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Design and Fabrication of Multi-purpose Sieving Machine

Prof. Dipak U. Adhapure , Swapnil S. Bhoite, Vivek J. Deshpande, Umesh P. Chavan, Somnath B. More

[1]*Department of Mechanical Engineering, University of Pune, Maharashtra, India*
[2]*Department of Mechanical Engineering, University of Pune, Maharashtra, India*
[3]*Department of Mechanical Engineering, University of Pune, Maharashtra, India*
[4]*Department of Mechanical Engineering, University of Pune, Maharashtra, India*
[5]*Department of Mechanical Engineering, University of Pune, Maharashtra, India*
Corresponding Author: Prof Dipak U. Adhapure

Abstract
This paper presents the concept of Design and Fabrication of Multi-purpose Sieving Machine mainly carried out for production-based industries. Today in this world every task has been made quicker and fast due to technological advancement, every industry desires to make a high productivity rate maintaining the quality and standard of the product at a low average cost. We have developed a conceptual model of a machine capable of performing different operations simultaneously and easily. In this machine, we drive to the main shaft using a motor to which the slider-crank mechanism is directly attached; the slider-crank mechanism is used for sawing operation. The table is fixed with the crank which moves the tray to vibrate it and act as a separator with the help of a DC motor. And motor shaft (main/driven shaft) is mounted to pulley type mechanism. Thus the Design and fabricating of the Sieving Machine is to help the industrial people and farmers on the global market. The advantage is to obtain the easy separation of things according to mesh and reduction in cost associated with power usage, increase in productivity rate and produce less space, etc.

Keywords: *Sieving mesh, grinding, single slider crank mechanism, agricultural purpose, etc.*

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I. INTRODUCTION

A Multipurpose sieving machine is used for the extrication of the needed elements from unwanted material further it is used for characterizing the element to the required size by the allocation of a sample.[1] Using a pane such as a mesh or net. A sifter is used to separate and break up clumps in the dry ingredient particles like sand and flour. This project titled concentrates on providing descriptions of all the basic operation principles and design of DC motor. In the technical, education of Sieving plays a Major role in operations of various industries. [6-3] Construction of work device under a constrain is achieved by the systematic approach. The prime focus of the study of Sieving Machine integrates various skills and knowledge attainment and gives orientation towards application in practical life. It helps in intensifying the thinking and alternatives for potential applications. Sieving is an uncomplicated practice for sorting out particles of different sizes. [3] Very fine small holes are used in this sieve to sift flour core. [6-2]The fine coarse particle are separated or broken up by grind against one another and screen openings. Different types of sieves are used for the separation of industrial wastages like bolts, nuts washers, and nails of various particle sizes of the holes. Similar types of sieves are used for agricultural equipment.

II. TOOLS AND INSTRUMENTS

1. Drilling machine: It is used to drill the hole in the aluminum ‘C’ angle.
2. Hacksaw: It is used to cut the ‘C’ angle with the required dimension.
3. Screw Driver: A screwdriver is used to tighten the nuts and bolts.
4. Steel Rule: It is used to measure the length.[4]
5. Pulley and Pulley Belt mechanism: For transmitting of power from motor shaft to crank which is attached to sieving bracket.
6. ½ HP Motor/drive: It is used to give movements and actions to sieving.
7. 3cm in diameter bearings: Bearings are used between these two components. (C type angle rod and sieving bracket).
8. Sieve-net: Different type of sieve net for screening purpose.

III. METHODOLOGY

The methodology is the proposed work will be carried out with following steps:-

1. Study of sieving machine.
2. Study of different operations which is need for fabrication.
3. Selecting the project's components.
4. Calculation.
5. Experimentation by assembling all components.
6. Testing.
7. Result.

IV. OBJECTIVES

A. Primary objectives:

- To design and fabricate rotator sand sieving machine which separates sand from mixture.
- To replace traditional method of using hand as it is time consuming.

B. Secondary Objectives:

- To learn sliding crank mechanism.
- To develop interpersonal skills and to be familiar with the tools and process used in mechanical workshop.
- To learn how to arrange time and budget.

C. Significance:

- The project involves design of the mechanical part of machine using advance software like CAD and Solid works and the system using this mechanical part then fabrication is carried out based on selected design.
- By changing the mesh size of this multi-purpose sieving machine, the machine can separate a product of selective particle size only.

D. Limitations:

- For the finer sand repeated screening process is required which is tedious.
- Refining more amounts of will consume time.

