

## MONITORING BELT STATE OF BELT CONVEYORS

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**Summary:** *In the article is presented the various types of belt conveyors monitoring systems. In the world there are plenty types of such kind of monitoring systems. Some of them use visual systems, others use X-ray or mechanical contact with the belt or belt equipment. In the article are shown the advantages and disadvantages of each inspection system. There are also shown the typical use of the conveyor belt systems and monitoring systems. The monitoring systems are obliged to control surface damage, steel cord defects, splice deterioration, tracking errors and monitor the state of glued and steel connection, before they cause any bigger problem. Stopping the belt conveyor cause wasting money and time. Nowadays factory, mines or seaport cannot afford more cost, so the systems that can avoid any dangerous accident are the most wanted. One of that is to prevent belt conveyor damages.*

**Keywords:** *belt conveyors, monitoring systems, visual systems*

### 1 Introduction

Belt conveyors are commonly used in the mining industry and each place, where the big amount of material need to be transported continuously. The belt conveyors are also used in open cast mining industry. The typical usage of belt conveyor is shown in Figure 1. Overburden is transported from bucket wheel excavator to spoil tip or coal is delivered to power plant [1, 2].



Figure 1: Belt conveyor in Coal Open Cast Mine Konin. Poland

The main components of a belt conveyor are:

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- The belt that forms the moving and supporting surface on which the conveyed material rides. It is the tractive element. The belt should be selected considering the material to be transported,
- The idlers, which form the supports for the carrying and return stands of the belt,
- The pulleys that support and move the belt and controls its tension,
- The drive that imparts power to one or more pulleys to move the belt and its loads,
- The structure that supports and maintains the alignments of the idlers and pulleys and support the driving machinery. All of belt conveyor elements are exposed to high damage that could cause dangerous accident [2, 3].

## 2 Typical damages of belt

Typically the wearing of the conveyor belt surface has been inspected visually, photographed, marked up where events observed, combined with thickness and hardness testing to project the expected life of the conveyor belt. This service whilst accurate requires a significant amount of downtime of the target belt to be performed. Typical damages of belt are:

- Mechanical failure of glued or steel belt joints shown in Figure 2,
- Cutting or delamination the belt: along the direction of moving or across, shown in Figure 3, 4,
- Overheating idlers bearing, shown in Figure 5,
- Mechanical damage to electrical equipment built along the conveyor structure,
- Excessive belt load bearing capacity in relation to the tape,
- Overheating the rotating elements [4].

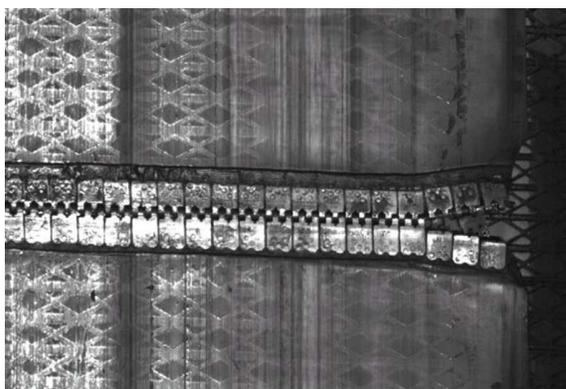


Figure 2: Mechanical failure of steel belt joint [6]



Figure 3: Cutting the belt along the direction of moving

Each of damage causes the stop of production and to mitigate the risk of catastrophic failure the monitoring systems are developed.



Figure 4: Cutting the belt by the rock

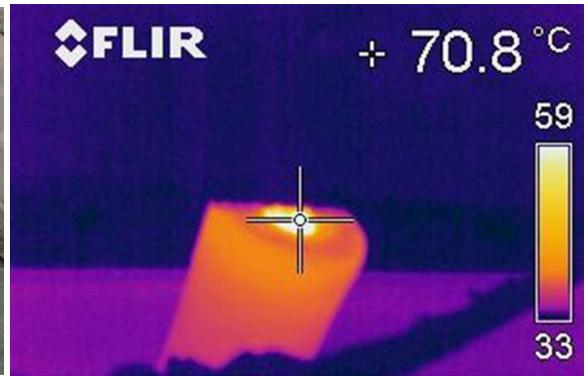


Figure 5: Overheating the idlers bearing

### 3 Monitoring systems

#### 3.1 The Vision & Profile monitoring system

The Vision & Profile monitoring system is shown in Figure 6 and it does:

- Generate an event after a comparison of a "baseline profile average" to the current belt profile. The baseline is generated by an average over the belt,
- The system signals an event where the current profile differs from the baseline by an area and by a height change in either direction,
- the position of this event is logged to an event file which is used by the system to know where events are so as to not keep signaling them,
- the system sends an email and also pulses a relay when an event is detected,
- the events are removed after a repair or a removal of the damage,
- CBM access the system remotely analyzing the data and reporting to the mine site at agreed frequencies.

