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Investigation into Early Loss of Lubricant Viscosity in Agitator Gear Box at CIL Plant at Goldfields Ghana Limited

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Abstract:- Lubrication is very important when it comes to maintaining any mechanical equipment. Poor lubrication can cause friction which intends lead to wear and breakdown of the agitator gear box. The viscosity of oil is also very important because when oil loses its viscosity, it fails to perform its function in lubricating the machine which causes a lot of breakdowns and wear of the gear teeth. Moisture formation on the oil, which then mixes with the oil, is one of the factors that cause oil to lose its viscosity and other factors would be discussed. Experiments were conducted on the oil to know the amount of water content on the oil and additives on the oil that causes frequent breakdowns on the agitator gear boxes. It was achieved through several temperature calculations, that there is some amount of moisture content on the oil which causes the oil to lose its viscosity. Additional study could be conducted to further investigate into the loss of lubricant viscosity and means on how to improve upon the oil or maintain the oil viscosity for quite a longer period.

Keywords:- *Temperature calculator, Oil Contamination Control and Oil Sampling.*

I. INTRODUCTION

There would be continuous breakdown on the agitator gear box if the oil has lost its viscosity. Viscosity of the oil is very important when it comes to agitator gear box and other machines because wear and failure of the machines and gear teeth will begin to take place if the oil has lost its viscosity. Frequent agitator gear box failure at the carbon in leach plant at Goldfields Ghana limited is mainly due to the oil losing its viscosity. High temperatures can cause the oil to lose its viscosity especially when the heat exchanger is not functioning well. During the sunny day, the temperature of the oil rises to a high temperature and in the evening time, the temperature also drops which leads to the formation of moisture on the gear box. When this moisture mixes with the oil, it causes the viscosity of the oil to reduce and hence leads to wear on the gear teeth.

When the additives are high like Iron, Lead, Chromium, Aluminum, Nickel and Silicon it causes the oil to lose its viscosity. These additives content in the oil can cause the oil to lose its viscosity and when the oil loses it viscosity, it can lead to gear breakages. Sometimes when foreign material traps into the oil, it can cause the oil to lose its viscosity. Also, if the heat in the gear box generates steam, it leads to lose of viscosity in gear box. Especially, if the silica inside the breather is spoilt and not able to absorb the moisture, this moisture will mix with the oil and this can cause the oil to lose its viscosity and hence can lead to wear on the gearbox teeth.

Some gears move under high pressure like the Agitator gearbox (since is stirring the slurry in the mud tank). This high pressure increases the temperature of the oil hence resulting in the formation of moisture which when not absorb by the silica gel in the breather mixes with the oil, then causes the oil to lose its viscosity and leading to wear on the gearbox teeth. Malfunctioning of the radiator can also cause the oil to lose its viscosity.

Goldfields Ghana Limited, Tarkwa uses periodic system in checking the oil. Goldfields take a sample of the oil to Total lab so that an experiment is carried out on the oil to know how contaminated the oil has become. When the oil mixes with water, it becomes milky. This shows that, there is an amount of water on the oil before it is sent to total lab for the experiment to be carried out on it. Clean oil that is not yet contaminated is brown in colour. The name of the oil lubricant that is used by Goldfields is Total Carter SH 320. The viscosity index of the oil is 320. The oil losing its viscosity depends on how the oil is going to be contaminated by moisture or any foreign particles. There is a new machine called CJC mobile fine filter that was recently installed by goldfields that is used for filtering the oil for any contaminations. Fig 1 and Fig 2 shows the picture of agitator gearbox at Goldfields Ghana Limited.

Fig 1:- Breather and Heat Exchange Connected to Agitator Gear box

Fig 2:- Radiator Connected to Agitator Gear Box

II. MATERIALS AND METHODS USED

Samples of oil were taken from Goldfields Ghana Limited. Temperature readings were taken on the gearboxes as well and calculations were done to establish the effect of lubricant viscosity on the gearboxes. The sample analysis was carried out at Total and the results gotten were used to establish the amount of contamination in each of the oil sample taken.

III. RESULTS AND DISCUSSION

The results gotten from the experiment carried out would be discussed below.

