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# DESIGN AND FABRICATION OF FOODGRAINS PACKAGING SYSTEM USING SCREW CONVEYOR

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***Abstract :*** *This paper aims at developing a mechanism for easy and quick packaging of foodgrains or oils without being spilled out of the package. The need for such a system arises from requirements in our society wanting to have a packaging system that will pack the foodgrains more efficiently. The mechanism consists of screw conveyor as one of the component used for transferring the bulk from one place to another. The geometry of an Archimedes/Conveyor screw is governed by certain external parameters (its outer radius, length, and slope) and certain internal parameters (its inner radius, number of blades, and the pitch of the blades). The external parameters are usually determined by the location of the screw and how much bulk or liquid is to be lifted. The internal parameters, however, are free to be chosen to optimize the performance of the screw. In this report the inner radius and pitch that maximize the volume of foodgrains or liquid lifted in one turn of the screw are found. The optimal parameter values found are used in the design of modern Archimedes screws.*

***Keywords -*** *Screw Conveyor, Loadcell, Packaging.*

## I. INTRODUCTION

We all know, what conveyors are and why conveyors are used? Conveyors are used to transport marterial from one place to another. Generally belt conveyors are used to transport materials for a long distance ranges and for short distance ranges screw conveyors are used.

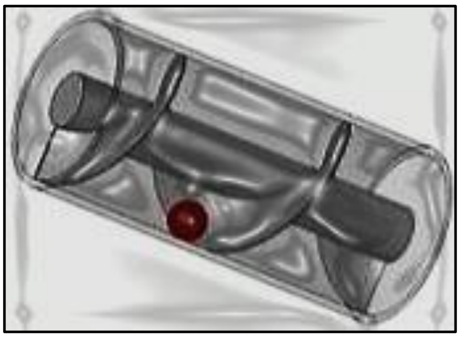

Fig. 1.1: Simple Screw Conveyor

A Screw conveyor or Auger conveyor is a mechanism that uses a rotating helical screw blade, usually within a tube, to move liquid or granular materials. The rotating part of the conveyor is sometimes simply called an Auger. Screw conveyors are widely used for transporting and/or elevating such items from one place to another at controlled and steady rates. Screw conveyors in modern industry are used horizontally or at a slight inclination as an efficient way to move semi-solid materials. In industries, screw conveyors are mostly used in many bulk material applications like industrial minerals, agricultural grains, pharmaceuticals and chemicals, sand, salt and food processing. In industrial control applications, the device is often used as a variable rate feeder by varying the rotation rate of the shaft to deliver a measured rate or quantity of material into a process.

### 1.1 Project Background

The first type of screw conveyor was the Archimedes' screw, used since ancient times for water irrigation. It usually composed of a tube containing a spiral blade coiled around a shaft. It is driven at one end and held at the other.

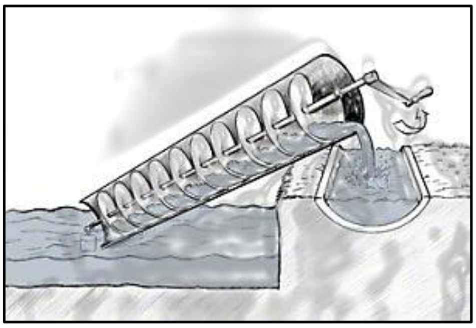

Fig. 1.2: Archimedis Screw used for Irrigation

This Archimedis screw, was usually turned by windmill, manual labor or by other modern means, such as a motor. As the shaft turns, the bottom end scoops up a volume of water. This water is then pushed up the tube by the rotating helicoid until it pours out from the top of the tube. The rate of volume transfer is proportional to the rotation rate of the shaft.

The contact surface between the screw and the pipe does not need to be perfectly watertight, as long as the amount of water being scooped with each turn is large compared to the amount of water leaking out of each section of the screw per turn. If water from one section leaks into the next lower one, it will be transferred upwards by the next segment of the screw. In some designs, the screw is fused to the casing and they both rotate together, instead of the screw turning within a stationary casing.

