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Design and Fabrication of Bucket Elevator For Cattle Feed Industry

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Abstract— In a rural Area there is increasing demand of cattle feeds. Whereas there is animal husbandry is the main resource of money. Animals in India have limited access to cultivated green fodder and grasses. Most of the macro and micro nutrients to meet animal's requirement are provided by compound feed, especially on crop residue-based diets. Now days for completing this demand of cattle feed product various manufacturer are work on it to produce maximum amount of feed within the less time. But the problem occurring is, there is more interference of human being while operating which tends to require more time and more manpower at time of production on actually at workplace. This is increasing costing and also time requiring for product. To install Bucket elevator for machine for reducing product cycle time, our aim of project is to be reducing human interference and also production within less time. We are working on bucket elevator to lifting the raw material from ground level to hoper of cattle feed machine. Bucket elevator is the media of transportation of material from one location to another in a commercial space. Belt conveyor has huge load carrying capacity, large covering area simplified design, easy maintenance and high reliability of operation. Belt Conveyor system is also used in material transport in foundry shop like supply and distribution of moulding sand, mould sand removal of waste.

Keywords: Belts, Belt Conveyor, Drive Units, Conveyor, Frame, Bulk Material Roller, etc.

I. INTRODUCTION

In a rural Area there is increasing demand of cattle feeds. For completing this demand various manufacture are work on production of maximum amount of feed within the less time. Animals in India have limited access to cultivated green fodder and grasses. Most of the macro and micro nutrients to meet animal's requirement are provided by compound feed, especially on crop residue-based diets. It is possible to formulate balanced rations for growing and lactating animals only if the feed used conforms to the laid downspecifications, for energy, protein, minerals, vitamins etc.

- Snehal Patel, Sumant Patel, Jigar Patel, A Review on Design and Analysis of Bucket Elevator, International Journal of Engineering Research and Applications This paper deals with the design and analysis of different parts of elevator for conveying different types of materials. This study also shows that the negative influences of support of the shaft reflected through the increase in the stress concentration and occurrence of the initial crack are the main International Journal of Engineering Science and Computing, July 2016 8350 http://ijesc.org/[1]
- N. Yashawini, Raju. B and A. Purushottham, design and optimization of bucket elevator through finite element analysis, International Journal of Mechanical Engineering Authors have designed a bucket elevator and analyzed it for conveying granular materials to the height of 15m at the rate of 10 tones/hour output. This paper gives basic design calculations for the development of the bucket elevator. Static and vibration analysis carried out on the bucket elevator in order to need the required output from 10 tones/hr-20 tones/hr. This paper also gives the dynamic behavior of the bucket and gear shaft assembly. The results obtained from the analysis study critically examine the modification of design parameters. [2].

- Hemlata H. Mulik, Bhaskar D. Gaikwad, Design of Sugar Bucket Elevator and Roller Conveyor Chain for 20 Tones-per Hour Capacity, International Journal of Engineering Trends and Technology. In this paper the different components of roller conveyor chains are designed for sugar bucket elevator used in sugar industries for 20 tons per hour capacity and the loading conditions are described. The advantages of chain drive as compared with other drives are discussed. The chain wear mechanisms found in literature are listed. Abrasive and adhesive wear between pin, bushing, and roller are also discussed. [3].
- F.J. C. Rademacher, Non-Spill Discharge Characteristics of Bucket Elevators, Elsevier Sequoia S.A., Lausanne. One of the well-known disadvantages of a simple type bucket elevator is still the backflow or spill. The accordingly lower capacity and in-creased power consumption are not always the worst consequences, provided that the boot does not become too full. With the considerable heights of modem bucket elevators, up to 225 ft and over, serious damaging of the conveyed material, an intensified noise level and increased wear can be far more inconvenient. The discharge of the buckets has been recognized as an extremely complicated phenomenon which strictly speaking cannot be analyzed theoretically. This holds even more for free-flowing materials.[4]
- Suhas M. Shinde and R.B. Patil (2012): The major objective of this paper is to tell us that Over the years a lot of work has done and is still continuing with great effort to save weight and cost of applications. The current trend is to provide weight/cost effective products which meet the stringent requirements. The aim of this paper is 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 [5].

II. PROBLEM SATEMENT

In an industry actually total wok is carried manually. Raw material which is want to fed in to the hoper of the machine which is at the 5 feet from the ground level now it is carried with a hand. But the problem occurring is it require more time and more manpower which increasing costing of product. Our aim of project is to be reducing manpower and also product within less time.

