



# Cylinder Condition Optimization Program *Report Example* "MV Vessel Name"

Report based on Port inspection pictures and scrape down analysis from vessel

Date:

**Company Name**

Address

City

Country

Att.: Contact Name

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General Data	
IMO	XXXXXXX
Engine type	7K80MC-C
ME run hrs.	43623
Lubricator	HJ Lubtronic
Valve type	HJ SIP
Installation date	2014
Lube oil	Alexia S4
Sulphur % in fuel oil	2.49
Regulation	HJ Lubtronic
Reported feed rate	0.60 g/kWh
Calculated feed rate	0.71 g/kWh

Software	
MFC	5.976
PC	1.24a
CLC/HSC/LFC	5.934

## 1 Summary

This report is based on received oil samples from vessel taken at the 11<sup>th</sup> of August 2014 together with the received questionnaire and pictures dated at the 27<sup>th</sup> of August 2014.

Based on below report we recommend you to focus on the following:

- Reduction of cat fine level
  - Clean fuel oil system – vessels fuel day tank to be thoroughly cleaned
  - Optimize operation of purifiers – adjusted to lowest throughput and highest temperature
- Replica to identify cat fines on liner surfaces (Please see SDA page 4+5)
  - Potential honing of liners
- Increase feed rate for short period to flush out particles from system
- Check and adjust the actual feed rate setting
- Potential for lowering the feed rate when cat fine issue is solved

## 2 Data

Please note this report is based on SDA samples, port inspection pictures and below data from vessel.

Data received	
Feed rate	0.60 g/kWh
Operation load	32 %
RPM at 32 % load	68 rpm
kW/Cylinder at 32 % load	1503.3 kW
CLO consumption at 32 % load	190 L/24h
Stroke length	2.25 mm

## 3 Comments on feed rate

Calculation from received data	
$\text{Feed rate} = \frac{\text{CLO consumption} * q * 1000}{24 * \text{cylinder amount} * \text{kW/cylinder}}$	$\Rightarrow \frac{190 * 0,945 * 1000}{24 * 7 * 1503.3}$
Calculated specific feed rate	0.71 g/kWh

From the data you have provided we have calculated the specific feed rate to 0.71 g/kWh at the given load (1503.3 kW/cylinder) which is different from your informed feed rate setting of 0.60 g/kWh. Our calculation is based on a CLO consumption of 190 ltr/24hr.

The difference can be caused by using the LCD function when vessel is maneuvering or sailing in hard weather, if data have not been steady for 24 hours or by vessel crew making a wrong reading.

## 4 Comments on cylinder condition

This report is only based on received oil samples from vessel taken at the 11<sup>th</sup> of August 2014 together with the received questionnaire and photos dated at the 27<sup>th</sup> of August 2014.

ANALYSIS RESULTS										
Color code:		Normal limit			Warning limit			Critical limit		
CYLINDER NUMBER		Average	1	2	3	4	5	6	7	
Feed rate	g/kWh	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	
WEAR										
Iron	Fe	mg/kg	222	311	201	258	211	195	135	244
Chrome	Cr	mg/kg	4.7	4	3	3	7	6	5	5
Copper	Cu	mg/kg	7.57	7	5	6	11	11	8	5
PQ index			26.6	27	30	29	25	25	25	25
CONTAMINATION (non-magnetic)										
Cat fines	Al+Si	mg/kg	20.9	21	19	18	24	22	21	21
Silicon	Si	mg/kg	14.3	15	13	13	16	15	14	14
Aluminum	Al	mg/kg	6.6	6	6	5	8	7	7	7
Sodium	Na	mg/kg	77	76	75	59	87	87	75	80
Nickel	Ni	mg/kg	117.1	107	124	85	136	126	126	116
Vanadium	V	mg/kg	701.6	670	675	527	805	761	739	734
Sulphur	S	% Wt	2.45	2.55	2.38	2.38	2.40	2.29	2.62	2.54
Water		%	1.08	1.04	1.03	1.05	1.20	1.13	1.09	1.02
Soot content		%	0.4	0.2	0.5	0.2	0.5	0.7	0.4	0.1
Excess system oil > 20%			14.2	14.2	15.6	13.8	12.5	11.9	16.3	15.0
OIL CONDITION										
Viscosity at 40°C		mm <sup>2</sup> /s	222.31	211.36	202.12	204.01	251.98	238.02	244.00	204.69
BN		mgKOH/g	16.03	14.80	18.10	20.53	16.61	18.03	14.64	9.47
ADDITIVES										
Calcium	Ca	mg/kg	20783	20760	19870	20739	23586	21632	19284	19611
Magnesium	Mg	mg/kg	74.1	74	71	74	84	77	69	70
Zinc	Zn	mg/kg	41.7	45	47	41	38	37	42	42
Phosphorus	P	mg/kg	29.9	33	33	30	27	26	30	30

