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Bernd Küsel, CBG Conveyor Belt Gateway, Germany

A system for substantially increasing safety and operating efficiency of conveyor belts

Conveyor belts often are subjected to exceptionally high stresses. Apart from countless bends in both longitudinal and transverse directions, the belts suffer from permanent material loading impact, from lack of maintenance, from worn, failing or wrongly adjusted conveyor parts and from foreign objects. A failure or massive damage of the conveyor belt often has dramatic consequences. Monitoring systems based on X-ray technology are well on the way to revolutionising the safety and the operating efficiency of conveyor belts. This article describes such a system, the CBGuard scanner from CBG.

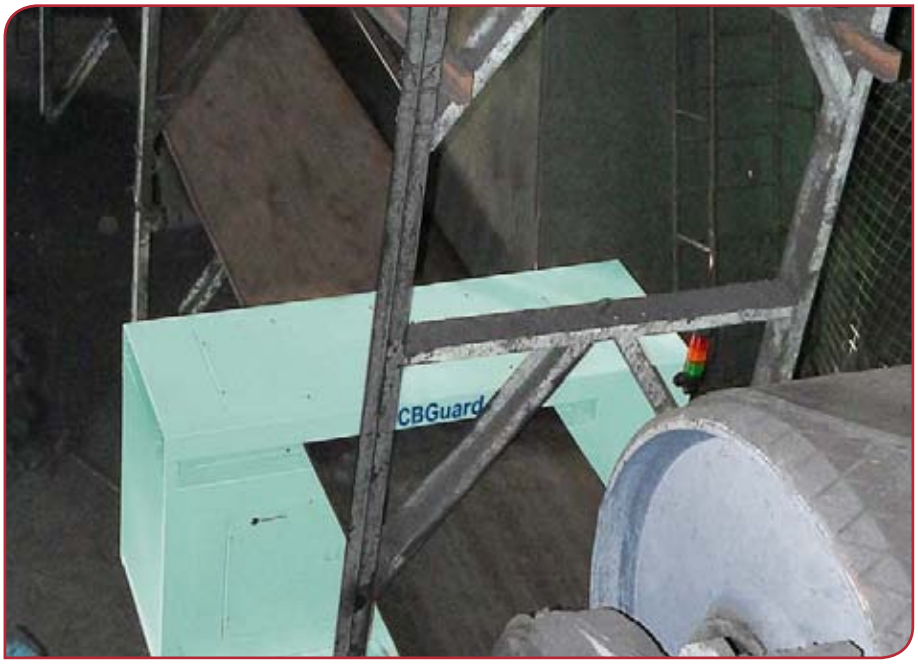
Benefits of X-ray monitoring of belts

Cost reduction: Having a conveyor belt permanently monitored obviates the need for time-consuming visual inspections by maintenance personnel. During the time gained, the conveyor can continue to work and the staff can take care of other tasks. Repairs can thus be performed at the optimum point in time, not unnecessarily early and not too late.

The system constantly and precisely informs operators about the severity of flaws within the belt. This allows damage to be fixed within the scope of scheduled maintenance stops, rather than stopping the belt to conduct visual inspections. This is because X-ray analysis can better tell how serious the carcass damage than a visual inspection. Additionally, apparently harmless damage, for example a longitudinal groove that has been caused by misaligned or incorrect chute seals, may lead to a total failure of the conveyor belt, although its general condition appears good. The X-ray system measures the belt thickness and yields timely information about the upcoming need for a replacement belt, again saving maintenance costs and time.

Safety: Exact, continuous status reports not only offer cost benefits, but they also increase safety. Damage that is not visible from the outside can be eliminated in a timely manner. Serious damage, for instance broken or corroded steel cords, trigger an alarm, which advises the belt operator to carry out repairs as soon as possible. The X-ray unit is thus an important part of an effective preventive maintenance programme.

