Wear rings separate rotating and stationary, higher- and lower-pressure sections of a pump. A major component of pump efficiency is the recirculation flow across the wear rings. Reducing wear ring clearance reduces the area between the wear rings, thereby, reducing the recirculation flow and increasing pump efficiency.

Fluid processing industries have embraced the use of modern composite materials in centrifugal pumps to increase efficiency, improve MTBR (mean-time-between-repairs), and reduce repair costs. One such material that has been used successfully by major refineries is a proprietary PFA, a carbon fiber composite with uniquely low coefficient of expansion and superior temperature stability.

As of early 2005, every one of the seven refineries in the San Francisco, California, area had successfully applied this particular high performance polymer composite in some of their API-style pumps. This PFA has replaced traditional metal and previous generation composite materials in pump wear rings, throat bushings, line shaft bearings, inter-stage bushings, and pressure reducing bushings. The properties of a properly formulated PFA eliminate pump seizures and allow internal rotating-to-stationary part clearances to be reduced by 50% or more. It is for good reason that composite wear materials are included in API 610, 9th Edition (2003) and later centrifugal pump standards from the American Petroleum Institute.

Not all high-performance polymers are suitable

The market place is competitive and more than one vendor is trying to supply pump users. However, only low-expanding, high temperature capability proprietary PFA materials have proven to provide dry-running capability and greatly reduce the severity of damage from wear ring contact. Users report freedom from pump seizures during temporary periods of suction loss, off-design operation, slow-rolling, or start-up conditions. When the upset condition has been corrected, the pump continues operation with no damage or loss of performance. Conversely, when metal wear components contact during operation, they generate heat, the materials gall (friction weld), and the pump seizes. This creates high-energy dangerous failure modes, which can result in extensive equipment damage and potential release of process fluid.

1 (www.industryuptime.com)
Consider High Performance Polymers as Wear Components in Pumps

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It is worth noting that proprietary PFA wear components undergo only about 15% of the thermal expansion of certain other high performance polymers\(^3\). This is an extremely important distinction that contributes to the success of this engineering material.

**Efficiency gains are worth money**

Reducing wear ring clearance by 50% increases pump performance and reliability through increased efficiency, reduced vibration, and reduced NPSHr. The efficiency gain for a typical process pump is 4-5% when clearance is reduced by 50%\(^3\). Minimized wear ring clearance also increases the hydraulic damping of the rotor, reducing vibration and shaft deflection during off-design operation. The lower vibration and reduced shaft deflection increase seal and bearing life, and help users achieve reliable emissions compliance. This reduction in clearance also reduces NPSHr on the order of 2-3 ft (~0.6-0.9 m), which can eliminate cavitation in marginal installations\(^4\).

Field experience shows remarkable success when installing proprietary PFA’s to achieve all these benefits. One refinery installed such wear rings and line shaft bearings to eliminate frequent seizures in 180º F condensate return service. The condensate return pumps have subsequently been in service for six years without failure. Another user improved the efficiency and reliability of two gasoline shipping pumps by installing wear rings, interstage bushings, and throat bushings made of the leading proprietary PFA. As of 2005, the pumps have been in successful service for six years. Hundreds of other applications have benefited from such composite wear components, including light hydrocarbons, boiler feed water, ammonia, sour water, and sulfuric acid.

**Application examples tell the story**

The cost justification below incorporates the value of efficiency gains in a typical 75kW centrifugal pump, where clearance was reduced by one-third\(^5\).

Essentially, a one-time incremental outlay of $1,000 - $520 = $480 returns $1,890 per year for seven years. The first year payback ratio is $1,890 / $480, almost 4:1. The seven-year payback is $13,230 / $480 = 27:1.

No matter how you look at it, proven high performance polymers represent one of the essential upgrade materials for reliability-focused fluid machinery owner-users. In conjunction with the most modern bearing housing seal, the LabTecta®, cost-effective long-term pump upgrade benefits are easily obtained.

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\(^3\) Marketing Literature for Vespel ® CR-6100, Dupont de Nemours, Wilmington, DE
