Maximizing uptime with coated nozzle rings
How operators can benefit from longer turbo washing intervals with superior nozzle ring coating.
Small components, big impact

Profitability in the marine and power generation sectors is affected by numerous factors, some of which have a dramatic influence on operational costs. Because many of these influences are external, operators must closely manage those that are within their control to strengthen profit margins. At the top of the priorities list is efficiency, both in terms of processes and physical machinery. Even the smallest details can have an effect on profit, so controlling waste and maximizing uptime at every opportunity is crucial.

Take the humble nozzle ring for instance. Used to convert exhaust gases into kinetic energy in turbochargers, nozzle rings are crucial to energy efficiency. By directing exhaust gases onto the turbine blades in an optimal way, the speed and torque of the turbine can be maximized. This in turn improves the speed and torque of the compressor wheel, which is driven by the turbine, and leads to an increased air intake into the engine cylinders.

Increased air intake means better and stronger combustion, which invariably increases the engine output and efficiency if done in an optimized way.

Thus, the optimal flow of exhaust gases through the nozzle ring is crucial for the overall turbocharging and application efficiency.
Nozzle rings, pollution and efficiency

The contamination of the turbine can cause unequal exhaust gas flow, leading to mechanical excitation and high rotor unbalance. This could ultimately lead to the turbine blades breaking and a complete turbocharger failure.

Having a fully functioning nozzle ring is important in order to maintain original turbocharging efficiency levels. However, the reality is, over time dirt from the combustion of heavy fuel oil (HFO) in diesel engines contaminates the turbine blades and nozzle rings of turbochargers.

Eventually, these deposits on the nozzle ring vanes obstruct the exhaust gas flow and if left unchecked can lead to a significant loss in turbocharging efficiency. At the same time, there will be a corresponding increase in charging and ignition pressures as the turbocharger speed rises, placing additional strain on the engine. This very likely will lead to a reduction of the engine performance and reliability.

Furthermore, the contamination of the turbine causes unequal exhaust gas flow, leading to mechanical excitation and high rotor unbalance. This could ultimately lead to the turbine blades breaking and a complete turbocharger failure.

It is important to note that deposits and contaminations are a global problem that affect all turbochargers when using HFO.
Dealing with dirty nozzle rings

With an average engine runtime of 6000 hours per year, turbo washing would generate 60 hours of reduced load per year.

Typical maintenance routines rely on injecting water into the turbocharger at significantly reduced engine load.

Although wet cleaning improves overall efficiency, there are side effects to consider. First, power output is reduced for approximately one hour following every cleaning cycle as the engine is de-loaded.

Second, the use of cold water causes thermal shocks to the turbine side components; these events will decrease the lifetime of said components, increasing the total cost of ownership, as more frequent repairs may be required. And that’s before you consider the time and effort involved in each cleaning cycle, further adding to the cost of turbocharger maintenance.
The true costs of dirty nozzle rings

Experience from both marine and stationary applications show operators suffer huge financial losses due to repeated turbine cleaning. A large operator with a fleet comprising 15 vessels would lose more than $3,150,000 per year due to maintenance downtime.

The financial losses of reduced power output for stationary application are apparent. Less power, means less electricity output and thus less revenue. Similarly, lower power output can have dire business consequences for marine applications. For example, in dredging every minute and cubic meter counts as these translate into potential revenue gain or loss.

Dredgers are heavy duty applications, powered by combustion engines burning HFO. The component parts of these engines, specifically the nozzle rings are thus subject to heavy contamination leading to frequent turbo washing. Each time the turbine needs to be washed, the engine power has to be reduced, thus resulting in reduced production.

For example, take a dredging vessel with an average dredging capacity of 1,000 m$^3$ sand per hour and an average engine runtime of 6,000 hours per year, turbo washing would generate 60 minutes of reduced load every 100 running hours, leading to a yearly financial loss of over $210,000 per year - just due to turbocharger cleaning. Consequently, a large operator with a fleet comprising 15 vessels would lose more than $3,150,000 per year due to maintenance downtime.

Surely, there has to be a better solution.
Extension of cleaning interval up to 6 times with coated nozzle rings

For application operators this would mean a reduction in cleaning cycles from 60 times per year to just 10 times per year, maximizing uptime.

To counteract the fast buildup of deposits from engines burning low-grade HFO and therefore maximize uptime, by reducing the turbo washing cycles, ABB has developed a superior solution - a new nozzle ring with a unique surface coating. Thanks to the surface coating, deposits are less likely to stick.

With fewer deposits collecting on the nozzle rings, operators are able to increase the time between cleaning cycles. According to tests conducted with ABB customers, the interval between cleaning cycles can be extended up to 6 fold.

This means that businesses using the new ABB coated nozzle rings can reduce the frequency of cleaning and increase operational availability.
Maximizing dredging output with coated nozzle rings

With every dredging minute and cubic meter of sand translating into a potential loss or gain in revenue, maximizing power output becomes crucial in remaining competitive and staying profitable.

A dredging operator, using the coated nozzle ring by ABB Turbocharging is able to reduce cleaning by 50 hours per engine, per year. An extension of the cleaning interval by up to 6 times. This will not only translate into cost savings. It will result in additional revenue of up to $175,000 per engine, per year.

In relation to the financial benefits of installing the coated nozzle ring, the operator is able to realize payback just within a few weeks.
EGE Haina earns an additional $3.3m with extended cleaning interval

“With the upgrade to ABB’s coated nozzle rings we have been able to extend our intervals between cleaning from 50 to 300 running hours. This means we regain nearly 1,900MWh of otherwise lost power on each engine annually with even less maintenance effort.”

The Sultana del Este is a floating diesel power plant owned and operated by EGE Haina, with an operating capacity of 153MW. Like every power plant reliant on turbochargers, the Sultana del Este was affected by residue within the nozzle rings, leading to loss of production during cleaning operations which were taking place every 50 hours.

As part of an ongoing program to reduce downtime and increase efficiency, EGE Haina upgraded to ABB’s coated nozzle rings on all nine engines. The Sultana del Este plant manager reports that the results were almost instant.

The benefits realised are considerable – more than $3.3m of additional sales made possible by upgrading to ABB coated nozzle rings:

“And the savings begin immediately. The installation of the upgraded nozzle rings fitted into our regular maintenance schedule. Therefore, it was remarkably convenient for us with no additional downtime.”
Maximum return on investment (ROI) with longer cleaning intervals.

ABB customers can reap the rewards from the many benefits of longer cleaning intervals and maximized uptime business by replacing existing nozzle rings with coated alternatives from ABB Turbocharging.

To understand the benefits of how ABB coated nozzle rings apply to your operations, and how your business could realize significant new efficiencies, please get in touch with ABB Turbocharging.

Want to know how coated nozzle rings can help you improve operations?

Contact ABB Turbocharging