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Modification and Design Development of Hinged Belt Conveyor System

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Abstract: *The current project addresses the analysis of a metal chips carrying conveyor extracted from various operations performed on the CNC machine. A conveyor system is the main component in material handling. This study starts with understanding the standard operation procedure and thus the removal of chips formed during these operations and analysing the role of the chip conveyor belt. Here the conveyor gets jam due to the structure and length of the chips which get stuck in the conveyor belt. This causes the halt in the operations as the extra time is required for the removal of the chips from the conveyor belt. This causes the wastage of time thus hampering the production.*

This problem can be solved in various ways. One of the efficient and effective solutions to this problem is the application of twin belt conveyor instead of the single belt conveyor. This will allow the chips to be pressed between the two belts, thus reducing their volume and reducing the size of the bulk. These chips can then easily be removed. These will remove the problem of jamming of the conveyor belt and eventually reducing the wastage of time and increasing the productivity.

Keywords: chips, twin belt conveyor, CNC machine,

I. INTRODUCTION

A conveyor system is a common piece of mechanical handling instrumentation that moves materials from one location to different. Conveyors system particularly helpful in applications involving the transportation of heavy or bulky materials. Conveyor systems enable fast and economical transportation for various types of materials that create them very popular within the material handling and packaging industries. Various types of material transportation system are available which are used according to the various requirements of various industries [4]. A conveyor is the carrying medium of a belt conveyor system (often shortened to belt conveyor). A belt conveyor system is one amongst many sorts of conveyor systems. A belt conveyor system consists of 2 or a lot of pulleys (sometimes observed as drums), with associate degree endless loop of carrying medium that rotates regarding them. One or each of the pulleys area unit hopped-up, moving the belt and therefore the material on the belt forward [5].

Efficiency in Bulk handling like all alternative industrial branches, the majority handling trade still has a massive potential to save lots of energy and prices similarly. As in several industrial branches, in bulk materials handling most of the energy is consumed by electrical motors. If the area of the conveyors is taken into account a lot of closely, different starting points may be known for saving energy. Machine with less friction between bulk material and conveying part need less energy than others. Due to appurtenant conditions in hygiene, environment- or explosion protection, Vclosed system varieties are fairly often needed nowadays for many transfer tasks [6]. The more friction and, thus, more energy demand can't be avoided with these machines. The drives maybe energetically optimized, e.g., in victimization frequency controlled, economical motors, low-loss transmission units. It's necessary to think about the interaction of the whole conveyor chain, besides the individual conveyor components [7]. Savings are significant thought once coming up with a conveyance line. Due to the massive variety of conveyors, value will simply be unacceptable and also the return on investment is also problematic.

The following points give the usual cost family

- 1) Direct and variable costs. The resources listed during this cell are completely used for the products; these expenditures are directly charged to the product.
- 2) Direct and constant expenses. They can directly be affected to the value of the products. Once their quantity is critical, these expenses are separated from the mounted common charges and utilized in an extra stage throughout the calculation of the partial prices. What has the advantage of purification the analysis and to own a correct plan of the contribution of every product to cover the common mounted charges.
- 3) Indirect and variable costs. In fact these costs tough to judge and need a complex method and an exhaustive analysis. Energy potency has the foremost impact on these costs.

- 4) Indirect and fixed costs. They are generally tough to cut back. They're managed in a completely different method as per the chosen method of research. Ways to progress exist for every cell. Sometimes it is necessary to rethink the operation of the production line. The saving, not possible to avoid, consists of moving the fastened prices to variable prices. In different words permitting what's simply necessary for the operation. This may be done by modifying the in operation modes of the instrumentality, for example create it running only if needed. Ideally, it's fascinating to transfer direct prices into indirect variable prices by subcontracting some work or eliminating the superfluous prices [8].

II. LITERATURE REVIEW

A. Design and Development of Automated Conveyor System for Material Handling

In the process or manufacturing industry, raw materials and products need to be transported from one manufacturing stage to another. Material handling is design in such a way that it is cheap, fast and safe loading and unloading with less human involvement. For instance, belt conveyor system can be employed for easy handling of materials beyond human capacity in terms of weight and height. This project discusses the design calculations and considerations of belt conveyor system for press machines, in terms of size, length, capacity and speed, roller diameter, product to be handled as well as its maximum loading capacity in order ensure fast, continuous and efficient movement of material. The successful completion of this project work is help to the development of an automated belt conveyor system which is fast, safe and efficient [1]. It is aimed to reduce human effort and at the same time increase the productivity & accuracy levels that cannot be achieved with manual operations.

