iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** III **Month of publication:** March 2021

DOI: https://doi.org/10.22214/ijraset.2021.33236

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue III Mar 2021- Available at www.ijraset.com

Design and Fabrication of Automated Sand Filter and Waste Separator Machine

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Abstract: ***Machine proves of no or little help as the sand needs to be manually transported and material handling takes place twice to get different sizes of sand. These processes are carried out manually motion. Also we have a frame to hold the filter frame in place while ensuring proper horizontal motion at the same time. On switching on the motor using our motor controller circuit, the system allows to operate the motor. Sieving of sand is carried out using rectangular mesh which is inclined at certain angle. This causes a relative motion between the particles and the sieve. Depending on their size the individual particles either pass through the sieve mesh or retained on the sieve surface. There are different machines that are being used for sand sieving processes. In our project the process will takes place automatically. Thus the time consumed during the whole process of preparing the concrete is reduced.***

Keywords: Design, fabrication, automated sand filter, waste separator machine.

I. INTRODUCTION

We here demonstrate the design and fabrication system. Sand is used in construction, manufacturing and many industries. Sands needs to be filtered and separated from unneeded particles, stones and other large particles before it is put to use. This project focuses in design, fabrication of the mechanical part of machine and the system of the sieve machine. To achieve this project objective, this sieve machine body structure and mechanical system needs to concern some other criteria such as strength, safety and ergonomic design. This project flow must start from design, analysis, and lastly fabrication process, before develop the sieve machine, it must compare with other product in market. It is because to study the customer need and to create a new design with new feature. This project focuses in design, fabrication of the mechanical part of machine and the system of the sieve machine. To achieve this project objective, this sieve machine body structure and mechanical system needs to concern some other criteria such as strength, safety and ergonomic design. This project flow must start from design, analysis, and lastly fabrication process. Before develop the sieve machine, it must compare with other product in market. It is because to study the customer need and to create a new design with new feature.

II. LITERATURE SURVEY

Aldo Boy A. Atienza et.al, analyzed and improved the inclinable trammel sand sieve machine. Trammel sand sieve machine that can resolve problems in sieve machines integrated with flat screens such as progressive blinding of screen, formation of sag when heavily loaded and poor spreading of material being screened.

It features concentrically arranged trammels having different mesh sizes for each layer. Inclination mechanism depends on a power screw which ranges from 0° to 16.2°. A series of tests and experiments were performed to determine the optimum inclination and maximum feed rate capacity of the machine for dry and wet feed. For dry feed, the feed rate is 28.55 kg/min with 96.5% screening efficiency while 21.2 kg/min with 98% screening efficiency for wet feed. The result implies that the prototype exhibits effective screening and considerably efficient. Andrew Parr et.al, studied the hydraulic and pneumatic principles. Most industrial processes require objects or substances to be moved from one location to another, or a force to be applied to hold, shape or compress a product. Such activities are performed by prime movers, the workhorses of manufacturing industries. The main advantages and disadvantages of pneumatic or hydraulic systems both arise out of the different characteristics of low-density compressible gases and (relatively) high-density in compressible liquids. This chapter compares various advantages and disadvantages of electrical pneumatic and hydraulic systems. Hydraulic systems require a pressure regulator to spill excess fluid back to the tank, but pressure control in a hydraulic system is much simpler. Pneumatic and hydraulic systems generally rely on pressure in a fluid. Behavior of a fluid can generally be deduced from measurements of flow or pressure. Where more accurate pressure measurement is required, transducers based on the force balance principle are generally used.

Benny Yulianto et.al, Analyzed the evaluation in conceptual design of human powered sand sieving machine. Sand sieving machine has the function to sieve sand and stone that mixed together. The sand and the stone cannot process further if they mix. Thus, this machine will help operator work which was doing sieve with no machine mechanism. With machine mechanism driven by human power will reduce the time to sieve. The objective of this paper is hopefully can make the best concept design in terms of production costs and production capacity. The results of this design obtained the best concept of sand sieving machine in terms of efficiency, energy, and flexibility. From this paper, it can be concluded that the design of this sand sieve will environmentally friendly and bring many benefits, is positive and very good to continued. Bin Zhang et.al, studied the intelligent prediction of sieving efficiency of vibrating screen. In order to effectively predict the sieving efficiency of a vibrating screen, experiments to investigate the sieving efficiency were carried out. Relation between sieving efficiency and other working parameters in a vibrating screen such as mesh aperture size, screen length, inclination angle, vibration amplitude, and vibration frequency was analyzed. Based on the experiments, least square support vector machine (LS-SVM) was established to predict the sieving efficiency, and adaptive genetic algorithm and cross-validation algorithm were used to optimize the parameters in LS-SVM. By the examination of testing points, the prediction performance of least square support vector machine is better than that of the existing formula and neural network, and its average relative error is only 4.2%. Gajbhiiye P.R et.al, studied the design parameter of sand screening machine., Construction of buildings requires sand as an important ingredient Sand is used at different stages in construction right from the foundation to the finishing work i.e. plaster. This sand is needs to be screened properly for various stages in construction. Size of sand for construction work is slightly coarse whereas that used for plaster work is fine. Conventionally screening is normally done manually using fixed screens or machines. This manual process time consuming and laborious takes a lot of time and cost.

