

Performance of Grease in Work Roll Bearing of Roughing Stands of Hot Strip Mill.

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Introduction:

Steel Plants encounter one of the most severe application regimes as far as lubrication is concerned. In Steel Mills, the table and roll-neck bearings are subjected to Severe Service Conditions. In this hostile environment, rolling-element bearings have been found to transmit power and withstand loading more effectively than plain bearings.

In the rolling process, the space setting between rollers is reduced after each consecutive pass of the sheets. The bearings must, therefore, tolerate high initial impact loading and must then sustain loading over long time periods as the sheets are thinned to a final prescribed dimension.

High performance specialty greases are designed to extend the service life of the bearings in heavy-duty application and elevated temperature. These greases match the rugged service requirements of rolling mills. Load carrying and anti wear capabilities of these greases along with high performance is the result of chemical additives working synergistically with solid lubricants. These additives are dispersed uniformly through out the greases attributing superior load carrying/ anti wear characteristics and excellent water resistance to cold and hot water.

After completion of successful trial the products are to be accorded “proven” status and can be used on a regular basis. The present paper highlights results of the trail of the candidate Grease.

A Water Resistant, High Load bearing premium quality grease was developed with required performance criteria. This is specially formulated to meet the demand of severe water wash-out and AW grease for boundary lubrication. This grease is recommended for both plain and anti-friction bearings for wide variety of applications such as automotive and industrial applications. It is preferred for Steel Mill Lubrication under high load and high water wash-out conditions.

This grease was offered for trial in the Work Roll bearing lubrication of Roughing Stands R#2 to R#5, HSM of one of the integrated steel plant. The plant was facing severe grease pumpability problem during winter with the grease earlier in use.

Properties of the Grease

The subject grease is specially developed to meet the severe application requirement of work roll bearing. The properties of the grease is tabulated in Annexure-I. Some of the expected performances are listed below:

- Has excellent resistance to Oxidation.
- Ensures minimum softening and loss of structure even when subjected to substantial shear.
- Has excellent resistance to Water Wash-out.
- Prevents spot welding and seizure of moving parts often caused by shock loading.

Specifications of the Roughing Stands R#2 to R#5 in which the trial was conducted:

4 HI Roughing Stands (R#2 to R#5):

The horizontal stands R#2 to R#5 are 4-Hi stands with attached edgers and designed for rolling in tandem with the respective edgers. Exit thickness of slab after R5 is in the range 33 — 38 mm.

Description	R # 2	R # 3	R # 4	R # 5
Work roll dia	1200 / 1100 mm	1200 / 1100 mm	1200 / 1100 mm	1200 / 1100 mm
Work roll barrel	2000 mm	2000 mm	2000 mm	2000 mm
Back up roll dia	1600 / 1460 mm	1600 / 1460 mm	1600 / 1460 mm	1600 / 1460 mm
Back up roll barrel	2000 mm	2000 mm	2000 mm	2000 mm
Mill speed	1.5 m/sec	2.0 m/sec	2.5 m/sec	3.2 m/sec
Roll separating force	3000 t	3000 t	3000 t	3000 t
Rolling torque per spindle	340 tm	400 tm	400 tm	326 tm
Back up roll bearing	Oil film type	Oil film type	Oil film type	Oil film type
Work roll bearing	Cylindrical Bearings.	Cylindrical Bearings.	Cylindrical Bearings.	Cylindrical Bearings.
Main drive rating	5000 kW AC @ 100 rpm	10000 kW AC @ 150 rpm	10000 kW AC @ 150 rpm	10000 kW AC @ 150 rpm
Main drive gear ratio	4.14	4.7	3.75	2.95
Max. roll opening	300 mm	300 mm	300 mm	300 mm

(i) Avg. Campaign tonnage for work rolls change in Stands are as follows:

R#2	:	120000- 130000 T (12 days approx)
R#3	:	80000- 90000 T (8 days approx)
R#4	:	70000- 80000 T (7 days approx)
R#5	:	30000- 40000 T (3 days approx)

In order to provide better surface quality of the products rolled in HSM, the rolls are changed more frequently in Stands R#4 & R#5.

