Pump ED 101

Dezincification – Another Type of Erosion

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In June, I received a call from an engineer with the Vancouver, Washington water department. They had a bearing failure in one of their close coupled, end suction pumps and, upon disassembly, noticed what appeared to be moderate to severe cavitation damage on the silicon bronze impeller. It had been in service for about two years. He wanted to know if I knew what might be causing the cavitation. I received several photos (on the right) and upon first glance it did look like recirculation cavitation. There was erosion on the high pressure side of the vane entries and exits and along the surface of the eye that interfaces with the wear ring.

After further study I began to see some unusual characteristics of the erosion. It looked more like chemical erosion rather than cavitation erosion. When I learned that the pump was running at 95% of BEP flow and that the suction pressure was 70 PSI, cavitation was ruled out.

The idea of traditional chemical erosion did not last long either. When I asked if the pump was in a process line or near their chlorine injection system, I was told it was just a booster pump that provided finished drinking water to a nearby subdivision. The residual chlorine averaged about one part per million. After consulting with some of my associates at PumpTech, we found the right answer - - dezincification.

Dezincification is a corrosion process in which zinc is selectively leached from

brass and bronze alloys and normally occurs when the zinc content is 15% or greater. The result is a porous copper material of reduced strength. Often the first sign of dezincification is a reduction in hydraulic performance. It was first detected in high zinc impellers used in salt water applications and high chlorine applications such as swimming pools. Studies have also shown that chlorine concentrations as low as two parts per million can cause dezincification. It can also be caused by conditions that give rise to high dissolved oxygen or carbon dioxide concentrations.

The definitions of bronze and brass seem to have changed over time. Originally, bronze was an alloy of copper and tin while brass was copper and zinc. Today bronze and brass tend to be generic terms. An alloy of copper and zinc is often called "Commercial" bronze while "Naval" brass contains a small amount of tin.

For over fifty years SAE-40 bronze was the most common alloy used for impellers. It was discontinued by most US foundries in the mid nineties due to its 5% lead content. Due to its low zinc content (4 – 6%), dezincification did not occur. Silicon bronze or brass impellers which contain 16% or more zinc are prone to dezincification. Some manufacturers have reduced the zinc content to just 12% which reduces the potential for dezincification. Alloys that can completely eliminate dezincification include nickel, aluminum bronze and tin bronze. 304 stainless steel is also an option in potentially troublesome applications. I did some price checking and found that a nickel, aluminum bronze impeller costs about 10% more than silicon bronze. 304 stainless steel costs about 20% more.

If you need to see another example of dezincification, take a look at these photos. This impeller is also silicon bronze and was installed in a split case booster pump at the same facility in Vancouver. This pump had been in service for about five years. They have since upgraded these impellers to nickel, aluminum bronze.

Joe Evans is responsible for customer and employee education at PumpTech Inc, a pump & packaged systems manufacturer & distributor with branches throughout the Pacific Northwest. He can be reached via his website www.PumpEd101.com. If there are topics that you would like to see discussed in future columns, drop him an email.