It is also observed that the conventional machine prove of no or little help as the sand needs to be manually transported and material handling takes place twice to get different sizes of sand. These processes are carried out manually. Sieving of sand is carried out using rectangular mesh which is inclined at certain angle. This causes a relative motion between the particles and the sieve. Depending on their size the individual particles either pass through the sieve mesh or retained on the sieve surface. There are different machines that are being used for sand sieving processes. The project process will takes place automatically. Thus the time consumed during the whole process of preparing the concrete is reduced. GanjarKurnia et.al, Studied the contact mechanism between shaft, key, and crank in the sieving machine. The sand sieve machine that has been designed and has a drive system consisting of a crank, shaft, and key. These three components interact with each other. This paper will explain the contact that occurred. The interaction will be simulated with the help of Abacus software. Stages of simulation performed are preprocessing starting from making 3D images, describing the material and determining load and boundary conditions. Then the analysis where the previous process as input to the finite element code. Finally, post-processing is the form of the result after analysis by the software in the form of stresses. The result of this paper is the von misses stress for contact between the three parts and the stress distribution along the key. From this paper, it can be concluded that the contact mechanics of the sand sieving machine is useful for making the most optimal design so that users can operate it smoothly. Goldowsky M.P et.al, Analyzed the reciprocating linear electric motor. Features include structural simplicity and good force/displacement characteristics. Reciprocating motor has simple, rugged construction, relatively low reciprocating weight, improved power delivery, and improved force control. Wear reduced by use of magnetic bearings. Intended to provide drivers for long-lived Sterling-cycle cryogenic refrigerators, concept has less exotic applications, such as fuel pumps. John Ryan Coryez Dizon et.al, Designed an automatic sand sieve. An automatic sand sieve comprising: a frame, a motor provided with a drive pulley fixedly connected to said frame; a pair of big pillow blocks fixedly attached on top of said frame; a drive shaft mounted on said pillow blocks; a wheel fixedly attached to said shaft; a belt attached to said pulley and said wheel; a pair of cams attached on both ends of said shaft; a pair of reciprocating arms attached to said pair of cams; a pair or small pillow blocks attached to said pair of reciprocating arms; a sieve assembly provided with a mesh attached to said pair of pillow blocks; a plurality of bearings attached to said sieve assembly, said bearings are slid ably connected to said frame, a switch attached to said frame and a sand tray attached below said frame. Jyoshi Anil kumar et.al, designed the solar based sand sieving machine. Sieving machine serves is to remove large grains with a small grain through a sieve. Separation occurs when the sand is placed on top of a filter having holes size. The first sieving is done to get rid of the sand with a larger than standard withholding sand filter and the second sieving is done to get rid of the sand with a size too small means that the sand filter is ignored. A sieve is a device for separating wanted elements from unwanted material or for characterizing the particle size distribution of a sample, typically using a woven screen such as a mesh or net or metal. This system puts forward a fully automated sand filtering and separator that automatically filters the sand poured on it. For this a motorized shaft is mounted horizontally on the mounts. The shaft is connected to a filter frame with a mesh below and enclosed frame on sides which operates the motor when switched on.