A. Oil Contamination Control

The best way to control the oil contamination is to stop the contaminants from entering the system in the first place. This entails making sure that all machine components are clean when installed and that the oil systems are thoroughly flushed before taken into operation. Furthermore, the oil system should be as well sealed from the environment as with intact seals and gaskets as well as high quality tank breathers including fine particle and moisture retention (desiccant and/or bladder type breathers). The oil should be pre-filtered before coming in contact with any machine component preferably by continuous filtration in the lube room, storage area or at least when transferred to the machines in operation. Oil contamination control also includes maintenance procedures for topping up with oil, replacing parts and taking oil samples to the Total lab (Lars, 2015).

Unsatisfactory or careless handling of Lubricant by the user may lead to:

- Leakage or contamination
- Ingress of dirt, water and dust
- Contaminants to enter the lubricants and machines when dispersing

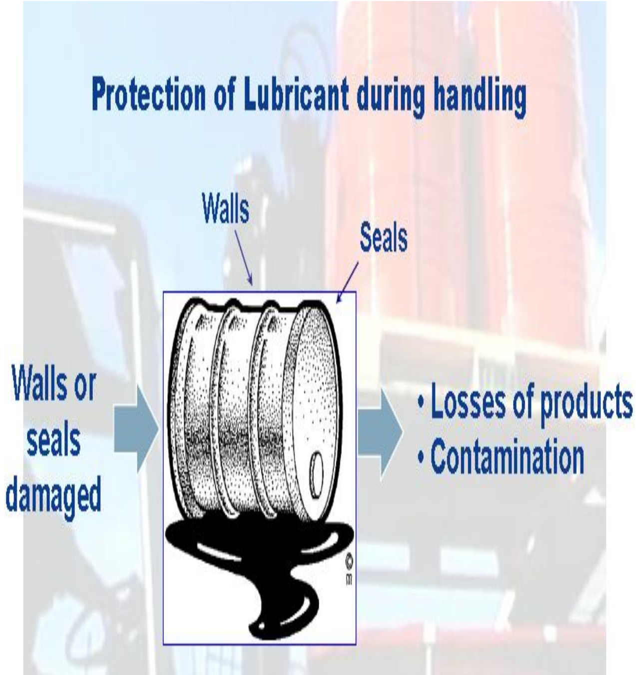

Fig 3:- Protection of Lubricant during Handling

B. Oil Sampling

The purpose of oil sampling is to utilize the oil as a messenger telling how the machine is doing. This can prompt pro-active actions in order to achieve the highest level of machine performance and reliability at the lowest possible cost. The initial samples serve to establish benchmarks and to identify the machines with critical levels. The routine sampling is done to document that goals are met and can also provide abnormal wear that needs to be addressed. The quality of analysis results depends first on correct sampling and handling of the sample, secondly on the quality of the laboratory performing the analysis. The importance of the knowledge about where and how to take a sample is paramount and requires special attention. The best place to sample in order to see how machine components are doing is downstream from the machine before any filtration and before the oil is returned to the system tank. This will show the undiluted result of any wear being created in the machine. The best guarantee of clean oil in the system is to sample from the most contaminated part of the oil system – the bottom drain of the system tank. This bottom drain is typically where the offline/kidney lube filtration system is connected, so a satisfying oil analysis result taken from between the pump and the filter housing of an offline filter, is the best guarantee that the oil and the system is clean (Lars, 2015).

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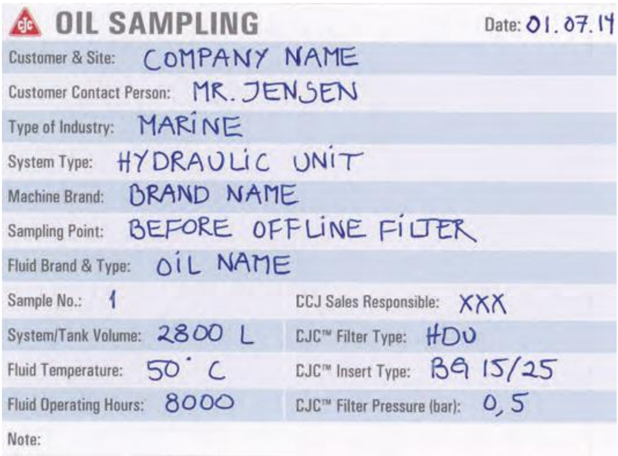
OIL SAMPLING Date: 01.07.14
Customer & Site: COMPANY NAME
Customer Contact Person: MR. JENSEN
Type of Industry: MARINE
System Type: HYDRAULIC UNIT
Machine Brand: BRAND NAME
Sampling Point: BEFORE OFFLINE FILTER
Fluid Brand & Type: OIL NAME
Sample No.: 1
CCJ Sales Responsible: XXX
System/Tank Volume: 2800 L
CJC™ Filter Type: HDU
Fluid Temperature: 50° C
CJC™ Insert Type: B9 15/25
Fluid Operating Hours: 8000
CJC™ Filter Pressure (bar): 0,5
Note:

