HIGH SPEED CONVEYING SYSTEM AS APPLICABLE TO THE INDIAN PLANTS

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This paper discusses the merits and limitations of the high speed conveyors and the effect of higher speeds in the selection of the components.

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SUMMARY:

This paper covers the aspects of the high speed conveyor system as applicable to the Indian Industry. Generally the belt conveyors in the Indian Industries are low speed type with belt speeds in the range of 2 to 3 mps. There are few installations with speeds up to 4.5 mps. Most of the conveyors existing in India are short distance conveyors with length up to 1 km. There are few installations in the mines and ports with higher lengths. However, the speeds of the conveyors existing around the world are up to 9 mps. This paper discusses the merits and limitations of the high speed conveyors and the effect of higher speeds in the selection of the components.

1. INTRODUCTION:

In the recent past, significant developments have taken place in the field of material handling. The following are the major reasons for the new developments.

- Higher demand for the energy which necessitated addition of higher size of coal
- fired power plants which in turn call for higher capacity of coal handling plants.
- Development in the field of infrastructure which have increased the demand for
- mineral resources like iron ore, bauxite, limestone etc.
- Increased capacities of the handling systems due to higher consumption of the
- materials.
- Stringent environmental norms to keep the pollution level low.
- Economically viable system which demands simple technology with energy efficient systems
- Higher reliability and availability of the systems to reduce the unnecessary redundancies.

Further, studies have proven that belt conveyor system is the most economical system

for transporting the material over 5million tonnes for a distance of up to 30 km. High speed conveyors is one of the alternatives which could be considered for meeting the above requirements. Long overland conveyors with higher speeds use narrower belt widths which are more economical. It would be necessary to select the optimum speed of the conveyor system which consumes lower power per tonne of material transported per km distance.

2. CLASSIFICATION OF LOW SPEED AND HIGH SPEED CONVEYORS:

In the Indian context, the normal speed of the belt conveyors is about 3 mps. Belt conveyors with speeds of 5 mps and above could be classified under higher speed conveyors. However, conveyors with speeds of 8-9 mps are very common in Europe, Australia, US, South Africa etc. The conveyors with speeds of 10 to 20 mps are classified as high speed conveyors in these countries.

3. HIGH SPEED CONVEYORS:

The higher speeds could be adopted for longer overland conveyors. The width of the belt for the high speed conveyors could be narrower as compared to the low speed conveyors. The belt tensions will be lower and hence belt rating required will also be lower. The pitch of the idlers could be higher due to which lesser number of idlers could be provided. The overall friction factor would be lower. Variable Voltage and Variable Frequency Drives (VVVFD) would be provided for conserving the energy.

The higher speeds of the conveyors would be associated with the higher wear and tear of the components used in the conveyors. The idler rolls and pulleys will be rotating at higher speed, the loading cycle of the belt will be higher, turbulence of the material at the loading and discharge points will be more. Higher speeds would also induce more vibration in the conveyor system and hence, it is necessary to pay special attention while selecting the various components. The noise level will also be higher. The selection of components for conveyors for the high speed application is discussed

below.

4. SELECTION OF COMPONENTS FOR HIGH SPEED CONVEYORS:

The principal resistances for the motion of the horizontal belt are, resistance to idler rotation, indentation rolling resistance, flexural resistance of belt and the flexural resistance of the bulk material. The major contribution to the overall resistance is the indentation rolling resistance which accounts for almost 60%. The indentation rolling resistance mainly depends on the diameter of the roller and the visco-elastic property of the rubber cover of the belt. Hence the idler roller diameter shall be selected appropriately to reduce the above resistance. This resistance could be further reduced by adopting belt with cover material of “low indentation rolling resistance compound”. The conveyor shall be designed under steady state condition. For longer conveyors with larger capacity operating under higher speeds, it would be necessary to carry out the dynamic analysis of the conveyor. With the dynamic analysis, it would be possible analyze the starting and stopping characteristics of the belt conveyor. The analysis of the system will give more accurate results and closer safety factors could be selected. The starting and stopping time for the high speed conveyors is generally high. In case of an emergency stopping by braking, the energy to be absorbed will also be high and it could cause more damages. Hence, it is necessary to take all the safety measures for any emergency stopping.

4.1 IDLERS:

As discussed above, the idler diameter shall be selected appropriately for reducing the frictional resistance. The selection of the pipe shall be such that the ovality of the tube is within the limits. The idlers shall be manufactured with better quality control to limit the total run out to less than 0.5mm and lesser friction factor. The excessive run out would cause vibration and noise in the conveyor system at higher speeds. The bearing size shall be selected based on the RPM of the roller and L10 life. Presently this type of idlers are not available in India and needs to sourced from outside. However, this could be developed by the Indian manufacturers provided volumes are more.

4.2 BELT:

The rating of the belt shall be selected considering the safety factor depending on the type of belt viz. steel cord or nylon or EP. The thickness of the cover shall be selected based on the loading cycles. The belt cover shall be of “low indentation rolling resistance compound”. The Indian manufacturer can offer this type of belt.

4.3 DRIVE:

For the high speed conveyors, it would be preferable to provide Variable Voltage Variable Frequency Drive (VVVFD). With this type of drive, it would be possible to conserve the energy. This would also help in operating the conveyors at lower speeds, in case the carrying capacity on the belt is reduced on any occasion.

4.4 PULLEYS:

The pulleys shall be designed considering the tensions at each pulley as per the tension analysis. The shaft shall be selected based on the bending and torsional shear stresses. The bearings shall be selected based on the L10 life. Ring feder type of locking system shall be adopted for connection between the shaft and hub. The pulleys shall be statically balanced to avoid any unbalances.

4.5 DISCHARGE AND LOADING CHUTES:

As the speed of the material at the discharge point is high, the corresponding wear will also be high. Suitable deflector plate with necessary liners shall be provided for smooth flow of the material. The chutes shall be adequately sized to avoid the chocking of material. The chute at the loading shall be such that the material is guided on to centre of the succeeding belt smoothly in the direction of the belt and at velocity equal to lower than that of the belt. The material shall be fed at the centre of the belt and eccentric loading shall be avoided.

4.6 BELT ALIGNMENT:

The alignment of the belt has to be perfect as the misalignment would cause excessive damages at the higher speed. The number of splice joints shall be as minimum as possible to ensure straightness of the belt.

4.7 BELT CLEANING SYSTEM:

The belt cleaning system has to be more effective. The un-scraped material would be carried to the return idler and form coating on the same. This would cause excessive vibration and noise in the conveying system.

4.8 SUPPORTING STRUCTURE:

The supporting structure shall be designed taking care of the resonance of the conveyor system. The effect of resonance on the structure in the high speed conveyors will cause excessive damage.

4.9 TAKE-UP ARRANGEMENT:

The take-up arrangement shall be gravity type as far as possible. All the safety aspects shall be provided to take care of any eventualities in case of emergency braking system.

5. LIMITATIONS OF HIGH SPEED CONVEYORS:

The high speed conveyors are not suitable for in-plant conveying system which have generally short conveyors, more number of transfer points, the conveyors provided with tripper etc.

6. CONCLUSIONS:

The various aspects of the high speed conveyors are discussed in the above paragraphs as applicable to the Indian Industry. The following conclusions can be drawn:

- The high speed conveyors could be used economically for the long distance,
- high capacity conveyors. These find application mainly in the mines and ports.
- Proper care shall be taken while selecting the components as enumerated above
- and undertaking the installation of the same.
- The high speed conveyors would not be suitable for the in-plant conveying system.

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