydeUnion Pumps CUP-OH2 pumps in boiler feed water service.

The damage was in random areas of the casing and cover, and limited to cast steel (ASTM A216-WCB) components only.

ClydeUnion Pumps aftermarket engineering team were asked to evaluate the failed components and make recommendations to prevent future damage.



Close-up view of wear ring area

ClydeUnion Pumps

Challenge

In order to determine the root cause of the failure, a request was made by the customer to provide the operating parameters of the pump with particular emphasis on temperature and conductivity of the water.

The water properties of interest were as follows:

- **Temperature** – 269 °F
- **Conductivity** – 11 µmho/cm
- **pH** - 9

Inspection of the failed components revealed damage consistent with carbon steel in hot, low conductivity water service. The type and random nature of the damage along with service conditions are key factors in making this determination, which was later supported by an independent metallurgical examination.

This failure mechanism involves erosion and corrosion of the metal, where the protective oxide scale at the surface is dissolved, and the underlying metal is removed due to the velocity of the water.

Generally speaking, carbon steel casings must be avoided in boiler feed applications where the water temperature is greater than 200 °F, and the conductivity of the water is less than 20 µmohs/cm. In these cases, damage will occur primarily in high velocity areas. In addition, the presence of oxygen while not desirable in boiler feed water services can provide some corrosion resistance. Typically this is not an option.

Solution

Two options exist to prevent repeated damage in these situations:

- An overlay can be applied to provide a more noble material to be in contact with the low conductivity water in high velocity areas. Typically Inconel products are recommended. This option is more cost effective on CUP-BB3 type pumps in areas where stationary wear parts mount in the casing.
- The second option, which was recommended in this case, is to replace the carbon steel components with 12% chrome (CA-6NM), 316 stainless, and 400 series stainless steels (CA-6NM and CA-15) are not affected by this failure mechanism.

Financial illustration

Replacement casing and casing covers were provided in upgraded materials with no additional reported failures.

Annual replacement cost for original metallurgy estimated at US$80,000 for parts and labour.

One time replacement cost for upgraded materials US$30,000 including parts and labour.

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