V. LITERATURE REVIEW

From The human community has been the most important thing for years. The majority of sediments, including sand, are comprised of fragments of rock that have been weathered by wind and rain (weathering). In general, they are created as larger fragments (gravel) that break down as rivers carry them downstream; the finer the particle, the further it has traveled. In other words, large pieces of gravel can be found close to the head of a river. Flowing downstream, gravel becomes finer and becomes cobble, pebble, granule, and eventually sand, then finally flowing into the ocean, where the sediments are deposited. Sediments formed in the ocean sub-duct to Earth's interior (mantle) from trenches with sub-ducting tectonic plates. Occasionally, pieces tear loose from the wall continental plate, becoming part of a new continent. Geological structures formed in this way are called accretionary bodies (prisms). Accretionary bodies are common in sub-duction zones like Japan, which makes up a large part of the Japanese islands. Since sand is a basic element in all construction projects, and most often available in mixtures (gravel), there are numerous ideas being developed to remove the sand from mixtures. Depending on the size of the net that is used, this process sieves the sand into its size. Usually, this smooth sand or product is used as the main building material in buildings or houses. To attain better quality products, smooth sand is necessary, for instance for any other product.

Figure 2 show modified sieving method. It uses handle to rotate and make the process sieving more efficient mainly use in small, manufactured process such as in lab. Nowadays it has been upgrade using motor to replace

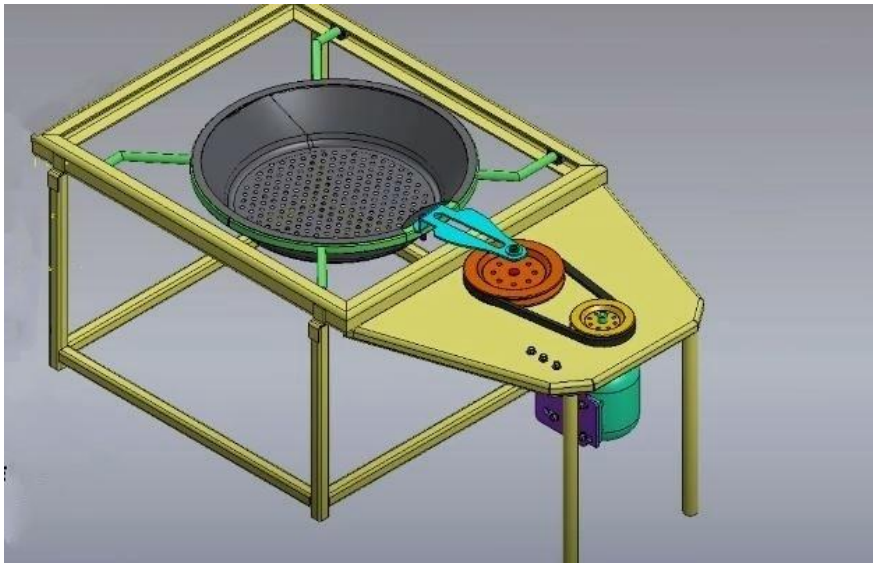
the human power which is shown by figure 3. Since this machine is important in our daily life it has been upgrade one by one and been marked all over the world.

VI. IDEA GENERATION AND CONCEPTUAL DEVELOPMENT

Taking in consideration the advancement in technology and industrialization the need of more efficient and portable sand sieve is the must have at the present. A simple sand sieve process came into use from the very past starting from the separation using a mesh strainer. After studying the objective tree for designing of sieving machine, following concept are considered.

- Concept 1: For the first concept, a simple hand operated reciprocating sand sieve was taken into account. A simple machine with mesh strainer was the very first sieving process and is also in use now in many parts of the world. Also, the vertical reciprocating sand sieve is the nice improvisation. It operates with the reciprocating motion created by moving the mesh back and forth.
- Concept 2: After, the introduction of vertical reciprocating sieve, the machine became easier and more efficient by adding a rotary mechanism to create the relative motion which helps in separation**.**

- Concept 3: With the introduction of automation in the machinery field, automation in every machinery field has become mandatory. Considering, the need and make the machine more efficient and easily operable we have attached DC motor in our sand sieve machine to operate our machine. Our motor rotates the shaft at about 60RPM and sieve net producing the relative motion between them so that finer sand passes through the net and remaining particle slides in collector.



VII. DESIGN AND CALCULATION

1. Torque Calculation:

- To calculate the power generated by the motor to operate the machine torque is calculated,
- Diameter = 20 cm
- No. of revolution (N)= 1150 rpm
- Power= ½ hp=375 W

Force (F)= $m \times r \times \omega^2$

- Where m be the total mass of rotation chamber For m= 15 kg,
- $\omega = 2 \times \pi \times (1150/60) = 120.366$ rad/sec
- Torque (given by motor) =power/ω
  = 375/120.366
  = 3.115 Nm

2. Machine Efficiency:

- Power of motor =375W.
- Power for one hour =375Whr.
  =0.375 KWhr
- Unit consumption for one hour=0.375 unit.
- Let us suppose we use it 5 hours a day on average, then

Unit consumption for one month=0.375 ×5×30
=56.25 unit

- Approximate price of 1-unit electricity costs about Rs 10/unit, so

Total expense for 1month=10×56.25=Rs.

