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CYLINDER LUBRICATION (MW)

SIP - Swirl inject^{n} principle. - Han Jensen Lubricator.

Q Why liner wear is max in the upper region?

Ans Cos at upper region, there is high temp, high pr. and speed of piston is min

also bearing Modulus (BM) $\propto \frac{\mu N}{P}$

μ = viscosity of oil
N = velocity of moving part.
P = pr.

So as BM ↓, the hydrodynamic lubricat^{n} convert into boundary lubricat^{n} and hence mech. contact b/w piston and liner occurs.
Coz in boundary lubricat^{n}, the oil film is very weak

Properties of cyl. oil

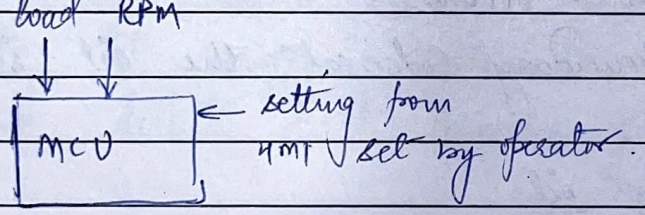
1. Base No. (BM) - to neutralise acidic products of cold corros^{n}.
2. Viscosity Index should be high.
3. Detergency - cleaning ability of oil.
4. * Dispersency - Not req for cyl. oil but for system oil. this property doesn't let contaminants mix in & keep them suspended.

Alfa Lubrication System

- mostly fitted on MAN B&W engines.

- it is a fully electronic system.
- Pump station :- 2 pumps delivering 40-45 bar pr. __/__/____
  tank - oil comes from main cyl. oil tank to this daily tank.
  starter panel for both the pumps.

- ALCU → MCU BCU SBU
  Alfa lubricator control Unit
  Master Control Unit (MCU)
  Back-up control Unit (BCU)
  ~~Stand by~~ unit (SBU)
  Switch board.
- MCU & SBU controls the oil delivery.
- HMI module (in ECR)
  Human - machinery interface.
  for monitoring & adjustment. & alarm system
  S% & feed rate factor is fed in HMI panel.



- For 70-98 cm bore engine - 2 lubricator for each unit.
- 4 / lubricator each unit in medium & small size engines
- Each lubricator has 2 accumulator.
  1 on inlet - with nitrogen pre-press of 25-30 bar
  1 on outlet - with nitrogen pre-press of 1.5 bar.

Alarms associated with alfa lubricator system
- oil pr. low
- Feed back fail
- Cinder failure
- Common alarm
- Mask / triggers fail

Working Principle

- pump station supplies Alpha lubs. with 40-50 bar oil pr.
- MCU controls oil injection by activating solenoid V/v of relevant lubricator.
- A feed back signal indicates that oil injection has taken place by lighting the LED on intermediate box for each cylinder.
- Timing is based on 2 signals from angle encoder, a TDC cylinder 1 marker and a c/shaft position trigger.
- timing of injection into piston ring pack b/w 1st & 2nd piston ring during compression stroke.
- Const. amt. of oil is supplied per injection, specific feed rate is controlled by variation of injection freq.
- injection freq. is calculated from index & speed.
  Injection freq & MEP (load mode)
  However rpm mode is also available.
- Basic feed rate at MCR (100% MCR) is calculated as a co-relation b/w no. of injection/rpm & stroke of lubricator.
- On HMI adjustment of feed rate for individual cyl. is possible b/w 60% to 200%.
  Default value is 100%
- During normal operation MCU is in control in ECR
  incase of any failure - common alarm is activated & details of specific alarm comes on HMI panel.
- incase the fault is critical in MCU system, BCU takes over if the system is in auto mode.
- BCU is based on random timing & rpm mode
- at this time the basic feed = basic feed rate + 50%

Cyl. Lo pr normal service value = 40-50 bar
Alarm value = 35 bar
normal service temp = 40-60°C
alarm value = 70°C.

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* Adjustment of basic feed rate?
& How will you decide feed rate factor.
from the chart pasted near HMI panel.

Alpha Lub ACC
BN 70 Cyl. Oil

std	ACC factor Running in Phase 2	Phase 1	Dosage (ACC factor x Std)	HMI Setting
0.2	0.23	0.26		
0-3.0	0-2.6	0-2.3	0.6	55
3.1	2.7	2.4	0.62	57
,	1	1	1	1

Similar chart for BN50

Similar chart for BN40.

(C) → in ME Engines → load change dependant.
When RPM slipped ± 2%, the basic feedrate is increased by 25% automatically for 30 mins.

