Condition monitoring on Low pressure feeder

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1 Introduction

This case study describes how to measure and monitor the bearing condition of a low pressure feeder.

The measurements in this case study were taken at Swedish pulp mill Södra Cell Mönsterås, a continuous cooking plant that is one of the biggest pulp mills in Sweden.

2 Conclusion and summary

There are some challenges when measuring bearing condition on this type of machines:

• The low speed; 29 RPM
• Pressure pulsations will generate high measurement values
• The bearings and bearing houses need to be able to move in the axial direction in the bearing holders, see Figure 4. To make this movement possible, there is grease between the bearing house and the holder of the house. This will cause damping of the bearing signal.

Using the SPM HD measuring technique and being aware that the bearing signal is reduced on its way to the transducer, it is possible to monitor bearing condition. Due to the high values generated by the pressure pulsation, it is not possible to use the basic measured trend for the alarm setting. To be able to monitor bearing condition, alarms must be applied to the bearing symptoms.

A test installation was made on a feeder and after a while, a clear outer race pattern was shown in the measurements. The levels were low but after some additional measurements it was decided to change the bearing. Analysis of the changed bearing showed a very clear outer race fault, see image 1. The high dynamics and accurate measuring technique made this measurement possible.

Image 1. Photo of the damaged bearing.
3 Application description

The low pressure feeder, see image 2, is an important part of the cooking process in plants designed like this one. In the latest type of cooking processes the low pressure feeder and steaming vessel has been designed out.

Fig 1. Drawing of a low pressure feeder. Source: Valmet

The purpose of the low pressure feeder is to move chips from the inlet of the process into the steaming vessel, where the air pressure is about twice the pressure on the inlet, see Figure 2. The rotor in this feeder has five blades, see Figure 3. The speed of the rotor is about 29 RPM.
**Fig 2.** A simplified process description of a continuous cooking plant.

**Fig 3.** Wood chips enter the rotor in atmospheric pressure and leave it in double atmospheric pressure.
The bearing houses of the low pressure feeder are designed to enable to move in axial direction in the holder of the bearing house, see Figure 4. The reason is that when the feeder rotor gets worn, it must be possible to tighten the gap between the rotor and the feeder house. This is done by using the wheel on the non-drive side of the feeder. Turning this wheel will move the conical rotor into the feeder house, reducing the gap.

**Fig 4.** Schematic picture showing how the bearings and bearing houses are mounted inside of the bearing holder.

### 4 Background

The background for this case study is the discussions between SPM and Södra Cell Mönsterås about the possibility to monitor the condition of bearings in feeders. It was decided that test equipment be installed on the low and high pressure feeder at the Södra Cell Mönsterås plant in order to evaluate the measuring system.
5 System setup

5.1 Measuring equipment

One Intellinova Compact INS18 online system and two shock pulse transducers were mounted on the feeder bearing houses. One RPM transducer was also mounted to enable the use of order tracking measurements, see Figure 5.

Figure 5.
5.2 Condmaster setup

The measurement setup (see Image 2 below) is this:

- Measuring time: Same as FFT measurement
- Upper frequency: 100 orders
- Lines in spectrum: 3200
- Symptom enhancement factor: 5
- Measuring interval: 1 hour

*Image 2. Condmaster setup for one of the measuring points.*
6 Case descriptions

6.1 Case #1

Readings from a low pressure feeder are usually dominated by the number of blades in the rotor, with harmonics. In this case there are five blades. In some cases, the readings also showed an outer race signal pattern (see Image 3).

Image 3. Colored spectrum overview from the low pressure feeder with the BPFO symptom trend shown at the bottom.

Looking at the trends (see Image 4), a high and stable HDm/HDC trend can be seen. The high levels are generated when the rotor blades enter and leave the respective pressure zones. In that trend, it is not possible to detect any bearing fault. However, in the symptom BPFO trend it is very clear where the bearing fault has developed. At the high levels in the trend, a part from the outer ring race way has come loose. When more parts come loose, causing sharp edges in the bearing, the BPFO trend will rise again. When the damage in the raceway has been smoothed out by the rollers, there will be no high measurement values.

The measured bearing levels were very low, but after some additional measurements, a decision was made to change the bearing. The inspection of the replaced bearing showed big spalls in the outer race, see image 5.
**Image 4.** HDm/HĐc trend and BPFO symptom trend. At the high BPFO value, a part from the outer race has come loose.

**Image 5.** Picture on bearing low pressure feeder (non-drive end).