0ptimization Cylinder Filling Factor Based 0n 0il Sample Scavenge Box

Qiang WANG [1, a], Boyang LI [2,b] and Fuqiu WANG [3,c]

[1, 2, 3] Department of Marine Engineering, Qingdao Ocean Shipping Mariners College
[a] wangqiang@coscoqmc.com.cn, [b] liby@coscoqmc.com.cn, [c] wangfq@coscoqmc.com.cn

Keywords: Scavenge box oil sample; Alkali value; Alpha ACC technology; oil factor

Abstract. In this paper, through assay scavenge box drain tank iron (Fe) content in the oil and alkali value, calculate the wear volume and fuel sulfur (S %), optimization of cylinder filling factor ACC, concluded that the best cylinder oil injection rate and injection timing. In order to improve the cylinder liner wear, improve the operation economy of the diesel engine, is worthy of reference for shipping companies and reference.

Introduction

According to related statistics, 10 ~ 20% fuel consumption accounts for the total cost of the shipping enterprises, and the ship host oil costs accounted for 70% of the host total maintenance cost. Especially in the environmental protection requirements, under the background of international energy becomes more and more serious, how to reduce the consumption of fuel oil, cylinder oil, reduce the pollution to the environment, is each shipping enterprises must face and research topic.

Especially in shipping market downturn, the speed of main engine droop power operation, the use of high viscosity inferior fuel, more stringent requirements are put forward for cylinder lubrication, Using the Alpha ACC (Adaptable Cylinder oil Control) of traditional optimization Control of Cylinder lubricator, improve the injection timing control, fuel injection precision, it is very important.

The shortage of the traditional oil cylinder device

Traditional way of mechanical speed adjusting control cylinder oil rate exist the following disadvantages:

One is the injection timing out of control, oil is not timely, produce unnecessary waste.

Second, oil injection rate control is not accurate, if the large amount of oil, piston ring and cylinder liner wear serious, cause waste; If the oil injection quantity is too small, can't conform to the requirements of the lubrication, the first piston ring, and the first piston ring on the top dead center corresponding to the position of the cylinder liner, wear will be more serious, serious when cause cylinder, cylinder sticking failure.

The technology of electronic timing cylinder oil injection device Alpha ACC

Electronic timing Alpha ACC cylinder oil injection device, the mechanism is that, cylinder oil injection power provided by the electronic timing injection of high pressure lubricating oil pump, oil supply pressure is 4.5 Mpa, the pressure can be regulated by pumping station hydraulic circuit to realize; Amount of homogeneous cylinder oil through the loop to the injection needle valve, through the electronic timer control, get the best injection timing, the cylinder oil injection cylinder, cylinder wall to lubrication. This device is suitable for the MAN B&W ME \ MC main engine mechanical oil cylinder oil injection equipment technology optimization.

The Relationship between Wear Rate and the Cylinder Oil Base Number . By testing of diesel engine wear, cylinder liner, piston ring wear rate is bigger, should be optimized to improve filling oil factor ACC, to reduce the wear rate of diesel engine cylinder liner, piston ring.

MAN B&W diesel engine company is given, scavenge box drain tank, oil analysis report, and according to the operation condition of diesel engine, as shown in Fig. 1 can be drawn from the relationship between wear rate and the cylinder oil alkali value.

Fig.1, the green part of the said engine cylinder lubrication in good condition; Yellow said according to wear and sulphuric acid corrosion is relatively serious, need to change cylinder oil filling rate, to improve the cylinder lubrication condition; Red part means danger restricted areas.

