Design Aspect of Roller Conveyor System

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ABSTRACT

Conveyors are gravity or powered equipment commonly used for moving bulk or unit load continuously or intermittently, unidirectional from one point to another over fixed path, where the primary function is conveying of the material by the help of movement of some parts/components of the equipment. The equipment as a whole does not move. A roller conveyor supports unit type of load on a series of rollers, mounted on bearings, resting at fixed spacing on two side frames which are fixed to stands or trestles placed on floor at certain intervals. A roller conveyor essentially coveys unit loads with at least one rigid, near flat surface to touch and maintain stable equilibrium on the rollers, like ingots, plates, rolled stock, pipes, logs, boxes, crates, molding boxes etc. The spacing of rollers depend on the size of the unit loads to be carried, such that the load is carried at least by two rollers at any point of time.

Keyword *Conveyor, Roller.*

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1. INTRODUCTION

Roller conveyors are classified into two groups according to the principle of conveying action. These are: 1. Unpowered or Idle Roller Conveyor. 2. Powered or Live Roller Conveyor. In an unpowered roller conveyor, the rollers are not driven or powered from an external source. The loads roll over the series of rollers either by manual push or push from an endless moving chain or rope fitted with pusher dogs, rods or clamps. Generally these conveyors operate at horizontal plane, but at times a gentle slope is given to these conveyors to aid motion of the loads. An inclination of 1.5% to 3% ensures that the load will roll by gravity. Such conveyors are termed "gravity roller conveyor''. In a powered roller conveyor, all or a selected number of rollers are driven by one or a number of motors depending on the selected drive arrangement. The driven rollers transmit motion to the loads by friction. The powered roller conveyors may be installed at a slightly inclined position, up to 10° up or up to 17° down. The load can be moved in either directions by changing the direction of rotation of the rollers, where these are called reversing conveyors. Roller conveyors are used for conveying almost any unit load with rigid riding surface that can move on two or more rollers. These are particularly used between machines, buildings, in warehousing as storage racks, docks, foundries, rolling mill plants, manufacturing, assembly and packaging industry. They are also used for storage between work stations and as segment of composite handling system. However, the limitations of rollers conveyors are that they can be best used for objects with rigid flat surfaces, and for movement to relatively short distances. Needs side guards to retain the loads from falling off. Gravity roller conveyors have the risk of accelerating loads. It can also be noted that the analytical work in the literature is focused on load estimation. Very few researchers have explored the fatigue life estimation and stress analysis for the chain assembly Reducing weight and increasing strength of the products research are high in demand in the market. And composites materials are getting up to satisfying those demands. This research deals with the analysis for link plate of roller chain with new material that is glass fiber and carbon fiber. composite material. In this research reducing weight of conveyor chain and increasing the strength of their connected links are considered.

2. LITERATURE REVIEW

An unpowered roller conveyor consists of series of rollers, the frame on which the rollers are placed and the stands on which the framework rests. Because of simplicity of design, competitive cost and trouble free operation, these

conveyors are used extensively in handling unit loads in workshops or process plants to convey articles from one working station to another. Unpowered roller conveyors are often used as a storing platform and as such are often termed as roller table. These are also used in stores as storing racks and in loading bays for loading / unloading materials from carriages. A gentle slope may be provided in the conveyor to aid movement of the loads on idle rollers. These gravity roller conveyors are used to convey load in one direction only. The conveyors can have a curved section to change direction. Material movement between two levels may be done by an inclined or a spirally formed gravity roller conveyor. The spiral form increases the length of the conveyor and thereby controls the velocity of the articles moving down the conveyor trend is to provide weight/cost effective products which meet the stringent requirements. The aim of his paper was to study existing conveyor system and optimize the critical parts like roller, shafts, C-channels for chassis and support, to minimize the overall weight of assembly and material saving. Existing design calculation shows the factor of safety is very greater than requirement and there is a scope for weight reduction. Critical parameter which reduces the weight is C channels, roller outer diameter and roller thickness. Though value of deflection, stress is more in case of Optimized design, but it is allowable. 30.931 % of weight reduction due to Optimized design. The literature reviews that have been discussed above were divided into three categories. First category is a discussion about the FEA with shape optimization for weight reduction. Most of the previous study used Scanning tensile testing and hardness testing. Bošnjak S. et. al. (2011) diversifies the investigation with finite element method to prove the most stresses zone have been identified around the chain link.
Reducing weight and increasing strength of the products research are high in demand in the market. And composites materials are getting up to satisfying those demands. This research deals with the analysis for link plate of roller chain with new material that is glass fiber and carbon fiber composite material. In this research reducing weight of conveyor chain and increasing the strength of their connected links are considered. As conveyor chain links contributes considerable amount of weight to the conveyor chain and needs to be strong enough, a single composite chain link is designed

