EJSIT
European Journal of Science, Innovation and Technology
ISSN: 2786-4936
www.ejsit-journal.com
Volume 3 | Number 3 | 2023

Design and Modification of Sieving Machine for Lower Energy Consumption

Ifeyinwa F. Ogbodo[1], Ezeagwu C. Ogwugwuam[2], Emmanuel U. Ogbodo[3]
[1]Department of Industrial and Production Engineering, Nnamdi Azikiwe University, Awka, Nigeria
[2,3]Department of Electronic and Computer Engineering, Nnamdi Azikiwe University, Awka, Nigeria

ABSTRACT

In this paper, the design and modification of a sieving machine for lower energy consumption was achieved. One of the main goals of this paper is to minimize energy lost due to idleness of the machine which can lead to wear, by incorporating sensors.

The sensor used in this work detects the presence and absence of materials fed into the machine and automatically switches on and off the machines respectively. When a material is fed into the machine, the IR source also known as the transmitter, emits radiation of required wavelength, this radiation reaches the object and is reflected back. The reflected radiation is detected by the IR receiver and is then further processed in the microcontroller to give an output.

The parts of the machine that were modified were designed using solid works software. Every progression of the design was assessed and interpreted in details in this paper. The materials are locally sourced material and the fabrication was done using the sourced materials. The materials used include aluminum for hopper and sieve chamber. The sieve chamber was redesigned to be adjustable to suit different particle sized materials.

Furthermore, the cost effectiveness of the design, fabrication and modification process was considered in the work. It is expected that the project work in this paper will allow industries where sieves are required such as bakeries, construction companies, spices production companies etc., who find sieving process time wasting and energy consuming to consider the introduction of this sieve.

Keywords: sensitive efficiency, sieve, DC motor, infrared sensor, cassava flakes

INTRODUCTION

Sieving is one of the separation techniques achieved by the use of a sieve done mostly by shaking which in turn separates two mixtures of different sizes. Due to poor efficiency, there is need for an effective separation with high efficiency therefore the need for a machine. A sieving machine is a kind of machine fabricated to be used in separating solid particles. The sieving equipment works by allowing solid particles of different sizes to pass through the pores or the aperture done basically by breaking the lumps for proper sieving and achievement of the desired product. The sieving machine incorporates a shocker in accordance with its speed range.

The sieve equipment operates best when the solid particles is in their coarse and fine form. The equipment has high sensitive efficiency, but only few have been constructed since the development of separation of particles. This is as a result of the losses incurred and the procedure involved and also the labor needed to clean the sieve plate and to handle the sieve equipment.

However, in the construction of sieve, we have to bear certain qualities in mind to portray such as determination of size and shape of the equipment which contributes to the efficiency of the equipment. Size separation is a unit operation technique which is often used daily in industries, and our daily lives. Sieving is one of the size separation techniques that are often

needed and therefore sieve is the equipment used. For effective size separation, there is need for construction of a sieving machine.

Sieving is used to separate and to break up lumps in the particles like sand, cassava flakes, agro-materials etc. This project titled concentrates on sieving, providing descriptions of all the basic operation, principles and design of DC motor which is to be used in the fabrication. In the technical education, Sieving plays a major role in operations of various industries. Construction of work device under the constrains 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 its application in practical life. It helps in intensifying the thinking and alternatives for potential applications. Sieving is an uncomplicated practice for sorting out the particles of different sizes.

The particles mixture are separated or broken up by grind against one-another and sieve 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 purposes and a typical example is in cassava processing industries where garri and flour are processed and construction also. Sieves are also used for grading the grain size to detach stones from sand from grains.

Due to the problem of attaining the desired texture of the product in the market, at the right time, there is a high chance of spending more money for the desired texture or category and the required time to be attained which will lead to increase in the budget and time to wait for the supplier preparing the goods.

Nowadays, people always prefer the most suitable way to cut their cost and time. Example in a construction company where they must finish the work before the due date, there might be a problem since a lot of time have been wasted while waiting for the materials to arrive.

However, the need for the use of a high technical machine that can do the work of sieving of any mixture or sub mixture. A special sieving machine that is comfortable and easy to use is required.

The aim of this project is to modify an already existing sieving machine through automation and control for efficiency.