B. Typical failure analysis and processing of belt conveyor

Belt conveyor is a commonly used equipment for continuous transport of material, it has a higher efficiency and have large conveying capacity, it is simple in construction, and has small amount of maintenance. It can be achieved at different distances and different materials transportation. It is mainly used in mining, coal handling system in power plant for transporting coal and other projects. Belt conveyor will often use some typical problems in the course, this paper Based on research common typical failure of belt conveyor during use, analysis the cause of failure, proposed some effective methods to solve the problem [2].

C. Conveyor Belt Troubles (Bulk Material Handling)

There are two main industrial classes of belt conveyors in general material handling such as, moving boxes along inside a factory and bulk material handling such as to transport large volume of resource and agricultural materials. Conveyor belt not only includes proper care of the belt itself but also includes care and maintenance of the frame and accessories. The same way life of a conveyor belt not only depends on good design and manufactures but also on the care and attention it receives in storage and service. The main damages are occurring in bulk material handling system due to the sticking of the material which is transporting and the damages due to the chemical reaction and also there causes failure due to carry back of product. The problems and failures need proper and permanent maintenance. The removal of sticking materials can be done by two methods, by using a wire brush which is placing under the conveyor belt it will remove the sticking materials when the conveyor rotates.[3]

III. REASONS WHY CONVEYORS ARE IMPORTANT IN AUTOMATION SYSTEMS

Conveyor systems have varied uses and functions which will be applied in numerous industrial sectors for various operations, starting from production to packaging, carrying and even supply. The three reasons that justify their importance in virtually each automation system. Reduces Manual Waste certain tasks in an exceedingly method, like moving extraordinarily significant objects in an exceedingly line, are often avoided manual labour. In fact, attempting to realize such tasks mistreatment human labour ends up in manual waste and you won't add any price to the production method. Moreover, the probabilities of injuries and accidents could rise, so risking the employees' safety within the plant. You'll be able to scale back all of this by automating such tasks. When you introduce conveyors in production line, they will not only speed up the processes but also make the plant more productive. An automatic conveyor resolution can unlock the staff from unproductive manual work and that they will pay that time acting on crucial business development tasks. Your staff are the crux of your organization — ensure that their efforts are place to sensible use instead of wasting them. Provides flexibility Flexibility is a key component for achieving lean operations. Conveyors are not immobile and inflexible. Standard conveyors facilitate in achieving the flexibility that's needed for numerous operations.

Moreover, they'll be established simply within the field additionally. Modular conveyors enable you to customise the conveyor system for your operations. Rather than choosing a conveyor system that you just cannot move, invest in one that's versatile, to

higher serve your goals.

Even if you utilize fastened systems, you'll be able to gain flexibility by configuring and coming up with properly. Once you do thus, the conveyors will transport material from a range of storage and production areas to their finish destination. You will be able to get this flexibility from having a conveyor system that may offer straight-through lines. Such a system may accommodate a range of merchandise and destinations inside one line.

A. Enhance Quality Control

When you implement automatic systems, you'll be able to eliminate scrap and enhance quality control. Moreover, automation additionally helps in detection vital problems among the merchandise, like defected elements, unwanted metal. Conveyor solutions facilitate in orienting merchandise for subsequent assembly or operation, so making certain that no time is wasted for positioning of any product. An automatic answer additionally helps in making additional turnout and ensures improved client satisfaction attributable to prime quality merchandise. There are variety of technologies that you'll be able to implement in your producing and/or production unit. Among them, conveyors are unit guaranteed to be a transparent winner. Before automating warehouses, it's imperative that you just diligently assess your necessities or consult an industry expert therefore on realize the most ideal conveyor type for your processes and applications [9].

IV. TWIN BELT CONVEYOR

Twin belt conveyor involves addition of extra conveyor belt which will help to compress the bulky chips which comes from CNC machine. Twin belt conveyor is the ultimate solution to compress the bulky chips.

Reasons of selecting the twin conveyor belt solution:

- 1) Easily compress the bulky chips.
- 2) Chips do not get jammed at one place.
- 3) Because of using this solution it is not required to stop conveyor at regular intervals for removing the bulky chips.
- 4) It will help to manufacture more pieces of big washer and increase the production rate.