The Vision & Profile hardware continuously maps a 2D, 3D and photographic image of the surface of the conveyor belt allowing for accurate wear rates over time to be established and reported on. A direct web interface allows the belt condition and all events to be monitored remotely. Ideal for monitoring the typically hazardous and remote environments associated with large industrial conveyors. The results from monitoring system are shown in Figure 7 [5].

#### 3.2 Belt Watch and Belt View systems

BeltWatch is a cost effective steel cord conveyor belt inspection system that provides enormous benefits to operators of conveyor belts. By identifying and monitoring steel cord defects, surface damage, splice deterioration and tracking errors before they become serious problems, BeltWatch shown in Figure 8 and 9 reduces unscheduled maintenance, downtime, stockpile size requirements and increases belt lifetimes. The condition of the belt is monitored continuously, providing immediate alarms of impending major failures, such as splice failure, belt tears, etc [6]. BeltView is a cost effective steel cord conveyor belt inspection system that provides enormous benefits to operators of conveyor belts. By identifying and monitoring steel cord defects, surface damage, splice deterioration and tracking errors before they become serious problems, BeltView reduces unscheduled maintenance, downtime, stockpile size requirements and increases belt lifetimes. Westplex's BeltView conveyor inspection system combines the power of a high resolution computer-based visual

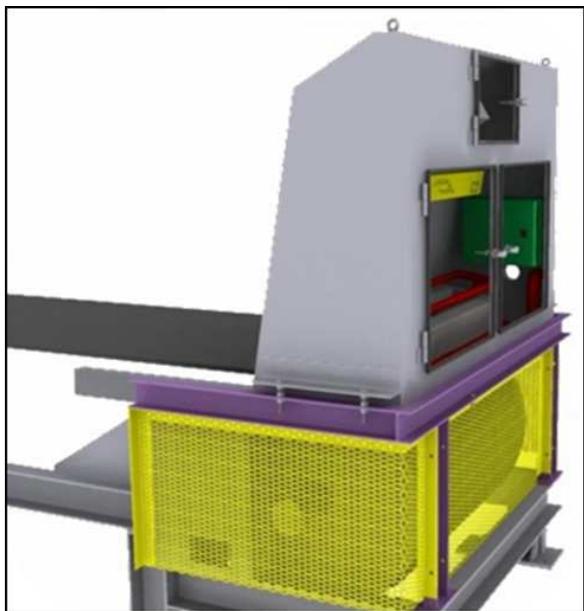


Figure 6: The Vision & Profile monitoring system [5]

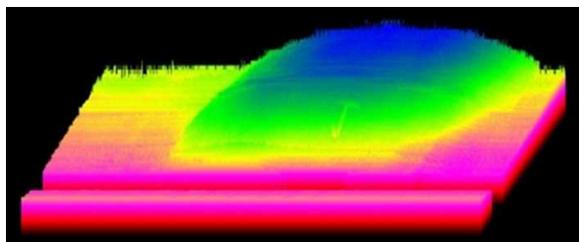


Figure 7: Sample results from The Vision & Profile monitoring system [5]



Figure 8: The Belt Watch system [6]

inspection system with the diagnostic ability of a multi-channel magnetic sensor system. It enables comprehensive measurement of a conveyor belt, detecting both surface defects and buried steel cord faults [6].

#### 4 Summary

Automatic belt conveyors monitoring systems are in common use, because they are reliable and allow to avoid human presence in dangerous environment. The dust and high humidity cause the very hard conditions for a human and make problems to identify the eventual damage of belt. Monitoring system always measures with the same precision at any time and any conditions. Monitoring system works 24 hours a day, 7 days a week and let the industry work well.

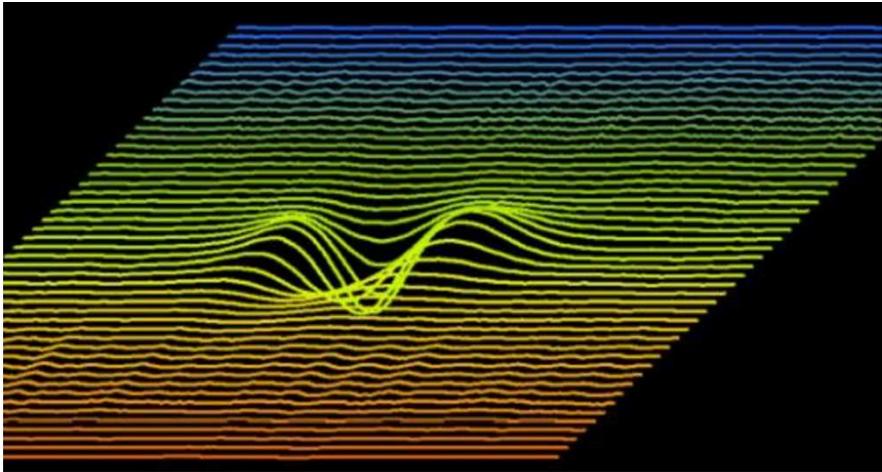


Figure 9: The results from The Belt Watch system [6]