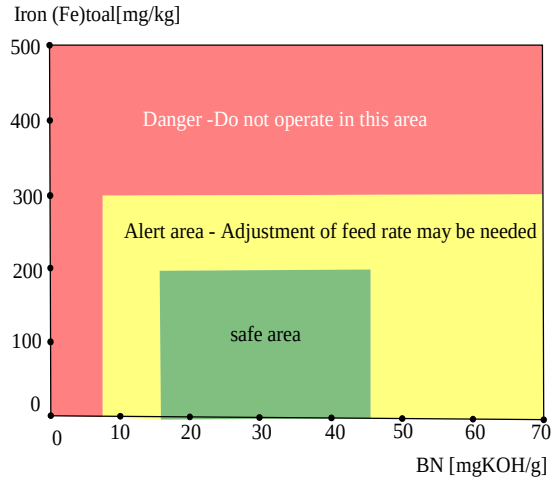

Figure 1. Drain oil BN vs. iron(Fe)

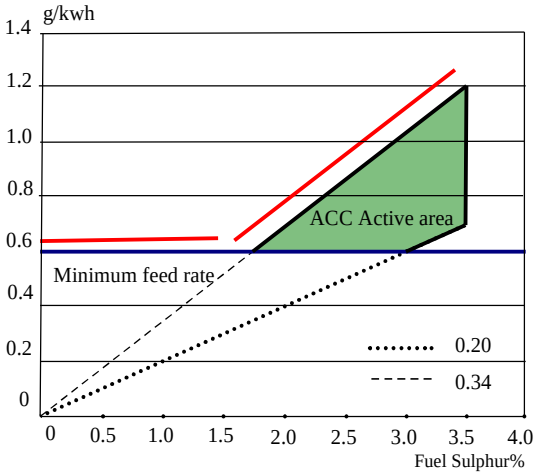

Figure 2. BN70 ACC range

The Scope of Alpha ACC oil Filling Factor . MAN B&W diesel engine company ACC (BN70) filling factor is given the value of the range of 0.20 to 0.34 (g/kWh x %S), as shown in Fig. 2, the minimum value is 0.60 g/kWh.

Diesel engine under 50% load running, scavenge box drain tank through test sample, alkali value BN in 5 ~ 25 mg KOH/kg, iron (Fe) content between 200-300 mg/kg, can be shown in Fig. 3, the best filling factor ACC between 0.25 ~ 0.30, based on the best filling factor, through adaptive electronic timing cylinder oil injection device control unit won best oil rate adjustment.

