ULTRASONIC THICKNESS TESTING OF REINFORCED RUBBER CONVEYOR BELTS

TEST OBJECT

A conveyor belt is the carrying medium of a belt conveyor system which is widely used across many industrial branches, especially in mining industries for bulk handling of raw materials like coal, coke, iron ore etc. The operation of conveyor belts is closely connected to various kinds of mechanical loading, which causes wear or gradual degradation of the conveyor belts. One of many symptoms indicating such wear and tear is the abrasion of the carrying and of the pulley cover. Decrements in the belt’s cross-section reduce its puncture resistance, thus increasing the risk of core damage. A failure of the rubber belt in conveyor systems can lead to unexpected downtime of the plant and poses high safety risks.

MEASUREMENT METHOD

The primary purpose of thickness measurements is to determine the trended wear pattern and rate of wear for reinforced rubber belts. This maximizes the life of the rubber belt by predicting the end of its lifespan providing a tool for effective maintenance as well as allowing belt changes to be incorporated into the relevant budget cycle.

CHALLENGES

Reinforced rubber conveyor belts consist of many layers of rubber, layers of woven fabric or steel cords or combinations of those. This means that the production process is rather complicated and there are many joints needed. These joints are done by vulcanization process. During this process, there are chances for delamination formation (air pockets) in the joint of the conveyor belt.

This defect is caused mainly by improper vulcanizing pressure or curing temperatures during the joining process. If the joints contain delamination, they will fail during their use in harsh conditions. Therefore, conveyor belt manufacturers also need ultrasonic testing to check the depth and the location of the reinforcement layer across the belt in order to ensure that the product meets the required specifications.
MEASUREMENT OF TOTAL BELT THICKNESS

Reinforced rubber conveyor belt is a rather difficult material to test by ultrasound, as the attenuation inside its structure is quite high. It contains multiple layers of rubber and often even inserts of woven fabric, which prevents ultrasonic waves from penetrating the material easily. A large part of the sound energy reflects off the first layer of reinforcement. Some of it penetrates deeper into the material that can reveal valuable information of the next layers, especially if the belt contains fabric and steel cords.

Braker fabric to cord measurement at the same time with SONOWALL 70

However, ultrasonic testing of conveyor belts is limited. The measurement of the total belt thickness is not always possible, especially in case of some steel-reinforced belts combined with fabrics with no sufficient separation between the steel cords. Prior to the inspection, a feasibility study including a wide probe selection should be performed in order to determine the possible testing performance. SONOTEC and its distributors typically offer demonstrations on-site to verify the basic requirements.
SONOWALL 70

The SONOWALL 70 advanced A-/B-scan thickness gage was successfully employed for this kind of application. It shows great advantages over available thickness gages and matches or exceed the performance of market available flaw detectors.

Using SONOWALL 70 for testing rubber belt conveyors brings many advantages to the user:

- **Improved thickness range** due to signal strength (square wave 400V transmitter) and the possibility to use low frequency probes (down to 0.5MHz, single or dual elements)
- **Improved accuracy** due to an improved signal quality (averaging, digital filters selection, low noise amplifier up to 110db dynamic range)
- **Measurement efficiency** (time) optimization due to software flexibility in adjusting automated functions (Auto Gates; Auto Gain and Auto Range)
- **Fast Reporting** due to comprehensive data logger with easy export to Excel (*.xls), PDF or CSV file

**PROBE SELECTION**

Belt thickness, composition and measuring accuracy will determine the probe selection – but in general, SONOTEC recommends:

- 0.5mm – 5mm dual element 0 degree, piezocomposite, 5MHz TS5i probe
- 3mm – 50mm dual element, 0 degree, piezocomposite, 2 MHz TS2i probe

A big advantage of SONOWALL 70 is the full software support for the third party probes, which opens a possibility to solve any virtually possible task by the device.
MEASUREMENT PROCEDURE

Rubber is a very sound attenuating material. Obtaining two clear back wall echoes is in most cases not possible. Accordingly using the pulse echo technique is recommended. For this reason, the equipment has to be set to single echo mode. SONOTEC recommends dual element probes. In this case, it is important to set up a V-path error correction curve for the probe used during the measurements.

Conveyor belt rubber is usually unique and may vary from belt to belt, it is necessary to calibrate the sound velocity using a sample of known thickness(es) of the exact rubber which needs to be inspected. Ideally, a two-point calibration is performed which requires two reference thickness of the same material. If this requirement cannot be fulfilled the suggested approach is to zero the probe and using a one point calibration. The sound velocity of typical rubber used for conveyor belts should be around 1650 m/s. If a sample is not available, V-path error correction, probe zero procedure and a manual adjustment of the sound velocity is the recommended approach.

Measurement of the rubber above the reinforcement fabric (top cover) is relatively easy. Fabric is oriented perpendicular to the ultrasonic beam propagation and has a significant acoustic impedance mismatch. The amplitude signal in most cases will be much stronger and easier to evaluate than the back wall echo.

Conveyor belts that consist of steel cords are rather harder to inspect. The cords are not placed over the whole area. One of the difficulties is to locate them by observing the amplitudes that appear before the expected back wall echo. The second difficulty would be the round shape of the cord which is not an ideal reflector. In addition, it can be observed that, due to its composition, the actual reflection point from the cord is actually a bit deeper than the cord tip. It has to be taken into consideration that the remaining rubber thickness is based on the steel cord reflection measurement.

ABOUT US

With currently over 170 employees, SONOTEC GmbH is an international growing company. The company has established itself on the worldwide NDT market with UT products developed and made in Germany.

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