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Solar Bucket Conveyor

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Abstract: *Energy conservation is one of the growing concerns of today. Energy sources are depleting at higher rate so, their conservation is necessary. Non- renewable resources are used for making energy such as wind power, solar power, hydro power, etc. These energy sources are infinite and can be used endlessly for producing energy. Solar bucket conveyor system designed is able to provide gentle handling and least spillage. The other advantages of this solar bucket conveyor system are that it requires low maintenance and also it operates quietly. Growing demands of systems employing renewable energy sources had increased demands for such projects.*

Keywords: Solar Power

I. INTRODUCTION

1.1. Material Handling Equipment's:

A bucket wheel excavator (BWE) consists of a superstructure to which several more components are fixed. The bucket wheel from which the machines get their name is a large, round wheel with a configuration of scoops which is fixed to a boom and is capable of rotating. Material picked up by the cutting wheel is transferred back along the boom. In early cell-type bucket wheels, the material was transferred through a chute leading from each bucket, while newer cell-less and semi-cell designs use a stationary chute through which all of the buckets discharge.

A discharge boom receives material through the superstructure from the cutting boom and carries it away from the machine, frequently to an external conveyor system. A counterweight boom balances the cutting boom and is cantilevered either on the lower part of the superstructure (in the case of compact BWEs) or the upper part (in the case of mid-size C-frame BWEs). In the larger BWEs, all three booms are supported by cables running across towers at the top of the superstructure.

Beneath the superstructure lay the movement systems. On older models these would be rails for the machine to travel along, but newer BWEs are frequently equipped with crawlers, which grant them increased flexibility of motion. To allow it to complete its duties, the superstructure of a BWE is capable of rotating about a vertical axis (slewing). The cutting boom can be tilted up and down (hoisting). The speeds of these operations are on the orders of 30 m/min and 5 m/min, respectively. Slewing is driven by large gears, while hoisting generally makes use of a cable system.

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.

Material handling also should be considered with in a system context. Rarely, if ever, are activities performed in a one area or department of a facility without having an impact on other operations. Example: The efficiency of store room will affect the efficiency with which the production operations are performed out on the shop floor. The positioning of conveyor line in plant might improve material flow through the facility or it could present a hindrance to plant traffic. A significant improvement in the efficiency of one operation, without a corresponding improvement in a subsequent step in the work sequence, may only result in a piling up of materials down the line.

These simple examples illustrate the point that to maximize overall productivity of the plant or warehouse, the material handling steps that supports production, order assembly, and other operations must be integrated in to a system of activities rather than being viewed as a number of isolated independent procedure. In addition to considering time and place utility and system approach, a through definition of material handling must also include the human aspect. People

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are always a part of material handling weather the operation is simple one, involving only a few items of equipment, or a large, complex, automated system

Finally, the definition of the material handling must contain an economic consideration. Certainly, the delivery of parts and materials to a specific time, it not completely meaningful unless accomplished at an acceptable cost so that an adequate return is realized. Material handling is a system or combination of methods, facilities, labor, and equipment's for moving, packaging and storing of materials to meet specific objectives. A materials handling operation can be simple and small, and involve only few pieces of basic equipment's. Or, it may be large, complex or automated. Material handling equipment is generally separated into four main categories.

- Storage and handling equipment.
- Engineered systems.
- Industrial trucks.
- Bulk material handling

Bulk material handling is an engineering field that is centered around the design of equipment used for the handling of materials such as ores, coal, cereals, wood chips, sand, gravel and stone in loose bulk form. It can also relate to the handling of mixed wastes. Bulk materials handling plants and processes quite often require the elevation (lifting) of bulk materials to other parts of the plant or process. Numerous technologies and equipment are currently available for this purpose to the designer and practitioner. Generally, they are classifying in to three main categories.

- Pneumatic conveyor or air lifter.
- Conventional screw conveyor.
- Bucket elevator.

1.2. Bucket Elevator

Bucket conveyor system is the material handling equipment which is used for transferring the material from one place to another place. It is used for mainly transferring the material from lower place to higher places. A bucket conveyor moves the granular material or powder or liquid. Bucket may be mounted on chain or belts. Conveyors are employed to transport materials, over a fixed path which may be horizontal or inclined, to different locations in a factory. They prove economical if the flow of material is continuous.