After study of processes in company it is noted that actual production process is too lengthy because it needs to lift the material from ground to hoper. Which affect the production process and increase time and also costing of product. After taken account all those things we decided to install the bucket elevator which helps to lift the material from ground to hoper and makes process much simpler.

III. METHODOLOGY

Bucket elevators operate by using an endless belt or chain on which rectangular buckets are mounted. The belt or chain revolves between a top and bottom pulley and the buckets move with it. At the bottom the buckets pick up product fed into the elevator boot and at the top the product is discharged as the bucket turns downward over the head pulley

3.1 Material Handling Equipment

Expressed in simple language, Material handling equipment is relating to the movement, storage, control and protection of materials, goods and products throughout the process of manufacturing, distribution, consumption and disposal. One of the definitions given by the American Material Handling Society is: Materials handling is the art and science of moving, packaging and storing of substance in any form. To do it safely and economically and efficiently, different types of tackles, gadgets and equipment are used, when the materials handling is referred to as mechanical handling of materials.

3.2 Bucket Elevator

Bucket elevators are the simplest and most dependable units for making vertical lifts. They are available in a wide range of capacities and may operate entirely in the open or be totally enclosed. Main variations in quality are in casing thickness, bucket thickness, belt or chain quality, and drive equipment. The main purposes of bucket elevators are used to lift bulk materials from one height to another.

For stable work and application widely bucket elevator are used. By using this one should get high Productivity. This bucket elevator is normally designed and made for metallurgy, chemical industry, building materials, mine, pulp and paper industries, ports and terminal, grain and vegetable oil, food, fodder, plastic and medicine related application. Bucket elevator systems are used for the following industrial field

Different major important system in bucket elevator

3.2.1. Drive Head and Bottom Head:

Drive head section made with high thickness steel sheets heavily stiffened. Steel split upper cover easily removable for inspection and maintenance of drive pulley or wheels. Dust or relief vent on top and inspection panel located at some height of the outlet. Bottom head is made with high thickness steel sheets is equipped with a removable bolted door for inspection and cleaning.

3.2.2 Inlet and Outlet:

Openings prearranged for the connection with other machines; chutes lined with wear resistant material when required.

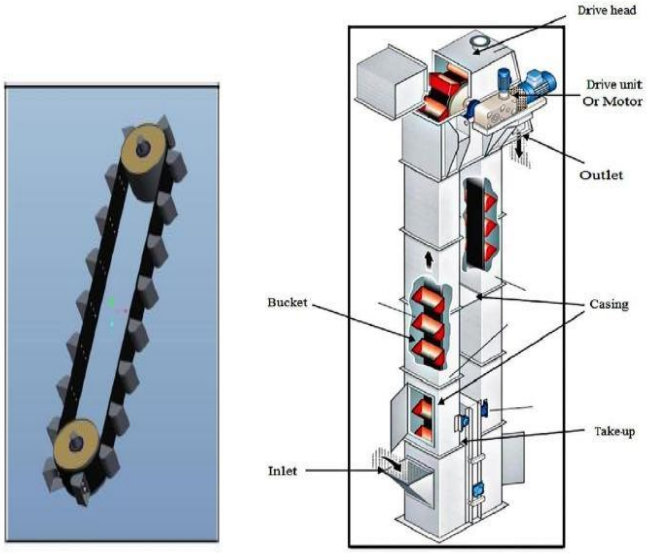

Fig. 1 Bucket Elevator

3.2.3 Buckets:

On the basis of the conveyed material characteristics the buckets are generally made of:

- Carbon steel
- Wear resistant steel
- Stainless steel
- Plastic material

Buckets are made with bent and welded steel plates, properly reinforced with welded plates in wear resistant material for heavy duty application, drawn or pressed for light materials.

Fig. 2 Bucket

3.2.4 Casing:

It is the cover part of elevators which is made of welded and bolted sections, designed to obtain a self-supporting structure of the machine for the vertical loads. The assembling sections are done by bolted flanges, with seals between each section. There is a bolted door for easy bucket inspection and mounting.

Fig. 3 Cover Shell

3.2.5 Drive Unit:

This configuration may vary depending on the application. The typical drive unit for installed power of 22kW or more includes an electric motor, hydraulic coupling and right-angle gearbox with backstop and torque arm directly mounted on the drive shaft. Additional electric motor for creeping can be installed, upon request, on the gearbox. As an alternative, drive units can be equipped with a belt drive between electric motor and gear unit.

3.2.6 Take-Up:

The gravity take-up system of the bucket elevators is equipped with additional dust-tight seals between the casing and the guide of the idle shaft belt bucket elevators

Realized for heavy duty application are equipped with a self-aligning system which en-sure the safe parallel guidance of the pulley.

project is based on the handling of bulk material and its packaging process. It is a combination of bucket elevator and belt conveyor

After surveying on various industries, we cleared our concept and designed our machine with proper dimension.