* for load less than 25% MCR → rpm dependant lubrication.
for loads abov 25% MCR → load dependant lubrication.
here load = MEP

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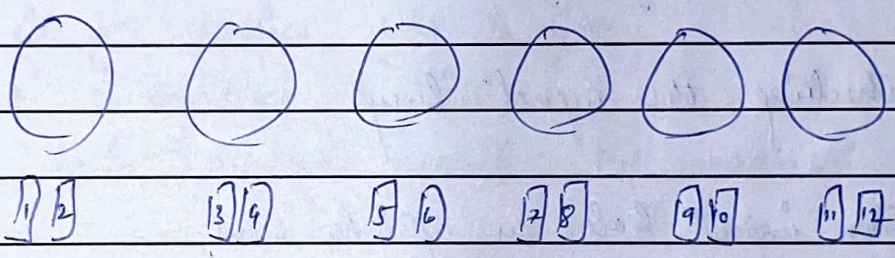
Specific cyl. oil Consumptn

feed rate g/kwh =.

$$\frac{\text{strokes/min (from HMI panel)} \times \text{lubricator vol}^{m} \text{ (from manual)} \times \text{oil density} \times 60}{\text{power (kw)}}$$

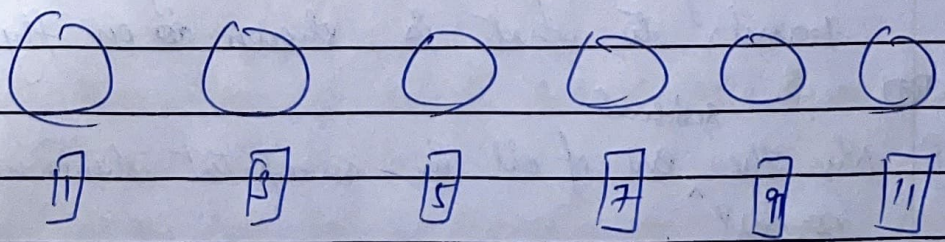
↑ from BMS

* for large bore engines more than 700mm bore dia, there are 2 lubricators/unit.
So numbering of lubricator will be as follows.



4 if any one unit's one lubricator fails, then the other lubricator of same unit will deliver 200% oil. but engine will operate normally & faulty lubricator can be changed at convenience

* for engine with bore less than 700mm, only 1 lubricator is present.
and numbering will be as follows



if one unit lubricator fails = engine slow down.

Q Emergency running without external trigger signals (Tacho signal + pickup sensor both failed)

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- In MCU card connect J52 to J22 with an emergency operation cable
- lubrication = 1 pulse/second = 60 pulse/min.
- J52 is called strokes generators.
- The system now lubricates regardless of whether the engine is running or stopped.
- 125% of basic feed rate
- random and rpm dependant lubrication

* Min. feed rate cannot be reduced less than 0.6 gm/nozzle/hr. coz of hydrodynamic lubrication.

Q Checking the injection timing

- Open inspection hole on cylinder liner.
- clean it.
- wear safety glasses.
- Turn engine in ahead direction, till you see fuel piston going from the inspection hole.
- check the angle on flywheel.
- compare this with angle of HMI panel.
- if they both match timing is correct.
- if they doesnot match change the timing on HMI panel to what is shown on flywheel.

Q Why the residual BN of oil in sweep test should not be more than 50 BN?

Ans Alkalinity in oil is due to the presence of calcium carbonate.

- So excessive BN will cause bore polishing due to deposit of calcium on rings.

Alpha lubricator operation

- 40 bar cyl. oil is supplied from p/p unit to lubricators. Inlet solenoid v/v is de-energised.
- No cyl. oil is supplied to quills.
- As per timing, MCU gives an electrical signal to solenoid v/v.
- Energizing of solenoid will cause cyl. oil to feed into respective lubricator.
- Plungers will move due to ~~arm~~ of actuator piston having a stroke.
- cyl. oil pr. pushes NRV to open.
- cyl. oil is supplied to quills.
- Feed back sensor monitors the movement of actuator piston.
- After cyl. lub. is accomplished, MCU gives signal to de-energize the solenoid.
- pr. acting on actuator piston reduces as the oil return is open due to de-energising of solenoid.
- Causing actuator piston's spring to push it back.
- Resulting in shutting of NRV.

Accumulator charging & pr. testing procedure

- Connect the hose of kit to reducing v/v. & another end to the filling v/v.
- Connect a 0-60 bar calibrated pr. guage to filling v/v.
- Connect reducing v/v to nitrogen cylinder.

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- Secure inlet accumulator on bench wise with soft jaws & remove its top protective caps.
- Clean the seating surfaces of accumulator & filling v/v.
- mount filling v/v on accumulator
- make sure venting v/v & fitting v/v are closed.
  ↓ on filling v/v ↓ on reducer
- Open the plug screw on accumulator with socket wrench.
- pr. guage will show pr. of accumulator & compare it with manual. high
- if the pr. is ~~low~~ open the vent v/v & bring pr. to desired value.
- if the is low first open the reducer v/v & then open the nitrogen cylinder v/v.
- Turn the needle v/v slowly in clock wise dirⁿ until the outlet pr. guage on reducer shows pr. slightly higher than desired pr.
- Open the outlet v/v on reducer.
- charge the accumulator to specified value.
- close the filling v/v on reducer.
- Tighten the plug screw to specified torque
- close the vent v/v.
- close the cylinder v/v.
- fully turn the needle v/v on reducer counter clock wise.
- Remove the filling v/v from accumulator.
- once again tighten the socket screw to specified torque
- put the protective cap back.

Q Diff b/w alpha Acc of ME & MC engines.