Bucket conveyors consist of a bucket elevator and an endless belt or chain with a series of attached buckets. The buckets are filled, lifted vertically to a head pulley or sprocket, and dumped. The buckets are then returned to a tail pulley or sprocket at the bottom. Bucket elevators are not self-feeding. To avoid overfilling the buckets and damaging the machinery, bucket elevators should be fed at a controlled rate. Typically, bucket elevators are placed where the chain or belt path is vertical or steeply-inclined in a single plane. Special, chain- supported bucket systems that can travel in two and three planes are also available. There are four broad categories of bucket elevators: centrifugal, continuous, positive, and internal discharge. The most commonly used types are centrifugal elevators and continuous discharge elevators. Positive discharge elevators and internal discharge elevators are used for special applications.

The movement may be vertical or flat. Material is fed in or near the bottom or foot of the conveyor. Discharge is either by gravity or by centrifugal action as the buckets invert after passing over the head of the elevator.

Bucket conveyors are suitable for handling with height differences and basic division of pile of components. We deliver and develop belt bucket conveyors (also cranked) as a part of production lines or single-purpose machines. For correct selection of conveyor, tests with the components being transported must be carried out. Any of various devices that provide mechanized movement of material, as in a factory; they are used principally in industrial applications but also on large farms, in warehousing and freight-handling, and in movement of raw materials. Conveyors may be only a few inches in length, or they may be integrated systems several miles long.

1.3 Types of Conveyors System

Gravity-roller conveyors consist of a series of parallel rollers fastened to a metal frame supported at intervals. The frame can be inclined slightly for gravity flow, but objects and packages may also be rolled along manually. Gravity-wheel conveyors are similar but consist of skate wheels instead of rollers and are usually used for lighter loads. Live-roller

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conveyors are gravity-roller conveyors that are power driven by means of a belt snubbed against the underpart of the rolls or by a chain driving sprockets attached to the rolls.

Belt conveyors of fabric, rubber, plastic, leather, or metal are driven by a power-operated roll mounted underneath or at one end of the conveyor. The belt forms a continuous loop and is supported either on rollers, for heavy loads, or on a metal slider pan when the load is light enough to prevent frictional drag on the belt. Electric motors operating through constant- or variable-speed reduction gears usually provide the power.

Floor conveyors use chain, cable, or other linkage mounted in or close to the floor in an endless track. They are usually designed to drag a train of four-wheeled carts around in a loop to carry large products or materials for assembly on the conveying system. Power is furnished to the chain by guiding rollers. Slat conveyors consist of endless chains, driven by electric motors operating through reduction gears and sprockets, with attached spaced slats to carry objects that would damage a belt because of sharp edges or heavy weights

1.4 Simple Belt Conveyor

A bucket elevator, also called a grain leg, is a mechanism for hauling flowable bulk materials (most often grain or fertilizer) vertically. It consists of: i) Buckets to contain the material ii)A chain drive to carry the buckets and transmit the pull, iii)Means to drive the belt iv)Accessories for loading the buckets or picking up the material, for receiving the discharged material, for maintaining the belt tension and for enclosing and protecting the elevator.[1]A bucket elevator works by connecting many buckets via chains or a conveyor belt around a powered pulley system. The buckets are first filled with bulk material at the bottom of the elevator. Then the buckets ascend the elevator ramp, until they reach the very top where the material is discharged. The buckets are designed to stay upright to prevent spillage. The head is one of the major structural elements of the overall elevator. It supports the weight of buckets and belt, and also accommodates the drive and anti-runback back device

Conveyor is almost universal in application. It can travel for miles at speeds up to 5.07 m/s and handle larger amount of weight in metric tons with the help of belt. It can also operate over short distances at speeds slow enough for manual picking, with a capacity of only a few kilograms per hour. Generally, they are use in inclined position and not preferable for vertical transport. However, it is not normally applicable to processing operations, except under unusual conditions. Belt conveyors inside the plant may have higher initial cost than some other types of conveyors and, depending on idler design, may or may not require more maintenance. However, a belt conveyor given good routine maintenance can be expected to outlast almost any other type of conveyor. Thus, in terms of cost per ton handled, outstanding

1.5 Simple Bucket Conveyor

Bucket elevator is a type of vertical or inclined transport equipment that efficiently moves goods between floors, vessel or other structure. Elevator is generally powered by electrical motors that either drive traction cables or counterweight system like a hoist or pump hydraulic fluid to raise a cylindrical piston like jack. Generally, it is preferred for short in distance compared to belt conveyor. It is more preferable to transport the materials vertically. The detail explanation of bucket elevator is given in next chapter

1.5.1 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. The trend is toward highly standardized units, but for special materials and high capacities it is wise to use specially engineered equipment. 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. They are a reliable and well-proven piece of equipment. The various major parts of bucket elevator.

