"PERFORMANCE OF SYNTHETIC GEAR OIL IN I.D FAN GEAR BOX OF COOLING TOWER"

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ABSTRACT

The lubrication of cooling tower gearboxes in a Thermal Power Plant is a complex process and embodied with most severe application requirement. The lubrication requirements of the gearboxes of ID Fans of Cooling towers in a power plant should be addressed at utmost priority with respect to the following conditions of severity.

- Ingress of moisture.
- High temperatures
- Heavy loads
- Dusty environment

To meet these requirements, the industry is using industrial gear oil based on S-P Chemistry in mineral base oil, based on the recommendations of the gearbox manufacturers. They were using Mineral Gear oil in their cooling tower Elecon Gear Boxes. The customer is facing the following problems

a) Over heating of the Lube oil

b) Frequent top up due to excessive oil consumption

c) Inaccessibility of the gear box makes frequent top-up and repair very tedious

In order to solve the above problems faced by the customer, we proposed for the use of improved cost effective maintenance free synthetic gear oil for the lubrication of cooling tower Elecon gear boxes.

We shall be discussing in this paper the details of performance obtained with the proposed new oil vis-à-vis the mineral oil based S-P type Gear Oil with respect to the desirable performance parameters as well as problem areas enumerated above.

INTRODUCTION:

M/s Visakhapatnam Steel Plant, (VSP) Vizag has 240 MW generation capacity thermal power plant. The total capacity is generated by 4 steam turbines 60MW each. The water from the thermal power plant is cooled by 32 cooling towers located at Pump house-4 under the water management department. All these cooling towers are Induced draft cooling towers, where the fan is located at the top and air enters from the openings located at ground level. Air, mixed with vapours, is discharged through a fan stack located at the top of the tower. In this case moist air is discharged higher in the atmosphere and thereby dispersing to a greater distance from the tower. Hot water is taken to the top of the tower by steel pipes and discharged on the packing with distribution system of recast RCC trough and tubes. Eliminators of asbestos are provided at the top to arrest the droplets. The fan is located at the top to draw air from the cylinder for dispersion. The induced air travelling up cools hot water. Cold water is collected in the pond located below the cooling tower where make up water is also discharged.

There are 32 nos of ID fans coupled with a gearbox driven by a motor in each cooling tower. The operation of cooling tower is very important and any down time for want of maintenance is very critical for running of each unit of the power plant.

M/s VSP is using Mineral gear oil in the Gearboxes of Cooling towers. They were facing with frequent oil changes (every 4-6 months),

increased gearbox oil temperatures etc with the use of mineral oil.

They had tried out synthetic gear oil in 8 gear boxes. The oil is imported and hence expensive due to which they have not yet converted the entire 32 gear boxes to synthetic oil.

Faced with the above situation, we proposed for the use of improved high performance synthetic gear oil for solving the above problems faced by the customer. The customer has willingly accepted our proposal and the product was tried out in one of gearbox in 16/3 cooling tower.

We shall discuss the trial performance of the improved gear oil with respect to the problems faced earlier by the customer in this paper.

OBJECTIVE:

We proposed to VSP for the use of Synthetic Gear Oil in their Cooling Tower Elecon make Gear Box in order to solve the problems being faced by them.

The objective of this trial was to provide problem free lubrication to the gearboxes coupled with enhanced drain interval/ Oil life, thereby providing cost benefit to VSP in terms of improved production, reduced maintenance and improved equipment life.

The trial was found to be successful by the customer.

CUSTOMER PROFILE:

The customer is the one of the benchmark integrated steel plants in the India. They are having a captive power plant of 240 MW. The plant caters to the need of the Steel Plant as well as the steel plant Township area. When the power generated is in excess, it also caters to the requirement of the local government power supply.

SYSTEM DETAILS

Cooling Tower - Induced Draft Fan Gear box

Enclosed Gearbox

Make	-	Elecon
Model	-	(Model : 350 CTU)
Reduction	-	Ratio: 10:1 (Single stage)
Input (Mech) Power	-	75 KW
Output (Mech) Torque	-	3807 Nm
Weight	-	1470 Kg.
Type of gear	-	Worm gear
Sump capacity	-	90 ltrs.