3.3 Design

During design of bucket elevator a few factors are consider for design and based on this for input data whole design calculations were carried out. The following factors are considered during design.

Material for lifting Wheat, Rice, Maize

Average bulk density 720-768 Kg/m3

Specific requirements

It should have excellent chemical resistance and it should have higher transmission capacity.

CALCULATION:

Within 1 hr 90 bag fill. (1 bag = 50kg) =90 50 =4500 kg/hr

5 Tonne/hour

5.00 m, 0.768 Tonne/m3

3.3.1 Characteristics

A belt elevator with widely spaced deep buckets and belt speed = 2m/s is suitable for the transmission purpose. We select a four-ply belt; then the diameter of the drive pulley is given by DP = 300 mm = 0.30 m and its radius Rp = 0.15 m.

The rotational speed of the pulley at = 2 m/s is given by, N=60.00 (D p) = (60 2) (0:30) = 127:32rpm 127:00rpm

The pole distance hp is found by the formula,

3.3.2 Linear Gravity Force

The linear mass of the belt with four-ply of material like rubber ground is given by, mrb = 2.40 m/s then, qrb = g mrb

=9.81 2:40

= 23:54N=m 24:00N=m

The mass of standard deep bucket of Bucket width (B) =250mm; is given by mb = 3:38Kgthan;

q0=qrb + g (mb) (t b)

=24.00 +9.81 (0:5) (0:32) = 40N=m

The useful load is given by, q1 = gQ 3:60

= (9:81 5) (3:60 2) = 6:810N=m

Then the total linear gravity force acting on the carrying runs is given by, q=q0 + q1 =40+6.81 =46.81N/m 50N=m

3.3.3 Pull Calculation

We can make only a rough calculation, since we do not know the tension in the belt section running off the drive pulley as required to ensuring the rated pull. We assume that T1 = T0. The tension at point 2 is found by considering the resistance on take-up pulley and the scooping resistance by formula for heavy-duty operation =

1.08 and Ksc = 2.0

T2 = T1 + Wsc

= T1 + Ksc q 1

=1.08 T0 + 2* 6.81 =1.08 T0 + 13.62

T3 = Ton = T2 + q H

= 1.08 T0 + 13.62 + 50 *5 = 1.08 T0 + 263.62

Calculation against the direction of belt motion gives,

T4 = Tof f = T1 + H q0

= T0+40 5

= T0 + 200

According to theory of frictional drives we have,

= sin 1 (Dp - dp) 2C

Now angle of contact/arc of contact/angle of lap is given by

= + 20 = rad , Ton T of f e
Or for the case considered T 3T 4 e
For a mild steel pulley and high humidity (the elevator operates outdoor), the friction
Coefficient = 0.35, so that at = rad:
Therefore e = 3:00: Hence; T 3 3:00 T 4 or for the case considered 1.08 T 0 + 263.62 3:00(T 0 200)
Solution of this equation gives T0 270:51N: To ensure the certain margin; we take T 0 = 0 N and then,
T4 = Tof f = T0 + 200
= 200.0 N
T3 = Ton = 3.00 T4 = 3.00* 200 = 600.00 N
600:00= 1:08kW
Hearse, we take finally a drive motor of a power P = 1.08 kW We select for our application 2HP motor

3.3.4 BELT CALCULATION

Length of belt is given by,
Belt Tension,
T = T3 T4 (D p) 2 = (600*200) (0:50 2) = 60Nm
Permissible Tension in belt per mm width (f), f= T3 B b
=600 200 , 3N=m
Application of belt for bucket elevator is lightweight and need to transmit the lower torque. So, we select belt for power transmission either chain drive. Also belt drive has less NVH. (Noise, Vibration, Harshness)

3.3.5 BEARING

By using series: 60
Inner diameter: d = 83 mm Outside diameter: D = 130 mm Width of bearing: b = 23 mm Static load: Co = 42 KN Dynamic load: C = 49 KN
Permissible rpm for grease = 5187.5 rpm and For oil = 6536.25 rpm

