Belt Conveyor Drive Control

How to ensure Sustainabliliy and Energy Efficiency

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Wherever energy savings, availability, reliability, reduced equipment wear and difficult terrain are an issue, speed controlled belt conveyor drive systems are among the most economical drive options for large belt conveyors.

Belt conveyors have proven to be the most efficient and cost-effective method of moving bulk solids in mining operations. For decades the AC wound rotor motor system with starting resistors was the drive solution for large scale fixed speed conveyor systems. These robust and high performances drives have been implemented successfully in numerous conveyor applications world wide and were state of the art during those days.

Today, innovative and efficient AC drives are the basis for advanced conveyor drive systems.

But to achieve an advanced conveyor drive system it is not sufficient to just pick an AC drive system and connect it to the mechanical components – it is rather more than that. It is the selection of the right AC drive system based on the requirement of the conveyor application and the technology control system which forces the AC Drive System to behave in a way which suits all the requirements of belt conveyors most. This article describes the advantage of innovatively designed conveyor control systems in combination with an innovative AC drive system. The Simine CON Solution from Siemens, as part of the product family Simine, is the completely integrated solution for conveyor applications and takes care regarding energy savings, availability, and reduced equipment wear and tear.

Pictures: Siemens

Fig. 1: An carefully selected control and drive concept ensures stress-free conveyor operation.

System Requirements

Considering the investment costs for conveyors, the main mechanical components like the drives and the belt are the biggest portion. The belt itself is by far the biggest single portion.

In order to maintain these assets it is important to select the right drive system according to the requirements of belt conveyors. The typical belt conveyor requirements are:

- Minimisation of the belt tension during acceleration and deceleration.
- Minimisation of translational oscillation during acceleration and deceleration.
- Guidance and limitation of the motor torque.
- In case of multi pulleys, precise load sharing with the option to adjust different torque values between the pulleys.
- Reduced slip between drive pulleys and belt during acceleration/deceleration.
- Prevention of belt lifting.
- Reduced wear of mechanical brakes.
- Starting and stopping time independent from the conveyor load.
- Flexible operation according to the requirements of benefication plants.
- Creep speed operation.
- Simultaneously starts and stops of conveyor systems.
- High availability and reliability electrical and mechanical.
- Reduced energy consumption.
- Regeneration capability.
- Controlled braking in case of loss of electric grid.
- Noise level reduction.

