Ball Mill

Bearing Damage

by

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Contents

1 Introduction

This case study describes the detection of bearing damage on one of the main bearings in a 60 ton ball mill.

Rana Gruber AS is one of Norway's largest companies in mining and iron ore beneficiation and one of the key companies in the area of Nordland in Norway. The products are based on their own natural mineral resources, upgraded and tailored for applications, and exported to customers worldwide. Currently 1 million tons of hematite concentrates and 100,000 tons of magnetite concentrates are produced annually.

In October 2016, Rana Gruber invested in a Leonova Emerald system as their first step into condition monitoring of their applications. In their production, they have a number of critical low-speed applications and gears.

2 Conclusion and summary

Since mid-December 2016 up until the summer of 2017, the bearing in question had been frequently measured. From the very first measurement result, bearing damage was suspected. There were relatively high SPM HD and HD ENV4 values, and a BPFO match for both measurement techniques.

Over the following months, the measured SPM HD results were relatively high but stable, with no obvious development. The BPFO values, however, showed an increasing trend.

It was decided to replace the bearing during the planned maintenance summer stop, and a new bearing was ordered well in advance (the delivery time for a new bearing of this type is close to three months).

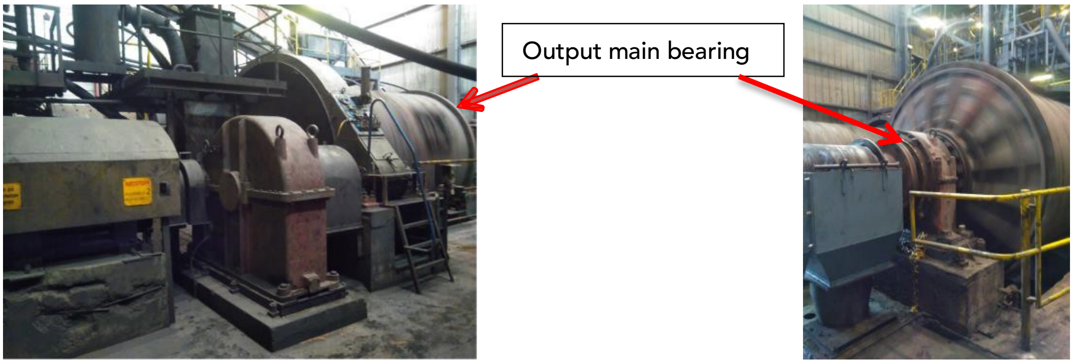
3 Application description

There are many different types of mills; ball mills, rod mills, SAG (Semi-Autogenous Grinding) and autogenous mills. In a ball mill, steel or stone balls are mixed with the ore and during rotation of the drum the ore is ground, by friction and compression, into a suitable fineness for the next step in the process. The main component of all mills is a rotating drum, turning with a suitable speed, gearbox and motor.

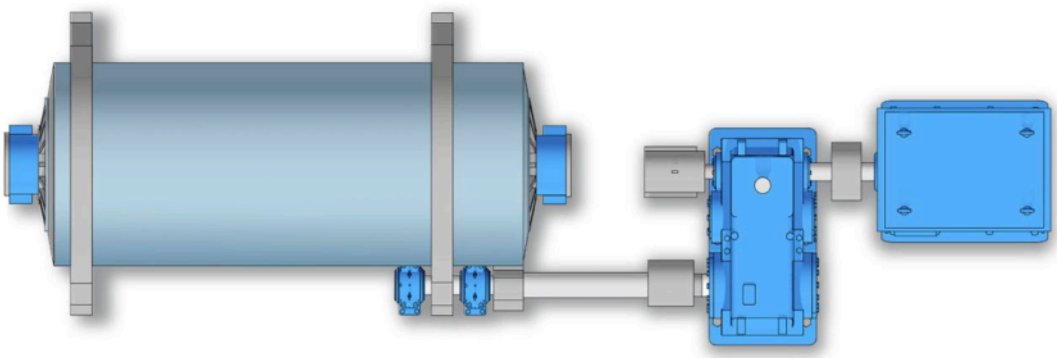
The mill is a very important part of the milling process. In many cases, the entire process can be severely limited or completely stopped if the mill ceases to operate and close observation of mill equipment condition is therefore essential. An unplanned stop must be avoided at almost any cost.