The objectives of this project are as follows:

To achieve this, the following objectives were adopted;

- To study the existing sieve in order to determine their merits and demerits.
- To program IR sensor to enable smart sieving.
- To under study the application and benefits of programmed IR sensor sieves.
- To design a programmed IR sensor that is capable of detecting presence and absence of objects in the machine.
- To authenticate the efficiency of the designed sensor sieve

RELATED WORKS

The quality of product achieved by sand casting is partly a function of the kind of sand used during molding. Quartz and other silica rock particles are the source of silica sand which is commonly used in molding (Chipil & Basal, 2014). However, the natural sand does not possess the actual properties needed for molding and plastering. It consists of different shaped and sized particles (particle size distribution), responsible for important physical and mechanical properties of the product (Hagen, Skidmore, & Fryrear, 1987). If the particle size distribution changes during manufacturing process, then the quality of the finished product will also change. Hence only a continuous monitoring of the particle size distribution can maintain constant product quality (Ayodeji *et al.*, 2014; Scott & Tim, 2015). In order to determine the particle size distribution of sand, sieving is employed. Sieving is a unit operation carried out

by allowing solid particles of different sizes to pass through the pores of an orderly arranged set of stacked sieves in a manner of the particle sizes and shape (Abubakar *et al.*, 2015). Numerous studies (Keshun, 2009; Ujam & Enebe, 2013; Christopher & Robinson, 2014; Ayodeji *et al*., 2014) reveal the fabrication of electrically operated sieving machines, in which agitation and vibration of the sieves are accomplished via electric motor. The sieves are vibrated and rotated about its axis. These designs equally work in similar manner with the electromagnetic sieve (Ujam & Enebe, 2013; Smith, 1990), in which a combined action of electricity and magnetism is utilized to operate the sieves. The sieving operation is achieved by either rotary or vertical motion, or a combination of both.

In other design (Simolowo & Adeniji, 2011; Oladeji, 2012; Hagen, Skidmore, & Fryrear, 1987), vibrating the sieves may be achieved by mean of pulley and belt drives operated by electric motor. The pulley system is supported on a shaft mounted on bearings that facilitate both lateral and vertical oscillation with amplitude of 32mm in each direction. A special type of the sieve shaker is the Pedal driven type (Abubakar *et al.*, 2015; Smith, 1990) wherein, sieving is achieved by driving the set of sieves by a chain sprocket mechanism using bevel gears. The sieve vibrates vertically. In all these designs, the sieving method can be vibratory sieving, horizontal sieving, vertical sieving, tap sieving, air jet sieving or a combination of two or more of these methods (Ngabea *et al.*, 2015; Oladeji, 2012). In the vibratory sieving method, the sample is thrown upwards by the vibrations of the sieve bottom and falls back down due to gravitation forces (Ayodeji *et al*., 2014). The tap sieve shaker sieves the sample via a horizontal circular movement superimposed by a vertical motion generated by a tapping pulse (Rajput, 2010). Air jet sieving involves the use of only one sieve in which the material on the sieve is moved by a rotating jet of air (Adebayo, 2014). In this work, a mechanical sieving machine that uses bevel gears to sieve sand grains is fabricated and tested for operational effectiveness and sand particle size analysis. The machine requires an input power source for its operation as it is not manually operated. It is proposed to be used for experimental research purposes in areas where power supply is not a problem.

Sand substance is one of the most important things in industrial world. Nowadays the industry needs the sand sub sand that are already been process known as sand product. As we know the sand sub sand are mixtures with variety other component such as dirt and metal.

As we know the way sand is been collected still used the conversional way such as sieving using hand or machine. And human energy is needed to run the process. So to make the process more efficient new technology is needed to help increase the productivity so the human power can be reduce and also can cut the cost of the process.

MATERIALS AND METHODOLOGY

Materials

The materials used for the fabrication of the sieving machine are mild steel sheets (galvanized), aluminum sheets, mild steel bars. Other materials used were mild steel wire mesh of different mesh sizes. These materials were chosen because of their excellent mechanical and physical properties such strength, ductility, machinability, weldability, availability, corrosion resistance, weight and affordability (Rajput, 2010; Adebayo, 2014).

In the design of this portable sieving machine, careful consideration was given to a number of factors such as strength of materials for the fabrication, moisture content of the materials, cost of the required materials, expected life span of the design, cost of maintenance of the design and availability of replaceable parts.