### Iron level:

The iron levels are good and below our warning limit (yellow) at 400 ppm. Together with the low PQ index (content of magnetic ferrous particles) this indicates no abnormal wear. We recommend keeping an eye on unit # 1 since the iron level is higher than on the other units. It will be a good idea to check piston rings, skirt and liner on unit # 1 for abrasive wear if the iron level is increasing.

### Chrome level:

The chrome level is good for all units (3-7 ppm). Our recommendation (green) is between 2 and 5 ppm and the warning limit (yellow) is 10 ppm. High chrome level indicates high ring gap wear which need to be checked if the level is above the warning limit (10 ppm).

### Copper level:

Copper level on unit # 4 and 5 is a little high (11 ppm) compared with the other units. Therefore we recommend you to check the stuffing box sealing and piston rod for abrasive wear.

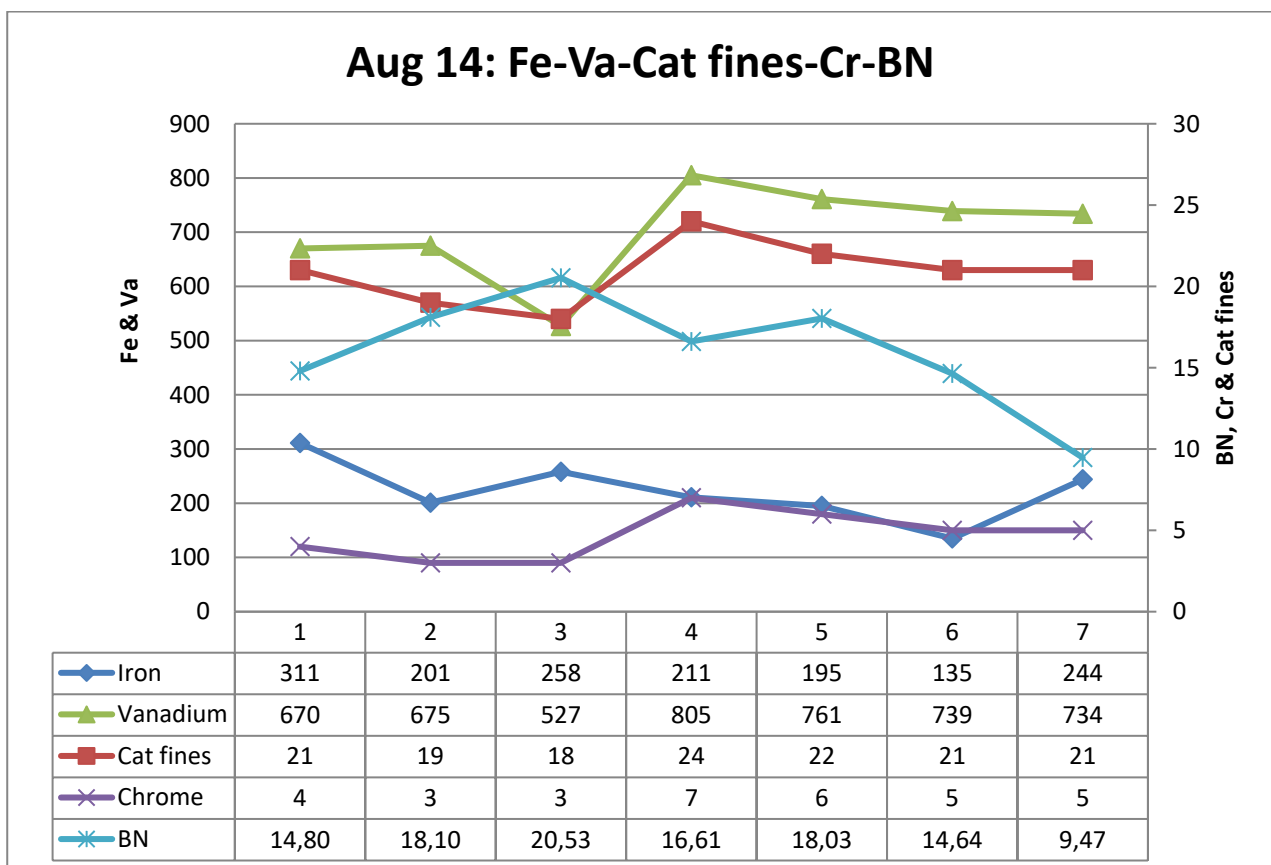
### Cat fine level (Silicon + Aluminum):