Fig 4:- CJC Oil Sampling

C. *Temperature Calculations*

There are seventeen agitator gearboxes at CIL plant. CIL 1 has 8 agitator gear boxes and CIL 2 has 9 agitator gear boxes. The temperature gun was used as the measuring instrument for taking the readings of the temperatures of the oil in the gear boxes. Three technicians and I at Goldfields Ghana Limited took readings each from one of the four agitator gear boxes that I randomly selected at both CIL 1 and CIL 2 during the sunny period and evening period.

Agitator Number	Temperature During the Sunny Day, T_O (℃)	Temperature During the Evening Period, T_1 (℃)	Change in Temperature, ΔT (℃)
404	37.3	29.3	8
406	45.1	36.9	8.2
410	41.1	34.3	6.8
412	39.2	30.1	9.1

Table 1:- Calculated Values of Temperature

From the above calculations, with agitator 404, the temperature difference was 8℃ which show that the temperature has dropped by 8℃ during the evening period. With agitator 406, the temperature difference was 8.2℃ which also show a temperature drop during the evening period. Also, for agitator 410, the temperature difference was 6.8℃ which show a temperature drop from the calculation and for agitator 412, the temperature difference was 9.1℃ which also show a temperature drop during the evening period. Hence, from the calculations, it is known that during the evening period, there is a temperature drop on the oil which causes the heat that was built up as a result of the agitator heating up during the sunny period to intend lead to the formation of moisture on the oil. The moisture that was formed then mixes with the oil which causes the oil to lose its viscosity and hence can lead to wear and breakdown of the agitator gear box.

The experimental results below were gotten using the ANAC database after a sample of the oil from different gear boxes were sent to total lab in other to determine the amount of water content in the oil that causes the oil to lose its viscosity and also to know the amount of contaminated additives in the oil.

Considering agitator 418 and agitator 405, the experiment carried out, shows that there is the presence of water and some contaminated element which has resulted in the oil change and the oil losing its viscosity. The amount of the additive such as calcium, zinc, phosphorus, boron, sodium, potassium, magnesium, molybdenum, lithium, barium and vanadium that is found in oil is expressed in ppm (part per million) which can also be expressed as milligram per liter (mg/L) was also known from the experiment conducted and the results shown below.

IV. CONCLUSIONS AND RECOMMENDATIONS

It is concluded that, Formation of moisture is due to the weather conditions as a result of drop in temperature between the sunny period and the evening period, moisture content that mixes with the oil causes the oil to lose its viscosity which intend leads to wear and breakdown of the agitator gear box., other components such as the radiator, heat exchanger and the breather should function properly to avoid easy formation of moisture on the oil in the gear box which intend lead to breakdowns on the agitator gear box and wear of the gear teeth and Fresh oil should always be filtered with the CJC mobile fine filter machine to prevent the contaminants from entering the agitator gear box and these contaminants causes early loss of lubricant viscosity.

It is recommended that, A reasonable amount of oil in the agitator gear boxes should be continuously taken to Total lab monthly for lab test to know the impurities, additives contaminated and water content in the oil so that immediate actions would be taken to prevent the oil from losing its viscosity early, consistent daily preventive maintenance (PM) and predictive maintenance should be carried out on the agitator gear box and further experiment and research on how to prevent the oil from losing its viscosity should be carried out on the oil in the agitator gear box to find alternative means in solving the problem.

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