Sieving Machine Components

Components of the sieving machine are:

1. The frame

2. The sieving unit: comprising of a rectangular sieve and its corresponding chamber
3. The power unit: The power unit comprises of Bevel gears, Pulley, Belt, Electric motor
4. The hopper
5. Fasteners
6. Shafts
7. IR Sensor

Main frame: this is the main unit on which every other components of the machine are supported. It is fabricated with high strength material that will withstand vibration. The frame provides structural stability of the machine.

Hopper: The hopper is a funnel shape receptacle through which lumps of the mixture to be sieved is fed into the breaking unit through gravity.

Sieve chamber and sieve: It is a square trough of considerable depth that prevents spilling. Sieve on the other hand is formed and holes are drilled on it.

Pulleys: These are mechanical devices that are used to transmit motion/power from one shaft to another. The pulley is preferred for this purpose as the velocity ratio is the inverse ratio of the diameters of the driving and the driven pulleys.

Electric motor: The electric motor is used to convert electricity into mechanical energy, opposite to an electric generator. They operate using principles of electromagnetism.

Bevel gears: Bevel gears are used to transmit motion or power at constant ratio between two shafts whose axis intersect at an angle.

Shafts: Shafts are rotating machine elements used to transmit power from one place to another. The power is delivered to the shaft by some tangential force and the resultant torque or twisting moment set up in the shaft permits power to be transmitted to various machine parts linked to the shaft. Motor with the aid of a v-belt.

Bearing: Bearings are used in the machine to hold the shaft and rotating parts on the frame for rigidity and easy rotation

Fasteners: Fasteners are used to secure or fasten materials together. Fasteners are of different sizes depending on what's meant to be secured for example, u can't use a 10bolt size to secure materials that has great friction, it tends to worn out or break. There are many types of bolts and hardware nuts. Most, if not all, bolt types have machine threads. Screws are fasteners made of metal and characterized by a helical ridge. It is the most important part of almost every mechanical device with its main objective to hold different parts together.

Infrared Sensor

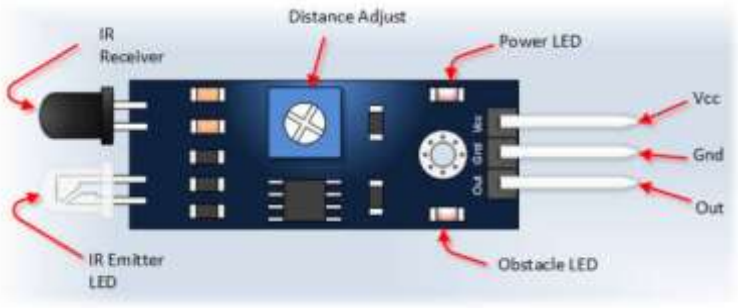

Figure 1: IR Sensor Module

IR sensor is a simple electronic device which emits and detects IR radiation in order to find out certain objects/obstacles in its range. Some of its features are heat and motion sensing.

Infrared sensor is most used sensor in wireless technology where remote controlling functions and detection of surrounding objects/ obstacles are involved.

IR sensors use infrared radiation of wavelength between 0.75 to 1000μm which falls between visible and microwave regions of electromagnetic spectrum. IR region is not visible to human eyes. Infrared spectrum is categorized into three regions based on its wavelength i.e. Near Infrared, Mid Infrared, Far Infrared.

Working Principle of Infrared Sensor

Infrared Sensors works on three fundamental Physics laws:

- Planck's Radiation Law: Any object whose temperature is not equal to absolute Zero (0 Kelvin) emits radiation.
- Stephan Boltzmann Law: The total energy emitted at all wavelengths by a black body is related to the absolute temperature.
- Wein's Displacement Law: Objects of different temperature emit spectra that peak at different wavelengths that is inversely proportional to Temperature.

Methodology of Machine Elements Design

The design of each component is done using software called AUTOCAD which offers complete tools needed for engineering design, the three-dimensional model of each component is designed at first and then all the parts are assembled to bring out the outlook of the final product. The time dedicated for this project is utilized for the modeling and analysis. The components of the machine are designed by the team using their knowledge on the courses taught over the years which include, Design of Machine Elements, Theory of Machines, Mechanical Vibrations, Engineering drawing and CAD. Below are the designs of the components.