Recommended - Mineral Gear Oil, ISO VG 320

GEAR METALLURGY

Worm wheel – Phosphorous – bronze

Pinion -- Case hardened alloy steel

SYNTHETIC GEAR OIL:

Synthetic gear lubricant is formulated from synthesized hydrocarbon base fluid and meet US steel 224 specifications. They are combined with suitable additive package to provide enhanced oxidation stability, corrosion protection and load carrying capability. The base fluid provides much better thermal and oxidation stability than conventional gear mineral oils. In addition, with high viscosity index of over 130, they also provide higher viscosity at high temperature than mineral oils of comparable grades. Since high viscosity index are inherent properties of these fluids, the change in viscosity as a result of mechanical shearing in service can be minimized, even under heavily loaded gear application.

PROPERTIES:

- Excellent High Temperature oxidation stability.
- Excellent Thermal Stability
- Improved Low Temperature fluidity.
- High load carrying capability.
- Low co-efficient of friction.
- Natural High Viscosity Index.
- Good Demulsibility Retention

BENEFITS:

- Reduced friction and wear
- Reduced operating temperatures
- Extended lubricant life
- Increased production
- Energy efficiency
- Long equipment life

Synthetic Gear oil exhibits low coefficient of friction and high viscosity index enhancing improved viscosity temperature relationship. These properties combine to give substantial reduction in power consumption required to operate industrial equipments. This indicates that overall frictional losses will be reduced. Reduced frictional loss in turn results in lowered operating temperature, extended parts life and extended lubricant life.

TRIAL METHODOLOGY:

1. The trial started during June 2008.
2. Gear box of 16/3 cooling tower of 90 ltrs sump capacity was filled with Synthetic Gear Oil.
3. It was decided to monitor the following parameters at regular intervals:

- K. V. @ 40 deg C
- K. V. @ 100 deg C
- Viscosity Index
- Total Acid Number
- TAN change (After period of one year)
- Flash Point
- Wear Metal Analysis
- 3 months sampling frequency

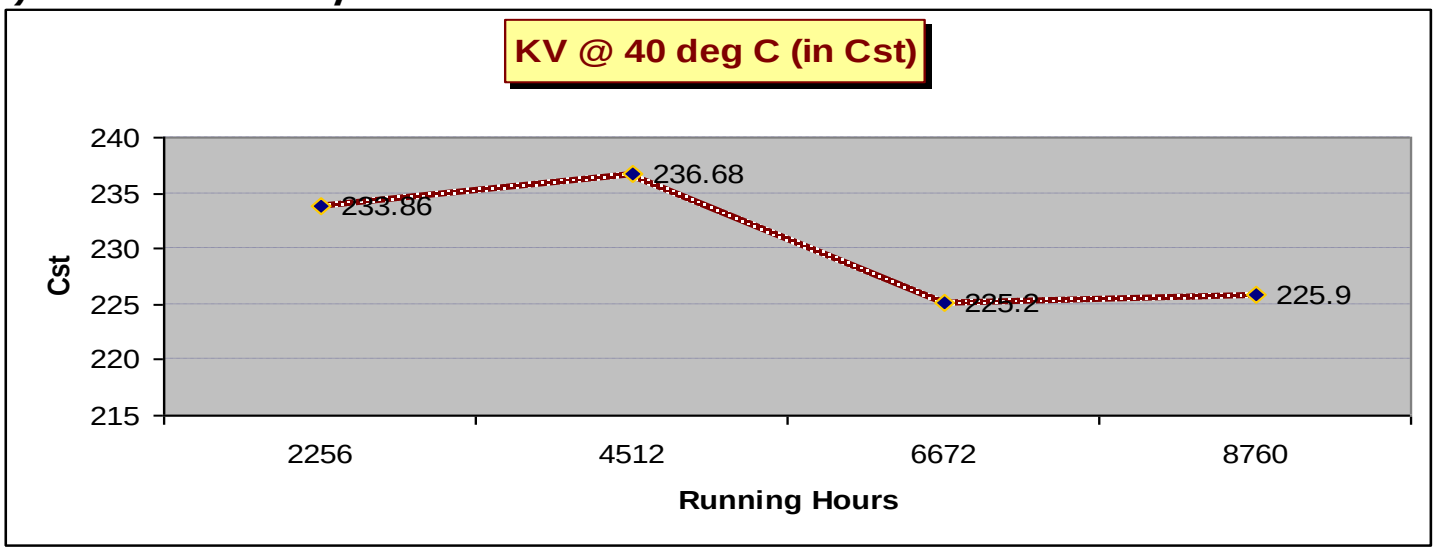
RESULTS:

The sample of used oil was drained from the gear box at an interval of 3 months for a period of 15 months from the date of introduction. The oil samples were analysed at IOC R&D Center.