2.1. Aspects of Gravity Roller Conveyor Design

The major design calculations involved are to determine the force required to overcome the resistance to motion of the loads and the angle of inclination required for a gravity conveyor. Total resistance to motion is made up of:
(1) Resistance to rolling of the load on rollers due to friction.
(2) Frictional resistance in the roller bearings.
(3) Resistance due to sliding of the load on the rollers and force required for imparting kinetic energy to rollers.
Resistance to rolling of the total load ‘‘G’’ on the rollers is given by F1 = Gk/R .. .(i) where k = rolling friction factor also called coefficient of rolling resistance, mm R = roller radius, mm (ii) Frictional resistance on roller journals is expressed by F2 = (G + wn′) μr/R ...(ii) Where, w = weight of rotating part of each roller. n′ = number of rollers supporting total load, and hence in motion. μ = coefficient of friction at the journal. r = journal radius.
When a moving load comes over a static roller, it slides over the roller and starts accelerating the roller till the roller attains the surface speed equal to speed of the load. When the load leaves the roller, it starts decelerating and eventually stops until it is accelerated by the next load.

3. DESIGN CONSIDERATION

The part of the axle which is between the two bearings on either sided will be given a rough surface finish and can have a diameter of more than 30mm. This will reduce machining costs. The part of the axle in contact with the bearing will be given a good surface finish and will have an exact diameter as the bore of the bearing. There will be an interference fit between the inner race of the bearing and the axle. The part of the axle outside the bearing will have a smaller diameter than 30mm. This will ensure that when the bearing is fitted there is no rubbing between the axle and the bearing.

Some Sample Calculation of Conveyer Design:-
The minimum inclination angle ‘β’ of the gravity conveyor:
Pitch = 200mm
Total length of the conveyor = 4 meters = 4000mm
Number of rollers necessary = 4000/200 = 20 Volume of the 73OD pipes

$= \pi/4 \times h \times (D1\ 2 - D2\ 2\ )$

$= \pi/4 \times 500 \times (732 - 652\ ) = 433539.79mm3 = 433.5398cm3$

Weight of the rotating part of the roller

= density of steel × Volume = 7.8 × 433.5398
= 3381.61g = 3.382 kg

$$\tan \beta = (2k/D) + [\{1+ (wn'/G)\} \times (\mu d/D)] + \{q \times (Z0nwv2 /gLG)\}$$

k = rolling friction factor (wood-steel) = 0.0012m = 1.2mm
D = roller diameter = 73mm
w = weight of the rotating part of the roller = 3.382 kg
n′= 3 G = total load = 200kg
μ = coefficient of friction at the journal = 0.5
d = journal diameter = 30mm q = factor of value between 0.8 to 0.9, because not all the mass of the roller moving parts is on the periphery, and thereby not moving with velocity
v = 1 (assumed)
Z0 = numbers of loads moving simultaneously on the conveyor = 1 (assumed)
n = number of rollers= 20 v = linear velocity of the load = 0.2 m/s (assumed)
g = acceleration due to gravity = 9.81 m/s2
L = total length = 4m

$\tan\beta=(2k/D)+[\{1+(wn'/G)\}\times(\mu d/D)]+\{q\times(Z0nwv2/gLG)\}=(2\times1.2/73)+[\{1+(3.382\times3/200)\}\times(0.5\times30/73)]+\{(17\times3.382\times0.22)/(9.81\times3.5\times200)\}$
= 0.249 β
= 13.98 ° ≈ 14 °

4. CONCLUSION

Thus we have enlighten the concepts of Design cycles of Roller conveyors, by focusing on various Design aspect, Result of FEA software and Actual Prototype Testing can help to Improve Visualization in future.

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6. REFERENCES

[1] Dr. Siddhartha Ray, "Introduction to Materials Handling", New Age International Publishers 2013.
[2] "Design of Machine Elements" by V B Bhandari, McGraw Hill Education, Third edition.
[3] "Machine Design Data Book" by V B Bhandari, McGraw Hill Education, 2014 edition.
[4] M.D Jagtap (2014) Gaikwad B.D, Pawar P.M. Study Of Roller Conveyor Chain Strip Under Tensile Loading, Ajmer, From India