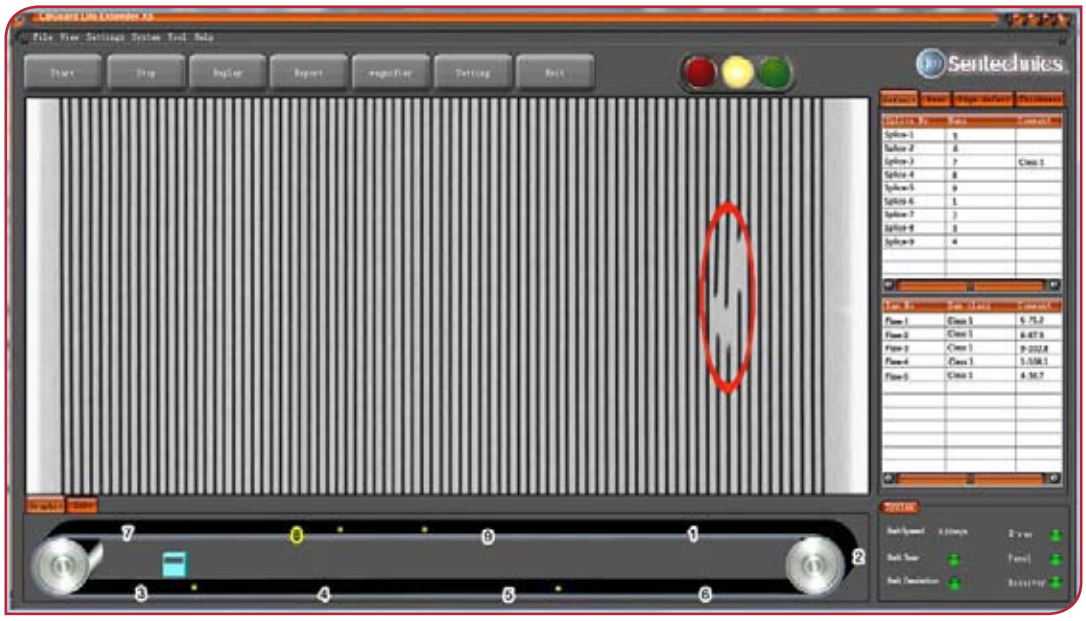
Extremely critical failures like the start of a belt-splice opening or slitting of the belt, automatically stop the belt drive to avoid dramatic consequential damage to personnel and the plant.



Below - Figure 1: The CBGuard monitoring a belt.

Industrial Internet of Things (IIoT): The X-ray scanner digitises the entire conveyor belt and every cubic millimetre of the belt is captured. This means that the X-ray system can be integrated into the IIoT. A reconciliation with the control units of other conveyor components is enabled. For example, in the event that belt mistracking is caused by misaligned pulleys or idlers, the X-ray unit sends a signal to the pulley and the pulley's software corrects it. Since the X-ray also detects material build-up on the belt, it is possible to automatically demand correction from the cleaning devices.

In combination with other elements of the logistical chain, the optimal time of the next maintenance stop can be scheduled. The condition of the belt can also be observed from anywhere in the world via the internet. A video



Left - Figure 2: Defects can be readily identified and appropriate actions taken.

reproducing the entire X-ray image of the belt can be played at any time and speed, reproducing the entire X-ray image of a belt. The position of every fault is identified by the software.

Who needs it?

The use of an X-ray belt scanner is recommended for most of the conveyors. However, the economical benefit increases with the length of the conveyor or when there are special risks. It is not unusual that overland belt conveyors run through the wilderness, on high trestles or over difficult terrain.

Initial requests for such an X-ray system came from underground coal mining, because a visual assessment of the conveyor belt is very difficult in the conditions found in that sector. Under the Safety First rules, belts were replaced, because it was assumed they were not reliable anymore. Assets were 'burned' because of a lack of information.

Also of particularly importance is the X-ray scanner for steel cord conveyor belts with a length of 500m (250m centre-to-centre) or more. Damage to such long (and often expensive) belts can have catastrophic consequences. In most cases they are the lifelines of limestone quarries, cement plants and ports.

Mode of operation

The scanner utilises the technology known from medical diagnostics. The entire belt is X-rayed continuously. The findings are available in real-time.

The software generates an intelligent, holistic analysis of any kind of threat to the belt. The current condition of the belt and the splice(s) is compared to the target condition. Any deviation triggers a customised action, from a warning to the automatic shut down of the conveyor system.

Installation of the CBGuard scanner

The CBGuard scanner is suited for a belt width of up to 3200mm, a belt thickness of up to 60mm and a velocity of up to 8m/s. The imaging resolution is up to 0.8mm x 0.8mm.

The device is compact, weighing 700kg with a size of 1.9m x 0.7m x 1.1m in the case of a 1200mm wide belt. It fits in almost all conveyors. The preferred place to install it is in the bottom run of the conveyor. The belt needs to run flat, untroughed through the device.

A concrete foundation and a safety fence have to be provided. Only authorised, qualified personnel will have access to the system. The scanner itself is equipped with several safety devices.

The X-ray radiation directly at the scanner when it is in operation is a maximum of 5µSv. That is the same value as an airport scanner. At the fence, the radiation is equal to the normal environmental radiation.

Before working on or near the device, it is switched off in the control room and there is no radiation at all. The analysis software runs on Windows XP, 7 and 10, with access through TCP/IP protocol. The programme is intuitive and very easy to use.

The scanner is almost entirely wear-free, because it neither has moving parts nor contacts the belt. The device signals in good time when the X-ray bulb, which normally has a lifetime of some years, needs to be replaced.

Conclusion

X-ray technology, in combination with sophisticated software, has begun to make inroads with regards to conveyor belt condition monitoring. No other technology is capable of providing and processing such a wealth of detailed information. The reduction in operating cost and the increase in safety are very convincing arguments for the implementation of these state-of-the art scanners.