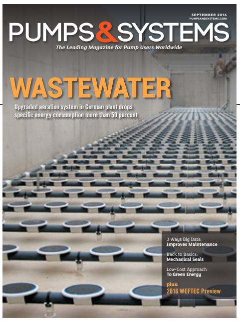


Reprinted from September 2016

5 Ways Structural Composites Improve Pump Efficiency

These engineered machined products can help increase a facility's return on investment.

By **John A. Kozel**
SIMS Pump Company

As industry invests tremendous amounts of effort to reduce energy consumption, the U.S. Department of Energy (DOE) and the Hydraulic Institute (HI) have focused on improving efficiencies of pumps, motors and pump systems.

One way end users can reduce energy consumption—in some cases, by 10 percent or more—is the use of highly engineered structural-composite pumps and impellers.

Upgrading existing pumps with qualified structural-composite components can reduce energy use and improve return on investment (ROI) in five key ways.

1 Composite materials extend pump life because they are inert, corrosion-resistant and withstand cavitation better than metallics such as bronze.

An evaluation of the performance curve of any pump will show a huge drop in efficiency once a metallic impeller begins to wear, cavitate and/or corrode.

Even if the starting efficiency of a pump appears sufficient when a pump is new, tests demonstrate rapid deterioration of efficiency and performance as a pump continues to operate more inefficiently. Engineered structural-composite impellers and rings can help prevent these heavy losses of efficiency and performance. Pump inefficiency contributes heavily to increasing energy, maintenance and repair costs.

In some cases, structural composites can provide five to seven times the lifespan of metallic pumps and impellers in corrosive applications.

2 Structural composites provide a reduction in energy costs through pump optimization.

In many cases, a facility purchases a pump for one specific performance, but once the pump is put into service, system requirements cause it to operate at another point entirely different from the pump's original design point.

When a pump operates away from the original design point or best efficiency point (BEP), problems occur, including higher loading; excessive noise and vibration of the pump; shaft oscillation; cavitation;

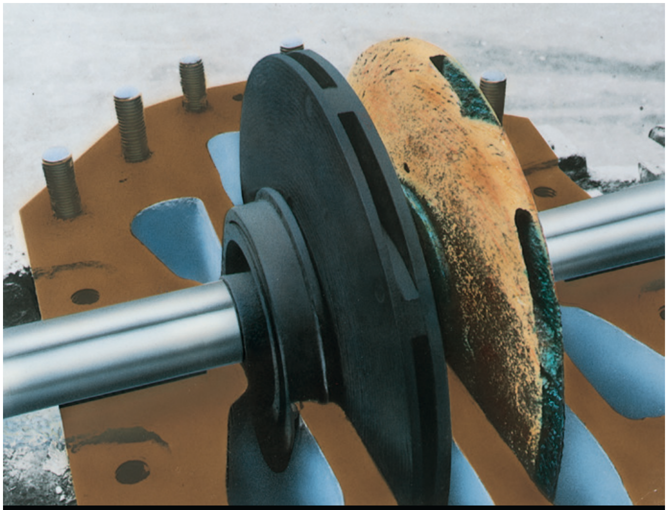


Image 1. These two impellers ran for two years in seawater. The structural-composite impeller on the left is like new, and the bronze impeller on the right shows heavy corrosion. *(Images and graphic courtesy of SIMS Pump Company)*

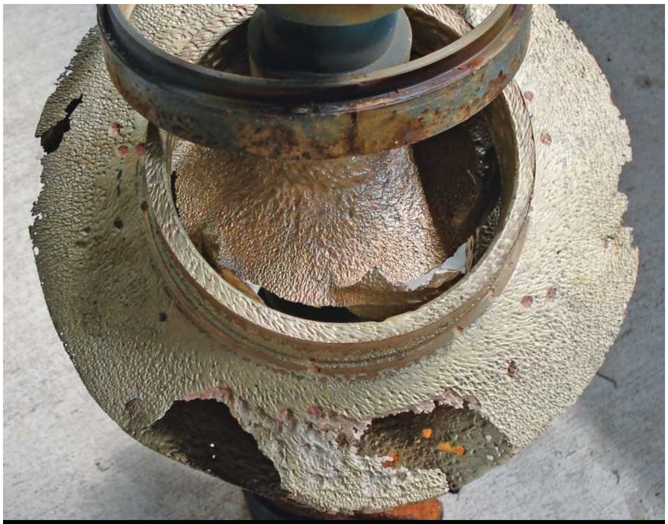


Image 2. Worn and corroded bronze impeller.

and premature wear and failure of the mechanical seals, bearings, rings, sleeves and impellers.

