Optimizing Harvests with an Automated Agricultural Conveyor System

Nithya S, Chandrasekaran K, Sujay S, Thenmozhi N, Vikram Y,
[1]*Department of Aeronautical Engineering, M.A.M. School of Engineering, Trichy, Tamilnadu, India.*

Abstract - There are many different ways to transport goods, and the agriculture industry frequently uses these systems for manual goods handling. In order to decrease the amount of labour and time needed, a conveyor system must be developed in place of traditional methods. As a result, since material handling equipment is made to make loading and unloading simple, inexpensive, quick, safe, and efficient while requiring little to no human interaction, a variety of industries will use it to transport materials. The use of automated conveyor systems in many different applications is growing. When compared to forklifts and other comparable material handling equipment, they perform better and are comparatively easy to install in warehouses, cold storages, and store houses.

Key word: Conveyor, Goods, Material And Material Handling Equipment.

I. INTRODUCTION

'Agri' and 'Culture,' which signify land or field and cultivation, respectively, are the Latin roots of the word agriculture. It alludes to the science and art of raising livestock and crops for commercial gain. Agriculture dates back to the Indus Valley Civilization in some regions of southern India. India ranks as the world's second-largest producer of agricultural goods. In farming, farmers must load and unload crops and goods in order to transport them from the farm to the market, cold storage, or storage facilities. The time and effort required for this process to complete increases the cost of the process. Farmers typically experience fatigue or illness as a result of the high effort requirements. This paper aims to reduce the time, effort, and expense associated with material handling in transportation systems. Using the principle of gravity, it is simple to modify the transportation and packaging of the output mid-process to reduce energy consumption during material handling. There are numerous uses for conveyor belts in agriculture. They are used in the feeding process, which includes preparing fruits, vegetables, and other agricultural products for packing and delivery to retailers or other processing facilities by processing or freezing them. Apart from that, bulk materials can be loaded onto trucks and driven to their destination with the help of these conveyor belts. These belts were developed in response to the demands of the agriculture industry.

II. METHODOLOGY

Through interactions with farmers, it is observed how much difficulty farmers have when loading and unloading grains and crops to move them to different locations, such as farms to APMCs, private or public cold storage facilities, or farmer-owned store houses. Different crops make loading and unloading difficult. Because there is a greater need for these tasks during these times, there are fewer workers available, which prevents farmers from hiring workers in a timely manner to finish their work. When workers require more time to complete the task, it becomes more time-consuming, costly, and requires more effort.

Many of us are unaware of the challenges farmers face when bringing their produce to market and how it is transported from the farm to the consumer. After a certain crop is harvested, it is sun-dried, sorted, and graded before being transported to APMC in an appropriate transport vehicle. Here, the process of loading and unloading is typical for all crops. Loading and unloading is done when a farmer or merchant wants to transfer farm produce from one location to another. Because of the heavy workload that labourers have and the fact that loading and unloading require a large number of labourers and a lot of human effort, farmers are more negatively impacted because they have to pay labourers more. The approximate annual crop production in Maharashtra state in 2018–19 helps explain the loading and unloading problem.

Development of Solution

To facilitate loading and unloading, a conveyor system must be developed. This will enable farmers to handle the task with the least amount of labour. The belt conveyor's above rollers provide a smooth carrying operation. A single belt is all that makes up the belt conveyor; these belts are connected to create a continuous system. Most of the time, each roller allows for free rotating interaction with the belt. This creates a level surface that can be used to place fixtures or tooling details to hold parts in place. Belt conveyors travel at a moderate speed and are used in both horizontal and inclined applications. They are commonly used for cargo transportation.

It takes a lot of effort, time, and labour to manually move farmed grains, vegetables, and other items from their field to another. Farmers are therefore having trouble moving completed goods like tomatoes, onions, grains, etc. from one place to another. Consequently, these methods help to solve the issue of material handling in agriculture. India is the world's largest producer of grains, including wheat, soy, and mustard. Before storing these harvested grains, farmers must rinse and dry them in the sun for two to three days. Grain sorting and grading is a laborious and time-consuming process. Spiral seed graders are among the tools used by farmers to sort and grade grains. It is approximately ten feet tall. Grain lifting ten feet in the air is a challenging task. This conveyor can therefore be applied in this way. Grain can be lifted and dumped using a conveyor in a spiral seed grader. Using a conveyor will make it simpler for farmers to load and clean produce. Farmers must load and unload goods in various transport vehicles for a variety of agricultural applications. Since each transport vehicle has a different size, a universal conveyor can be used, and it can adjust its height and length to fit the dimensions of the transport vehicle. Farmers use a variety of transport vehicles for loading and unloading their products; typically, the size of the vehicle is determined by the volume of goods being transported. Therefore, different transport vehicle dimensions are taken into account when designing conveyors.