Kahandage P.D et.al, studied the reciprocating type sawdust sieving machine, Saw dust is a byproduct of wood cutting industry and it is readily available in Sri Lanka. For a very low cost. When saw dust is been used as the main substrate, it should be sieved well to get fine particles and then sieved particles should be mixed properly with other essential nutrient ingredients and water. Results of some research carried out on mushroom production shown that, it gives high yield within a short time period when using sieved saw dust for the growing media preparation. Most of the mushroom growers are aware about this and they use a sieve made with a wooden frame and a wire mesh to sieve saw dust. As some drawbacks are associated with this sieve, it has become a very laborious, time consuming and difficult task. The mesh of the container can be unfixed easily as it is hinged by one side, in order to facilitate the cleaning. The sieved saw dust is collected to the saw dust collector which is underneath to the container. Collected sieved saw dust can be taken out from the collector at the outlet of it with the support of gravity. The actual capacity of the machine was 212 kg of saw dust per hour with 84% efficiency. Therefore, this machine can be effectively use in mushroom cultivation process with low labor and low operating cost.

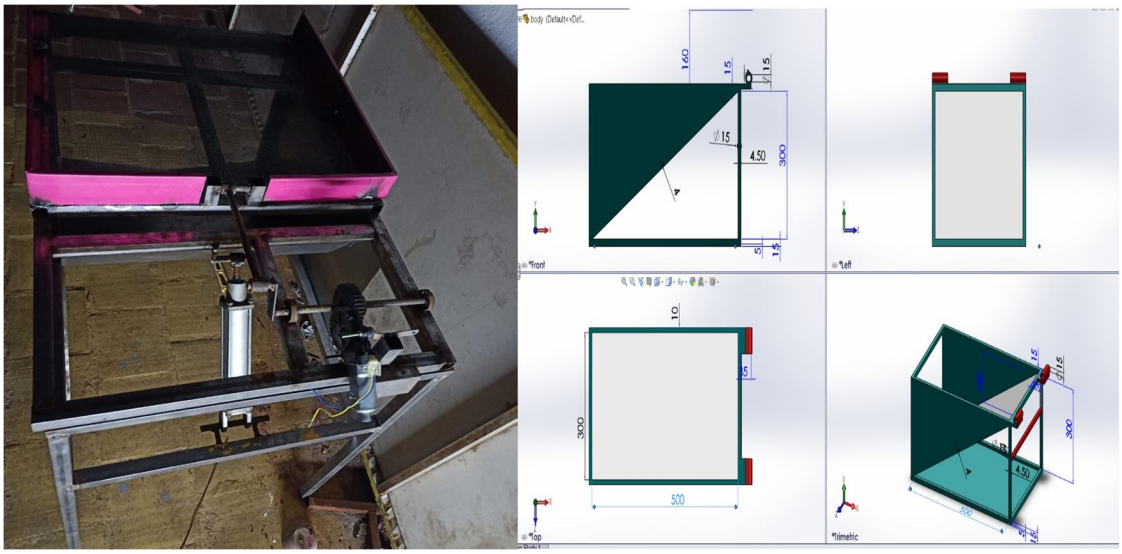
III. PROBLEM IDENTIFICATION

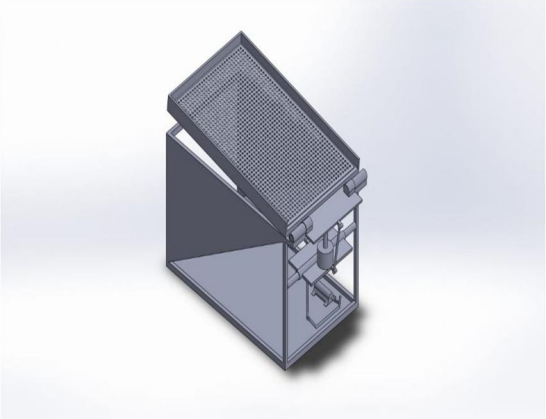
A. Man power used for filtering process.
B. Removal waste materials by manual.
C. Time consumption for the filtering and separating.
D. Less amount filtered in long time.

IV. DESIGN AND CALCULATIONS

1) *Motor Specification:* Output power = 1 H.P, 50 Hz, Rate of speed =1440 RPM, Rated voltage = 220 V – 240 V and Rated current = 15 A.
2) *Specification Mesh:* Dimension = 1100*800 = 3 mm, Sand particle size = 0.063 m and Mesh = no 4.
3) *Cylinder Specification*
a) Type: Double acting, Full piston area = 50 sq. Inch, Net area = 40 sq. Inch and
b) Force = P (supply pressure) x A (piston area) = 80 x 50 = 4000 lb.
4) *Crank and Connecting Rod:* Crank = 50 mm and Connecting rod = 350 mm.
5) *Specification Bucket:* Diameter =12 inch and Production rate =5 kg/min.
6) *Sand Size Specification:* Coarse size=2mm to 0.5mm, Medium sand = 0.5 mm to 0.25 mm and Fine sand = 0.25 mm to 0.06 mm
7) *Load Specification:* Allowable stress = 144 N/mm^2 and Maximum torsional shear stress = 2.40 N/mm^2

V. V-DESIGN





VI. CONCLUSION

By observing above information we conclude that, we have design this product with the intention of replacing the existing sand filter with automated sand filter and pneumatic waste separator machine. In order to reduce the time consumption, human effort, labour force, cost of labour etc., it also concludes that the machine was easy to operate and control during the field work.