V. METHODOLOGY ADOPTED

The twin belt conveyor can be used to transport virtually all types of chips or cuttings and small-size particles, but it is designed specifically for carrying masses of stringy metal chips. Material is carried on the primary conveyor belt through the entire length of the conveyor, and a secondary belt runs through the inclined and discharge portions of the conveyor which holds onto and even compresses the birds' nests of stringers. Simultaneously with transport, coolant can be separated, captured, or drained back into the cooling system. The basic application of this type of conveyor is as an elevating conveyor integrated directly into a machine tool, and/or in conveyor system along with other types of conveyors as an elevating conveyor, with chips deposited either into a collecting container or a disposal device.

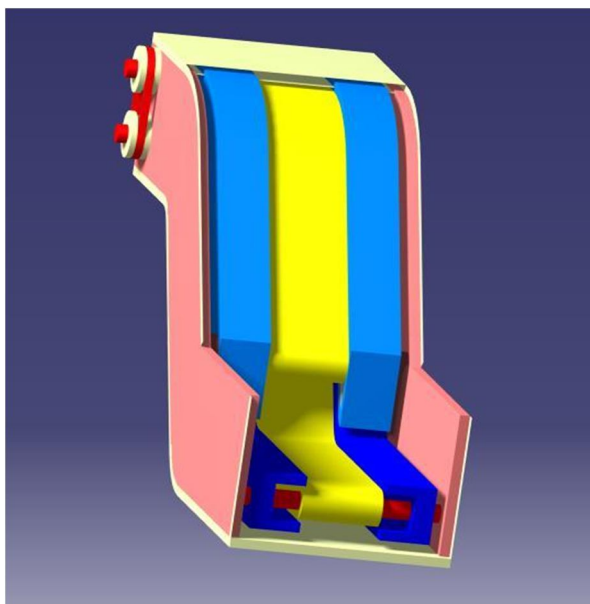


Fig 1. Twin belt conveyor

VI. CONSTRUCTION

The conveyor casing is a welded, watertight unit fabricated from sheet metal sections. Tracks are welded onto the inside of the casing sidewalls. The tracks act as supports and guides for the conveyor belt. The conveyor is driven by an electric motor through a speed reducer. The output of the gear motor is connected directly to the lower head shaft so that torque is transmitted via the head shaft and twin sprockets to the primary conveyor belt. Torque is transmitted to the secondary conveyor belt via roller chain and sprockets on the non-drive side of the conveyor. Alternative options include the head shafts driven by an indirect drive system comprised of a motor, speed reducer, roller chain and sprockets. The metal belt consists of sheet metal apron plates, mutually linked by axles. Rollers on each end of the axles, in turn, support the axles; the rollers are supported and guided by tracks mounted on the casing. The conveyor apron plates are sandwiched between side wings to contain the product being carried. The side wings are mounted on the axles, between the apron plates and the roller. Some belts are equipped with cross cleats to contain the material as it is lifted up the incline. Side bars are added to increase pulling capacity, based on the application. Conveyor belt pitch – the distance between axles – is either 1-1/2 or 2-1/2 inches [10].

VII. WORKING

Initially (and after prolonged shutdown) be sure that the conveyor drive has been correctly wired and that all covers and shrouds are in place. Operate the conveyor for approximately 15 minutes to observe and confirm trouble-free operation before placing the unit in service. The unit is usually operated through pushbuttons located on the machine, although, when requested, the controls can be mounted on the conveyor. Check for correct tensioning of the conveyor belt, as describe later under “Metal Belt Tension Adjustment.” The speed reducer is a single system.

The speed reducer is lubricated and sealed by the manufacturer and does not require further lubrication. The motor bearings are also sealed and do not require further lubrication. The unique dual belt conveyor design of the Twin belt conveyor manages the heaviest chip loads, long and stringy chips and balls of chips better than traditional hinged steel belt conveyor. Power form the lower belt is taken from the upper belt and due to which the belt is moving both in inward direction. During machining and metal removal chips are formed of various shape and size.