The ball mill is one of two main ball mills in the production at Rana Gruber. The application is a typical low-RPM application where bearing damage can be challenging to detect. This actual ball mill produces 100,000 tons of magnetite concentrate annually.

Img. 1 *Picture of the ballmill.*



Img 2. *A principal overview of the ball mill.*



4 System setup

4.1 Measuring equipment

Leonova Emerald with DuoTech and quick connector is used. RPM is not measured but calculated, based on input speed and gear ratio. The rpm of the application varies a little bit depending on production, but in this setup, it is set as fixed to 20 rpm.

4.2 Measuring techniques

For the bearing condition measurements, SPM HD, HD ENV4, HD ENV3, and vibration are used.

4.3 Condmaster setup

The setup is the same for SPM HD, HD ENV4, and HD ENV3:

Upper frequency:	100 orders
Lines in spectrum:	1600
Symptom enhancement factor:	3

5 Case description

Measuring point: Ball mill Output Main Bearing
Bearing type: SKF 239/850
Rpm: 20

From the very first measurement result, December 2016, a bearing damage was suspected.

Fig. 1 SPM HD trend.

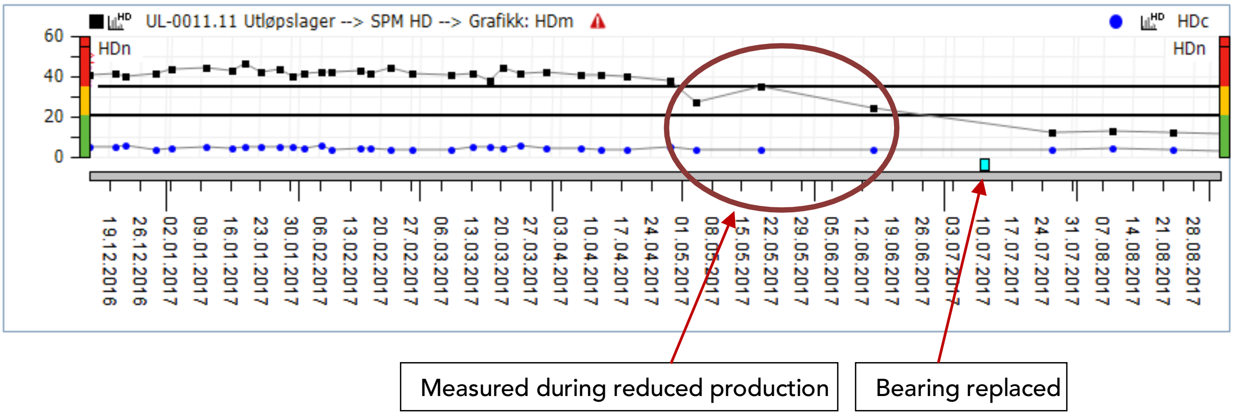


Fig. 2 BPFO trend.

