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ABB'S BELT CONVEYOR SYSTEMS PORTFOLIO

U. Richter, ABB Automation, Mannheim, Germany

INTRODUCTION

Conveyors are a highly effective means of transporting material over long distances.

Recently there has been a trend toward long conveyor systems with high capacity single flights. These conveyor systems are an efficient alternative to costly truck fleets. Also with deeper mines, the use of diesel driven trucks becomes more difficult. Another trend is in underground mining, where conveyors are an efficient alternative to drift hoists or dedicated rail systems.

Selection of the right electrical, instrumentation and automation equipment directly impacts the performance, flexibility of operation, efficiency, reliability and total life cycle cost of the conveyor system. Conveying systems are required to be solid and dependable and use process repeatable technology, to ensure the highest availability, under the most diverse conditions.

Based upon ABB's experience, a comprehensive applications portfolio of conveyors solutions has been developed. The application portfolio includes integrated systems for different types and geometric configurations of conveyors in the mining industry.

The ABB Conveyor System portfolio includes:

- Conveyor drive systems
- Conveyor interlocking, automation and optimization
- Conveyor material tracking
- Conveyor instrumentation
- Containerized drive and control system and
- Conveyor Scan solutions.

Figure 1. Coke Conveyor in China.

COMPLEX BELT-CONVEYOR

The creation of a control system for several successive conveyor belts (flights) requires exceptional know how. The starting sequence, mass flow separations, ascent and descent angles, bulk weights and distribution, changing operating conditions (particularly difficult to define are belt tensions and longitudinal oscillations) as well as emergency and repair modes and other critical factors must be taken into consideration. Using modern simulation techniques combined with the latest drive and motor technology, such as frequency-converter driven AC motors - we provide you with solutions to satisfy the highest expectations in terms of minimized wear, energy efficiency and maximized control. Worldwide, over 700 kilometres of belt conveyors are in operation and demonstrate our competence in this field.

DRIVE SYSTEMS

ABB's conveyor drive solutions correspond to state-of-the-art technology and are designed for reliable, long-life and low maintenance operation. In addition to classic motor starting methods such as binary or the new ABB ECOSS electronic resistor starters, there are Variable Speed Drives (VSD) solutions in medium and low voltage designs satisfying a variety of applications including even the largest and longest conveyor systems.

Variable speed control provides the opportunity for smooth starting, belt load profile optimization, belt slack and anti-slip controls, which result in higher reliability and lower operating costs.

Different configurations can be designed for geared or gearless conveyor drive system solutions, depending upon an economic life cycle evaluation and the site requirements. ABB's high speed solution (geared) significantly reduces the mechanical stress on the complete drive train. The low speed solution would eliminate the need for maintenance intensive gearboxes and makes high drive powers even possible.

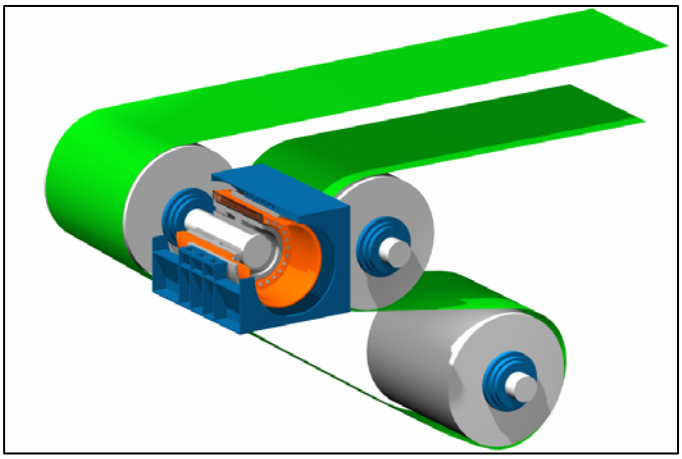

Figure 2. Gearless Conveyor Drive (GCD) Configuration with 1 Motor/ Drive Pulley.

ABB has also developed a Mining Conveyor Control Program (MCCP) which provides the conveyor main drives control. A sophisticated control loop is superior to traditional control methods (such as a basic master - follower) in control accuracy and flexibility.

The ABB MCCP provides adjustable speed for conveyors and offers the opportunity to tune a soft start profile (e.g. dwell function) and soft operation at the speed set point for optimal conveying with the maximum transport volume. Special attention is given to the load shared starting and operation between the motors on the head and tail end drive stations in order to mitigate high torque peaks and longitudinal oscillation in the belt.

CONVEYOR INTERLOCKING, AUTOMATION AND OPTIMIZATION

In normal operation, the conveyor will operate in an interlocked mode. This ensures that as the conveyor is started, the single flights in a conveyor system will each start when the conveyor ahead of it has reached a critical target speed. Belt slip detection as well as running at

the torque limit have influence to the interlocking of the upstream conveyor. When in interlocked mode, the whole conveyor system is controlled from a central control point.