The detail description of various parts of bucket elevators is discussed below. The major components of belt bucket elevator are

- Drive head
- Bottom head
- Inlet

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- Outlet
- Buckets
- Casing
- Drive unit
- Take up

Elevators can be made using different types of materials. Materials of the structure and brackets also can be different types as well. The materials used to construct the head structure vary depending on conveyed material, cost and appearance, which are specified by the customer. These materials can range from galvanized, mild steel or stainless-steel sheet. Mild steel is used when a painted finish is required and stainless steel for when high moisture or corrosive materials are being conveyed. This paper examines the design and analysis of bucket elevator to suite an output. The type of bucket elevator setup selected is useful for many engineering applications. Therefore, its CAD analysis plays very important role in assessing the functionality of the equipment.

1.5.2 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.

1.5.3 Inlet and Outlet:

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

1.5.4 Buckets

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

- Carbon steel
- Wear resistant steel
- Stainless steel

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. The buckets are also available in various sections, which are listed below.

- Square
- V
- Trapezoidal
- Circular

1.5.5 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.

1.5.6 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

1.5.7 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.

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1.5.8 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 ensure the safe parallel guidance of the pulley.

1.6 Classification of Bucket Elevator

Generally, bucket elevators are classified in mainly two types.

- Belt type bucket elevator.
- Chain type bucket elevator.

Now a day there are many types of bucket elevators are available and each one is different from other according to their feature, application, and design. The major classifications of bucket elevators are as follows.

1.6.1 Positive Discharge Bucket Elevator

These types of bucket elevators are widely used for elevating light, fluffy, fragile materials like free-flowing powders and granular products in a range of industries in vertical as well as inclined position. Buckets are mounted at a well-spaced interval, are loaded by digging material from the boot or by feeding the material in to them. After passing over head wheels, the buckets are inverted over the discharge spout, providing a positive discharge material. Generally, they have higher conveying capacity. Figure shows the typical diagram of positive discharge bucket elevator.

1.6.2 Gravity or Continuous Discharge Bucket Elevator:

In these types of elevators head shafts are fixed, the foot shafts take up are screw type. Gravity takes are available. This elevator consists of a series of steel made buckets mounted on spigot pins between two chains or on the belt with the help of special types of screw. Also, some time the buckets are mounted continuously on the normally friction surface belts.

1.6.3 Horizontal Discharge Bucket Elevator

These elevators are designed and engineered to conform to general practice in the handling of grain. In particular they are found in flour mills and animal feed mills, where whole grain is being transferred into intake silos.

1.6.4 Centrifugal Discharge Bucket Elevator

Centrifugal elevaors are the most common type of elevator installed to most industries supplied in both belt type and chain type depending on material characteristic and the capacity being elevated and in some case the feeding method of the elevator. Centrifugal discharge type elevators are offered as boot take up and head take up. In this type of bucket elevators buckets are mounted on chain or belt and will handle free-flowing materials with small to medium size lumps. The standard inlet chute and standard curved bottom plate direct the material into the buckets and reduce the “digging” action.

1.6.5 Twin Leg Bucket Elevator

The twin lagged or double trunk legging bucket elevator has been designed and engineered to provide efficient high capacities for handling various grains, feeds, mill stock and similar free flowing granular materials. The elevator is self-supporting with extra-large heads and boot pulleys. They are fabricated from heavy gauge steel and are dust and waterproof and with provision for easy clean out. It is manufactured in many different sizes to suit individual requirements. It has double trunk legging construction with connecting angles provided on each 10-foot flange section. Vertical angle supports are included on taller units.

II. LITERATURE SURVEY

[1] Ghazi Abu Taher, Yousuf Howlader, Md. Asheke Rabbi, “Automation of Material Handling with Bucket Elevator and Belt Conveyor” International Journal of Scientific and Research Publications, Volume 4, Issue 3, March 2014 ISSN 2250-3153 Volume 4, Issue 3, March 2014.

Belt conveyor & Bucket elevator are 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

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distribution of molding sand, molds and removal of waste. On the other hand Bucket elevator can be of great use during bulk material handling. This paper is mainly based on the combination of Belt & Bucket Conveyers to perform complex task within a short time and successfully in a cost-effective way. On account of this, a machine and its physical description is covered here with some basic calculation. Initial stage is to form a pre project plan. During the project design stage for the transport of raw materials or finished products, the choice of the method must favor the most cost-effective solution for the volume of material moved; the plant and its maintenance; its flexibility for adaptation and its ability to carry a variety of loads and even be overloaded at times. Again, a rough sketch of the proposed machine is evaluated so that the basic parts can be easily understood. More importantly a development team was formed to monitor the design to be robust and accelerate the work.