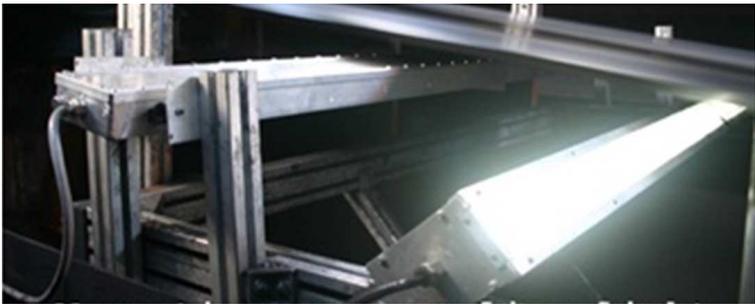


Figure 10: The Belt View system [6]

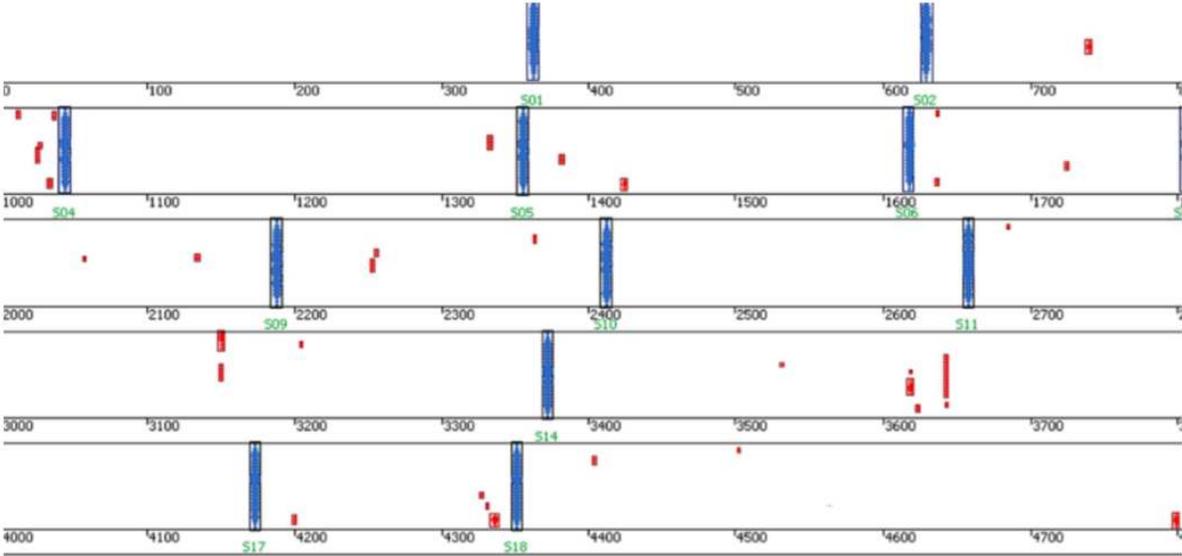


Figure 11: The results from The Belt View system [6]

## References

- [1] Gładysiewicz L., *Przenośniki taśmowe : teoria i obliczenia*, Wrocław: Oficyna Wydawnicza Politechniki Wrocławskiej, 2003 in Polish.
- [2] Antoniak J., *Przenośniki taśmowe w górnictwie podziemnym i odkrywkowym*. Wydawnictwo Politechniki Śląskiej, Gliwice 2007 in Polish.
- [3] Gładysiewicz L., Król R. Bukowski J., *Eksperymentalne badania oporów ruchu przenośnika taśmowego, Eksploatacja i Niezawodność-Maintenance and Reliability*. 2011, nr 3, p. 17-25., 2011 in Polish.
- [4] Biernat S. Hardygra M., Górniak-Zimroz J., Król R., Zimroz R., *Propozycja budowy informatycznego systemu wsparcia podejmowania decyzji w obszarze zintegrowanych danych technicznych dotyczących procesów eksploatacji ciągłych systemów transportowych, Górnictwo i Geoinżynieria*, R. 35, z. 3, p. 27-40., 2011 in Polish.
- [5] <http://www.cbmi.com.au> 20.02.2014
- [6] <http://www.beltspy.com.au> 20.02.2014