The frame

The frame is to carry the entire weight of the assembly. Based on the design considerations, mild steel was selected for the component due to the following factors considered in selecting suitable material; availability, weight, strength, ductility, wear and corrosion resistance.

In this design the frame was designed with a 2mm angle iron because it carries the weight of every other component of the sieving machine. The angle iron was held together by welding for strong joints. The frame size is 500 x410x710mm.

The total significant weight carried by the frame includes:

- Weight of the shaft
- Weight of the electric motor
- Weight of the outlet
- Weight of the lump breaker and its chamber
- Weight of the sieve and its unit

Figure 2: The frame

The outlet

The base plate is made of mild steel of 1mm thickness. The size of the outlet is 360mmx260mm.

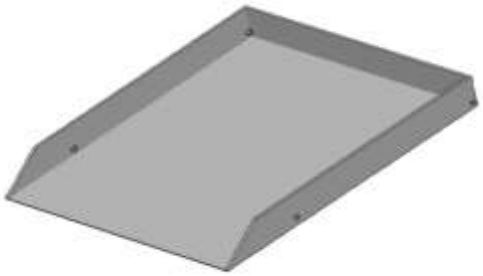

Figure 3: The outlet

The hopper

The hopper is designed to be fed in a vertical position only. The material used for the construction is a 1mm steel sheet metal (galvanized) which is readily available in the market and relatively affordable.

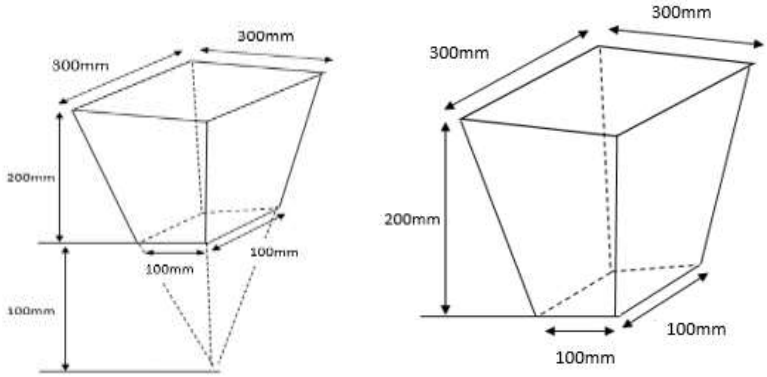

Figure 4: Hopper calculation

$$\text{Volume} = \frac{1}{3} \text{ x area of top base x full height} - \frac{1}{3} \text{ x area of bottom base x height of frustrum} \quad (1)$$

Top width = 300mm = 0.3m
Top length = 300mm= 0.3m
Bottom width = 100mm = 0.1m
Bottom length = 100mm = 0.1m
Full height = 300mm = 0.3m
Height of frustrum = 200mm = 0.2m

$$\text{Volume} = \frac{1}{3} \text{ x } 0.3 \text{ x } 0.3 \text{ x } 0.3 - \frac{1}{3} \text{ x } 0.1 \text{ x } 0.1 \text{ x } 0.1$$

Volume = 0.008677 m^3

Given that density of flour can be approximately 600kg/m^3,

Then the Mass of Flour that can be taken by the Hopper is given as:

m = 600 x 0.008677 = 5.2 kg per cycle.

Giving the hopper sieving time and some clearance, then an estimated mass of 4kg flour can per sieved per turn.

The Power Transmission

The pulley and V-belt were chosen for the transmission of power from the motor to the other moving parts. This is because this transmission system gives compactness, is easy to install with negligible slip. Most importantly, the belt and pulley produce a high velocity ratio. The diameter of the driver pulley, D_A, thickness of belt, T, input speed, N_A, output speed, N_B, diameter driver pulley, D_A, and service factor are essential parameters in power transmission calculation.

Pulley and Belt Design

The motor and shaft of the machine is linked by a drive system consisting of two circular pulleys of different diameters, connected together by means of a flexible belt that has a desired tension when mounted on the two pulleys. The essence of this union is majorly to transmit power from the engine to the shaft at constant cyclic motion.

Machine Efficiency

Power of motor =750W = 0.750kw

Power for one hour =750Whr = 0.750kwhr

Unit consumption for 1hr = 0.750 unit

Supposed we use it for 5hrs per day on average. The consumption for one month =0.750 × 5×30 = 112.5 unit.