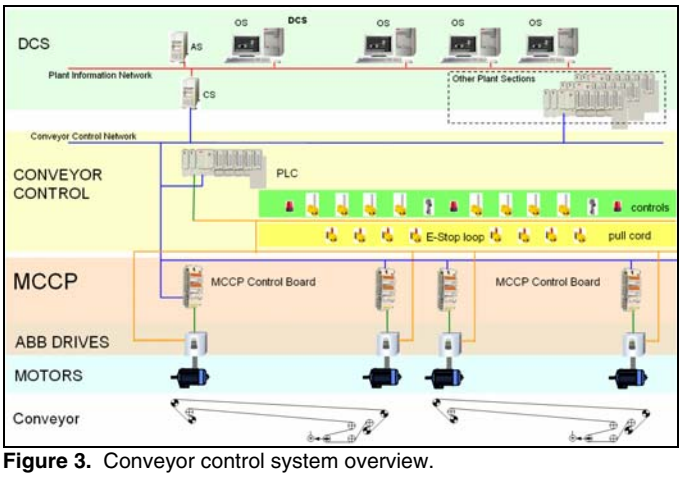

Figure 3. Conveyor control system overview.

When controlling a conveyor system a main issue to consider is potential blockage and spillage at chutes. A major aspect avoiding downtime and reducing belt wear is a correct baffle plate position control to direct the material flow properly.

With Variable Speed Drives operation at any speed is possible. This means, for example, that the filling level of the conveyed material on the belt can be kept constant and so matched to the upstream volume and process requirements. This can save energy and will increase mechanical life.

Material tracking, or Mass Flow Monitoring System (MFMS), is essential where material quality and conveyor load tracking is required. It provides input data for stockpile management or optimum conveyor load control.

The MFMS stores the current amount of material on each conveyor segment, including the material properties and provides a virtual overview of current load and position of the load on all conveyors.

The input data for the MFMS are load measurements provided at those places where the first conveyor in a conveying route is loaded. The measurement can be done by laser scanners or belt scales.

The screen display examples below show a visualization of current status in the MFMS. The height of segment blocks is the ratio of material amount on the conveyor segment, and color of the segment block specifies material property.

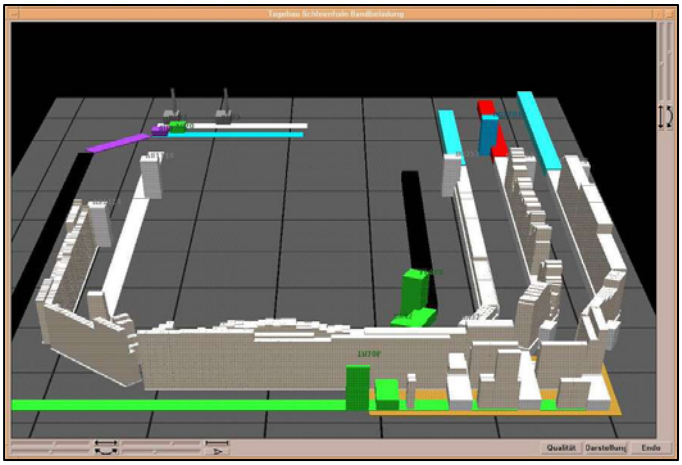

Figure 4. 3D Material Tracking model.

INSTRUMENTATION

Conveyor instrumentation incorporates all sensors and switches as well as actuators to protect the conveyor's mechanics and costly belt. Important features are, for example; tramp metal detection, belt misalignment avoidance and detection, slip detection and control, belt wear monitoring, belt rip and splice damage detection, and chute overfilling avoidance.

The conveyor's control software to be effective, measurements such as weight, volume, temperature, vibration, belt position and thickness, etc. must be taken in the right way.

CONTAINERIZED SOLUTIONS FOR ALL CLIMATE CONDITIONS

Electrical equipment, such as power distribution, drives and switchgear as well as the control system and auxiliary components need to be properly protected from the harsh conditions present in mining environment. Dust, shock and vibration, extreme temperatures and/ or high altitudes require a containerized E-house which is fully air conditioned and vibration proof. It is difficult to create an "standard" E-house solution, therefore each situation must be viewed as unique. Design considerations include factors such as the heat losses, size of the room, available space and reduced cooling capability and electrical strength of the air at higher altitudes such as those found in most mines in South America.

Figure 5. Container in the Copper Open-Pit Mine, Collahuasi, Chile.

CONVEYOR SCAN

Remote Access to the conveyor control system is essential to reduce maintenance costs, decreasing process down time and using „proactive" service.

However, avoiding unforeseen system failure and shutdown is the focus of ABB's Conveyor Scan. Conveyor Scan combines conventional conveyor monitoring practice with asset monitoring to enable failure prediction as well as to reduce overstressing the conveyor by assisting the operator or control system with helpful alarming functions.

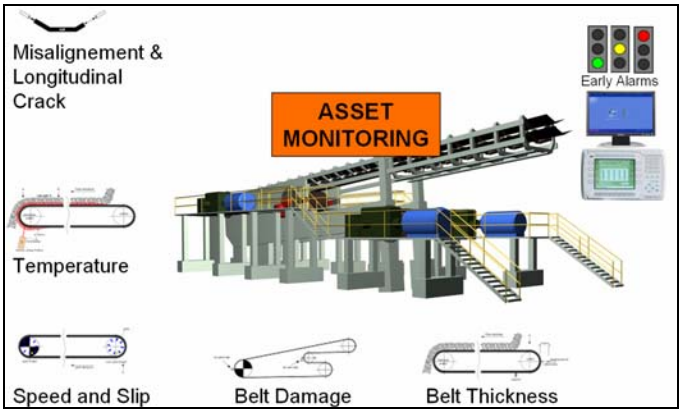

Figure 6. Conveyor Scan.