Design & Development of Vertical Chain Conveyor

Neil Vinod Deore
Mechanical Engineering,
Guru Gobind Singh Polytechnic
neilvinoddeore@gmail.com

Piyush Shrikant Khardikar
Mechanical Engineering
Guru Gobind Singh Polytechnic
piyushkhardikar@gmail.com

Prof. B.A. Burkule
Mechanical Engineering
Guru Gobind Singh Polytechnic
bhushan.burkule@ggsf.edu.in

Abstract:

A typical type of mechanical handling equipment that transports things from one place to another is a conveyor system. This project's major goal is to securely lift the weight. This report includes a selection and the design of fundamental mechanical components. As the material is moved vertically upward, this system is able to get over the limitations of inclined belt conveyors, achieve required heights, and take up less floor area. This chain conveyor lifts the cargo using a succession of a single pallet carried by a continuous chain arrangement. The stuff suspended on the pallets is transported to the following floor by a chain system that is powered by a motor.

***Keywords* —conveyor system, vertically upward, less floor area**

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I. INTRODUCTION

1. MATERIAL HANDLING Short-distance movement within a building's walls or between a building and a moving vehicle constitutes material handling. It takes into account the protection, storage, and control of materials throughout their manufacturing, warehousing, distribution, consumption, and disposal and utilizes a wide range of manual, semi-automated, and automated technology. Material handling can be utilized to provide time and place utility through the handling, storage, and management of the material.

1.1 TYPES OF MATERIAL HANDLING:

1.1.1 Manual Handling:

Manual handling is the act of moving individual containers by lifting, lowering, filling, emptying, or carrying them with one's hands. Workers may be exposed to physical situations that might result in sprains and strains to the lower back, shoulders, and upper limbs, which account for a significant portion of the more than 500,000 cases of musculoskeletal disorders recorded each year. Manual handling tasks can be modified with ergonomic changes to decrease damage.

1.1.2 Automated handling:

Equipment can be used to lessen or occasionally replace the need for manual material handling whenever it is technically and financially possible to do so. Although ongoing developments in sensing, machine intelligence, and robotics have made it possible to fully automate an increasing number of handling tasks, the majority of existing material handling equipment is only semi-automated because a human operator is required for tasks like loading/unloading and driving that are difficult and/or too expensive to fully automate.

Manual Material Handling

Automated Material Handling

II. PROBLEM DEFINITION

2.1. Carryback

Carryback is the material that remains on the belt after discharge and is perhaps the most common struggle among conveyor operators. Typically all industrial belt conveyors experience carryback to some extent, but given its potential for serious consequences, keeping it to a minimum is essential.

2.2. Conveyor Belt Mistracking

Tracking, or training, refers to the way in which the belt rides on the rollers. Conveyor belts should always track centrally. Mistracking occurs when the conveyor belt rides unevenly on rollers, favoring one side over the other.

2.3. Slippage

Belt slippage typically occurs around the drive/head pulley and happens when the belt and pulley do not have enough grip to adequately turn the belt around the pulley.

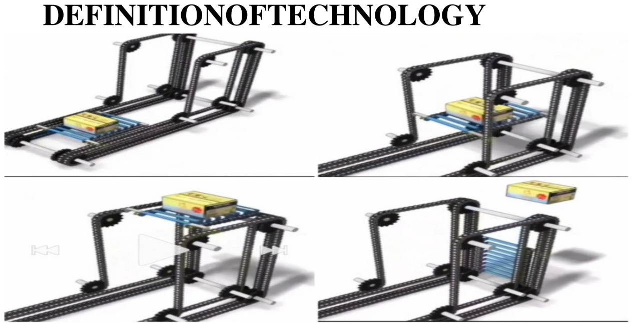
2.4. Material Spillage

Material spilling off of the conveyor is also a commonly encountered problem in industrial belt conveyors. While spillage can occur at any point along the conveyor path, not surprisingly, it is most common at load and transfer points.

2.5. Floor Space

Inclined conveyors are constructed in a way that they can be inclined at a certain angle. Due this inclination to reach a desired height, the conveyor requires a lot of floor space.

III. DEFINITIONOFTECHNOLOGY



A typical type of mechanical handling equipment that transports things from one place to another is a conveyor system. Conveyors are particularly helpful in situations when large or bulky materials need to be transported. Conveyor systems are highly well-liked in the material handling and packaging industries because they enable speedy and effective transportation for a wide range of commodities. There are many different conveying system types that can be utilised depending on the requirements of various sectors. Additionally, there are floor- and ceiling-mounted chain conveyors. Chain conveyors are made up of hand-pushed trolleys, I-Beam, towlines, power &free, and enclosed tracks.

IV. METHODOLOGY

Vertical Chain Conveyor

A particular kind of conveyor system used to move materials along production lines is the chain conveyor. Chain conveyors transport a number of single pendants along a motorised continuous chain configuration. The material that is strung on the pendants is transported by the chain arrangement, which is powered by a motor.

Products are moved along an assembly line and/or around a production or storage facility using chain conveyors. The majority of the time, big unit loads including pallets, grid boxes, and industrial containers are transported by chain conveyors. These conveyors can be set up with a single chain strand or two. When a load is placed on chains, friction causes the load to move forward. In general, chain conveyors require relatively little user maintenance and are simple to build.

