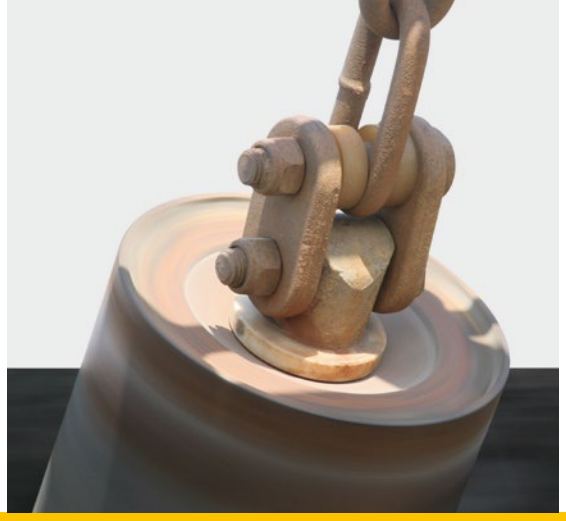
Polytec

Condition-based Maintenance in Open Cast Mining

Optical Vibration Measurement For Defect Detection on Bearings

Application Note

1
Conveyor belts for excavated material



2
Support roller

Non-Contact and Cost-Effective Monitoring and Differentiation Between Good/bad Support Rollers on Conveyor Belts in Open Brown Coal Cast Mining.

The dimensions of an open cast mine are enormous. The mine stretches over an area of 5 x 5 km^2. The conveyor belts (Fig. 1) have up to 12 MW driving power, are 2.8 m wide, typically 1.5 to 3 kilometers long, and move at speeds of e.g. 7.5 m/s. The belt is carried by support roller arrays that consist of 3 support rollers each. Monitoring this technology regularly is already challenging because of the dimensions and distances involved.

The Challenge of Monitoring the Condition of Equipment

Instead of a 100% measurement of all support rollers, the challenge of condition monitoring was to identify rollers with a single defect in areas where an increased noise level had been noticed or measured, but simple acoustic measurements would not be suitable to detect the array containing any support rollers with defective bearings. Therefore, the R&D department at RWE was looking for a technology capable of recognizing defective bearings on support rollers during operation (Fig. 2) with the possibility to investigate their vibrational behavior over a broad frequency range.

The spectral signatures of good and defective bearings have already been ascertained in tests. Now all that is needed is reliable and fast measurement technology to acquire the spectra. The option of gluing on accelerometers, or attaching them with magnets would take too much time for every roller and the dirt on the rollers would require the cleaning of the measurement point all the time.

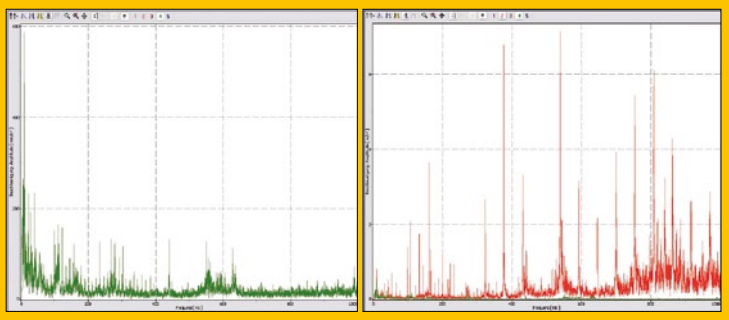
In addition to that, user safety needs to be taken into consideration. The support rollers are tight up against the conveyor belt moving at great speed which means high risk of injury.

Non-Contact Laser Vibration Measurement

A viable alternative is a non-contact process that can be used from a safe distance. The RSV-150 Remote Sensing Vibrometer (see cover picture) is perfectly suited for this task. This optical solution saves installation time while at the same time ensuring safety, as it is possible to measure over several meters. In the application shown here, the stand-off distance was 5 to 7 m. The RSV-150 is an universal instrument for non-contact acquisition of surface and structural vibrations over large distances. Depending on the amplitude and the back-scattering properties of the surface, the distance from the object can be between 5 m and 150 m. Fig. 3 shows the target alignment in the video image.

3
Measurement point with position of the laser beam in the video image of the RSV-150

4
Comparison of spectra of a defective bearing (red) and a good bearing (green)



Elegant Good/Bad Differentiation

The examinations with the RSV-150 Remote Sensing Vibrometer show the following:

- A support roller array containing at least one defective roller can clearly be distinguished from those consisting of only good rollers (Fig. 4). The spectra are very different. Additional resonance peaks and their harmonics, caused by defective bearings, appear in the spectrum of the defective roller. As only the spectral frequencies are decisive and not the amplitudes, the alignment of the vibrometer is less important.