Approximate price of 1-unit electricity costs about #1000unit, so

Total expense for 1month = 1000×112.5= #112,500

Electric Motor

The electric motor is the main component used to generate the power that will be transmitted to the shafts for operations using the belt and pulley system. The rating however, will be determined by calculation results.

Determination of Power Delivered by the Machine

The power delivered by the electric motor to the machine is calculated

- Torque calculation

To calculate the power generated by the motor to operate the machine torque is calculated,

Diameter = 75mm

No. of revolution (N) = 1150 rpm

Power= 1hp=0.75 W

Force (F) = m ×r×ω^2 (m w² *I*)

Where m be the total mass of rotation chamber

m= 8kg

$$\omega = 2\pi N/60 \quad (2)$$

= 2×3.14 × 1150/60 = 120.366 rad/sec

Torque (given by motor) =power/ω = 750w/120.366 = Nm= 6.231N/m

- Speed of Motor

$$\text{Speed of the driven} = \frac{N_1}{N} = \frac{d}{d_1} \quad (3)$$

d_1 = Diameter Of driver (motor) = 75mm = 0.75m

N_1 = Speed Of the driver (Rpm)

N = Speed Of the driven= 149.2 Rpm

d = Diameter Of the driven pulley = 135mm =0.135m

$$N_1 = \frac{Nd}{d_1} = \frac{149.2 \text{ x } 0.135}{0.75} = 59.68\text{rpm}$$

- Power Calculation

$$P = \text{Force} \times \text{velocity} \quad (4)$$

$$\text{Force} = \text{Weight} = \text{Mass} \times \text{Acceleration due to gravity} \quad (5)$$

g is approximately 10 m/s^2 ~ 9.81 m/s^2
So, P = 500kg×10m/s^2× velocity
Let velocity = 1.5 m/s
P=50kg × 10m/s^2 × 1.25m/s = 750w
So, we need nearly (750w) 1hp of motor

Figure 5: The electric motor

RESULTS AND DISCUSSION

The readings for the power of consumption of the improved sieving machine and the conventional sieving machine are taken and carried out in modelling and simulation environment as depicted in Figure 6.

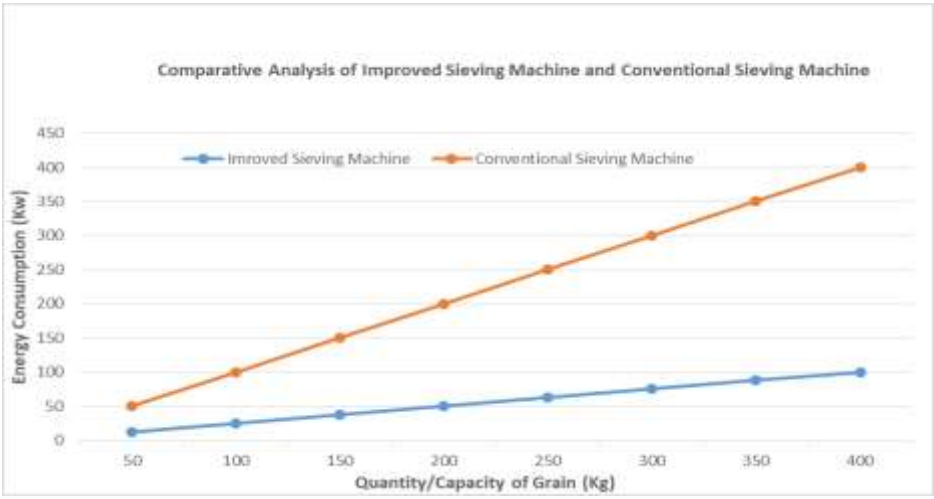

Figure 6: Comparison of Sieving Machines

Looking at Figure 6 it can be deduced that the improved sieving machine will consumed less power of consumption while the conventional sieving machine will consume more power for a particular quantity of grains to be sieved. This is because the improved sieving machine has incorporated sensors that automatically switch on if it detects the presence of item for sieving and switches of in the absence of any item in the sieving machine. Hence, the improved Sieving machine can sieve large capacity of grain with lesser power of consumption, thereby saving much unit of electricity. This makes it cost efficient.