In extreme cases, the pump shaft will break right behind the impeller from the excessive radial forces that occur when a pump operates away from the original design point.

Operating a pump away from the BEP has a detrimental effect on efficiency and performance, and it wastes energy and money. Operating the pump in this way also severely reduces pump life. The larger the pump, the more energy is wasted. These problems can be resolved with structural-composite pumps and/or impellers and rings that have been engineered for a facility's system requirements. This improves the pump's efficiency, reliability and longevity.

Many industry professionals do not realize the cost and impact of low efficiency. As an example, a motor powering a pump with a severely deteriorated impeller could easily lose 50 percent of its original efficiency.

If the motor was drawing 75 kilowatts (kW) at the original efficiency of 80 percent and now the pump is operating at an efficiency of 40 percent, there would be an approximate loss of half of the original efficiency, which would equate to $38,880 per year at $0.12 per kilowatt-hour (kWh) (37.5 kW loss x 8,640 hours x $0.12/kWh = $38,880 per year).

Even if the pump was operating only 10 percent away from the BEP, the approximate loss would be $7,776 per year plus additional maintenance expenses (7.5 kW loss x 8,640 hours x $0.12/kWh = $7,776).

Structural-composite pumps are designed specifically for the operating point in the plant, factory or system, making them more efficient than many traditional pumps.

The operating point in the system becomes the BEP, saving the user thousands of dollars each year. Because the pumps operate at the BEP, they have less radial and axial movement, resulting in a longer lifespan.

Structural-composite pumps and impellers are completely machined (as opposed to being cast or molded) on the outside as well as the inside using state-of-the-art computational fluid dynamics (CFD) techniques, which make them even more efficient.

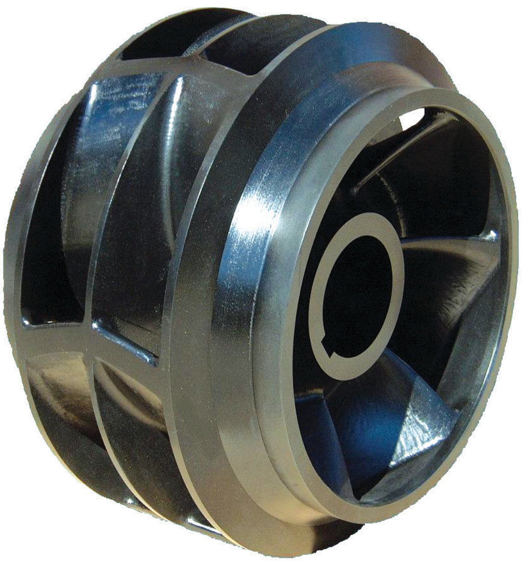


Image 3. This structural-composite double-suction impeller was machined from a solid block of structural composite on a five-axis machining center using state-of-the-art design techniques to provide greater efficiency and longevity.