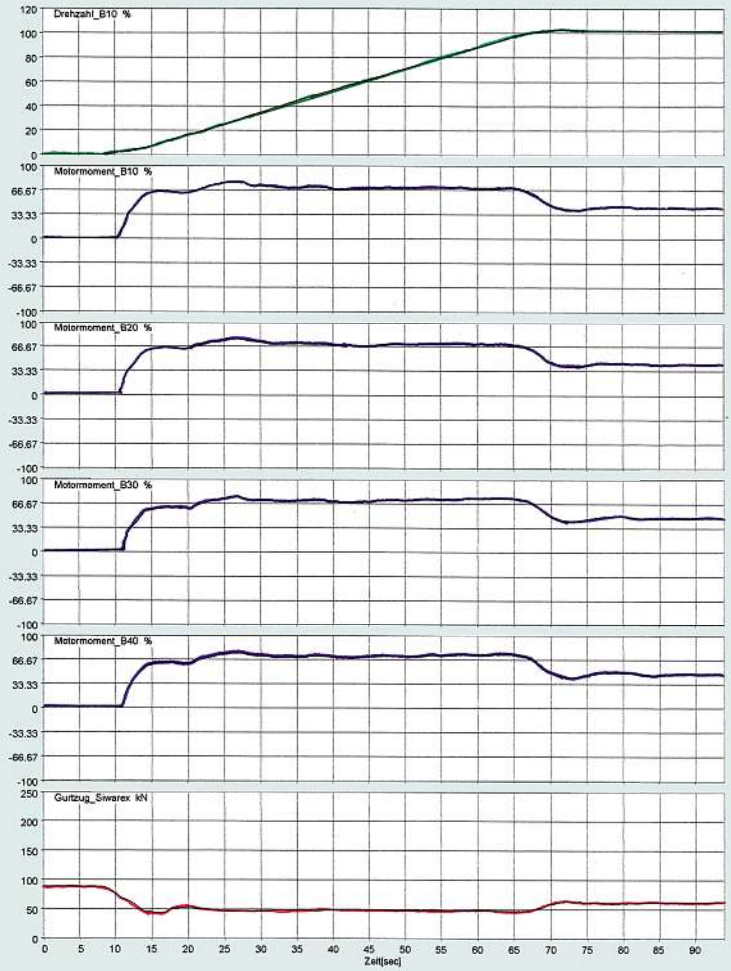

Fig. 2: Smooth start characteristic of large belt conveyor.

- Monitoring system for electrical and mechanical components.
- Reduction of operating costs.
- Reduction of maintenance costs.
- Increased productivity through less down time electrical and mechanical.

Based on the above named requirements the dynamical behaviour, the topographical situation and environmental issues the drive solution of belt conveyors must be selected in order to arrive at a high performance and innovative Conveyor drive solution.

Solution for Conveyors

In order to meet the above named requirements conventional drive systems like AC wound rotor motor system with starting resistors or squirrel cage inductions motors in combination with fluid couplings would be only a compromise.

The ideal drive configuration for large scale belt conveyors should be based on robust squirrel cage induction motors fed by vector controlled frequency converter including technology controller for belt conveyor application.

With this drive system it is possible to guide the motor torque according to the load requirements from the belt and insure the proper load sharing between the motors or even between the pulleys in case of multi motor or multi pulley application. Due to the fact that this type of drives are able to control the belt speed during acceleration/deceleration with no load, partial load, full load, and over the entire speed range a number of benefits will be achieved.

These benefits include, for example, the reduction of slip in all operation modes, precise start and stopping time independent of the conveyor load, and simultaneous start-up and stopping of conveyor systems.

In addition, the entire bulk material handling process can be controlled according to the plant or process requirements. Furthermore, no additional drives or gear inputs for creep speed operation (belt inspection) are required.

In case of stopping the conveyor, or for downhill conveyor applications, regenerative operation can easily provided. Besides that, a speed controlled stop in case of a grid loss is also possible to reduce the stress for the mechanical components including the mechanical brake.

In general, VFDs are able to control the behaviour of the squirrel cage inductions motors so that a lot of applications in the bulk material handling industry and other industries as well can be covered by this drive system without any problems. But if it comes to a belt conveyor application with multi motors or even multi pulley applications, the VFD control is reaching very fast its limits. Without further additional control options (Technology controller for belt conveyor application) the VFD is unable to warrant the proper performance of large belt conveyors.

Therefore several years ago Siemens developed a technology controller system which suits belt conveyor requirements. The challenge with multi drives for conveyors is the mechanical configuration.

Typically, two motors are connected via two gears to one pulley. Coming from the control theory gears behave like a spring and motors and pulley like a rotating mass. This configuration is a mass spring system and behaves like a mechanical oscillator. The Technology controller takes care during all operation modes, like acceleration, deceleration, unloaded, partial loaded, and full loaded that no oscillation occur.

Further tasks of the control system are the proper load sharing between the motors and in case of multi pulleys also between the pulleys. To avoid belt oscillations during acceleration and deceleration a special designed soft ramp function generator is providing the speed reference for the belt speed controller. The following graph in Fig. 2 shows how smooth the start from a belt conveyor can be.

Conclusion

Wherever energy savings, availability, reliability, reduced equipment wear and difficult terrain are an issue, speed controlled belt conveyor drive systems are the most economical drive option for large belt conveyors. ■

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