[2] Consorcio S. Namoco, Jr.[1], Juvy T. Cloma[2], Gerby Rabago[2], , Rejinald Surbano[2] And Cerilo C "Development Of A Mechanical Dry Corn Picker Utilizing a Bucket Conveyor" Arpn Journal Of Engineering And Applied sciences 1719-6607 Vol. 12, No. 2, January 2017

In this study, a manually-operated mechanical dry corn picker utilizing bucket conveyor was designed and developed using locally available materials. This post -harvest device is aimed to help farmers in reducing labor, time and cost in collecting dry corn during solar drying, hence, improving the production efficiency. Evaluation of the acceptability of the device in terms of functionality, safety, structure and efficiency was shown to be acceptable as assessed by randomly selected respondents. While it is moving, the bucket conveyor automatically picks and carries the corn up from the reservoir. The corn is directly unloaded into the attached sack located at the back portion of the device. The device is provided with four wheels and the handle is positioned relatively far from the rotating wheels. Moreover, since this device is manually operated and functions via the spur gear and sprocket mechanisms, it gives no pollution to the environment, making it environmental-friendly.

During solar drying, the usual manual practice among majority of the local farmers in collecting corn simply utilized the traditional device assembled from woods and plywood's as shown in Figure-1. This practice is time-consuming and labor-intensive, not to mention the high cost and low productivity process. Aiming to address this concern, a mechanical device for picking/collector the corn during solar drying is conceptualized, designed and developed. This innovative device operates utilizing a bucket conveyor. The conveyor functions by rotating the gear with a simple push of the device.

[3] Snehal Patel[1], Sumant Patel[2], Jigar Patel[3] "Productivity Improvement of Bucket Elevator by Modified Design" International Journal of Emerging Technology and Advanced Engineering (ISSN 2250-2459, ISO 9001:2007 Certified Journal, Volume 3, Issue 1, January 2013)

These are powered equipment for conveying bulk materials in a vertical or steep inclined path, consisting of an endless belt, or chain/s to which metallic buckets are fixed. With the flexible belt/chain, the buckets move unidirectionally within a casing and collect bulk materials at bottom end of the equipment and deliver it at the top end. A range of different research methods have been used to determine the productivity improvement of elevator. The present study shows the productivity improvement of elevator for granular materials by changing in parameter and structure affecting the efficiency of elevator.

Current work deals with the design and analysis of elevator for conveying granular materials at 2 tones/hr. output and lifting height 12m. Modeling of different components of bucket elevator has been done using 3d Solid Modeling software based upon the dimensions obtained from analytical design. The new modified design of the bucket elevator is proposed and validated using CAE tools which are well within the safe limit. A bucket elevator, also called a grain leg, is a mechanism for hauling flow able bulk materials (most often grain or fertilizer) vertically. The bucket elevator is probably the oldest known form of conveyor, its history can be traced back to the days of Babylon where wicker baskets lined with a natural pitch and fastened to ropes operating over wooden sheaves turned by slaves, were used for the elevating of water into irrigation ditches

[4] Vijay M. Patil[1] Niteshkumar A. Vidya[2] Roshan L. Katkar[3] Piyush S. Pande[4] "Research On Type Of Conveyor System" Ijsrd - International Journal For Scientific Research & Development| Vol. 2, Issue 12, 2015 | Issn (Online): 2321-0613

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Conveyor equipment selection is a complex, and sometimes, tedious task since there are literally hundreds of equipment types and manufacturers to choose from. The expert system approach to conveyor selection provides advantages of unbiased decision making, greater availability, faster response, and reduced cost as compared to human experts. Conveyor types are selected on the basis of a suitability score, which is a measure of the fulfillment of the material handling requirements by the characteristics of the conveyor. The computation of the score is performed through the Weighted Evaluation Method, and the Expected Value Criterion for decision making under risk. This paper discusses the work done by the different researchers for the development of conveyor system for industrial purpose.

A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials. Conveyor systems allow quick and efficient transportation for a wide variety of materials, which make them very popular in the material handling and packaging industries. Many kinds of conveying systems are available, and are used according to the various needs of different industries. Conveyor systems are commonly used in many industries, including the automotive, agriculture, computer, electronic, food processing, aerospace, pharmaceutical.

