



Condition-based Maintenance in Open Cast Mining



Fig. 2: Support roller.

Fig. 3: RSV-150 Remote Sensing Vibrometer.



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

Worth its Weight in Coal!

Brown coal is a source of energy that is important for the security of energy supplies, is available worldwide and is a relatively cheap source of energy because it is extracted in open cast mining. However, open cast mining is very capital-intensive so it is of primary importance for the conveyor belts to be constantly available if production is to be organized cost-effectively. Preventive maintenance is therefore a key task in open cast mining operations.

The dimensions of an open cast mine are enormous. The mine stretches over an area of 5 x 5 km². The seam of coal is about 60 m thick and is up to approx. 400 m below the surface, meaning the overlying rock has to be dug away first. This means that conveyor belts are required as well as bucket-wheel excavators to transport brown coal and excavated material in open cast mining.

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 searched for a technology to be able to recognize defective bearings



Fig. 1: Conveyor belts for excavated material.

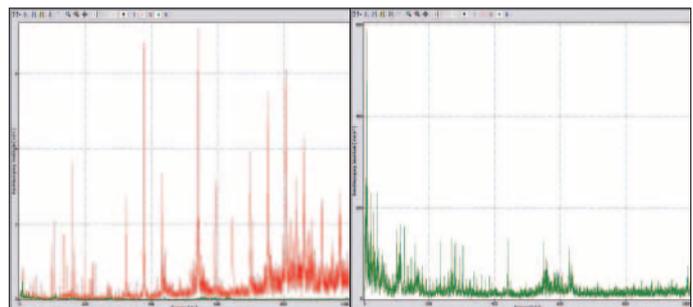


Fig. 5: Comparison of spectra of a defective bearing (red) and a good bearing (green).

on support rollers during operation (fig. 2) and 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 mean that the measurement point would have to be cleaned every 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 and are thus in an area with a 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 (fig. 3) is perfectly suited for this task. This optical solution saves the installation time while simultaneously ensuring safety, as it is possible to make a measurement over several meters. In the application shown here, the stand-off distance was 5 to 7 m. The RSV-150 is a universal instrument for non-contact acquisition of surface and structural vibrations over large distances. Depending on the amplitude and the backscattering properties of the surface, the distance from the object can be between 5 m and 150 m. fig. 4 shows the target alignment in the video image.

Good/Bad Differentiation now Possible with no Trouble

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. 5). 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 only of secondary importance. Furthermore, the study proved that during operation, even good support rollers show high-frequency resonances, probably caused by slipping sealings. These resonances were hard to hear due to the high frequencies, but caused a lot of trouble during the automatic evaluation of measurement results produced during a trial on a support roller test rig of RWE Power AG.

- 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 crosstalk when making a measurement on a defective support roller array merging the characteristics into those of a good array across the framework.

The Efficient Solution Provided by RWE: the Mobile Sensor

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. 6) 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 location (fig. 7). The mains power is supplied to the RSV-150 via the on-board supply system of the vehicle.

Optimization Options

The measurement rate between two support roller arrays is about a half minute if one roller is measured from each vehicle position respectively. However, it is also possible to measure three rollers in sequence from one vehicle position, as the amplitudes are not decisive for evaluating the damage. The decisive information on a defective roller is only provided by significant occurrence of resonances of defec-

tive bearings and their harmonics. The RSV-150 is sensitive enough to make measurements on rollers from different angles and distances without any impact on the signal quality being observed. This means that the measurement rate and thus also the efficiency can be increased.

More Info: www.polytec.com/rsv



Fig. 4: Measurement point with position of the laser beam in the video image of the RSV-150.



Fig. 6: Measurement technology in use on location.



Fig. 7: Graphic representation of the results in the back of the vehicle.

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