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Easy procedures as long-term investments

Why Turbine Side Washing (TSW) and coated turbine blades safeguard the TPL-C turbocharger's high efficiency in dual-fuel applications.

Dual-fuel engines in marine and stationary applications generally run most of the time in gas mode and some percentage of the time on diesel oil or heavy fuel oil (HFO). Normally, the lubricating oil used in these engines is the same as that used with standard HFO engines, where the Total Base Number (TBN) is typically 30 or higher.

Experience has shown that such lubricating oils, used together with HFO, create deposits when running in gas mode. The chemical composition of the high TBN lubricants reacts with the gas in the cylinders, resulting in the formation of substantial contamination on the turbine-side components.

Explanation of deposits build-up

One of the basic additives used in these lubricating oils to neutralize the acidic combustion products from heavy fuel compounds is calcium carbonate (CaCO3). The chemical reaction that takes place between CaCO3 and the combustion products from fuel and/or lubrication oil compounds, such as sulfur oxides, results in the neutralization product calcium sulfate (CaSO4). Analysis of the deposits from turbine blades have shown the main constituents to be calcium (Ca) and sulfur (S) along with oxygen (O), mainly originating from the lubricating oil.

Under certain conditions the calcium sulfate could also react with moisture/water and form gypsum, calcium sulfate with crystal water CaSO4·½H2O, which can be very sticky and could contribute to the formation of hard deposits. This is a white/light gray colored Ca-compound which is typically found in gas engine exhaust system deposits.

Turbine Side Washing (TSW)

In general, how TSW is carried out will be based on the type of fuel used. A turbine wash interval of ~150 h can be used as default. The interval can be further extended up to 500 hours, being guided by experience.
The wash procedure is the same as when running on gas. Switching to diesel mode is recommended when starting the wash sequence.

Coated turbine blades

Since 2008 it has been possible to install 6 coated blades (dragons' teeth) on the turbine as an option for ABB's TPL-A and TPL-C turbochargers operating on HFO. The advantages of coated blades are multiple:
– They protect the standard blades from wear, thus avoiding the costly repair or renewal of the blades.
– The tip clearance is maintained within the tolerance limit, which helps to safeguard the high turbocharger efficiency.
– Thermal loading of the engine is reduced.
– Eventually, this results in fuel savings.

Contamination buildup on dual-fuel engines

Experience has shown that there is also some hard contamination buildup on the turbine diffuser of turbochargers installed on Wärtsilä dual-fuel engines. The formation of this layer may lead to wear on the turbine blade tip during operation. Dual-fuel engines, especially when operated in gas mode, are also sensitive to an increase in the tip clearance between the turbine blade tips and the turbine diffuser. Based on the positive experience from HFO operation, ABB Turbocharging also recommends installing coated blades for turbochargers on dual-fuel engines.

Although the turbine diffuser is highly resistant to deformation, it can deform if water is injected at too high a temperature, in other words when the cooling time is too short. It is therefore recommended that the turbine diffuser be checked for any ovalness before installing the coated blades. An oval turbine diffuser can cause rubbing of the turbine blades, which will result in the blade coating wearing away. An ABB Service Station would be able to assist you in measuring and assessing the reusability of the turbine diffuser.

On April 1, 2015 Shailesh Shirsekar took over as Regional Manager, Service Sales for the Asia Pacific region. In his previous position as senior manager technical service his main activities were claim management, breakdown investigation and feedbacks to the technical department for product improvement. He joined ABB Turbo Systems Ltd in April 2002. A marine engineer with an MBA, he worked until 2000 as chief engineer on ocean-going ships – mostly very large crude carriers.