III. CONCEPT DESIGN

It was crucial to determine the ideal dimensions for conveyor system design. Farmers' transport vehicles are the main source for learning the system's dimensions because the conveyor's primary function is loading and unloading. The following parameters were necessary for the conveyor system's design:

1. Optimum height:

For finding out suitable height transport vehicle dimensions are considered. From Table 2. it is observed as the maximum height is 6 feet and another applications such as the spiral seed grader has maximum height of 10 feet so the conveyor is designed for 5.5 feet maximum height for prototype manufacturing.

2. Suitable angle for inclined conveyor:

The conveyors can be designed for maximum 35-degree angle so to cope up with the transport vehicle height the maximum inclination is fixed as 35 degrees and minimum 29 degrees.

3. Optimum length:

According to maximum height and conveyor inclination the maximum length is considered as 13 feet, but for prototype manufacturing it is considered as 6.5 feet.

4. Required belt width:

As farmers will transfer onion and other allied family crops such as potato ginger etc. and grains from one place to another, so the dimensions of 50 kg sack are taken into account. After measuring the sack dimensions, it was observed that maximum 300 mm width will be suitable.

5. Maximum load application:

The maximum load taken into account when designing the prototype is 55 kg because the working length is shorter and there won't be as much room for adding more weight in the form of sacks or directly putting potatoes and onions in bulk quantities on the conveyor. Following consideration of these variables, the conveyor's final model is produced. The conveyor's dimensions are determined by taking into account a number of factors, including how tall and how long it should be in relation to various types of vehicles. Conveyor dimensions are adjusted using two frames: a sliding frame that slides to the necessary length and a fixed main frame. Conveyor length can be changed based on application using linkages and mechanical arrangements for height adjustment. Base is designed according to application of load, as farmers need to load and unload goods in different farms and places for toeing purpose we have provided wheels so that farmers can take away conveyor with tractor and any other transport vehicle. As per the ground based collected data following design model Figure 1 is finalized as concept model for manufacturing model

IV. MODELING AND ANALYSIS

Material Specification: -Mild Steel Composition: Carbon 0.20% - 0.30% Manganese: 0.30% - 0.60% Uses: General purpose steels for low stressed components.
Details of analysis:
Total maximum Deformation: 4.55×10-7 m
Maximum principal stress: 50905Pa
Maximum principal stress: 25692 Pa
Details of Analysis on Frame
Total maximum deformation: 4.07×10-5 m
Maximum principal stress: 5.97× 105 Pa
Maximum Shear stress: 5.85×105 Pa
Analysis results of Telescopic Arrangement
Total maximum deformation: 1.75×10-6 m
Maximum principal stress: 5.17 ×105 Pa
Maximum Shear stress: 5.47×105 Pa

V. RESULTS AND DISCUSSION

Conveyor testing was done to determine the conveyor's operating parameters. This test involves testing the conveyor under various loads, and it calculates the velocity variation for each load. Conveyors are tested for varying heights, lengths, and inclinations since they can have their height and length adjusted. During testing, a velocity variation is noted for each load. The test was carried out in a room with a level surface and no product inclination. Weighted onions were used for the trial, which was done for different length inclinations and produced the following results for the finished product.

1. For handling the minimum weight of 3 Kg of agricultural product, the minimum time required to travel from initial position to final position of conveyor and it is 10.33 seconds.
2. after increasing the load on conveyor, it takes the maximum time than previous condition for same length of conveyor.
3. With the increase inclination of conveyor maximum torque is required to shift the agricultural product from one place to another.
4. For the lowest load (3 Kg) time required is less and for moderate (5 Kg) and maximum load (10 Kg) the time requirement is more.
5. Velocity for lowest load is maximum and for heavier weight it is less.
6. It was observed that, whenever there was 10 kg load application there was sufficient increased noise level is observed.
7. For the lowest angle time the time required for load transfer is less than that of highest angle.

VI. CONCLUSION

This project examines how long it takes to manually load and unload crops in an agricultural field using conventional methods and demonstrates how employing a material handling conveyor system in the field can save costs, time, and labour. This machine's primary goal is to minimise labour costs for workers who handle goods. The material is atomized and made easier to transport. This conveyor is easily usable in warehouses, farms, APMCs, and the food industry. Therefore, it is superior to a fixed conveyor system in every way. The speed at which materials are handled is increased by this conveyor system. Additionally, this system uses less human labour. In the end, operating costs are decreased and profit is raised by eliminating the workers.

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