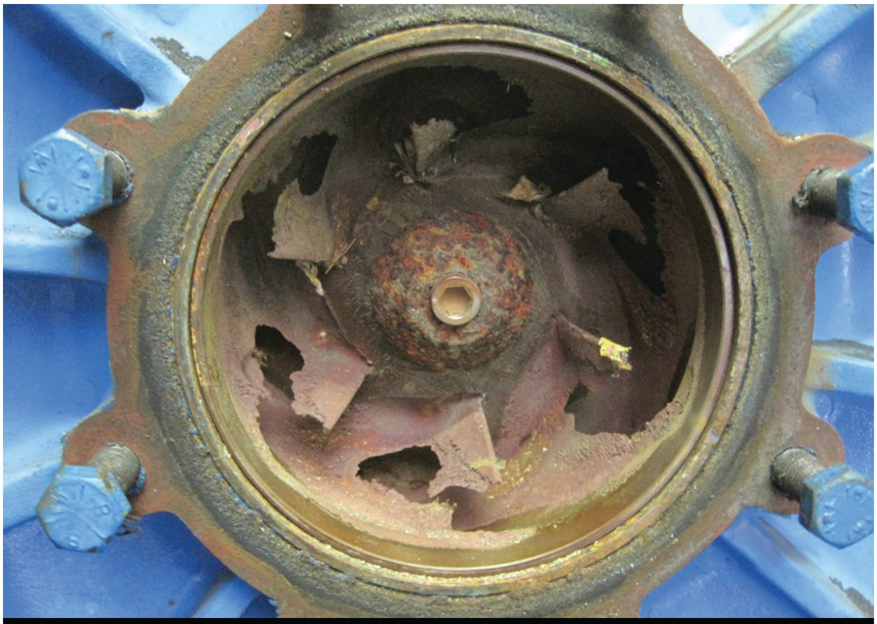


Image 4. This pump and impeller for a water park was destroyed by cavitation and corrosion. The pump and impeller were upgraded to a structural-composite model, which resolved the issues and dramatically increased efficiency and performance.

Table 1. Estimated operational savings provided by composite materials	
Pump service	Cooling water pump
Capacity	7,453 m^3/h or 32,793 gpm
Head	58 m or 190 feet
RPM	710
BHP	1,321 kW or 1,772 hp
Original metallic impeller diameter	935 mm or 36.82 in.
Original metallic impeller overall width	480 mm or 18.90 in.
Type of impeller	Double-suction impeller
Cost of composite impeller and ring set	$135,000
Estimated cost to overhaul pump	$250,000
Estimated maintenance and repair savings when the engineered composite impeller and casing ring set extends the life of the original metallic impeller	$250,000
Total estimated savings in five years	$592,145
Estimated weight of the metallic impeller	539 kg or 1,185 lb.
Estimated weight of the impeller	90 kg or 198 lb.

Depending on where the metallic impeller is operating on the pump curve, some composite pumps and impellers can increase efficiency by 5 to 15 percent.

3 Completely machined structural-composite impellers experience less vibration and lower radial and axial movement as a result of better mechanical and hydraulic balance.

Engineered structural-composite impellers are completely machined from a center position out of a solid block of structural composite on both the inside and the outside.

As a result, the vanes are all equally spaced and the impellers are well-balanced and remain well-balanced for the life of the pump, leading to increased longevity and enhanced performance as a result of less vibration.

A very similar type of technology has been employed for propeller design and manufacture. Propellers that are machined on five-axis machining centers not only produce less vibration, but they also pay for themselves in fuel savings.

4 Composite impellers are lightweight and reduce shaft deflection.

Structural-composite impellers and casing rings are only 15 percent the weight of traditional metallic materials. The lower weight reduces startup load and shaft deflection, which allows the rotating element to run with tighter clearances between the rings and the impeller.

The tighter ring clearance reduces leakage, and the reduction in shaft deflection enables bearings, sleeves, mechanical seals and rings to last much longer, which saves on repair and maintenance costs.

5 Composite impellers and casing rings reduce leakage and prevent pump "wash-out."

Because of the excellent lubrication qualities of many structural-composite materials and because of the low coefficient of friction, the ring clearances in operation are less than metallic rings and allow less leakage between the impeller casing rings and the impeller wear ring.

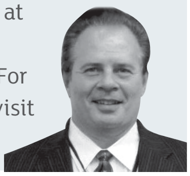
The smoother surfaces and less leakage between the casing rings and impeller wear ring result in a 2 to 3 percent increase in efficiency. Additionally, the structural-composite rings seal against the pump casing similar to a gasket, preventing the fluid from wearing or corroding the landing areas under the casing rings.