- In ME there is not MCV, BCV & SBV.
- ECU controls the inject^{n} timp & qty is controlled by ECU.
- feed rate etc can be changed from MOP panel.
- Actuat^{n} pr. in ME engine is 200 bar system oil, instead of 45 bar cyl. oil for actuation.

SULZER LUBRICATORS (Pulse Lubrication)

TRIBO PACK:- Fine b/w o'haul is largely determined by piston-running behaviour & its effect on wear of piston rings & cyl. liners.
To increase TBO Sulzer RTA series engine has introduced TRIBO PACK technology.

- it incorporates multi-level lubric^{n} also.
- it reduces ~~SOC~~ SLOC also.
- appropriate liner material.
- deep-honed liners
- Insulating tubes in cooling bore in upper part of liners.
- Mid stroke insulat^{n}.
- Anti polishing ring at top of liner.
- Pre-profiled piston rings.
- chromium-ceramic coated piston rings.
- Running in coating.
- Increased thickness of chromium layer in piston ring grooves.

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Pulse type lubricatn.

Components:-

① Daily serv. tank 1 for cyl. LO.
② LO filter - 1 per engine.
③ LO pump - 1 per cylinder

- control unit ALM-20
- 4/2-way solenoid v/v
- pr. transmitter.

④ Lubricating quill with injectn nozzle (6 per cyl.)
⑤ NRV
⑥ Control thing of the system via Engine control system.
⑦ Measuring tube.

* Servo oil pr. in sulzer = ~~200 bar~~. 50-60 Bar.

* SLOC Calculatn.
- via measuring tube.

$$SLOC = \frac{3600 \times (h \times k) \times \rho}{f \times t \times P}$$

h = measuring height. (cm)
k = const. conversn factor. (l/cm)
ρ = oil density (g/l).
f = Power correctn factor.
t = time period in (seconds)
P = Engine Power o/p (kW)

* Difference b/w pulse jet & pulse feed system.

Pulse Jet :- The lubricator delivers the LO as pulse jet on the liner wall.
- From there, the lubricating oil is distributed around the circumfrence of liner.
- vertical oil distribution is determined by inject^{n} timing.
- it is adjusted by means of control system.

Pulse feed :- The lubricator delivers the LO as compact pulse feed exactly into the piston ring pack (80%) & piston skirt (20%)
- from there the LO is distributed around the circumfrence of liner

SIP Lubrication (Swirl Inject^{n} Principle)
- It reduces cyl. oil consump^{n}.
- The main objective of cyl. lub. is to :-
(1) To lubricate liners and to obtain stable hydrodynamic lube oil film b/w liner & piston rings.
(2) Maintain cleanliness of piston, liner & PR pack.
(3) neutralise the acids formed during the combust^{n} in order to avoid the cold corosion of liner surface.
- The idea behind the Hans Jensen lubricator, swirl inject^{n} principle (SIP) for cyl. lubrication is to add the oil to the liners wall at each upward stroke & distribute evenly on liner walls, where it is mostly needed for acid neutralisation.
- Re tests shows that it is possible to reduce the oil feed rate from 0.9 g/kWh to 0.6 g/kWh and still secure the well lubricated liners. This further reduces

the sludge formatn.
- The corrosive wear & hence max wear rate was reduced even with lower feed rate, improving the liner life.
- Reductn in feed rate also reduces particulate emission & ash formatn.

Advs of SIP.
1. well lubricated liners
2. reduced oil feed rate
3. reduced corrosive wear, improves liner life.
4. reduced sludge formatn.
5. reduced emission.

* The Han Jensen's Swirl Injectn principle works by spraying cyl. oil onto the cylinder liners surface during pistons upward motion, before it passes the lub. grills. The scav. air swirl helps distribute the oil. and forces it outwards to liner walls. This ensures optimal distribut & places the oil at top of cyl. liner where the additives & oil film are needed the most.
Please not that HJ SIP is a type of I/V & not a lubricator

Sweep down test.

To determine:
1. Residual BN.
2. Iron content — Magnetic Iron - due to abrasive & adhesive wear
Non-Magnetic Iron - due to corrosn.

Freq:- On-board - 100-200 hrs or monthly -
lab analysis - 1500 hrs or 3 monthly.

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* A lab analysis is accurate and can determine :-
(1) residual BN.
(2) magnetic index (PS index).
(3) water content.
(4) wear particles.
(5) contaminants
(6) additives.

Iron content limit = 200 mg/kg.
residual BN limit = 25-40 mg KOH/g.

Q After 2020 sulphur % has reduced but cases of cold corrosion has increased. why?
(1) Longer strokes L, S, G strokes.
(2) Lower engine speed :- more time for sulphur dioxide to react with moisture and condense on liner walls which increases cold corrosion.
(3) Miller cycle :-
(4) Derating :- like adding shims below piston palm. due to which more expansn ratio compared to comp. ratio.
(5) higher cyl. pr.
(6) complexity of available fuels.

Remedies to overcome 2020 problems :-
(1) LSCL System.
(2) RSL liner, (rating dependent cyl. liner cooling)
(3) higher BN oil.