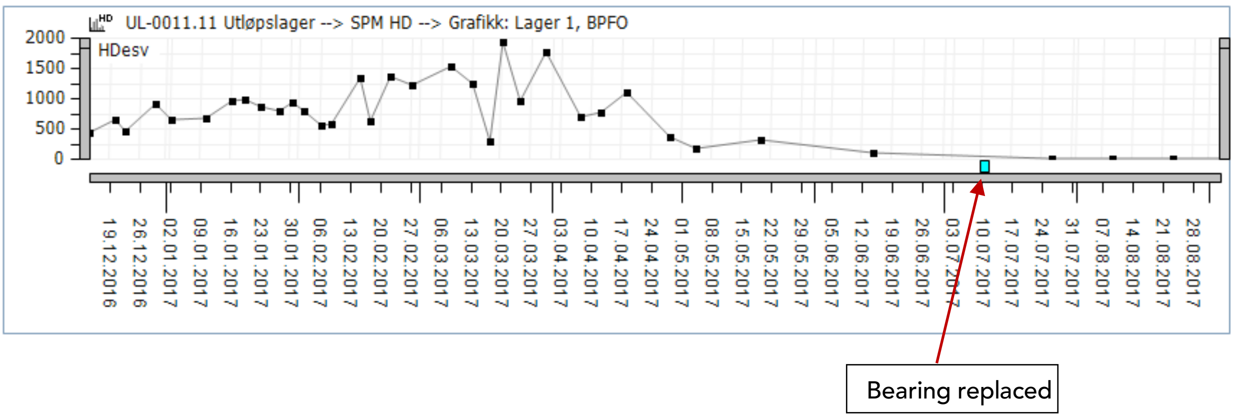


***Fig. 3** Spectrum from before bearing replacement.*

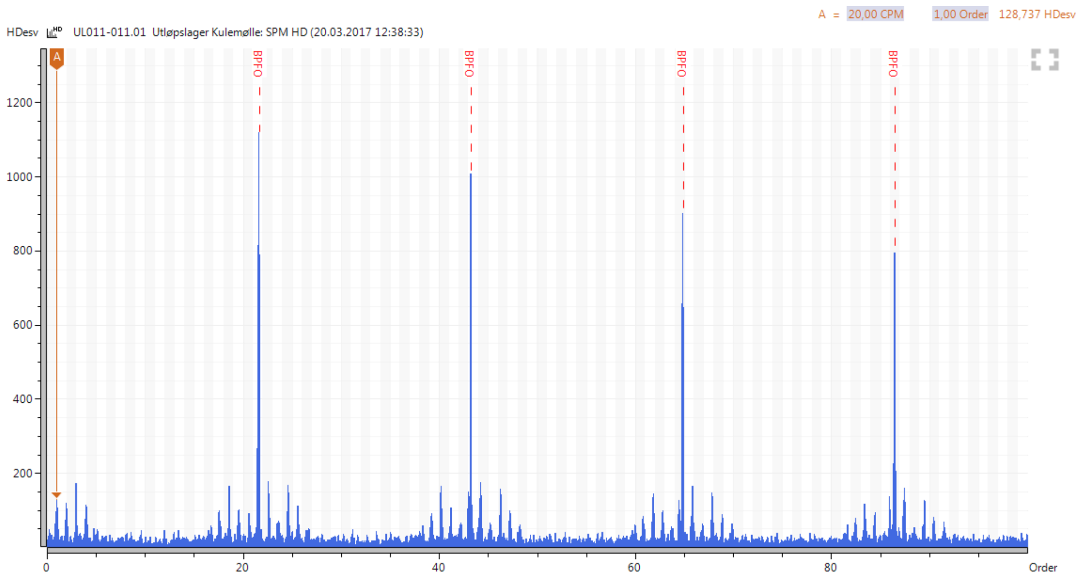


***Fig. 4** Time waveform from before bearing replacement.*

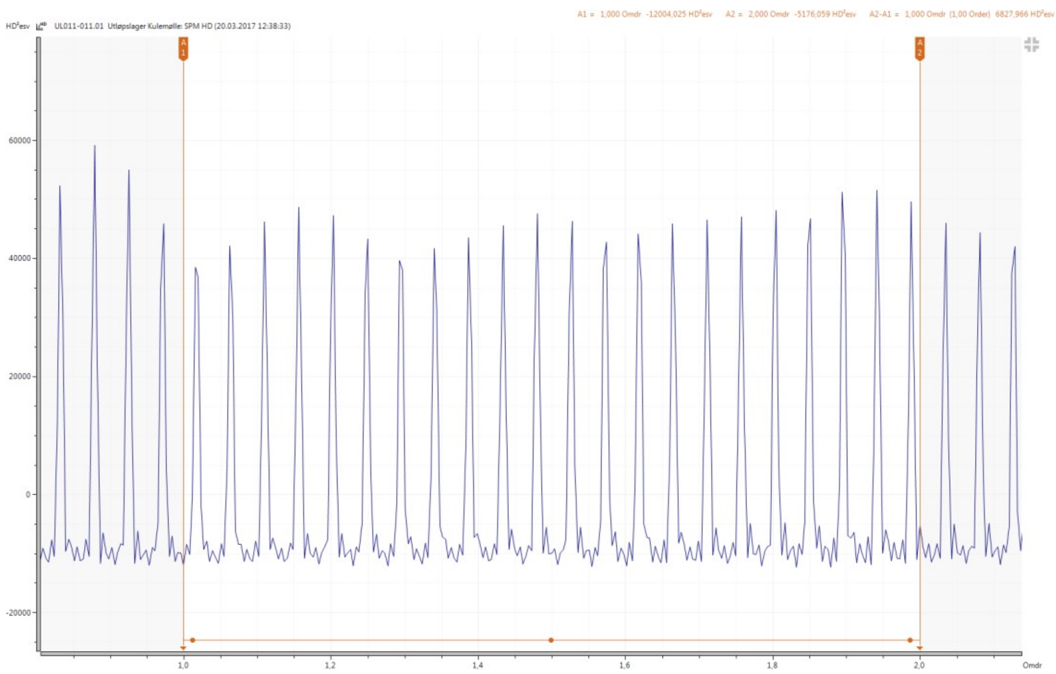
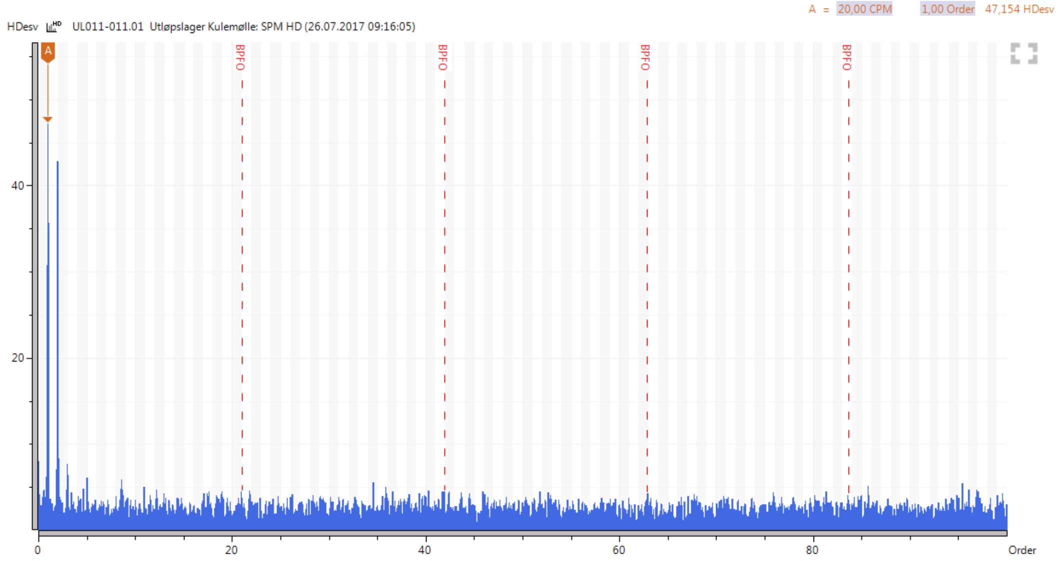


Fig. 5 Spectrum from after bearing replacement.



Img. 3 Photograph of the outer race damage.

6 Economic justification

The output main bearing is quite large: 850 mm in diameter. Delivery time for a new bearing of this type is close to three months.

Thanks to the fact that this bearing damage was detected through measurements, the bearing replacement could be carefully planned to take place during the planned maintenance summer stop.

The repair time for the planned bearing replacement was approx. 35 hours. Loss of contribution is more than NOK 100,000 per hour.

By avoiding an unplanned stop and a possible breakdown of the bearing, and with the new bearing already ordered and at the location, a quick calculation indicates several million NOK in saved maintenance costs and loss of contribution.