Silicon and aluminum are catalyst and residual product coming from the refinement process of oil, called cat fines. The cat fine level should be below 15 ppm which is our recommendation (green). Currently your cat fines level is higher than recommended for all units (between 18 and 24 ppm). Please note that silicon also can be present in the CLO and therefore we recommend you to send sample of new CLO together with the oil samples for each unit. Cat fines can cause huge damages on your system by increased wear on liner, piston rings, skirts and ring gap.

### BN level:

BN level is too low on unit # 7 (9.47 ppm). The BN levels on other units are good maybe a little high for unit # 3 and a little low for unit # 7 (between 9.47 and 20.53 ppm). Our recommendation is that the BN level should be about 15 mgKOH/g at normal operation with HJ SIP valves. Our warning limit is 5 mgKOH/g.

### Comparison between parameters:



As shown in above graph the parameters for each unit is almost following each other. As it can be seen high cat fine level influence in high iron level and chrome level. Vanadium shows the concentration of the samples and the other parameters will follow the vanadium.

Specific mentioned pictures are shown below with unit numbers and short description.

**Piston ring and ring land:**

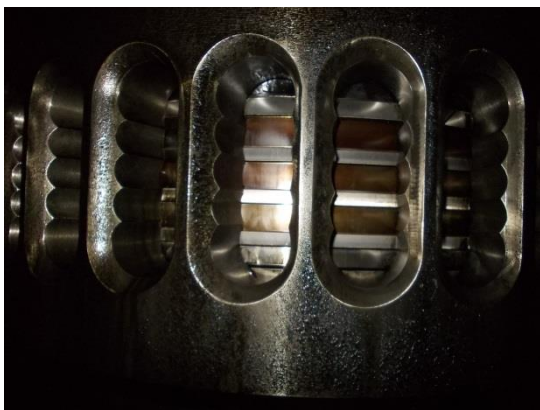
All ring lands look in good condition without too much deposit from unburned fuel. All rings also look in good condition and all rings are wet of CLO. Unit # 2 and 4 are good examples of the general condition.

**Piston crown top:**

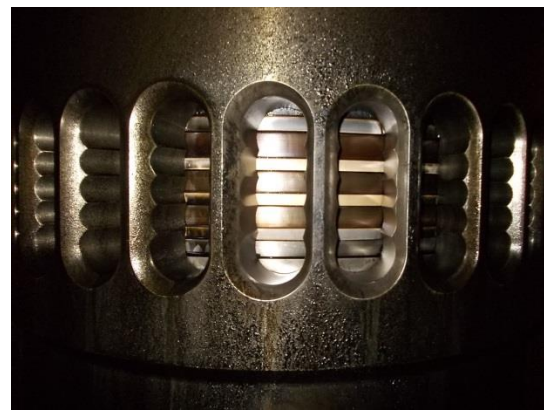
All units show clean and dry areas (see pictures of unit # 1 and 3).