[5] Hemlata H.Mulik , Bhaskar D.Gaikwad "Design of Sugar Bucket Elevator and Roller Conveyor Chain for 20 Tonnes per Hour Capacity", International Journal of Engineering Trends and Technology (IJETT), V20(1),35-38 Feb 2015. ISSN:2231-5381. www.ijettjournal.org. published by seventh sense research group

Roller conveyor chains are commonly used to transport goods in production lines or assembly lines, such as pallets, cars or steel coils. They are sometimes used in severe environments, soiled with water, foreign particles, chemicals or other contaminants. Normal use will result in wear of the components of the chain which can lead to unexpected failure and costly production downtime. Today, few literatures on the wear of conveyor chain are available and there are almost no reliable test-rigs to generate and measure chain wear in a reproducible manner. In this paper the different components of roller conveyor chains are designed for sugar bucket elevator used in sugar industries for 20 tonnes per hour capacity and the loading conditions are described. Additionally, 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.

[6] N. Yashaswini, Raju. B and A. Purushottham, design and optimization of bucket elevator through finite element analysis, International Journal of Mechanical Engineering Volume 2, Issue 9, September 2014 ISSN 2321-6441.

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, in 3D environment of NX software. Static and vibration analysis carried out on the bucket elevator in order to need the required output from 10 tonnes/hr-20 tonnes/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.

[7] 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 increased 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 feet 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. Nevertheless, an analytical approximation has been worked out for the relatively simple case of cylindrical buckets filled with cohesive bulk material, to start with. With the developed approximate theory a spill-free combination of the relevant parameters has been found

[8] J.L.P_erez-Aparicio, R. Bravo, J.J.G omez-Hern andez, Optimal numerical design of bucket elevators using discontinuous deformation analysis, Department of Continuum. Mechanics and Theory of Structures, Universitat Polit_ecnica de Val_encia, Valencia, Spain.

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In this paper, a study of discharge of elevator bucket is done. Bucket elevators are efficient machines to transport granular materials in industrial and civil engineering applications. These materials are composed of hundreds, thousands or even more particles, the global Behavior of which is defined by contact interactions. The first attempts to analyze the transportation of granular materials were treated. Given the internal discontinuity nature of granular media, it is reasonable to use numerical methods to model their behavior, such as Discontinuous Deformation Analysis (DDA) a member of the Discrete Element Method family that started to be used in the 90's .

III. PROBLEM IDENTIFICATION & PROPOSED SOLUTION

3.1 Problem Identification

Industries are basically meant for Production of useful goods and services at low production cost, machinery cost and low inventory cost. Today in this world every task has been made quicker and fast due to technology advancement but this advancement also demands huge investments and expenditure, every industry desire to make high productivity rate maintaining the quality and standard of the product at low average cost.

3.2 Proposed Solution

To design and build the Sand sieving machine working on renewable energy source to reduce human interference. So, this System should be efficient and cost effective and for that reason we are designing belt bucket conveyor which will also reduce time and Low maintenance and low cost.

IV. DESIGN

4.1 Design Procedure

Before we proceed to the process of manufacturing, it's necessary to have some knowledge about the project design essential to design the project before starting the manufacturing. Maximum cost of producing a part of product is established originally by the designer.

4.2 Design Procedure

When a new product or their elements are to be designed, a designer may proceed as follows:

- Make a detailed statement of the problems completely; it should be as clear as possible & also of the purpose for which the machine is to be designed.
- Make selection of the possible mechanism which will give the desire motion.
- Determine the forces acting on it and energy transmitted by each element of the machine
- Select the material best suited for each element of the machine

4.2 Solar Plate Specification

Size and Weight

- 17.5cm *22.1cm*0.5cm
- 225gm

Output

- Open circuit voltage :12 V
- Peak voltage: 10 V
- Peak current: 930 mA
- Peak power: 10 watts
- Power tolerance: +/- 10%

4.3 Design of Shaft

Specification and calculation:

- 60 rpm
- 12 V

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- 8 amp

Torque of motor: $\zeta = \frac{P \ X \ 60}{2 \ X \ 3.14 \ X \ N}$

$= \frac{18 \ X \ 60}{2 \ X \ 3.14 \ X \ 60}$

=2.866 Nm

= 2.866 x 10^3 Nmm

The motor shaft is made of MS and its allowable shear stress (Fd)= 10 Mpa

Torque: $\zeta = \frac{3.14 \ X \ Fd \ X \ d^3}{16}$

$5.72 \ 10^3 = \frac{3.14 \ X \ 10 \ X \ d^3}{16}$

5.73 d =14.28 mm

The nearest standard size is **d = 16mm.**

4.4 Cost Estimation

Cost estimation may be defined as the process of forecasting the expenses that must be incurred to manufacture a product. These expenses take into a consideration all expenditure involved in a design and manufacturing with all related services facilities such as pattern making, tool, making as well as a portion of the general administrative and selling costs.