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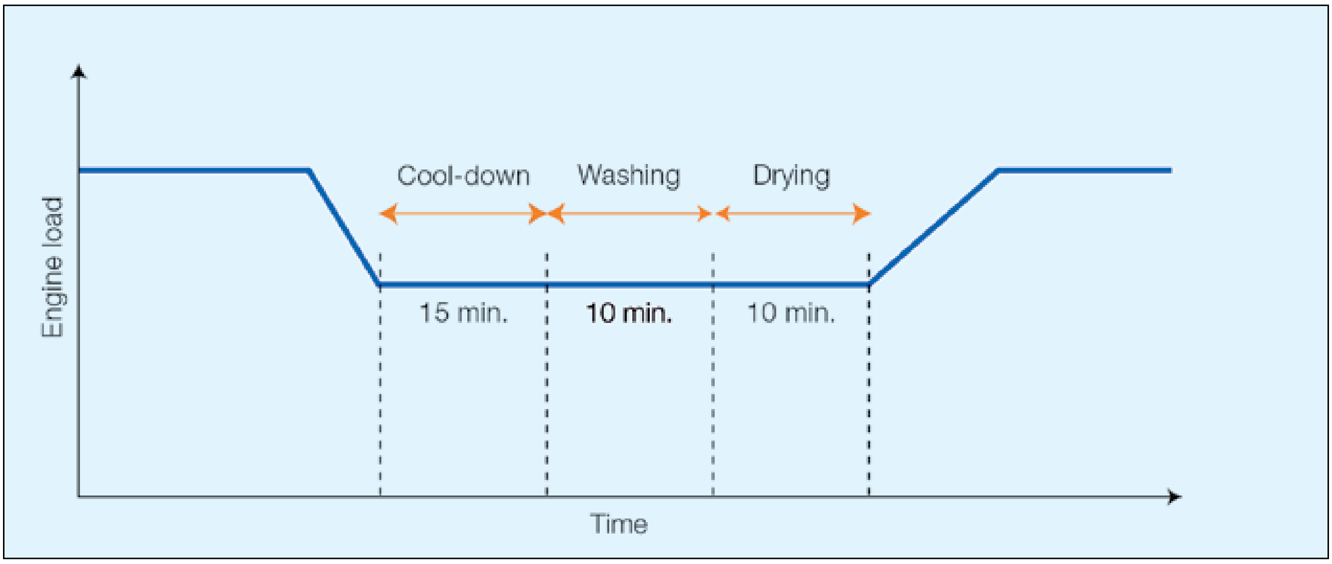
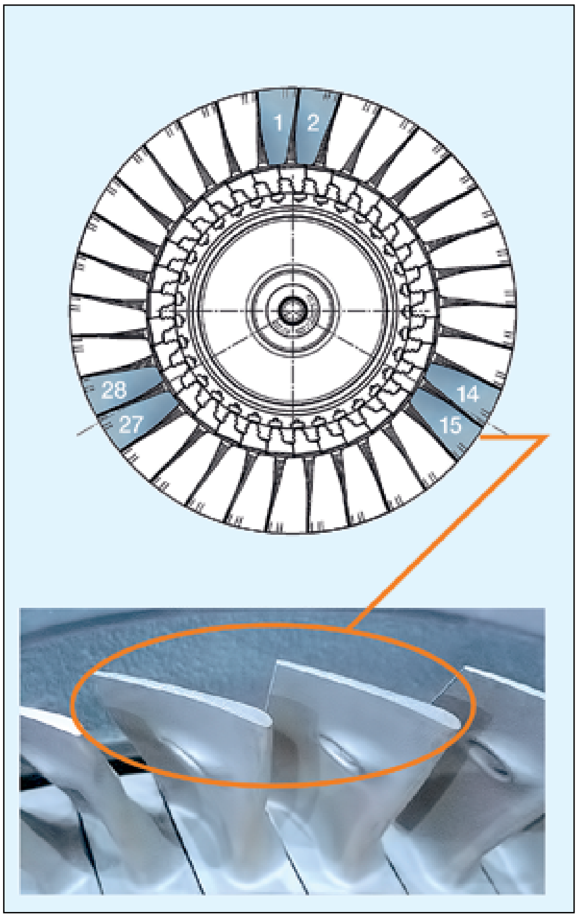


The wash sequence

– Record turbocharger speed, temperatures and charge air pressure at normal output.
– Switch to diesel mode and reduce the load to achieve an exhaust gas temperature < 430°C at the turbocharger inlet.
– Let the material temperature stabilize for at least 10 (preferably 15) minutes at < 430°C.
– Start the water injection and adjust the water flow as needed:
• TPL67-C and TPL69-A = 18 l/min per turbocharger
• TPL71-C and TPL73-A = 24 l/min per turbocharger
• TPL76-C and TPL77-A = 37 l/min per turbocharger
– Stop the water injection after 10 minutes.
– Let the engine run at the same low load for another 10 minutes before switching to gas mode and resuming normal load. As an alternative, switch to gas mode after the water injection but stay at low load for another 10 minutes.
– Repeat the speed, temperature and pressure readings after at least one hour at normal output. Use the readings to compare and judge the wash result.



Coated turbine blades

The coated blades feature a wear-resistant coating material at the blade tip. The coating material is also used in cutting tools and its application on the blade tip scrapes off the hard contamination buildup on the turbine diffuser.

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