Archimedis scew can be operated with the flow of water inclined upward. When space is less, keeping the screw axis inclined at an angle is a very economical method of elevating and conveying. As the angle of inclination increases, the capacity of conveying water per cycle rapidly decreases.

### 1.2 Introduction to Project

Using Archimedis Screw / Auger Screw / Screw Conveyor, we fabricate an Automatic Packaging System which can package foodgrains/oils according to the quantity, required by the Customer.

### 1.2.1 Constructional Details:

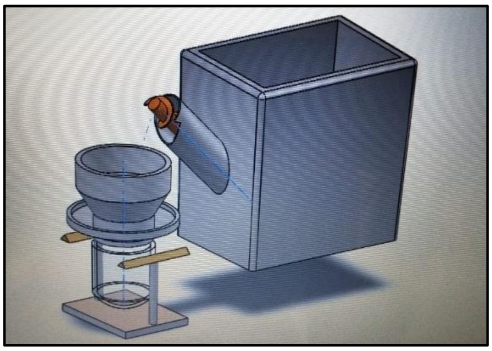

Fig. 1.3: Project Idea

1. Archimedes Packing System will be the device which will transfer the grains from the container towards plastic bag. This plastic bag would be connected to a mechanism which would allow the food grains to be collected automatically.
2. Below the plastic bag there would be weighing mechanism which would be programmed for desired weight as per requirement of consumer.
3. Once the bag is filled, sealing of bag would be done for which sealing mechanism is provided.

### 1.2.2 Working Process:

1. Grains from the container are transferred to plastic bags with the help of Archimedes Screw. When screw is rotated the grains from container are filled between screw pitch and due to rotation the grains are transferred to the end of screw and at last screw pitch discharges the grains which falls into hopper.
2. Now these grains travel through the hopper and are collected in the plastic bag. This plastic bag would be a continuous roll initially when grains enter the bag due to weight of grains bag travel in downward direction where it comes in contact with the load cell.
3. Load cell calculates the weight of the grains and send signal to the sealing mechanism. Once the bag is filled with required amount, sealing mechanism seals the bag and discharge it and further bag rolls for other grains to be packed.

## II. PROBLEM DEFINITION

### 2.1 Problem Statement:

- To eliminate the wastage of foodgrains/oil occurring in local grossery stores or supermarkets while packaging.
- Also making the process of packing fast.
- And avoid the formation of queue which results in loss of many customers.

### 2.2 Objectives:

- To make a machine compact and precise.
- To Ensure contact-less packaging (Covid Situation).
- To make the machine economical.
- To reduce the wastage of foodstuffs or foodgrains/oils which falls during manual packing.

## III. METHODOLOGY

### 3.1 Methodology:

1] Fixing the size Container/ Storage tank

1. Designing the container for Local Shops i.e, for 30 kg/30 Lit.
2. Maintaining Height of 0.5 meters and length of 0.3 meters, so that we can fit screw conveyor at desired angle (We can also keep the Screw Conveyor horizontal for maximum efficiency).

2] Design of Conveyor Screw

1. Selection of material – Stainless Steel ideal for food products
2. Finding the Flight dia., shaft dia. and Pitch For particular angle of screw and Calculating Disc Dimensions
3. Preparing the Disc by cutting and grinding process
4. Fixing the Disc onto the Shaft
5. Testing and Fixing it into the container.

3] Design of Hopper

Making hopper accordingly with suitable size.

4] Loadcell Weighing

Arduino will be so programmed that it will able to measure the live weight during filling and stop filling after the required weight has been gathered.


Fig. 3.1: Loadcell Weighing using Arduino

Requirements: 1. Programming using Arduino UNO

2. Testing-

a. Setting input value
b. Measuring weight
c. Displaying output

5] Plastic Bag Sealing

Using Cam Follower based plastic bag sealing mechanism for sealing of the already filled and measured plastic bag.

