# Gas engine lubricants

## High on the agenda at F&L Asia 2011

The popular F&L Asia conference, which attracts scientists and technologists from around the world, was held in Singapore earlier this year. The event, in its 17th year, featured a wealth of papers and presentations. Two papers, focusing on developments in gas engine lubrication were presented by Fred Girshick, a member of the Marine and Large Engine Technology Group based in Linden. Here he gives us an overview of the key findings of Infineum's research.


*photo: Wärtsilä*

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# Gas engine lubricants *Continued*

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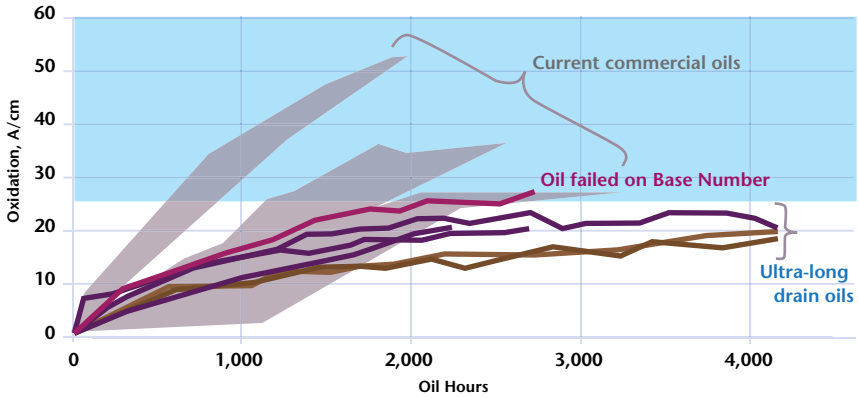



***Two Infineum candidate oils doubled the oil drain interval of the previous 'best in class' product***

Gas engines typically operate 24 hours a day, 365 days a year because they cannot make money if they are not running. The key objectives of gas engine operators are maximising engine in-service time, avoiding unscheduled maintenance and reducing operational costs, in order to maximise profitability. To help meet these requirements, oils must be able to handle the high oxidation and nitration stresses of gaseous fuel so that they can increase oil drain intervals while maintaining engine life, durability, and reliability.

At Infineum we have been working on new products that will help our customers keep their engines running for longer. The first paper looks at how far oil drain intervals can safely be extended for engines running on natural gas. The second features work carried out in collaboration with Salvatore Rea, Contributing Technologist in the Large Engine Lubricants Technology Group, to ensure engine oils can handle the effects of using more aggressive landfill and bio gasses for electricity generation.

### Extending drain intervals in natural gas engines

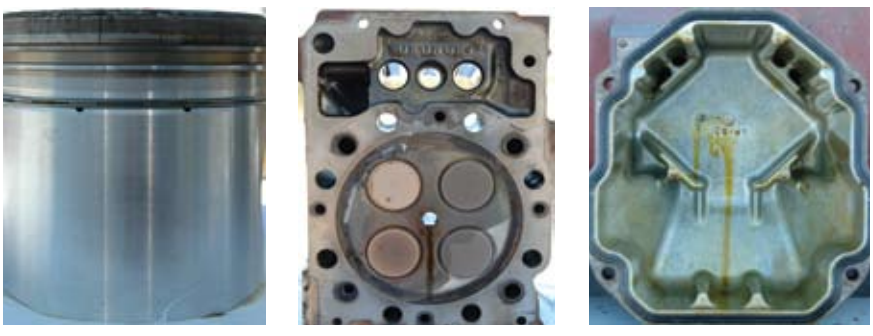
There is clearly a cost-benefit balance to be struck when operators choose the length of oil drain interval for engines using natural gas fuel. Longer oil drain intervals cut oil purchase and labour costs and reduce equipment downtime – the latter benefit usually being the most valuable. However, on the other side of the equation, shorter oil drain intervals may extend the overall life of the engine and reduce long-term maintenance costs, as well as providing a margin of safety and psychological 'insurance'. Somewhere in between is the optimum balance for a given engine make, model, fuel composition, and service.

Oil drain intervals for large industrial gas engines are often determined by used oil analysis. Typical parameters, such as viscosity and acid number increase, base number decrease, oxidation and nitration, and wear metals content are compared to recommendations from the engine manufacturer, the analysis laboratory, or from personal experience.