(ii) Lubrication: Grease Lubrication through pump, once every time before sending work-roll assemblies from RGBS to HSM.

(iii) Each stand consists of 2 rolls, each roll consist of 2 bearings, i.e 4 bearings per stand. These are classified as :

TM	:	Mill Side Top
BM	:	Mill Side Bottom
TD	:	Drive Side Top
BD	:	Drive Side Bottom.

(iv) Operating Temperature of the bearing chock: 50 °C Maximum.

Based on the above operating parameters, performance criteria were formulated by the Steel Plant for assessing the grease under trial.

Performance Criteria:

- (i) Good Grease pumpability, i.e. - no problem in pumping of grease using existing grease pumping system.
- (ii) Due to lubrication problem, the temperature of the bearing chocks taken out of the mill, after rolling campaign, should not be > 50°C.
- (iii) In the rolling chocks dismantled for random inspection after rolling campaign:
 - (a) Even if there is ingress of water in the bearing chocks during rolling, neither the grease should get washed off, nor there should be deterioration in the quality of the grease.
 - (b) Sufficient grease should be there in the roll chocks and bearings and none of the bearing surfaces/ elements should be dry.
 - (c) No wear or damage of bearing surface elements should be noticed, particularly in new bearings.
- (iv) Bearing failure should not take place due to lubrication problem.

Performance of the Grease in Roughing Stand at Hot Strip Mill

The grease was tried out for lubrication of Work Roll Bearings of 4 stands of Roughing Mill (R#2 to R#5) at Hot Strip Mill.

Period of Trial: 83 days.

Observations:

Grease was tested for its pumpability with the existing system at the user's end. After proper evaluation, the grease was put in the system for trial. Following observations were made during the trial:

- (i) Bearing Failures: There was only one bearing failure (Bearing **Standard Number 771/630**) in the Roughing Stand during the trial. The failure of the bearing (Bearing No: 2- Russian Make) was not attributed due to lubrication failure. The bearing had over exceeded its life and had rolled 1.5 Crore Tons of Steel against normal life of 40 Lakh Tons
- (ii) The grease was found to have excellent pumpability and water washout resistance property.
- (iii) Specific Grease Consumption: 0.0051 Kg/MT against target of 0.0057 Kg/MT (approx).
- (iv) Temperature of the bearings was recorded less than 45⁰C throughout the trial.
- (v) Sufficient grease was available on the bearings when the bearings were taken out of the chocks during inspection.

Initially, the consumption of the grease was more due to flushing out of the earlier grease. The grease was found holding in the bearings during operation and there was no visible grease leakage. Also, rolls taken out after campaigns were inspected after removal of chocks and grease was found inside the bearings as well as in the chock neck and liners.

Assessment of trial performance

The performance of candidate grease was found superior than the stipulated trial criteria and exceeded performance of the grease earlier in use. The reasons for the above were better retention and distribution of the grease in the bearings and higher weld load carrying ability and better shear stability of the grease restricted the bearing failures.

The specific grease consumption of the candidate grease was 0.0051 Kg/MT against 0.0057 Kg/MT with the grease earlier in use.

Estimated Benefits:

