MAN Diesel & Turbo

Cylinder Lube Oil Feed Rate optimising – based on drain oil

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1. Background

Corrosive wear in the combustion chamber is influenced by the load pattern, the sulphur in the fuel, part load optimisation such as EGB, T/C-cut out and naturally by the lubrication rate and the BN level of the cylinder oil. The drain oil from the cylinder lube oil will reflect the corrosive wear by the BN-values and by the iron-content.

Sulphuric acid is formed during combustion of sulphur containing fuels. The sulphuric acid may condensate on the cylinder liner wall depending on the temperature of the wall and the pressure in the cylinder. The measured BN in the drain oil is an indication of the oils remaining ability to neutralise this acid. A low BN value indicates that the oil is close to exhaustion and thereby cannot protect the engine from the acid. The iron (Fe) concentration will reflect the wear. A high number will be an indication of high wear.

We recommend to optimise the cylinder lube oil feed rate to secure the drain oil in the safe area. See Figure 1.

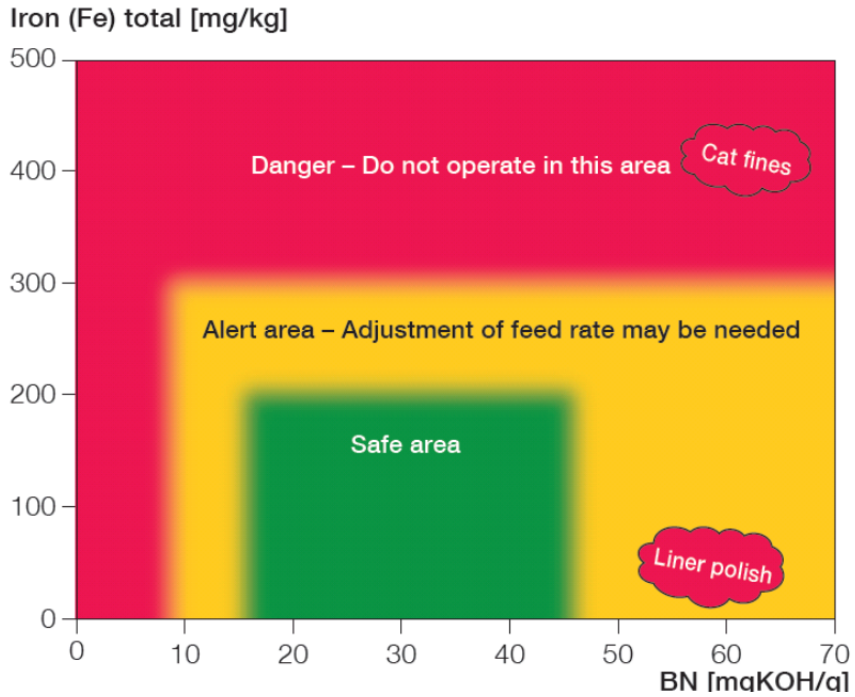

Figure 1: *Drain oil BN vs. iron (Fe) operating area.*
Results based on laboratory measurements.

2. Optimising procedure

The corrosive wear can be controlled by the cylinder lube oil feed rate and by selecting corresponding adequate BN.

Practical approach:

1. If the BN value in the drain oil is too low or the iron content is too high, the cylinder lube oil feed rate must be increased by increasing the feed rate factor (the ACC factor).
2. If the BN value is high and the iron content is low, the cylinder lube oil feed rate may be decreased.

The BN and iron-content may be measured by accurate laboratory methods, or it can be indicated by on board equipments. For the on board iron measurements, we recommend the methods that measure all the iron – both iron from corrosion and from abrasion and adhesion.

The BN may be measured by on board equipment. The most common – and also most convenient method - are small equipments where drain oil and an acidic reagent are mixed by shaking and the resulting pressure rise indicates how much CO_2 is formed. This value is converted to a BN value.

We refer to these equipments as "BN shakers". The results from the "BN shakers" are not as precise as the laboratory measuring methods, so we recommend building in extra safety margin and operating with "BN shaker" values above 20 BN in the drain oil. See Figure 2.

Figure 2: Recommended "BN shaker" results for reliable cylinder condition.

Procedure for reliable cylinder condition - based on drain oil and "BN shakers":

1. Calibrate carefully the "BN shaker" on the fresh, actual cylinder lube oil.
2. Check the "BN shaker" value on the fresh, actual cylinder lube oil.
    a. If the value differs (>± 5%) from the stated (and calibrated) value, recalibrate the equipment as point 1.
3. Sampling and feed rate adjustment to be carried out at stable conditions and actual load and actual fuel.
    a. Set the cylinder oil feed rate as according to ACC-factor = 0.45.
    b. Run stable conditions for 24 h, and then take drain oil samples from all cylinders.
        i. Measure the BN value using the "BN shaker".
            1. If the BN value is above 20 BN, then decrease the ACC-factor by 0.05 to 0.40 and wait 24 hours.
            2. If the BN value in new samples is still higher than 20, then decrease the ACC-factor further by 0.05 and repeat the procedure in 24 hours intervals until BN 20 is reached.
        ii. Check the "BN shaker" value on the fresh, actual cylinder lube oil.
            1. If the value differs (>± 5%) from the stated (and calibrated) value, recalibrate the equipment as point 1 and repeat the measurements on the drain oil samples.

4. When the fuel is changed, repeat point 3.b.
5. When the load is changed, repeat point 3.b.
6. Further to the on board testing, we suggest that you perform a feed rate full sweep test using fuel with high Sulphur, low load and forward the samples to an on shore laboratory.
   See attached procedure.