Infineum carried out a series of field tests to determine the trade-offs between oil drain interval, in-service oil properties, and overall engine condition as indicated by wear and cleanliness. As expected, longer oil drain intervals – for constant engine model, fuel, service, and engine oil – led to increased deposits, which may or may not affect engine life. Wear was much less sensitive for these highly hydrodynamic engine designs.

The validity of typical used oil condemning limits was explored by extending oil life beyond the recommended limits. In almost all cases, the engine manufacturer's guidelines were found to be highly conservative. Generally, oil drain intervals may be extended beyond those guidelines with no apparent harmful engine effects, although there may be warranty implications.

Differences among engine makes, models, and configurations were examined. A number of obvious factors including: brake mean effective pressure, oil sump volume and brake specific oil consumption all affect the oil stress factor. However, it is also apparent that



***Ultra-long drain oils do not compromise wear, cleanliness or used oil analysis parameters***

air:fuel ratio has an impact, with lean burn and ultra-lean burn configurations of the same make and model engine imparting significantly different stress on the oil and therefore requiring different oil drain intervals.

By combining prior learnings, Infineum has developed a new engine oil formulation, which uses more antioxidant and AntiNOxidant, changes the ratio of low sulphated ash detergents and rebalances the dispersants. In field tests this new package demonstrated the ability to double the oil drain interval of the previous 'best in class' product, without sacrificing wear, cleanliness, or used oil analysis parameters.

## Effective engine oils for landfill and biogas

Two gas sources that are being increasingly used in gas engines are landfill gas and biogas. At landfill sites methane gas is released as bacteria decompose the waste, while biogas is generated from the biodegradation of organic material like animal and vegetable waste, sewage, waste paper and wood chips. Gas engine operators can gain good returns by using their engines to generate electricity from these low value waste gases. However, to maximise profitability engines may need to run continuously at full load under very severe operating conditions, which means the lubricant must deliver exceptional engine protection.

These gasses are roughly half methane and half carbon dioxide, but also contain a number of impurities. Both types of fuel contain significant quantities of sulphur and landfill gas often contains halogens, both of which form strong acids on combustion. These acids must be neutralised by the engine oil to prevent engine damage.

***Gas engines in landfill service are susceptible to copper sulphide deposits on the oil cooler and hard silica deposits on the intake and exhaust valves***

Usually it is the 'soft' metal parts that are most sensitive to acid increase – like the copper often present in the oil cooler, bearings, and bushings, and lead, which may be in the bearings.

In addition to sulphur, landfill gas generally contains siloxanes – silicon compounds which burn to form hard, sand-like deposits in the combustion chamber. If allowed to increase, these deposits can form hot spots leading to pre-ignition or detonation, foul the spark plugs leading to premature maintenance, coat the liner honing marks leading to loss of oil consumption control, or interfere with valve operation leading to valve torching. Deposits derived from fuel siloxanes can shorten engine maintenance intervals and increase overall maintenance costs – significantly reducing profitability for the operator.

Engine oils designed for landfill and biogas service must control strong acids and deposits to a much greater extent than required for 'clean gas' service.

A field test was conducted comparing four engine oil formulations in commercial landfill service over 16 months. The oils showed differences in combustion chamber deposit control and oil consumption control – a mechanism likely to control liner deposits.

By using a detergent chemistry previously untried in this application, deposits were controlled to such an extent that the time between top-end overhauls could be extended. At the same time the control of used oil parameters, such as acid and base numbers, allowed oil drain intervals to be extended.

Building on this success, research was undertaken to further improve corrosion control without sacrificing any of the performance gains already achieved. With current industry tests proving inadequate in their ability to predict corrosion and deposit control performance in these applications Infineum developed new bench test screening tools. Benchmarking was done against several 'best in class' oils, and component responses and interactions were investigated. Detergents and corrosion inhibitors were found to be the main components that can define a robust engine oil additive package. The new generation oil, developed as a result of this research, is currently undergoing field tests in both landfill and biogas applications. It is expected that the results will show improved corrosion protection and deposit control; at this stage used oil analyses look very promising.