4.4.1 Purpose of Cost Estimating

1. To determine the selling price of a product for a quotation or contract so as to ensure a reasonable profit to the company.
2. Check the quotation supplied by vendors.
3. Determine most economical process / material to manufacture the product.
4. To determine standards of production performance that may be used to control the cost.

Basically, The Budget Estimation is of Two Tyres

1. Material cost
2. Machining cost

4.4.2 Material Cost Estimation

Material cost estimation the total amount required to collect the raw material, which has to be processed or fabricated to desired size and functioning of the components. These materials are divided into two categories.

A. Material for Fabrication

In this the material in obtained in raw condition and is manufactured or processed to finished size for proper functioning of the component.

B. Standard Purchased Parts

This includes the parts, which was readily available in the market like alien screws etc. A list is forecast by the estimation stating the quality, size and standard parts, the weight of raw material and cost per kg.

4.4.3 Machining Cost Estimation

This cost estimation is an attempt to forecast the total expenses that may include manufacturing apart from material cost. Cost estimation of manufactured parts can be considered as judgment on and after careful consideration, which includes labor, material and factory services required to produce the required part.

A. Procedure for Calculation of Material Cost

The general procedure for calculation of material cost estimation is after designing a project a bill of material is prepared which is divided into two categories.

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1. Fabricated components
2. Standard purchased components

The rates of all standard items are taken and added up.
Cost of raw material purchased taken and added up.

4.4.4 Labor Cost

It is the cost of remuneration (wages, salaries, commission, bonus etc.) of the employees of a concern or enterprise. Labor cost is classifying as:

1. Direct labor cost
2. Indirect labor cost

Direct Labor Cost

The direct labor cost is the cost of labor that can be identified directly with the manufacture of the product and allocated to cost centers or cost units. The direct labor is one who counters the direct material into saleable product; the wages etc. of such employees constitute direct labor cost. Direct labor cost may be apportioned to the unit cost of job or either on the basis of time spend by a worker on the job or as a price for some physical measurement of product.

4.4.5 Cost of Project

= (A) material cost + (B) Machining cost + (C) labor cost

Material cost is calculated as under

1. Raw material cost
2. Finished product cost

Material Cost

Sr. No.	Part Name	Qty.	Cost
1	Solar Plate	1	1600
2	DC Gear Motor	1	800
3	Buckets	8	300
4	12V DC Lead Acid Battery	1	1200
5	PLY	1	200
6	MS Frame	-	250
7	Sheet Metal	-	400
8	Wires and Switches	-	70
9	Belt	-	80
	Total		**4900**

Labor Cost

Drilling, Welding, Grinding, Power Hacksaw:
Cost =1800 /- Rs

Overhead Charges

The overhead charges are arrived by "Manufacturing cost"

Manufacturing Cost = Material Cost + Labor cost
= 4900+ 1800
= 6700
Overhead Charges = 20% of the manufacturing cost] = 1340

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Total Cost

Total cost = Material Cost + Labor cost + Overhead Charges
= 4900+ 1800+1340
= 8040
Total cost for this project = 8040 /-Rs
= 4900+ 1800
= 6700
Overhead Charges = 20% of the manufacturing cost] = 1340

Total Cost

Total cost = Material Cost + Labor cost + Overhead Charges
= 4900+ 1800+1340
= 8040
Total cost for this project = 8040 /-Rs

V. WORKING PRINCIPLE

In general, the conveyor system runs on A.C power supply but in our model, we are running it on D.C power supply as it is just a working model on a small scale.

The D.C motor is connected directly to the head pulley, to which motion is transmitted through the connected shaft. The whole system operated by using solar panel through DC power stored into the battery by using charging circuit to store the power into battery. On head pulley, a belt made of fiber is used which is also rolled over to the tail pulley, on which buckets are attached, when we connect the power supply, the motor starts running and provide rotary motion directly to the head pulley, which in turns also forces the belt to move over it , due to which the buckets also starts.