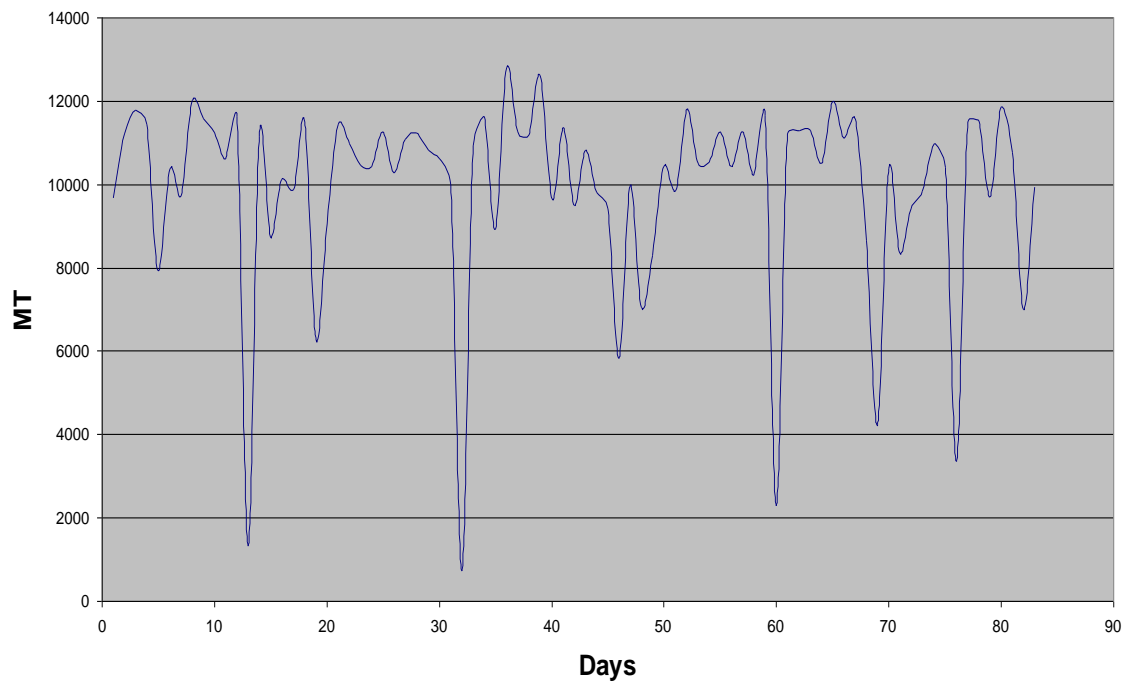
Following benefits were observed with the candidate grease during the trial:

1. No bearing failures attributed due to Lubrication Failure during the trial.
2. Excellent pumpability of the grease even during winter- Pumpability problem with the grease earlier in use was solved.
3. Compatibility with the Lithium base Grease which was earlier in use.
4. Temperature of the bearings was recorded less than 45⁰C throughout the trial with the candidate grease against the maximum limit of 50⁰C.
5. Retention of greases in the bearing housing was observed during roll changes. The structure of the grease remained intact.
6. The specific Grease Consumption was less with the candidate grease (0.0051 Kg/MT against 0.0057 Kg/MT with the grease earlier in use).
7. The Specific Grease Consumption Graph indicates that there is further scope of reduction in specific grease consumption with continuous application.
8. Competitive price of the candidate grease with respect to the grease earlier in use.

