ENGINE WEAR PROBLEMS A FACTOR OF OIL SOOT PARTICLE SIZE

Used diesel engine oil is readily identified. It's black. It's black because of soot produced by incomplete combustion of diesel fuel. This soot is also evident as black smoke coming out of the exhaust. Some of it passes the piston rings and reaches the engine oil. The amount entering the oil depends on numerous factors, including temperature, operation, engine condition, load, rpms, altitude, etc. Everything else being equal, the amount of cylinder "blow-by" controls the rate of soot entering the oil.

Well, that's how it gets there but what's the problem? If combustion was 100 per cent, diesel engine oil would not turn black with soot and no black smoke could be measured. However, for numerous reasons, including diesel fuel performance level, engine design, engine condition, etc. 100 per cent efficiency is never achieved. The problem is that soot is an abrasive, like valve grinding paste but on a smaller scale. Between two sliding surfaces, eg. piston ring and liner, or bearing and journal, the presence of soot can create abrasive wear, **if it bridges the minimum lubricating oil film thickness**, and interferes with the metal-to-metal clearance. The more soot, the greater the potential for wear.

The relative size of the soot particle to the minimum oil film thickness is of vital importance. What is the minimum oil film thickness in diesel engines? This varies with engine design, condition and load, oil temperature, pressure and viscosity, type of oil, etc. However, it is widely recognised that approximately 80 per cent of engine wear occurs during start-up when a good deal of the lube oil has drained back into the sump, leaving little for effective lubrication. The presence of soot will be most damaging during start-up.

The size of soot particles can vary considerably. This is based on microscope studies Fuel Technology has conducted on used engine oil. While there is some evidence to suggest that soot size may vary with oil type, this hasn't been our major finding. The most dramatic results by far have been observed by improving the combustion efficiency.

High performance diesel fuel, produced by a straight-run, narrow-cut distillation process, is a thing of the past. Today's diesel is not a true "distillate". It contains large amounts of catalytically cracked components (cycle oil) and higher boiling point components. The performance value of diesel fuel can be increased chemically by 6-10 percent in high speed diesel engines by introducing FTC combustion catalysts based on ferrous picrate.

on engine condition and life are not well recognised. Apart from its commercial value to fuel users, ferrous picrate is often used as a tool to study the effects of inefficient combustion since it is the easiest and cheapest way of altering combustion efficiency.

Studies were conducted at several mine sites. At Porgera Joint Venture in the Central Highlands of Papua New Guinea, the average diameter of soot particles in engine oil, decreased from 1 to 0.2 microns after a few months on catalyst treated fuel. At RioTinto's Tarong Coal operation in Queensland, catalyst use reduced the soot diameter from 0.57 to 0.3 microns. That's one-third to one-fifth the original size!

An effect of that magnitude would be expected to reduce engine wear noticeably. Reductions in engine wear of 20 to 25 per cent are not unusual with catalyst use and are supported by laboratory analysis of used oil. Ferrous picrate has long been known to reduce engine wear. Up until now it has been believed that this was due to a reduction in the *amount* of soot reaching the oil. However, there is now sufficient evidence to support the view that a reduction in the diameter of abrasive soot particles is the most important factor in reducing engine wear.

The world-wide trend to producing lower performance diesel fuels must put more urgency on maintenance people to strive for optimum combustion efficiency.

For operations experiencing wear problems, it is necessary to first determine what is the cause. However, in the majority of cases, optimising the combustion efficiency by use of the FTC catalyst will produce measurable improvements.

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