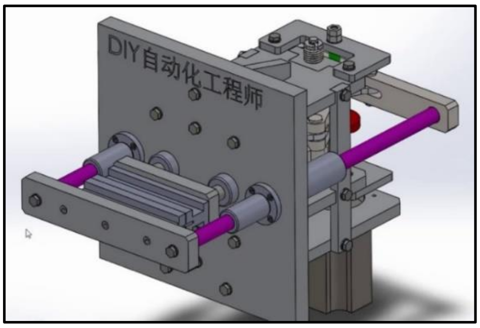


Fig. 3.2: Cam follower based plastic bag sealing mechanism

### 3.2 Calculations

1] Size of Container/Storage Tank

For 30kg capacity,

Volume = L x b x h

Put L = 0.3m , h = 0.5m

$30 \times 10^{-3} = 0.3 \times b \times 0.5$

b = 0.2m

b = 200mm

2] Section of Conveyor screw / Archimedis screw

Using C-Rorres Design Method,.

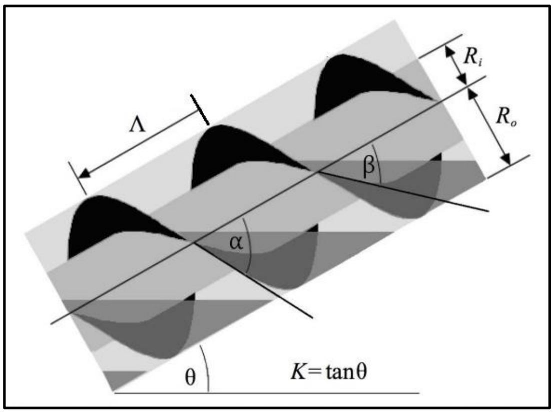


Figure 3.3: Nomenclature of Archimedis Screw

$R_o$ = radius of screw outer cylinder (in meters)
$R_i$ = radius of screw's inner cylinder (in meters) ( $0 \leq R_i \leq R_o$)
L = total length of screw (m)
K = slope of screw

α = angle of outer edge.
β = angle of inner edge.
Λ = pitch of one blade in (m) ( $0 \leq \Lambda < 2\pi R_o/k$ )
N = number of blades N = 1, 2, 3 . . . . . . .

Given:

Given the Number of blades, Outer radius, and slope we can find other parameters,

Deciding input Parameters, N = 8 , $R_o$ = 80mm = 0.08m

Θ = 30 (Since efficiency decreases with increase in angle

Taking optimal angle, Θ = 30 )

Therefore, K = tan Θ = tan 30

K = 0.577

Solution:

$\Lambda = 2 R_o$ ……………………….for, Θ = 30
= 2 x 0.08
Λ = 0.16m = <u>160mm</u>

And, $\Lambda = 2\pi R_i / K$
$\Lambda = 2\pi * R_i / 0.577$
$R_i$ = 0.01469m = <u>14.69mm</u>

$\tan \alpha = R_o ( 2\pi / \Lambda) = 80 (2\pi / 160 )$
α = 72.34 degree

$\tan \beta = R_i 2\pi / \Lambda) = 14.56 (2\pi / 160 )$
β = 29.75 degree

Volume of "one cycle of screw" = $\pi R_o^2 \Lambda$
= π x 80 x 160
= $3.21 \times 10^6$ mm³

Volume of each "chute" = $[\pi ( R_o^2 - R_i^2 ) \times L / N$
But, L = (N-1) x Λ
= 7 x 160

L= 1120mm
Volume of each "chute" = 2.72 x $10^6$ mm³

Table 4.1 Specifications of screw conveyor

| **Parameter** | **Values** |
|---|---|
| $R_o$ = radius of screw outer cylinder | 80mm |
| $R_i$ = radius of screw's inner cylinder | 14.69mm |
| L = total length of screw | 1120mm |
| K = slope of screw | 0.577 |
| α = angle of outer edge. | 72.34 degree |
| β = angle of inner edge. | 29.75 degree |
| Λ = pitch of one blade | 160mm |

## IV. CONCLUSION

We conclude here that the optimal design of archimedis screw and the design of the project with necessary selection of components is done and we can manufacture the archimedis screw with the calculated dimensions. Further for making this project successful we will need to setup Auduino based loadcell by using proper programming so that we could pack the foodgrains according to the required quantity in minimum time without any spillage or wastage.

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