Moving with the motion of the belt. The belt ¡s pulled tight to produce friction between it and the head drum. The friction overcomes the load and drag forces and the belt moves around the circuit from the head pulley to the tail pulley and back to the head pulley. Only friction ¡s used to drive the belt, If the friction falls the belt will slip or stop moving even though the head pulley keeps turning. The friction between the belt and pulley depends on the friction properties of the surfaces in contact, the amount of surface in contact (the arc and width in contact) and the tension in the two lengths of the be loaded side of the belt is the tight side and the return side is the loose side. The tight side needs to carry as much tension as possible to minimize the load on the drums, the shafts and the bearings.

Getting the maximum friction possible between belt and head pulley does this. Often a head pulley will be herringbone grooved or coated in rubber (or other such treatment) to increase the friction. Another option is to increase the arc of contact. A jockey (rubber) pulley can placed under the slack side close to the drum.

By lifting the return belt higher so it comes off the head pulley further around the circumference the contact area and hence the friction is increased.

Tensioning the belt also increases friction. This can be by jacking the head and tail pulleys further apart and forcing the belt harder against the drums or by making the slack (loose) side tighter. Tightening the slack side goes against the ideal of keeping the slack side tension low and the tight side tension high. If the loose side is used for tensioning, the load carrying components are made larger to take greater forces.

5.1 Mechanism of Bucket Conveyor

The mechanism of bucket conveyor is prepared by performing various steps for that it required various joint between two respective parts. Joint required for mechanism is applied during assemble the part. Various joints required for mechanism are pin joint, sliding joint, belt joint. The details procedure for mechanism is discussed under with the required figure.

- First off all call the support on which the driving on driven pulley is going to be fixed and apply fix constrain on it and take the direction pattern of the same at required distance.
- Call the driven pulley and a assemble it with lower end support by pin joint. Same procedure is followed during assemble of driving pulley
- Than call the belt bucket assembly and assemble it on outer surface of the pulley by sliding joint.

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- Now go to the mechanism and apply the servomotor between the pin joint of support and driving pulley and give required input for rotation of servomotor in servomotor definition.

VI. COMPONENTS AND DESCRIPTION

Parts of Solar Bucket Conveyor System

1. Buckets
2. Motor
3. Chain and Sprocket
4. Pulleys
5. Loading and Discharging Device
6. Solar Plate
7. Conveyor Belt
8. Steel Frame

6.1. Bucket

It is the essential part of this conveyor. It carries the bulk material to the required place. It was made with a 5mm thin plain steel sheet by folding the sheet at a certain dimension. The buckets can be also triangular in cross section and set close to on the belt with little or no clearance between them. This is a continuous bucket elevator. Its main use is to carry difficult materials at slow speed.

Early bucket elevators used a flat chain with small, steel buckets attached every few inches. While some elevators still are manufactured with a chain and steel buckets, most current bucket elevator construction uses a rubber belt with plastic buckets.

It is 12v dc motor used to give power to the chain and sprocket arrangement which is connected one side pully to rotate the conveyor belt.

6.3. Chain and Sprocket

A chain serves as a pulling member of bucket elevators. The buckets were attached to two chains bolted to the rear of buckets. The power of the sprockets transmits through the chains. It also helps to pull up the bucket with full of bulk materials.

Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. It is also used in a wide variety of machines besides vehicles

6.4. Pulley

Conveyor pulley is a mechanical device used to change the direction of the belt in a conveyor system, to drive the belt, and to tension the belt. Modern pulleys are made of rolled shells with flexible end disks and locking assemblies.

Pulleys are made up of several components including the shell, end disk, hub, shaft and locking assembly. The end disk and hub may be on piece. The locking assembly may also be replaced with a hub and bushing on lower tension pulleys. The shell is also referred to as the rim in some parts of the world.

6.5. Loading and Discharging Device

The design of loading devices depends on the nature and characteristics of the load conveyed and the method of loading. Our conveyor is made to convey the bulk material which is loaded by the bucket conveyor into the hopper.

Which is called the feed hopper that helps to load the material into belt at the proper position. The discharge for the bulk materials used a discharge plough board placed at a certain angle 31^0 to the longitudinal axis of the belt and fastened on the frame. This is installed slightly inclined section 10^0 of the conveyor

6.6. Solar Plate

Photovoltaic modules use light energy (photons) from the Sun to generate electricity through the photovoltaic effect. The majority of modules use wafer-based silicon cells or thin-film cells. The structural (load carrying) member of a module

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can either be the top layer or the back layer. Cells must also be protected from mechanical damage and moisture. Most modules are rigid, but semi-flexible ones are available, based on thin-film cells. It is the one of the main component in our project to generate electric power to operate the dc motor for chain and sprocket arrangement.

