As seen in

THE TRITON

NAUTICAL NEWS FOR CAPTAINS AND CREWS

/tritonnews www.The-Triton.com November 2017

New programs of condition monitoring make engine maintenance easy, economical

Engineer's Angle

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Reliability of marine diesel propulsion and generator engines is critical, yet regular maintenance of engines and machinery is met with a great deal of resistance.

It is seen as time-consuming and an expendable cost when attempting to meet budget targets. Vessel managers often will double (or triple) the time between inspections to lower overall operating costs.

Fortunately, new technology is changing that. Traditional maintenance programs, which follow time-based or statistical-based methods wherein mechanical elements are periodically checked based on the manufacturers' recommendations, are being replaced by predictive maintenance (PdM) programs.

These programs, which utilize condition monitoring (CM), have many advantages over the traditional methods, including earlier detection of problems and more precise maintenance planning to avoid costly and unexpected downtimes.

Condition monitoring of high-speed diesel engines utilizes the following three methods:

Oil analysis

Ineffective lubrication is one of the most common causes of machinery failures. Regular oil analysis is a very easy and cost-effective way to monitor this. It entails regular, periodic sampling of the engine lubricant oil, followed by a laboratory analysis of its condition, degradation and contamination.

The analyzed data is then stored in a computerized data base for quick manipulation and graphical retrieval to identify abnormal trends that characterize the development of a future problem.

How could such a small amount of oil give us such an incredible wealth of information regarding the health and condition of the engine and its lubrication?

Throughout its lifetime, an engine typically goes through three phases: running in-phase, with an increased wear rate; normal operational phase, with a relatively constant rate of wear; and wear-out phase, with an exponentially increasing wear rate.

By using various methods of lubricant and debris analysis, oil analysis effectively monitors the wear state of an engine. A detailed picture of water and contamination can be identified and trended over time.

- Dirt, water and contaminants in the machinery are detected, and warn when oil effectiveness is compromised.
- Accelerated wear is detected early when microscopic wear particles produced by engines through everyday operation are identified, thereby indicating when a particular component has

See **MAINTENANCE**, over

Enhanced monitoring adds detail

MAINTENANCE, from front

begun to deteriorate.

- The chemical balance of lubricants is monitored to indicate when they and other additive packages are approaching the end of their operational life.

Data comparison

In the second type of diesel engine condition monitoring, engine operating parameters are recorded and monitored to compare with a model of these same parameters under ideal conditions.

Data is compared against either an existing database (trending) or a model (model-based) to diagnose existing issues and show the beginning of wear and tear on mechanical components. By monitoring parameters such as fuel flow, intake manifold pressures, exhaust temperatures and others, the system is able to identify faults prior to failure. Many engine manufacturers are now offering this as a service.

Condition monitoring is becoming more accepted in yachting as the technology becomes more economical and easier to implement.

Engine analyzer

The third type of condition monitoring involves the use of compact and easy-to-use handheld analysis systems that record vibration and ultrasonic emissions synchronized to each cylinder at top dead center (TDC).

These devices were previously cost-prohibitive for all but commercial use, but now there are many with a price point that makes them accessible to the yachting industry.

For example, Windrock's 6400 is portable, lightweight, and easy to set up. In a system like this, data can be collected from reciprocating and rotating machinery to trend vibration, ultrasonic emissions, cylinder pressure and temperature.

In this capacity, the analyzer can been utilized to track vital pieces of equipment, such as pipeline compressors, trains, pumps, and reciprocating engines – as well as specific components.

The system is set up based on the vessel's machinery configuration quickly and with virtually no downtime. Once the software is set up in the analyzer, the sensors are then positioned on the engines, gear boxes, frames and cylinder heads for measurements.

Data collection can begin immediately and, within only 15 minutes, can produce analyzable readings. And with the switch from diesel to dual-fuel engines, enhanced monitoring will provide further information on the mechanical health of the engines and the condition of the control systems for cylinder pressures.

Balancing of cylinder firing pressures in large diesel engines has been successfully used to control emissions, reduce fuel costs, and reduce the overall mechanical degradation of mechanical components due to imbalance.

The economic benefits of condition monitoring are tremendous because outages and downtime become fewer and further between. It also increases mechanical efficiency and keeps components running at peak performance, thereby reducing emissions.

Class has also recognized the inherent value in condition-based monitoring, and it's expected that over the course of the next few years, it will become a requirement.

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