V. ADVANTAGES OF CHAIN CONVEYOR

1) They are Customizable
2) They are not bound by Stringent Compliance Laws
3) They are safe and efficient
4) They are Cost Efficient Solutions
5) They contribute to Increased Productivity

VI. DESIGN

6.1 Design considerations

Speed of conveyor = 6m/min
Material weight to be lifted = 20kg
Two pallets with one carrying material to be handled at any instant.
M = Material weight= 20kg
C= Additional weight which includes attachment, crossbars, fixings=20kg

6.2 Selection of chain

Chain pull:

$$P = \frac{9.81 \times (C+M) \times S.F}{\text{Number Of Chains}}$$

$$= \frac{9.81(40) \times 1.2 \times 1 \times 1}{4}$$

$$= 117.2\ N$$

Thus from standard catalogue of chains, chain number 40 witha maximum allowable load of 4.17 KN is selected.

Specifications:
Pitch=12.7 mm
Roller Diameter=7.92 mm
Inner Width=7.95 mm

Pin Dimensions:
Diameter=3.96 mm
Length=17.9 mm
Link Plate
Height = 8.8 mm
Thickness = 1.5 mm

6.3 Selection of Sprocket

Assuming no. of teeth as 19
Thus from standard catalogue of SKF sprocket,
No of teeth=19
Pitch diameter = 77.16 mm

Material:
En8–carbon steel
According to B.S 970 chemical composition of En8
Carbon→0.36 to 0.44
Manganese→0.6 to 1
Phosphorous→0.05
Sulphur→0.005

6.4 Selection of bearing

Radial load = 400N
Shaft Diameter= 25 mm

$$Ka = 1.5$$

Dynamic capacity =14KN

$$L□10 = 10000$$

Rating life of bearing

$$L10 = \frac{L□10 \times 60 \times N}{10^6}$$

$$L10 = \frac{10000 \times 60 \times 32}{10^6}$$

$L10$ =15 Million Revolutions

$$Pe = Fb \times Ka$$

$$= 400 \times 1.5$$

$$= 600\ N$$

$$L10 = \left(\frac{C}{P}\right)^3$$

$$14 = \left(\frac{C}{600}\right)^3$$

$$C = 1446.08\ N > 7.8\ KN$$

This design is safe and selecting bearing number UCP205 with 25 mm diameter.

6.5 Design of key

Material: Mild Steel

$$\tau S = 56.25\ N/mm2$$

Selecting square key, Hence

$$\square = w = = \frac{25}{4} = 6.25mm$$

4 4

Selecting next standard value = 8 mm

Considering crushing of key

$$\sigma c = \frac{4T}{d*l}$$

$$l = \frac{4 \times 108.9 \times 10^3}{25 \times 6.25 \times 112.5}$$

$$l = 24.576 \approx 30mm$$

Considering sharing of key

$$\tau s = \frac{2T}{d*l}$$

$$l = \frac{2 \times 108.9 \times 103}{25 \times 6.25 \times 56.25}$$

$$l = 24.57 \approx 30mm$$

Key Dimensions $\square = w = 8mm$

$l = 30mm$

6.6 Design of shaft

Material selection

Mild steel of the following composition is selected

Carbon-0.16 to 0.18 % (max allowable 0.25 %)

Manganese- 0.7 to 0.9 %

Sulphur-0.04%

Phosphoros-0.04%

UTS = 840 MPa

Yield stress = 247 MPa

Selecting shaft diameter as 25 mm

$\underline{108.098 \times 10^3} = \underline{\tau}$

$\times (25)4$ 12.50

32

$\tau = 35.23\ N/mm2$

Hence design is Safe

VII. SPECIFICATIONS OF PARTS

Parts	Material	Specifications
Frame	Mild Steel	Square Tube ($50mm$ ×50mm×2mm)
Shaft	Mild Steel	-
Sprocket	En8 (Carbon Steel)	19 Teeth, ½ Inch Pitch
Roller Chain	Stainless Steel	½ Inch Pitch
Bearing	Standard	ID = $25mm$
Geared Motor	-	½ HP, 3 Phase, Foot Mounted, Output Speed = 32 RPM
Roller chain flexible coupling	En8(Carbon steel)	NT 8316

VIII. CONCLUSION

Thus, we can draw the conclusion that the Chain Conveyor as constructed is capable of transporting products from one floor to another floor securely, a task that would need time-consuming and expensive human labour to complete.

The Inclined Belt Conveyor is more sophisticated than the Chain Conveyor, which is meant to take up less space.

IX. FUTURE SCOPE

It is possible to utilise rubber block chain, which is distinguished by its lack of links, silent operation, resistance to wear, and near-zero maintenance requirements. These exceptional advantages are further complemented by its corrosion-free construction. Advanced automation eliminates the need for operator supervision. Pallets can be used at a greater volume to move materials at a faster rate. Proximity sensors, for instance, can be utilised to detect incoming commodities and halt the infeedconveyor until the platforms are in the wrong position.

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