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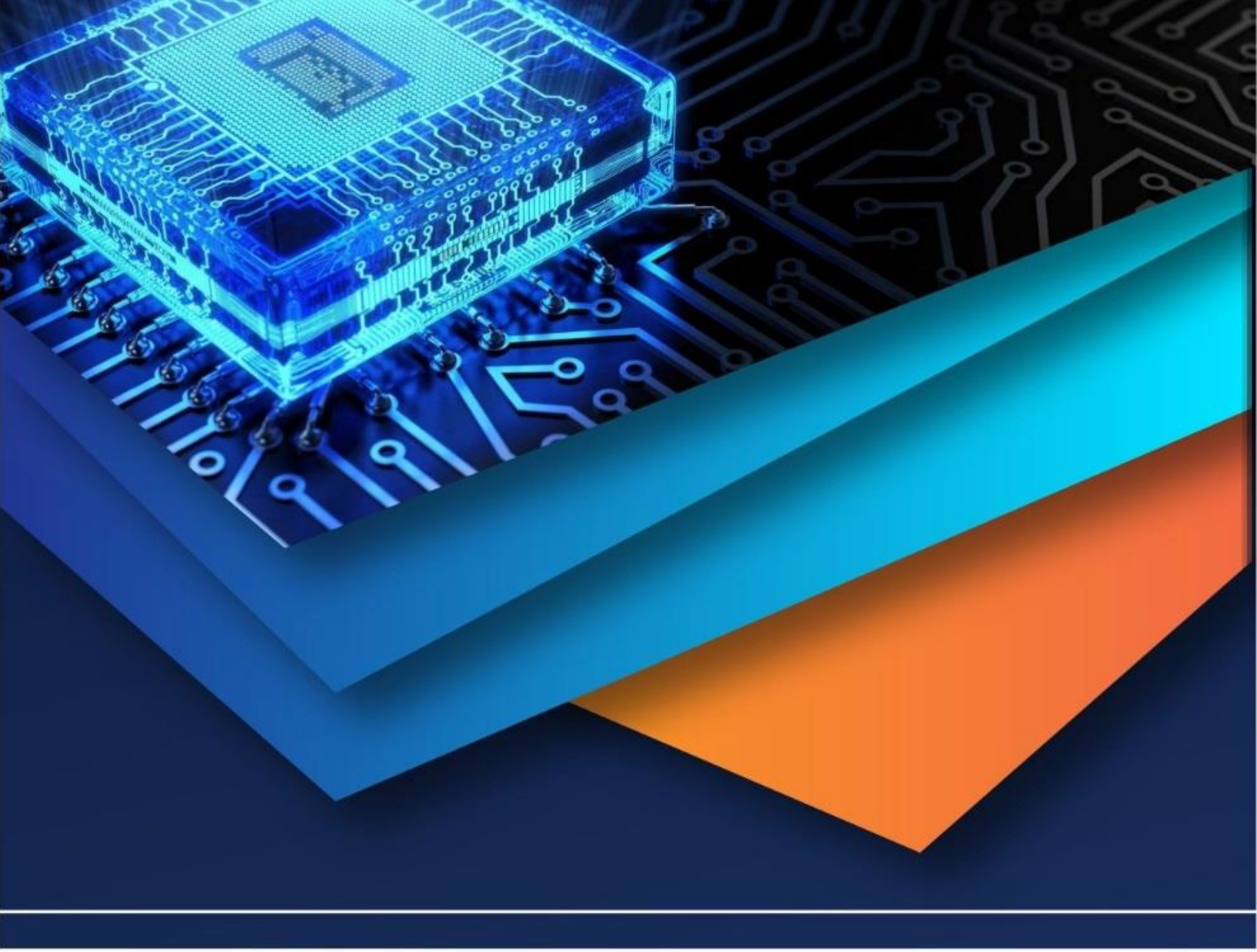

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