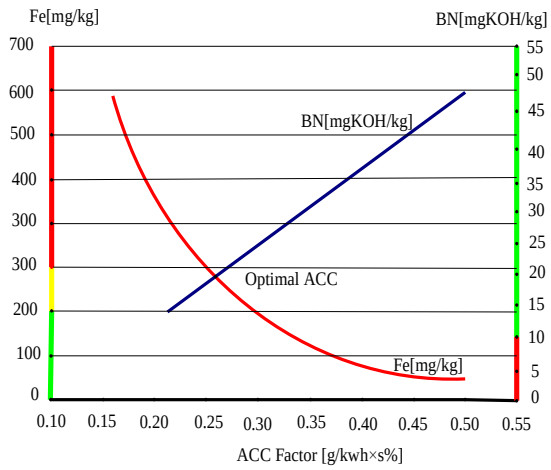

Figure 3. Feed rate sweep Figure

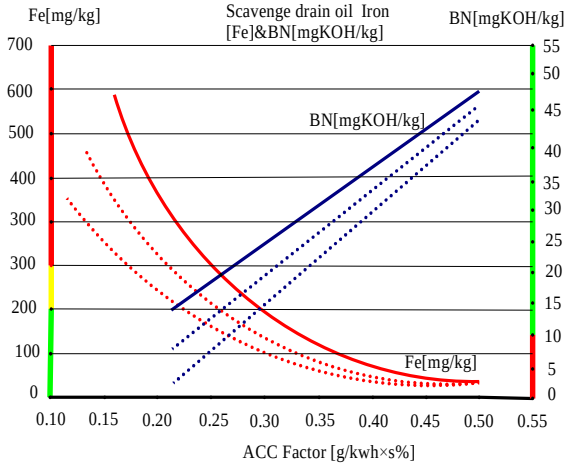

Figure 4. Scavenge box filling factor ACC optimal selection of sample test

Calculation oil factor. Shown in Fig.4, the vertical green part of the safe operation of the said, on the left said residual oil iron content: 0-200 Fe (mg/kg) normal range;200-300, Fe (mg/kg) cylinder liner wear rate has reached lubricating oil supply limit; more than 300 Fe (mg/kg) wear and sulphuric acid corrosion is serious, need to increase the rate of oil cylinder oil injection. The vertical axis on the right side of the said base number BN (mg KOH/kg) content: 0 to 10 BN said acid corrosion is serious, need to increase the rate of oil cylinder oil injection; 10-50 BN belongs to the normal range. Cylinder liner wear rate (Fe content) it is safe to under 200, Can get the best filling factor ACC is 0.30 (g/KWH x % S).

Different base number of BN cylinder oil, how to obtain the best oil factor, BN45, for example, are usually based on BN70 calculation analysis.

Select the ACC (BN70) = 0.26, the ACC (BN45) = 0.26 × 70/45 = 0.40.

By optimizing the cylinder oil filling factor ACC, Alpha ACC into electronic timing cylinder oil injection device control unit is analyzed to optimize give a best cylinder oil injection rate, injection timing, cylinder so as to make the diesel engine running under partial load, the cylinder lubrication can achieve the best condition.

Host scavenge box scraping cylinder oil monitoring measures

Using a liner operating state monitoring methods to ensure that control of the operating cost and spare parts, to ensure the feasibility of cost reduction. Laboratory analysis of scavenging air box scraping cylinder oil, cylinder oil injection rate, the relationship between the residual alkali value and iron content as shown in figure 5. Cylinder oil does not provide enough base number, when the residual alkali value dropped below 27.5 and iron content reaches more than 200 PPM, will wear and corrosion to occur in this also can be reduced to a limit of oil cylinder. Scavenge box scraping cylinder oil parameters as shown in figure 6, the relationship between each cylinder scavenging assay sample including box sampling, the host system oil drain valve (circulating oil tank) sampling, the burning fuel sampling. Residual alkali value monitoring cylinder oil consumption, judge cylinder filling rate is reasonable; Iron content in monitoring the wear, facilitate early detection failures; In ECA and the ECA area monitoring cylinder oil base number.

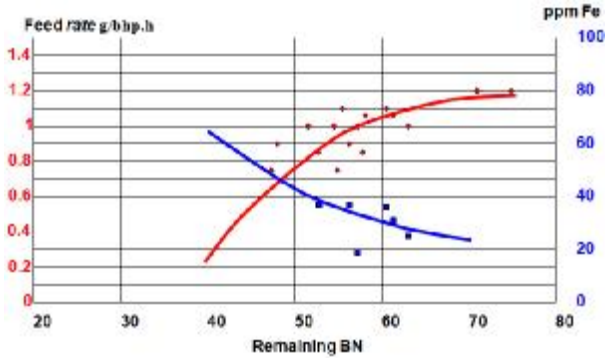

Figure 5.cylinder filling rate - residual alkali value - iron content diagram

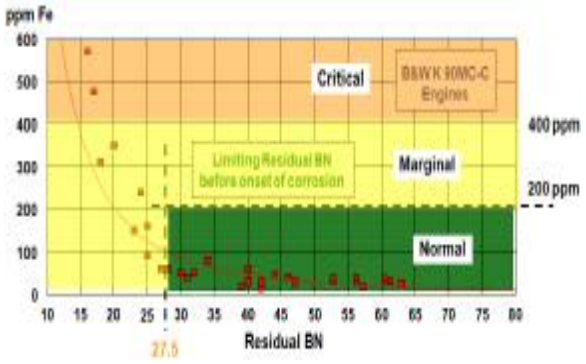

Figure 6 scavenge box scraping the relationship between the parameters of cylinder oil

The Alpha ACC device efficiency analysis

To Improve Diesel Engine Cylinder Liner Wear . The mechanism of Electronic timing cylinder oil injection device Alpha ACC is in maintaining the wear rate of cylinder liner right under the premise of lower cylinder oil consumption.