In turning operation on mild steel work piece namely “Big Washer”, long length chips are formed. In turning operation, long chips are formed. These chips entangle together and form bird nest. Due to this the bulk of chips coming from the conveyor system after turning the chips are pressed between this two belts. Due to the pressing the chips which are coming in bulk are pressed and convert into the bed of chips and discharge out from the conveyor into the chip collector basket [11]

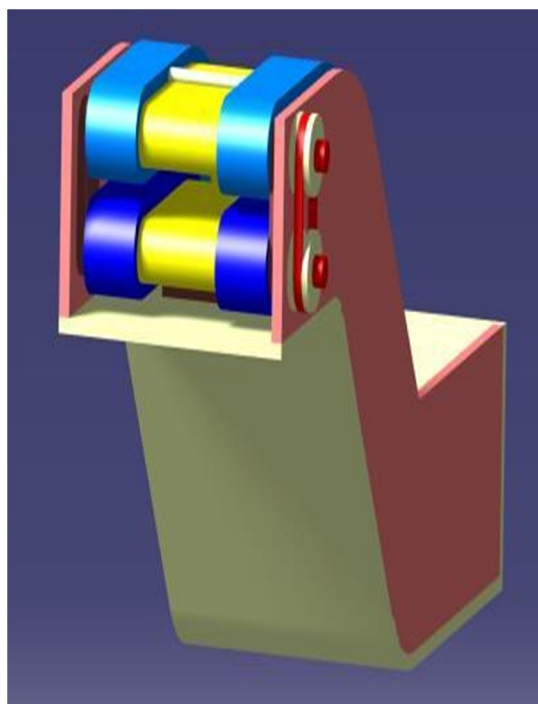


Fig2. Twin belt conveyor assembly

VIII. DESIGN CALCULATION

Design specifications [12].

- 1) Belt width = 457.2mm (18 inches)
- 2) Spacing between two belts = 100mm (3.93 inches)
- 3) Pitch of steel belt = 2-1/2"
- 4) Length of belt require = 16 feet
- 5) Spindle power = 15 KW
- 6) Spindle speed = 4 m/min (15 rpm)
- 7) Spindle torque:

$$\text{Power (P)} = \frac{2\pi NT}{60}$$

$$15 \times 10^3 = \frac{2\pi \times 15 \times T}{60}$$

$$\text{Torque} = 9.549 \text{ KN-m}$$

Where,

P= Power required to drive the conveyor system

N= Spindle speed in rpm

T= Torque require to drive the conveyor

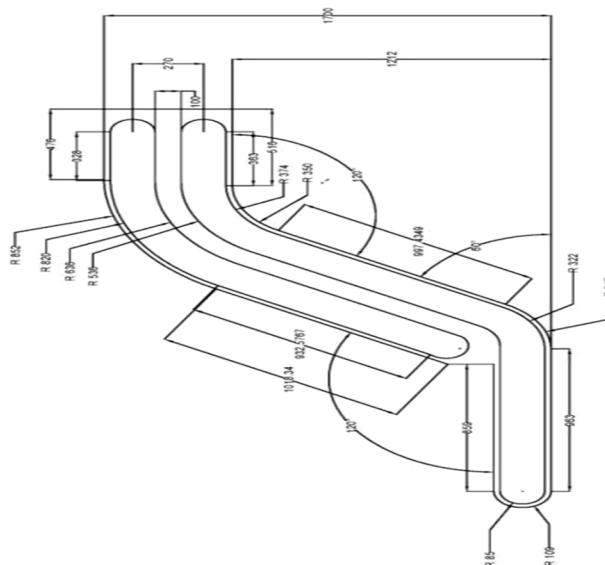


Fig 3. 2D model of twin belt conveyor

IX. RESULT

Some of the improvements have been tested in the conveyor system which is attached to the CNC machine for the removal of chips formed due to the cutting, turning, etc. operation. The exact efforts, time & cost for the formation of 'Big Washer' are calculated. In turning operation on mild steel work piece namely 'Big Washer', chips (10-15 feet long) are formed which creates lots of problems in handling and removal of these chips. Moreover because of this non-value adding process, there is an increase in overall operational time for the production of 'Big Washer'. While applying the modification over the existing conveyor system, 'TWIN BELT' conveyor manages heaviest chips loads, longs, nested and stringy chips. The same power from the lower belt is taken to the upper belt.

After applying the twin belt conveyor, the nested chips (consists of 10-15 feet long chips) pressed by the inward motion of the twin belt. Due to pressing the chips, the bulk formation of chips takes place and converted into the bed type compressed chips which are then discharge from the conveyor system to the conveyor basket. The non-value adding process of removal of chips takes the overall tie of 110 min/day but after the modification and improvement over the conveyor system, 34 more pieces of big washer can be manufactured.

X. CONCLUSION

This project has tried to raise and solve problems that exist due to single belt conveyor system by modification and improvement of conveyor system. The production process of big washer is studied and non-value adding activities are optimized. Data of various machines are calculated, analysis and improvement over the existing conveyor system is carried out and productivity is increased.

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