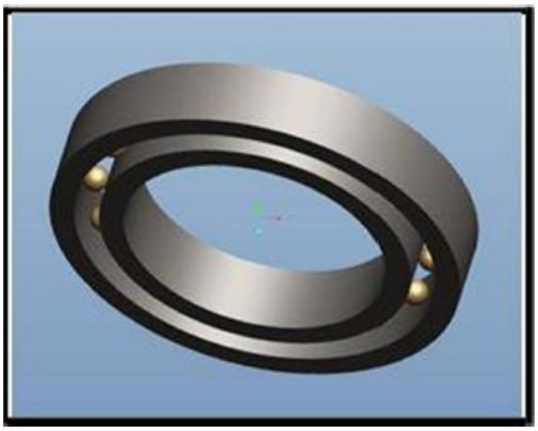

Fig. 4 Bearing

3.3.6 BUCKET CALCULATION

By using Table
Width of bucket = 160.00 mm Depth of bucket, h1= 105.00 mm Projection of Bucket, b= 105.00 mm
Now, assume =18

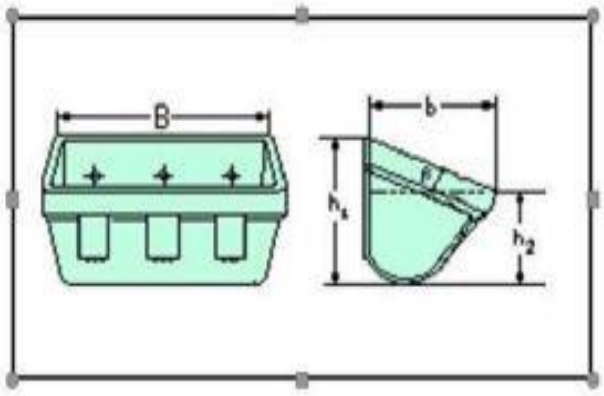

Fig. 5 Bucket Dimentions

Width of bucket = 160.00 mm Depth of bucket, h1= 105.00 mm Projection of Bucket, b= 105.00 mm
Now, assume =18
h1 h2 = b tan 18 = 105 0.325 = 34.11 mm h2 = h1 (h1 h2) = 105.00 34.11 = 70.88 mm
Therefore, Number of buckets = Belt length Bucket pitch = 10:94 0:40 = 28
It is used to conveying the material in the bucket elevator.
Specification = Material = Plastic
Bucket selected from standard table sized Width of bucket =160mm Depth of bucket=105mm Projection of
Bucket = 105mm Distance between two holes= 90mm

Fig.6 Belt Bucket Conveyor

Lower Basement:
It provides the supporting structure and protection for elevator system.
Specification = Material = Mild steel ,
Height = 1250 mm (4 feet 1.2 inch)

Fig.7 Lower Basement

Therefore, the method of bucket unloading is determined by the ratio between the pole distance and pulley radius. Now by using Formula at = 0.75 we have,

i0 b = Q 3:60

= 5:00 (3:60 2 0:760 0:75)

= 1:22m 1 =2m 1

Now by referring Table 1, we chose for i0/ tb = 2.0 deep type buckets with Bucket width (B) = 160 mm, Belt width (Bb) = 200 mm, Bucket pitch (tb) = 320 mm and also i0 = 0.6

IV OBSERVATION & CONCLUSION

Actual rotational speed of bucket elevator = 127 rpm

1 bucket capacity = 0.5kg so, for 28 bucket capacity = 14 kg

The current development of automatic bucket conveyer unit is used to avoid more human interference and maintain constant discharge of equipment which in turn reduces the downtime of equipment, reduces manual work of operators, improve efficiency and productivity of equipment and reduce the cost of operation. This project will be base for future development on the tensioned unit in the bucket elevator and other similar kind of equipment.

REFERENCES

[1] Snehal Patel, Sumant Patel, Jigar Patel Review on Design and Analysis of Bucket Elevator, International Journal of Engineering Research and Applications July 2016 8350 http://ijesc.org/

[2] Arora, R.P. and Raghunath, B.K. (2012), Production technology, Tech-Max Publication. First Edition

[3] “Positive Discharge Bucket Elevator Archives - Mechanical Engineering.” Mechanical Engineering RSS. N.p., n.d. Web. http://www.mechanicalengineeringblog.com/tag/positive-discharge-bucket-elevator/.

[4] Yardley, E. D., and L. R. Stace. Belt Conveying of Minerals. Cambridge: Woodhead and Maney on Behalf of The Institute of Materials, Minerals and Mining, 2008.

[5] Shamlou, P. A. Handling of Bulk Solids: Theory and Practice. London: Butterworths, 1988

[6] McGuire, Patrick M. Conveyors: Application, Selection, and Integration. Boca Raton: CRC, 2010.

[7] Colijn, Hendrik. Mechanical Conveyors for Bulk Solids. Amsterdam: Elsevier, 1985ISO 5048 (SN 26 3102) Continuous mechanical handling equipment, Belt conveyors with carrying idlers, Calculation of operating power and tensile forces.