In round to COSCO Europe main engine 12k98ME diesel engine cylinder liner wear process, according to the cylinder oil filling rate is too small and too much fuel sulfur content is the main cause of cylinder liner wear. By means of scavenging air box drain tank iron (Fe) content detection analysis and comparison, using two different adjustment modes, lubrication cylinder liner, get a different wear rate. Cylinder liner wear is larger, and the cylinder oil consumption is higher, is to use mechanical lubricator, speed adjusting control oil injection rate; Cylinder liner wear is small, cylinder oil consumption is low, it is to use electronic timing of cylinder lubricator, load adjusting control filling rate.

To Improve Diesel Engine Running Economy. Electronic timing cylinder oil device returns can be verified by marine testing. Table 1 shows main engine 12k98ME of the COSCO Europe ,and main engine 8S60MC of COSCO container , when load is 85%, the Alpha ACC cylinder oil oiling device and mechanical device cylinder oil prices impact on the cost recovery period. Verified, electronic timing cylinder oil injection device Alpha ACC has higher rate of return.

Talbe.1 Alpha ACC oil cylinder oil injection device and mechanical device cylinder oil price impact on cost recovery period

Main engine type	**12K98ME**	**8S60MC**
SMCR(kW)	68640	18080
NCR(=85%SMCR)	58344	15370
Fuel sulfur content	3％	3％
Mechanical cylinder oil injection rate	1.22g/kWh(=0.90g/bhph)	1.50g/kWh(=1.10g/bhph)
Alpha ACC cylinder oil injection rate	1.02g/kWh(=0.75g/bhph)	1.02g/kWh(=0.75g/bhph)
Running hour (h/y)	6000	6000
Save the cylinder oil (t/y)	70.01	44.27
Cylinder oil prices($/t)	1800	1800
Cost saving ($/y)	126018	79686
Alpha Oil unit price ($)	220000	106000
Payback period (y)	1.75	1.33

Conclusions

Electronic timing cylinder oil injection is a dynamic control, cylinder oil delivery rate control is in consideration of the fuel sulfur content and scavenging the Fe content of drain tank, alkali value and the load of diesel engine, determine the best filling factor ACC, oil cylinder oil injection rate is determined. Using adaptive electronic timing cylinder oil injection device after Alpha ACC technology optimization, not only can improve the cylinder liner wear, but also can improve economy of when ship sailing speed down and partial load operation of diesel engine; Daily maintenance work reduced, to reduce the maintenance cost and crew working strength, improve the work reliability of diesel engine, the resulting indirect benefit also is higher, is worthy of reference for shipping companies and reference.

Acknowledgment

This work is supported by Science and Technology Program of COSCO under Grant 2013-1-R-C001.

References

[1] Zheng Shijun Wang Weibin,. Marine diesel engine electronic timing cylinder oil injection technology [J], sailing in China, pp.71-73,April 2004.
[2] Alpha Lubricator System Operation Manual[M], MAN B&W Diesel A/S. pp,6 January,2003.
[3] N.M.Jørgensen, MAN B&W Diesel A/S Cylinder Condition, Copenhagen Diesel Academy. *April* ,2003.
[4] Anon. Cylinder oil feed rate reduction [J]. MER-Marine Engineers Review, pp26～27,*April* ,2004.
[5] Pan Feng. ALPHA cylinder oil lubricator management and fault analysis [J]. Journal of nautical technology,pp, 44 ~ 47 march,2007.
[6] MAN Diesel 12K98MC-C INSTRUCTION BOOK, VOLUME I, OPERATION.
[7] U.Mikkelsen, H.Rolsted, S.B.Jakobsen. CYLINDER CONDITION OF LARGE TWO - STROKE ENGINES. CIMAC Congress, Hamburg,2001.
[8] Sven Lauritsen, Jorn Dragsted, Bert Buchholz． Swirl Injection Lubrication A New Technology To Obtain Low Cylinder Oil Consumption Without Sacrificing Wear Rates. CIMAC Congress , Hamburg, 2001.