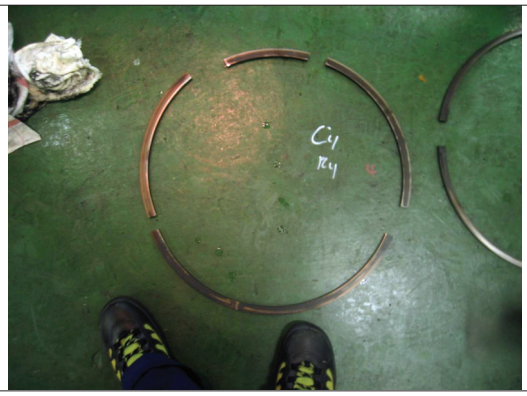
TROUBLESPOT

MONITORING PURIFIER EFFICIENCY

Maurice O'Donoghue* discusses the vital importance of a vessel's separators operating at optimum efficiency to remove catalytic fines and prevent damage to the engine

A stuffing box with damage caused by cat fines



Examples of cat fine damage

Since the 1950s, following work carried out by John Lamb on behalf of the Shell Oil Company, residual fuels derived from high sulphur crude oils have been used to power ships, providing a relatively low cost source of energy, despite the additional costs associated with their handling and treatment.

The 'oil crisis' of the mid-1970s, and the subsequent desire to wring every drop of value from the crude oil barrel, saw fluidised catalytic cracking (FCC) become the preferred method of refinery operation.

The catalysts used in this process, oxides of aluminium and silicon, are hard, abrasive and expensive. Despite it being in the interests of the refiner to recover them, this is not always possible and some fine particles - catalytic fines - can be carried over to the residual fuels.

Low sulphur problem

Following the introduction of Sulphur Emission Control Areas (previously known as SECAs, now redefined as ECAs), refiners have been forced to regard the fuel's sulphur level to be the controlling parameter and blend fuels accordingly, often using a low sulphur cutter stock to reduce sulphur levels to an acceptable level.

The addition of a cutter stock can influence the fuel's stability and ignition characteristics and can also lead to the introduction of waste chemicals into the fuel. In addition, analysis of data from samples submitted to Lintec's fuel testing programme has shown elevated levels of catalytic fines introduced by cutter stocks.

The potential for damage these particles can cause is well known. Small particles can damage fuel injection components, abrading the fuel injection nozzle and distorting the spray pattern, resulting in the fuel oil becoming unevenly distributed. In some cases the injector can begin to act as a flame thrower with fuel burning the oil film on the cylinder liner, leaving the piston rings without lubrication. This can progress to deposits being formed, causing the piston rings to stick in their grooves with piston rings breaking after only a few hundred hours operation.

Small particles can also progress into the combustion chamber itself, leading to excessive piston rod, piston ring and cylinder liner wear. Many commentators argue against the use of homogenisers as they break catalytic fines into smaller particles which are less likely to be removed by the purifier and less likely to be retained in fine filters.

Larger particles, unable to progress past the fuel injection pump due to the small internal clearances, can cause localised damage - typically scoring of the plunger and barrel.

In addition to the possibility of high levels of catalytic fines in delivered/bunkered fuel, it should be borne in mind that particles which might have settled in tanks on board can find their way into fuel after being agitated eg after a period of heavy weather. No matter how they arrived in the fuel, it is essential to ensure that the level of catalytic fines in the fuel oil meets the specification set by engine builder.

Removing the problem

Many major engine builders specify a limit of 15mg/kg in the injected fuel. However, the current edition of ISO 8217, the international standard for marine fuels, specifies a combined limit for aluminium and silicon (catalytic fines) of 80mg/kg.

In order to reduce the likelihood of fuel with high levels of catalytic fines from progressing further a combination of settling, purification and filtration is adopted.

As the time available for settling in tanks is limited, especially given the impact that the requirement for segregation of fuels with different sulphur levels has had on tank usage, the likelihood of catalytic fines settling out has reduced.

It is vital therefore that a vessel's separators operate at optimum efficiency, minimising the need for filtering – which should always be regarded as the last line of defence.

In order to ensure this is the case a number of criteria should be met.

For example:

- The 'dwell time', ie the time the fuel spends in the

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FOR PLANNED MAINTENANCE

separator, has a major influence on the separator efficiency. Consequently the flow rate through the separator should be at the minimum to allow for daily consumption

- The temperature of HFO at the separator inlet is critical, influencing both density and viscosity, and should be maintained at 98°C.
- The separator should be clean as deposits on the centrifuge discs reduce both the dwell time and the area available for separation, which can have a detrimental effect on separator efficiency.

Efficiency of the separators can then be determined by carrying out laboratory analysis of the fuel oil both before and after separation.

How do we do it?

As is the case for all laboratory analysis, obtaining representative samples is essential and reference should be made to the manufacturer's handbook for specific guidelines regarding the taking of fuel samples.

However, a few general points to bear in mind are:

- Reference to the shipping company's health and safety policy should be made
- Ensure that all personnel who may come into contact with fuel are adequately equipped with the correct personal protection equipment
- Sample points should be free from dirt
- Before any sample is drawn a small amount of fuel oil, enough to ensure that the correct fuel is being sampled, should be flushed through

  Note: Fuel oil collected from this operation should be segregated and carefully disposed of
- Samples should then be captured in a clean and previously unused sample bottle
- Sampling points will depend on the particular layout of each vessel but the 'before separation' sample should be taken as close as possible to the inlet of the separator and, if possible, before the separator inlet filter
- Similarly the 'after separation' sample should be taken as close as possible to the clean oil outlet of the separator
- Taking these samples directly from the settling and service tanks is not recommended due to the possibility of the build up of particles in the bottom of tanks mentioned above which may become agitated. Taking samples from the tanks may not give a true representation of the separator efficiency.

Samples should be forwarded to an accredited fuel testing laboratory which should then carry out full analysis against the ISO 8217 specification. A comparison can then be made of the analysis results, with special attention being paid to the levels of catalytic fines and water content.

In conclusion, typically, three things trigger efficiency monitoring:

(i) When laboratory analysis indicates that exceptionally high levels of catalytic fines have been found in bunkered fuel

(ii) When operational problems with propulsion systems are encountered

(iii) As part of a planned maintenance routine.

Including separator efficiency monitoring as part of any planned maintenance regime can significantly reduce the likelihood of operational problems with propulsion systems occurring due to the ingress of catalytic fines.

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