The results of tests are depicted below highlighting the salient parameters.

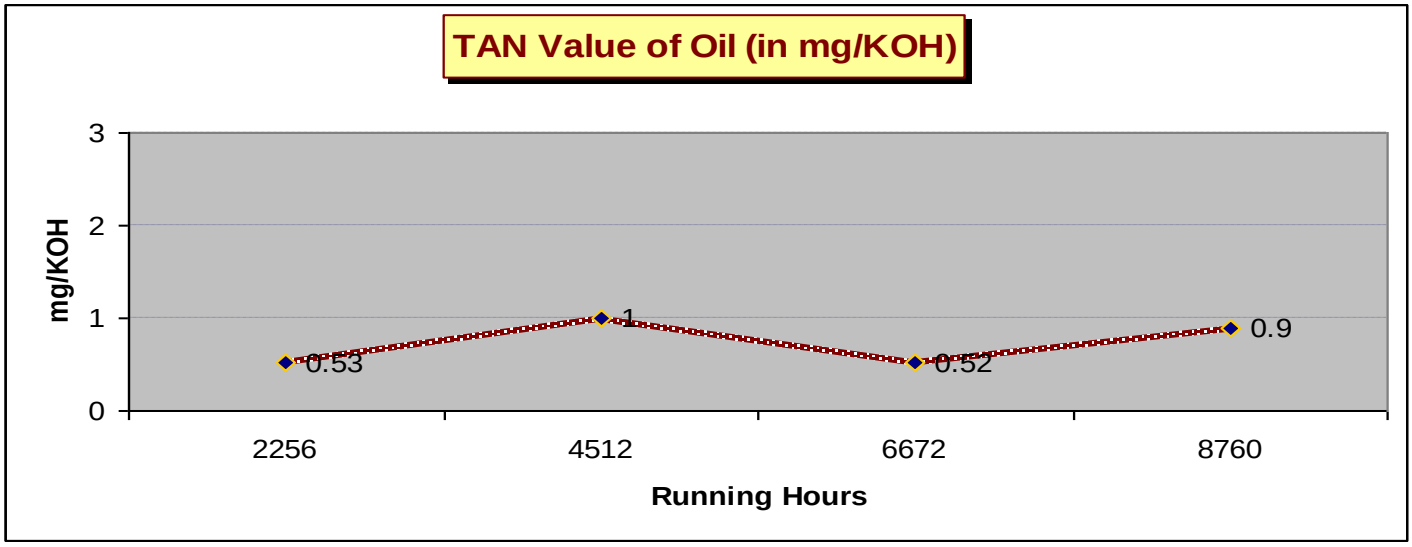
Test Results

a) Kinematic Viscosity at 40^0C



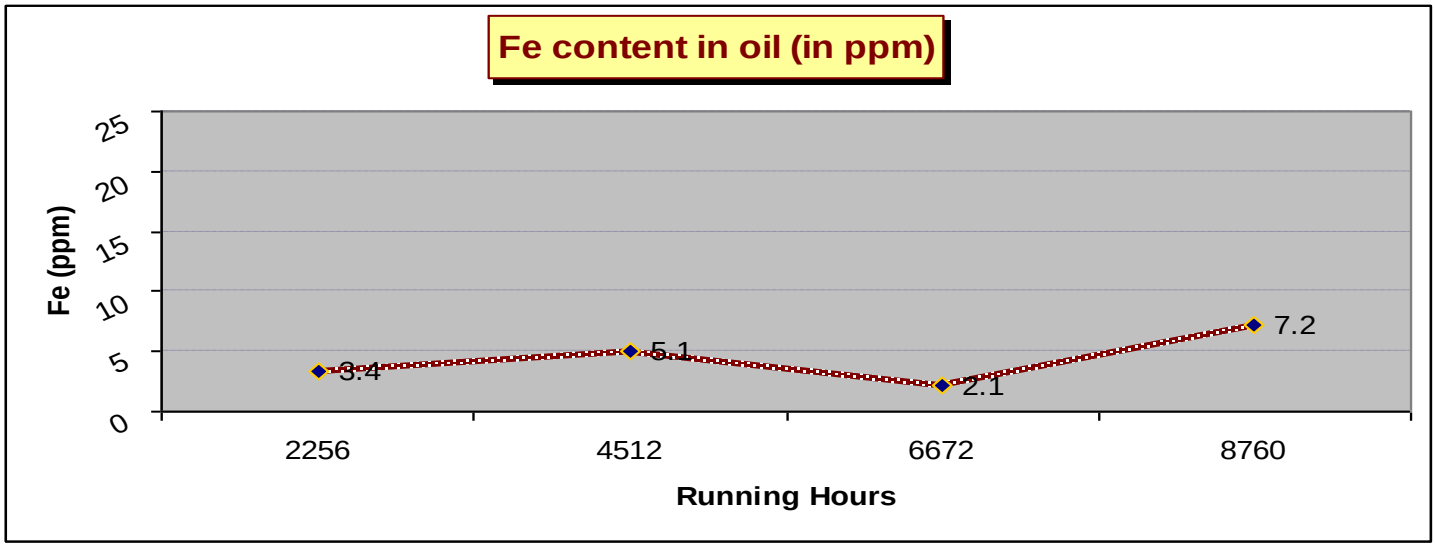
The oil was first tested after 2256 hrs into operation. The Kinematic Viscosity at 40^0C was found to be well within the limits. The oil samples were subsequently tested at various running hours as shown above. The test data shows that there has been very little deviation in the viscosity and the viscometrics of the oil has been retained well within the working limits.