6.7. Conveyor Belt

A conveyor belt is the carrying medium of a belt conveyor system (often shortened to belt conveyor). A belt conveyor system is one of many types of conveyor systems. A belt conveyor system consists of two or more pulleys (sometimes referred to as drums), with an endless loop of carrying medium—the conveyor belt—that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler pulley.

There are two main industrial classes of belt conveyors; Those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport large volumes of resources and agricultural materials, such as grain, salt, coal, ore, sand, overburden and more.

6.8. Steel Frame

Steel frame are used to construct the structure of any skeleton by arranging in horizontal and vertical manner as per the dimensions and structure is build according to the database The steel frame used in our model to give mild steel hollow rectangular bar and strip was used in the construction of the frame due to its strength, workability, availability and cost effectiveness. The frame provides support for the electric motor, battery as well as the handle frame.

VII. MANUFACTURING PROCESS

7.1 Drilling:

Drilling**s** a process of producing round holes in a solid material or enlarging existing holes with the use of multi-tooth cutting tools called *drills* or *drill bits*.

The shaft of the pulley of the belt conveyor on loading portion is stationary while the pulley is rotatable with the help of bearing. This shaft is held by two metal bars and these bars were drilled to hold the shaft. In this project two wooden pulleys were used. Both these pulleys were drilled along its central axis to make a path of shaft. The bottom portion of the frame was drilled in different points to make hole to screw the whole frame to a wooden board. Various cutting tools are available for drilling, but there is the twist drill.

7.2 Cutting

Cutting is a collection of processes wherein material is brought to a specified geometry by removing excess material using various kinds of tooling to leave a finished part that meets specifications. The net result of cutting is two products, the waste or excess material, and the finished part. If this were a discussion of woodworking, the waste would be sawdust and excess wood. In cutting metals, the waste is chips or swarf and excess metal.

Cutting processes fall into one of following major categories:

- Chip producing processes most commonly known as machining
- Burning, a set of processes wherein the metal is cut by oxidizing a kerf to separate pieces of metal
- Sniping tool: To cut the thin metal sheet to form the shape of bucket
- Hack Saw: To cut the shaft into desired length.
- Grinder cutting: To cut the thick metal bar into required length for making frame.

7.3 Welding

In this process welding was widely used. As the project was to make a small prototype and there was a small budget for it, welding was used here for most of the joining process. Welding was used to:

1. Attach the sprocket to the shaft.
2. Attach the bearing to the shaft.
3. Hold the bearing in the bearing holder.
4. Attach the bearing holder to the frame.

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5. Form the frame of both bucket and belt conveyor.
6. Join the bucket conveyor's driving shaft and belt conveyor's driving shaft to the electric motors.
7. And to join many other parts to the frame.

7.4 Grinding

It has been already mentioned that the welding process was widely used here. So, grinding process was also used here to grind the various parts after cutting to get a plane surface for welding. The welded parts were also grinded for fine surface.

VIII. CONCLUSION

The main purpose for building this machine is to automate the handling of bulk material and its packaging. We are trying to build a prototype for expressing our motive on this project. Though we have some mistakes caused by human error but we believe that we can clear our concept by our work. So, once it is set the requirement of skilled operator is also reduced as compared to a manual system. This project was designed to study the design of bucket elevator also enhance the manufacturing idea about the processes and fabrication of the equipment

In conclusion remarks of our project work, we have developed an "SOLAR BUCKET CONVEYOR SYSTEM" which helps to achieve low cost automation. We are proud that we have completed the work with the limited time successfully. We have done the project to our ability and skill making maximum use of available facilities and we are able to understand the difficulties in maintaining quality. We also observed that the prototype manufactured is working with satisfactory conditions and our work is able to achieve all the objectives which are necessary

8.1 Merits, Disadvantages and Application

8.1.1 Merits

- Higher speeds possible
- 2.Quieter operation
- High electricity saving by using solar system.
- Possess better abrasive resistance to materials like sand, coke etc.
- Less skilled labor is enough.

8.1.2 Disadvantages

- The material should not be very sticky
- The temperature of the materials should be ambient or slightly above
- The materials should not be excessively corrosive or abrasive

8.1.3 Applications

- Candy
- Coffee
- Rice
- Seed
- Detergents
- Plastic Granules

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