- Measurements can be made from both sides of the conveyor belt. The spectral signature of the defect is transmitted to the measurement point. The vibrometer is sensitive enough to measure both spectral characteristics.

- The vibrometer is not sensitive to ambient noise, in particular there is no cross talk when measuring on a defective support roller array affecting the characteristics of a good array across the framework.

Summary

The mission of the maintenance department of RWE Power AG was to perform test measurements at two conveyor belt systems with about 100 support roller arrays each. To save time, the sensor was attached to the 4 wheel drive vehicle (Fig. 5, above) using a self-built sensor support based on a big suction cup. This means that a mobile measurement and evaluation center is available. The condition can already be evaluated on site (Fig. 5, below). The mains power is supplied to the RSV-150 via the on-board supply system of the vehicle.

5
Measurement technology in on-site use (above)

Graphic representation of the results in the back of the vehicle (below)

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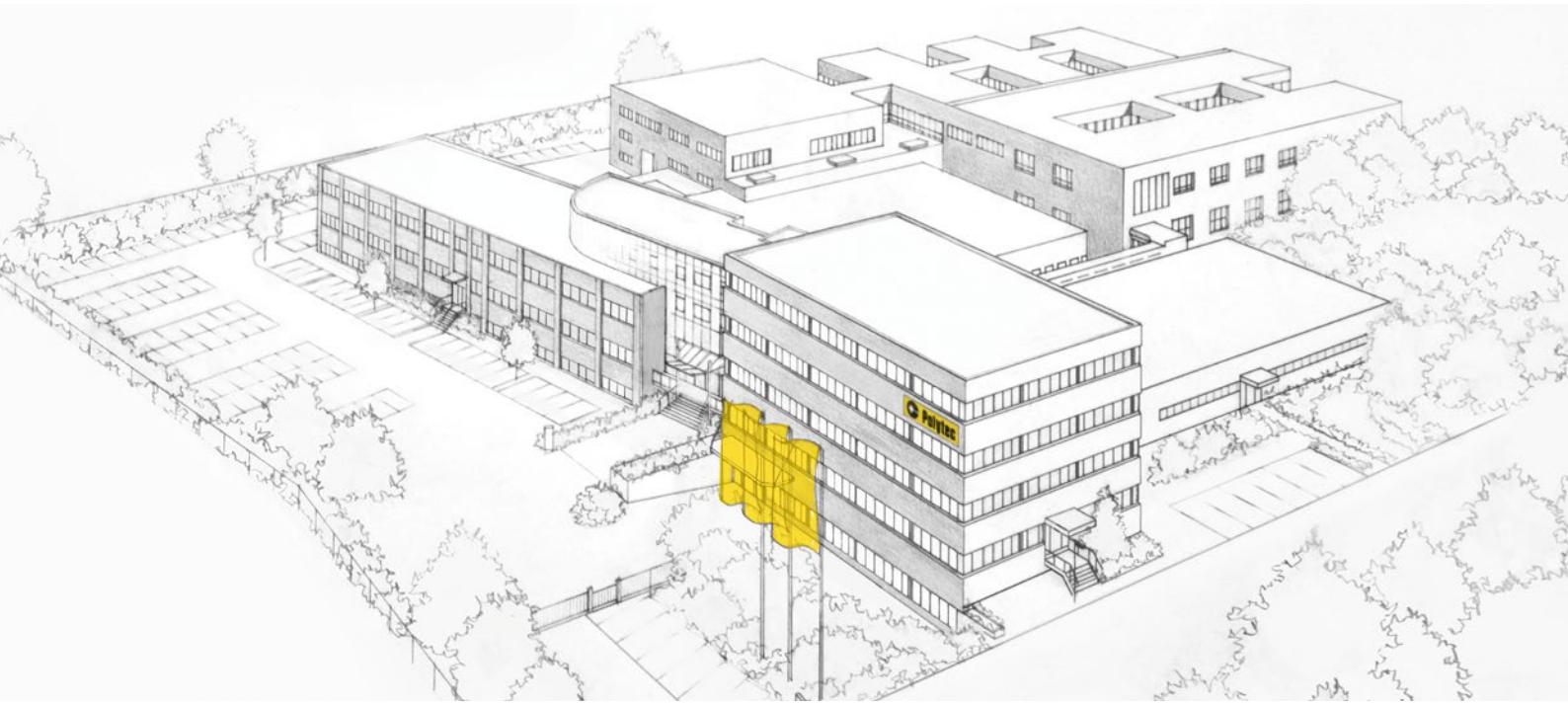
Source: Polytec InFocus



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OM_AN_VIB_G_018_Maintenance_OpenCastMining_E_42439
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