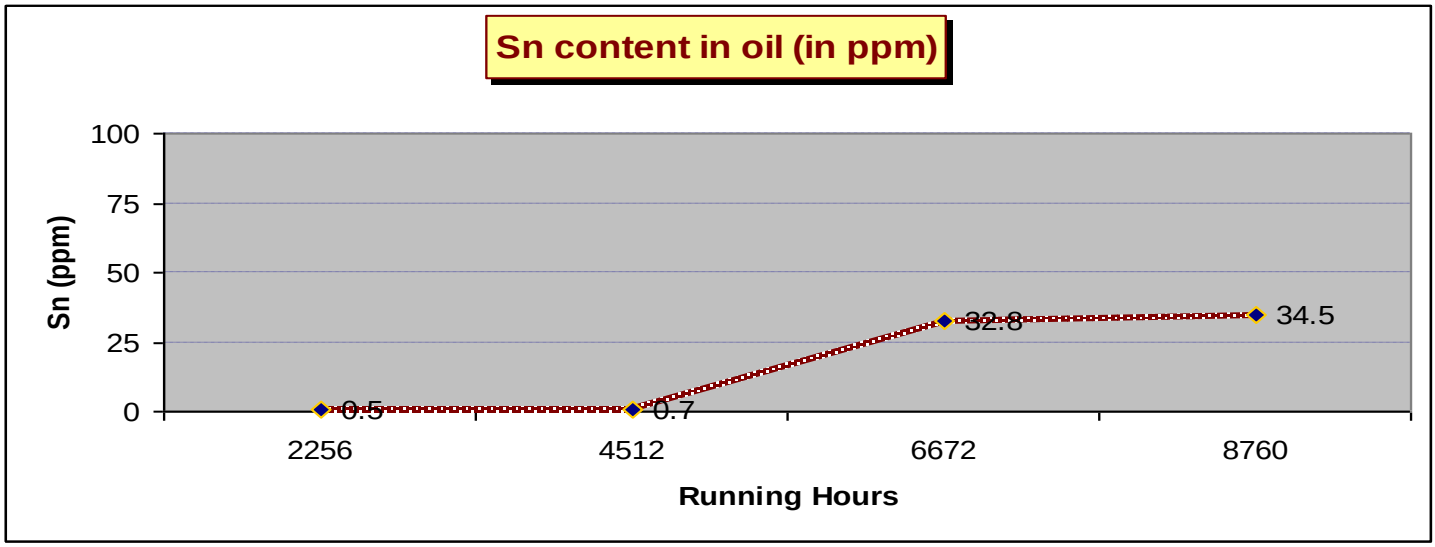
b) Total Acid Number

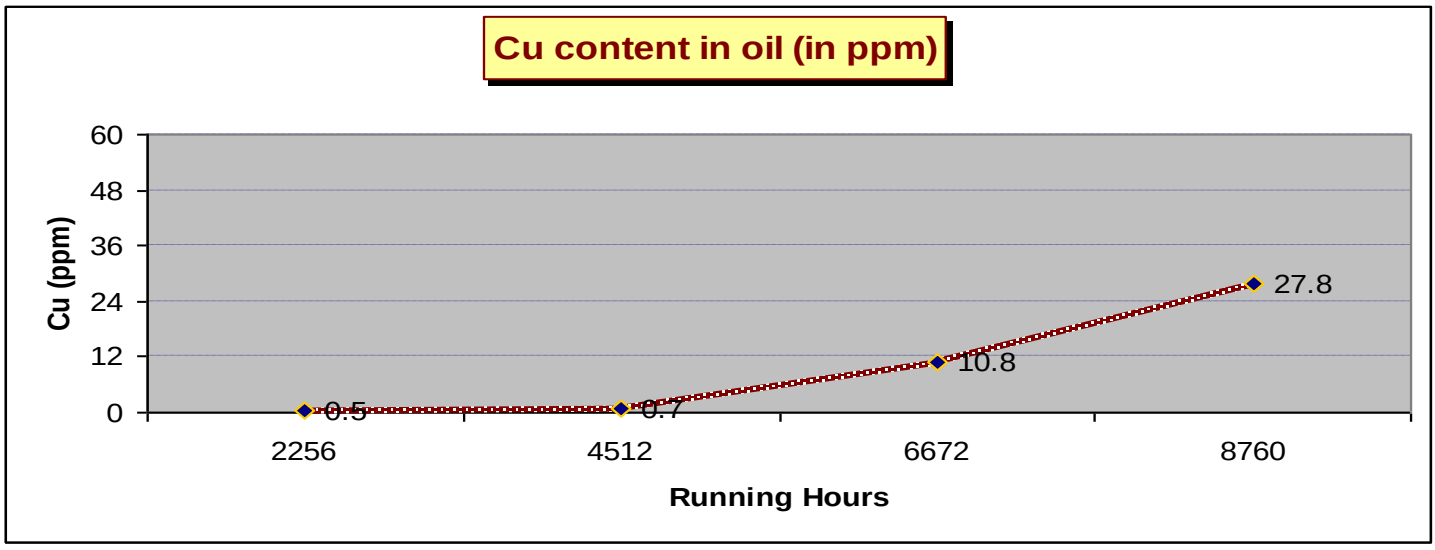


The TAN value of the oil was also monitored on a quarterly basis. As can be seen from the test data, the there has been almost no rise in the TAN value even after 6672 hrs of operation. The change in TAN value if only 0.45 after 1 year (8760 hrs).

WEAR METAL ANAYLSIS







The wear debris analysis shows that there has been very minimal wear and tear during the first one year of operation, i.e 8760 hrs. There has been an increase in the value of wear metals in the sample after running for more than 6672 hrs. This is normal for oil which has been in operation for prolonged continuous use for such a long time.

Oil Performance at a glance:

OIL PERFORMANCE AFTER 2256 hrs

The test data indicates that the oil parameters are well within the working limits. The oil condition is very good and is fit for further use. There is no deterioration in the properties of the oil.

OIL PERFORMANCE AFTER 4512 hrs

The first sample was drawn after 3 months and there was no significant color change and all parameters were well within the working limits. The second sample was drawn within 6 months of trial (after 4512 hrs). There is a slight increase in the Total Acid No. and the color also changed from pale yellow to dark brown. The properties such as viscosity and flash point are within the specification limits. The wear debris analysis indicates that the oil has good anti-wear properties. The oil is in good condition and fit for further use.

OIL PERFORMANCE AFTER 6672 hrs