3. Manpower Efficiency:

- Similarly, For the manpower cost to the very same work,
- One-hour labor cost of a worker =Rs.80
- Working 5 hour a day for 1 month it will take around
  =Rs. 80×5×30
  =Rs 12,000

4. RPM:

- Motor pulley diameter(outer)= 5 cm
- Machine pulley diameter(outer)= 16 cm
- Speed ratio= 5/16 = 0.3125

So0, 200 rpm motor speed is equivalent to (200×0.3215) = 62.5 rpm machine speed

5. Power calculation:

- P=Force × velocity
- Force= Weight = Mass × Acceleration due to gravity.

g is approximately 10 m/s^2 ~ 9.81 m/s^2

- So, P = 100kg×10m/s^2× velocity
- Let velocity = 0.5 m/s
- P=490 W

So, we need nearly ½ hp of motor

- Average diameter of circular net = 50 cm=0.5 m
- Circumference= 2×π ×0.5=3.14 m
- Time for screening of mass in 1 revolution= π×0.5=1.57 sec

6. Torsional force in shaft:

- Maximum tensile stress of a mild steel =525 MPa
- Maximum shear stress of mild steel (τ) = 525/1.73 = 300 MPa
- Diameter of shaft(D) = 3 cm = 0.03 m
- Torque transmitted by circular shaft = $\frac{\pi}{16} \times \tau \times D^3$ = 1589.625 Nm

7. Belt length:

- Diameter of small pulley(d_1) =5 cm
- Diameter of large pulley(d_2) = 18 cm
- Distance between center of two pulleys(x)=40 cm
- Length of pulley= $\frac{\pi}{2}(d1 + d2) + 2x + \frac{(d1-d2)^2}{4x}$= 117 cm

VIII. ASSEMBLY AND INSTALLATION

1. A table is made with the weld having a 'C'angle type frame
2. The sieve brackets are made with sheet metal covering with the outer circular ms -steel frame.
3. The sieve bracket with 4 legs or supports is to be attached with the guide bearings for performing horizontal sliding motion on the table respectively.
4. The sieve bracket is connected to the driven pulley by the arm/crank.
5. There are two types of pulley i.e. driver and driven pulley. Both pulley driver and driven are in mesh with each other with the help of a pulley belt.
6. The pulleys and motor are mounted on a table with the bearing.
7. The electric motor is placed with a nut bolt arrangement.
8. The motor shaft or main shaft is connected with the driver pulley.

IX. WORKING PRINCIPLE

The working principle of the Sieving Machine mainly depends on converting the rotary motion provided by the D-C motor into the sliding motion of the sieving bracket (a slider-crank mechanism). The motor is provided with pulley and pulley belt arrangement to provide the required motion as it rotates the shaft connected to the movable framing portion does back and forth motion as such the mesh attached to it when moves or slides separate the particles and other foreign Particles of required size based on the size of the mesh. This process can be used for as many numbers of different sizes of particles.

1. The electric supply is given to a motor/drive.
2. Particles that are to be separated are put in a sieve first. And sieve sizes are arranged according to our requirements.
3. As the motor gets to start, the shaft rotates (main shaft). The driver pulley which is attached to the main shaft also rotates around its axis. And driven pulley which is in mesh (pulley belt) with driver pulley also gets rotates.
4. A crank is connected between the driven pulley and a sieve bracket. The sieve bracket contains 4 supports with bearings respectively. Bearing is inserted in 'C' angle type rod or frame and has relative motion among them.
5. As the driven pulley rotates, the crank also rotates. Further rotating of crank connected to sieve bracket, the sieve bracket gets his sliding motion (to and fro motion).
6. Connected Sieve bracket with 4 support and bearing causes relative motion in the frame.
7. Due to the continuous sliding of the sieve, small/thin particles pass from provided size mesh and big/thick particles remain above on sieve.

At last, we got the required result.

X. ADVANTAGES

1. Simple in construction.
2. Nowadays, separation of different sizes of solid material is a need of hours; this project can be used for the separation of different sizes of solid only by changing mesh of required size.
3. Compact in size and required less space.
4. Less in weight.
5. Here different types of materials can be separated which depends on the mesh size used.

XI. APPLICATIONS

1. Substance industry: resin, pigment, industrial medicine, cosmetic, coatings.
2. Foodstuff industry: sugar powder, starch, salt, rice.
3. Environment: assistant detergent, active carbon.
4. Coatings: Powder coatings, pigment paints, etc.
5. Metals: Metal powders, zinc powder, copper powder, coal powder, alloys, etc.
6. Agricultural:-sorting of fruits grain.

XII. CONCLUSIO

Concluding the project up to now after research four different types of sieving machine was conceptualized to select the best considering every factor to make it more efficient, portable and easily operable. Then the required materials were selected by market study although the fabrication process was undoable due to condition occurred we continued the design process in Solid works and some preliminary calculations. This report also includes doing method of construction and research design flowchart and the Gantt chart. According to calculations and assumptions, this type of sieving machine will be efficient and easily operable, which can help society to learn new way of sieving sand.

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