**Liner surface:**

All liners look in good condition with vertical machining marks visible. Especially on unit # 1 and 4 the machining marks is still visible at the liner surface.



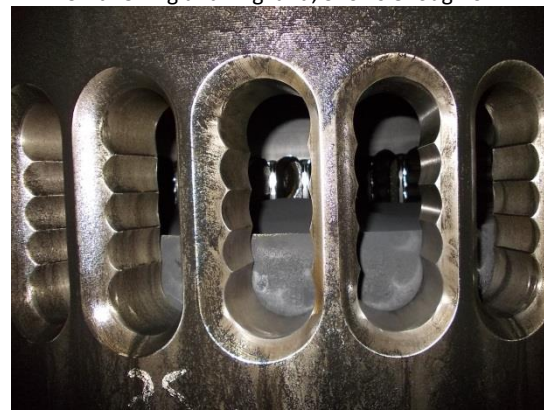
Unit #2 ring and ring land; Shows good condition



Unit #3 ring and ring land; Shows enough oil



Unit #1 piston crown top; Shows clean and dry areas



Unit #3 piston crown top; Shows clean and dry areas





Unit #1 cylinder liner; good condition with oil visible at the liner

Unit #4 cylinder liner; good condition with oil visible at the liner

## 5 Recommendations

Based on our experience high cat fine level can cause high wear rates and the high wear rate will continue for a very long time if nothing is done and therefore we strongly recommend you to focus on the potential high cat fine levels.

Once cat fines are found in the fuel system, there will always be cat fines in the system. As a minimum we recommend the vessels fuel day tank is thoroughly cleaned and the fuel purifiers must always be adjusted to the lowest throughput and highest temperature (approximate 98 degrees). Kindly note that silicon can be from the CLO and then it is not dangerous for the cylinder units. Therefore it is very important to send sample of new CLO together with used ones for each unit.

It is also recommended that the liner running surfaces are checked for cat fines if the cat fine level is not lowered in next sample. This is done by making a Replica. If replica shows cat fines on the liner running surfaces we strongly recommend you to hone the liners. We can provide the replica service by sending one of our engineers onboard to make the Replica. Alternatively you can buy a Replica camera from us and get training in operation and function by our service engineer. Then you will be able to make the Replica pictures on your own and then send the Replica pictures to us for evaluation. To make the Replica the cylinder top cover needs to be removed. Please let us know if we should send you a quotation for the Replica opportunities.

To flush out the loose particles we recommend you to increase the feed rate by 0.5 g/kWh for a shorter period. When the cat fine levels are within the acceptable limit the feed rate can be lowered again.

Since the TBN level is on a fine level and a little high on some units further reduction of the feed rate is possible when the level of cat fines is lowered to an acceptable level. Reduction is done, one unit first, by reducing feed rate by 0.05 g/kWh. Afterwards a cylinder inspection is carried out at earliest opportunity - preferably within 48 hours. If the observation indicates there is enough lubrication present you can reduce other units as well.

## 6 Action Points

1. Check if there are silicon present in the new CLO
  - a. Silicon in the CLO should be deducted from the cat fines, potentially lowering cat fines
2. If no silicon in the CLO increase the feed rate to flush out the particles (cat fines)
3. Ensure optimal operation of purifiers (lowest throughput and highest temperature)
4. Keep an eye on the running surfaces until cat fine issue is solved
  - a. Low iron (Fe) and adequate BN levels
5. When cat fine issue is solved the feed rate can be lowered

Yours faithfully,  
HANS JENSEN LUBRICATORS A/S