There is no change in the Total Acid number & viscometrics of the oil and these are within the specification limits. The wear metals Fe and Cu etc. in the used oil are are negligible, which indicates retention of anti-wear properties of the oil. Thus Servo Syn Gear HVI 220 is lubricating satisfactorily even after 6672hrs and is fit for further use.

OIL PERFORMANCE AFTER 8760 hrs

The oil has been in use for a period of 1 year. The report indicates that the KV @ 40 deg C, which is a very important parameter, is well within the working limits. There has been very minimum change in the oil viscosity when compared with a fresh oil sample. Also, the TAN value, which is another important parameter which indicates the oil quality, is also well within limits. The wear metal debris analysis of the oil shows that there has been very little wear of the equipment. This is a direct indication of the retention of the anti-wear properties of the oil and improved performance of the same.

CONCLUSION & CUSTOMER BENEFITS:

a) The oil has been performing satisfactorily over a period 15 months.
b) A more economical indigenous product which ensures easy procurement and faster supply.
c) Increased drain interval which increases the productivity as changing the oil in the gear box is a tedious process.
d) Increased life of gear box due to lesser wear and tear.
e) Lesser inventory as the drain period is substantially increased (established life of approx 9,000 running hrs against 4512 hrs for the existing mineral oil.

The trial is still under progress and has already crossed more than 12,000 hrs