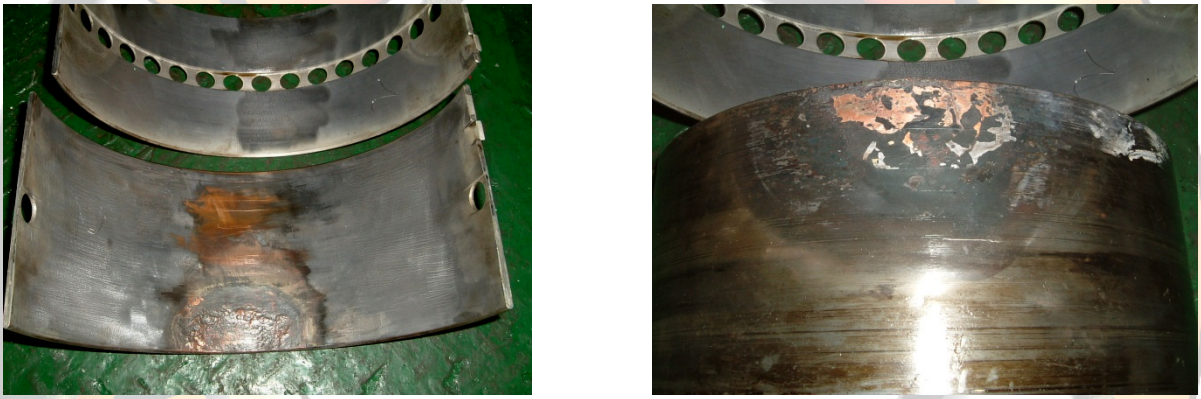
Lubricating Oil Maintenance is Critical

If there is one standout cause for failures of main and auxiliary engines, it is through inadequate monitoring and maintenance of the condition of lubricating oil – literally the life-blood of any engine. Indeed it has been largely the progress made with the development of lubricating oil over the past 60 years or so that has allowed engines themselves to be developed and for example be able to operate on heavy fuel oils.

In one case, the medium speed main engine of a bulk carrier suffered a turbocharger failure whilst on transatlantic passage to New York. The engine had then labored for several days with a non-functional turbocharger creating very poor combustion and black exhaust smoke. Whilst in port and undergoing turbocharger repairs the attending surveyor recommended that lubricating oil samples be taken from the main engine for analysis.

It wasn't done, and several days later during another loaded passage, the main bearings and then the crankshaft failed leading to towage, large general average costs and extensive disputes over seaworthiness.



Failed main engine bearings due to poor condition of lubricating oil

Procedures to Follow

The whole process of taking samples, landing the samples for analysis, obtaining the laboratory results and associated recommendations can be accomplished quickly. The process necessarily involves the vessel's technical managers/owners as the feedback from the laboratory is initially to them – thence to the ship with associated instructions.

Therefore there is a due diligence aspect to the correct handling of the analysis process and this again can cause major legal disputes when not followed by the managers. Medium and high speed engines are particularly susceptible to depleted lubricating oil properties.

Bearing design takes into account at least the three components crucial to the system; the bearing shell itself, the other surface that it interacts with (co-operating surface), and the lubricant between the two.

Each of these components must work together to prevent the system from failing. During the design phase, engines generally have specific desired power output specifications and operating conditions and it is from these and other considerations that the systems' preliminary designs are drawn.

Viscosity is Key

The lubricant introduced between the co-operating surface and the bearing must be chosen primarily to reduce friction and wear. The viscosity of the lubricant in operation is proportional to its coefficient of friction and thus the oil film thickness between bearing and journal is proportional as well. Lubricants' viscosities are measured by using the viscosity index (V.I.), a measure of the rate that viscosity decreases as temperature of the lubricant increases. A lubricant must therefore be chosen to exceed the minimum oil film thickness at all desired operating temperatures based on experimentally determined values of this index.

In addition to lubricating oils' viscosity and viscosity index, each one has other intrinsic properties associated with it that affects its ability to accomplish other, less crucial tasks: facilitating heat transfer away from the bearing, protecting against corrosion, and removing wear debris from the system while preventing other contaminants from entering. A lubricant may perform well at some or most of these tasks, but not all of them. To improve its performance, chemical compounds (oil-additives) are added for the purpose of increasing certain desirable properties in the lubricant.

Severe crankshaft damage from breakdown of lubricating oil in a medium speed engine

Man's Inhumanity to Machines

So against this background of extensive research and development of bearings and their lubricants you can imagine the exasperation of our surveyors when investigating the cause of engine bearing failures when on occasion they find:

- lubricating oil filter elements missing;
- system "O" rings missing;
- no record of analyses;
- oil condition so bad, holes punched through filter elements with a screwdriver to allow oil flow; and/or
- waste oil being recirculated back into the crankcase.

A particularly serious case developed with a reefer vessel having five main generators sharing a lubricating oil system. Water in the oil went undetected through a lack of analyses and the ship literally ground to a halts with all five engines sustaining severe bearing and crankshaft damage.

All crankshafts renewed

Typical bearing condition – all white metal removed

A properly designed and constructed diesel engine, when correctly matched to its intended service and afforded the periodical maintenance recommended by the manufacturer, can normally be expected to function reliably for many years and many thousands of running hours. Engines with over 150,000 accumulated running hours and giga-cycle (108 and higher fatigue cycles) are not uncommon.

The simplest way to prevent such reliability is to neglect its oil!

The American Club would like to thank John Poulson CEng., of Atlantic Marine Associates, Inc. for his contribution to this series - and who will be producing more case studies soon.

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