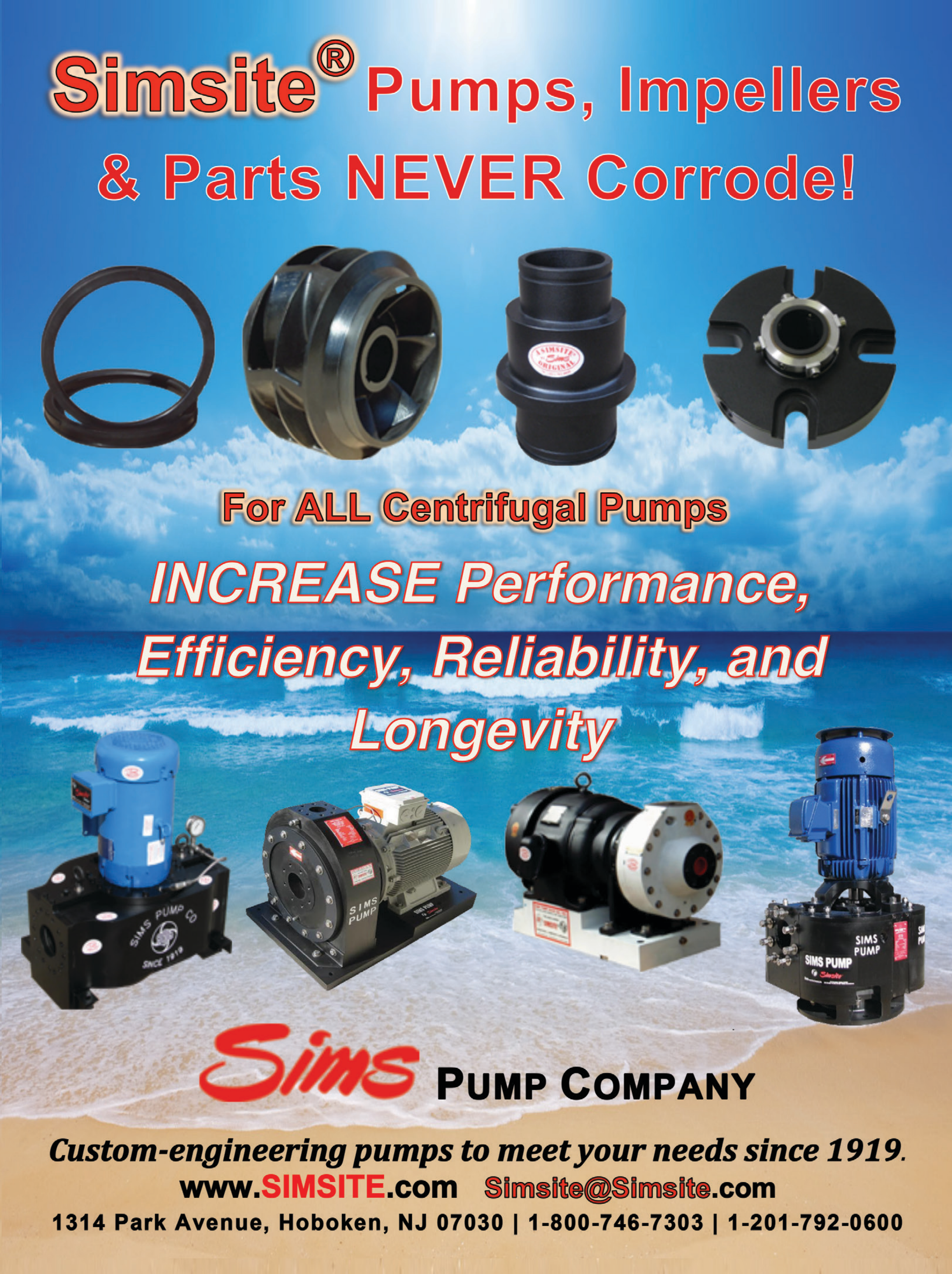
Estimated Operational Savings

Because of the many benefits listed above, structural-composite impellers and casing rings can outlast metallic impellers and ring sets, especially in corrosive environments.

Table 1 demonstrates the estimated operational savings that structural-composite materials can provide. ■

John A. Kozel is president and CEO of SIMS Pump Company. He may be reached at 201-792-0600 or at simsite1@aol.com. For more information, visit simsite.com.




Simsite® Pumps, Impellers
& Parts NEVER Corrode!
For ALL Centrifugal Pumps
INCREASE Performance,
Efficiency, Reliability, and
Longevity
Sims Pump Company
Custom-engineering pumps to meet your needs since 1919.
www.SIMSITE.com Simsite@Simsite.com
1314 Park Avenue, Hoboken, NJ 07030 | 1-800-746-7303 | 1-201-792-0600