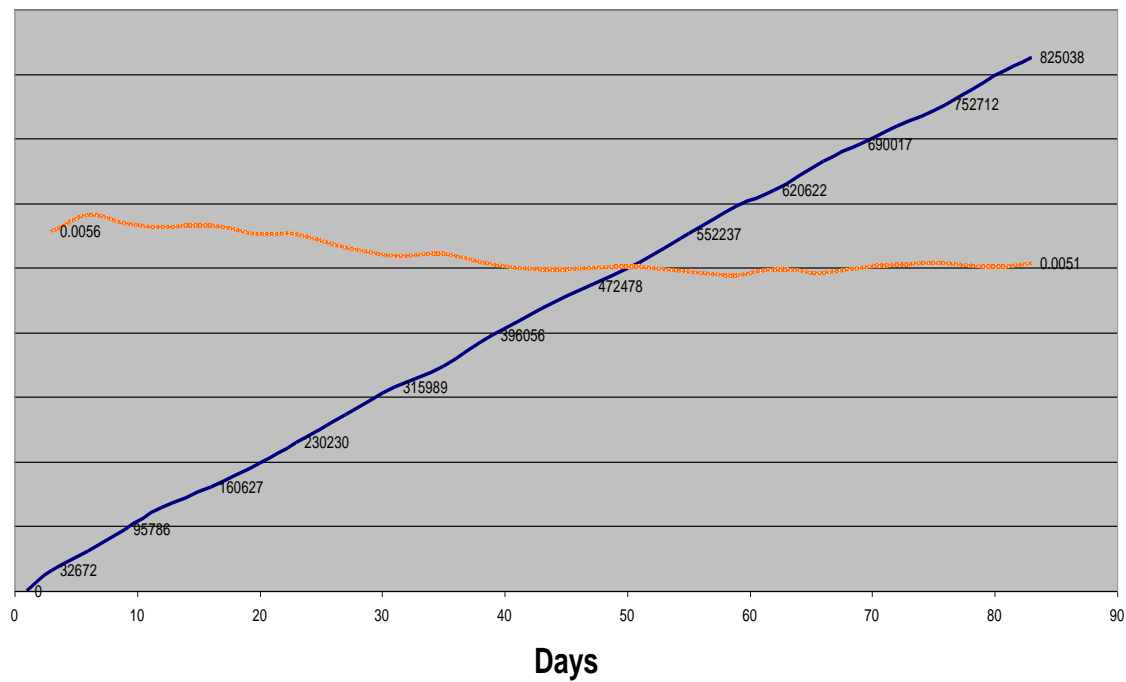
Conclusion

The performance of the grease was satisfactory. The technical committee of the Steel Plant has certified that grease was meeting the laid down performance criteria. The committee has recommended that the grease can be considered for regular use in Work Roll Bearings of Roughing Stands in Hot Strip Mill as a proven grease.

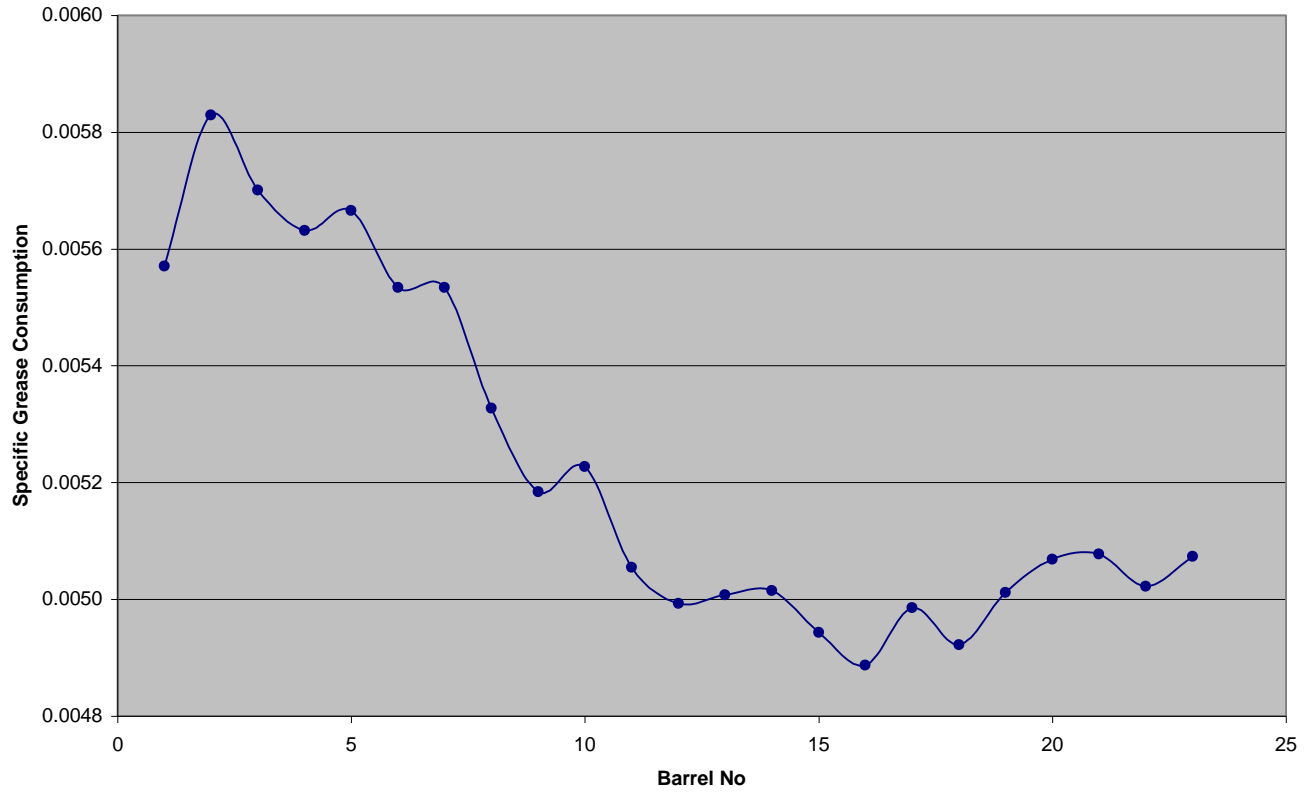
Production- MT/Day



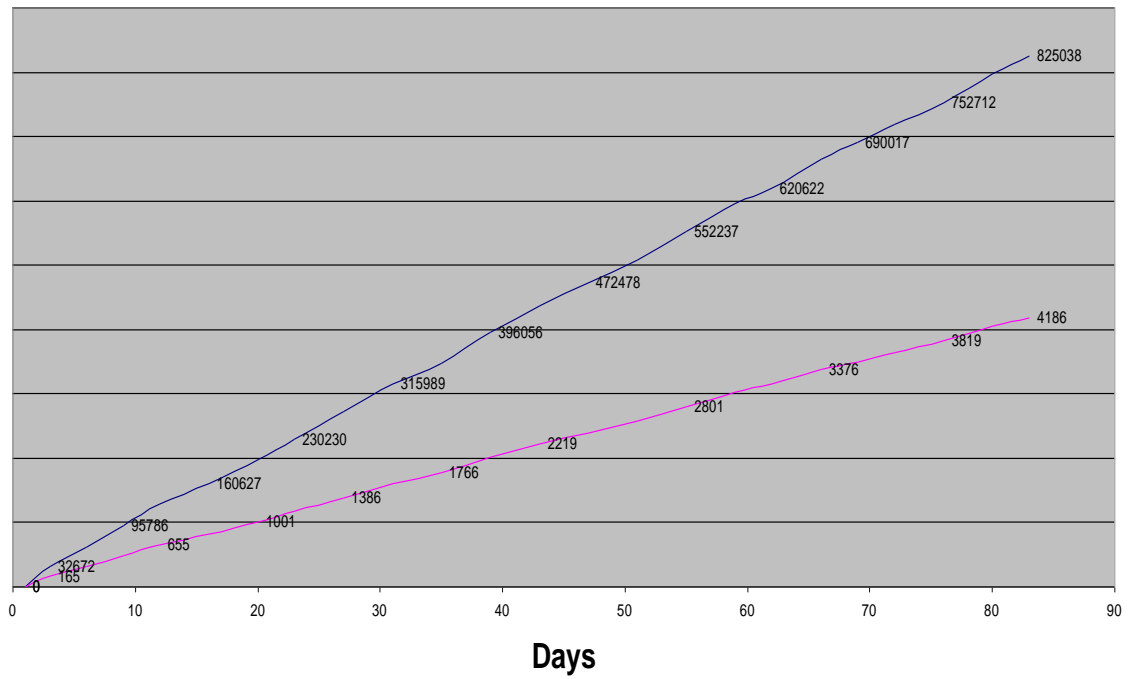
Production & Specific Consumption



Barrel Wise Specific Grease Consumption (Kg/ T)



Production & Grease Consumption



Annexure-I

Specification

NO.	Property	Test Method	Candidate Grease
1.	Colour	Visual	Black
2.	Texture	Visual	Smooth & Tacky
3.	Worked Penetration, 60X strokes		300
4.	Penetration change after 10^5 X Strokes		+15
5.	Dropping Point, °C	ASTM D-566	196
6.	Water wash out, @ 80 °C, %wt	ASTMD-1264	1.5
7.	Water Spray off, % loss	ASTM D-4049	8.0
8.	Copper Corrosion	IP-112	Pass
9.	Weld Load	IP-239	560