Results

- The modification of electrically powered sieve machine was achieved
- Locally Fabricated Electrically powered sieve machine was achieved
- Low cost universal sieve was fabricated and automated
- Optimum agronomical sieve machine was achieved.
- Lesser energy of consumption was achieved

Testing

The design calculations were employed in the fabrication of the machine. The machine was tested to ascertain the integrity and functionality of the device. The test was carried out with a 220 V single phase induction motor using a stop clock to determine the extracting time.

Table 1: Sieving Test results

S/N	Input Time (sec)	Output Time (sec)	Input Quantity (kg)	Output Quantity (kg)	Output Quantity from the breaking chamber	Output Quantity from the sieving chamber
1	10	5	0.380	0.440	0.110	0.330
2	20	10	0.480	0.720	0.260	0.460
3	40	20	0.480	0.740	0.270	0.470
4	60	40	0.880	1.020	0.310	0.710
5	50	30	0.680	0.760	0.280	0.480

The test result is ascertained by: first, feeding through the hopper at a determined time a particular quantity of a material (sand and flour) where the lump breaker works on them before sieving and at the same time feeding through the sieving chamber without encountering the lump breaker. The quantity of the product recovered is recorded.

Discussion

The Sieve machine is used in unit operation for separation of solid particles of different sizes, by passage of most of the solid particles through a mesh which retains most of the solid particles as oversized. The classification of particle fractions into sizes is affected by retaining high range of sizes while allowing the passage of low ranges through the sieve openings to the other side. Those particles that are retained at the surface of the sieve are larger than the sieve openings and therefore called the oversize or residues. While the undersize or fines are smaller than the sieve opening. From the analysis, it then implies that the sole function of a sieve is to separate any material feed into two fractions – undersize and oversize.

The construction of this project involves the following stages: development of solid works using CAD, marking, punching, cutting and smoothing, plaining, drilling were identified and solved also those are the capacity of the lump breaking chamber, size of the sieve and its unit, and the type of material used for the construction, was based on the study gotten from material selection, calculations and design considerations. Other problems such as the rate of passage of the solid, grain size, sieve sizes, method of cleaning and operation were also considered and solved simultaneously.

CONCLUSION

The aim of this study is to modify an already existing sieving machine through automation with ergonomic considerations for the sieving of two mixtures separation. The body, frame and parts of the sieving machine were designed with the aid of computer aided design software and are made up of about 70% locally sourced materials, and the fabrication and assembly of the machine was done using the sourced materials and sub-assemblies. Also necessary calculations were made based on the team's knowledge of design courses, strength of materials, material selection and vibration analysis. It is expected that the machine performs the separation of two mixtures at a time with maximum quantity of 5kg approximately considering the machine capacity; various sizes of the sieve can be used because of the detachability of the sieve.

Overall, the improved sieving machine can sieve large capacity of grain with lesser power of consumption, thereby saving much unit of electricity. This makes it cost efficient operating sieving machine.

REFERENCES

Abubakar, M., Abubaker, B.H., Kastina, C. B., & Abdulkarim (2015). Seiving Machine for Dewatered Grated Cassava. *American J. Eng. Research, 4*(2), 146-152.

Adzimah, S. K., & Seckley, E. (2009). Modification in the design of an already existing palm nut-fibre separator. *African Journal of Environmental Science and Technology, 3*(11), 387-398.

Ankit, J. D., Akash, B. C., & Haresh R. G. (2018). Design and Development of Raspador Machine. *International Journal of Scientific Research and Review, 7*(7), 2279-2543.

Ayodeji, S.P., Olabanji, O.M., & Akinnuli, B.O. (2014). Development of Performance Evaluation of a Sieving Machine for Pound Yam Process Plant. *J. Emerginal Trends in Engr. And Appl. SC., 5*(4), 229-236.

Bhandari, V. B. (2010). *Design of Machine Elements* (3rd ed.). The McGraw-Hill companies. New Delhi, India.

British Project Management Academy (2015). *Professional Study Guide in Project Management*. 2015 Edition, Wolverhampton Square, England.

Christopher, J. & Robinson, P.E. (2014). Mechanical Shaker; Time and Sieving Efficiency, Deformations. Retrieved April 10, 2017, from https://www.cmec.accreditation. com/wp-content

Chupil, W, S. & Basal, F. (2014). A rotary sieve method for determining the size distribution of soil particles. *Soil Sci., 56*, 95-100.

Credentials, T. O. F. (2010). Landfills, Project, Dept of Mech Engr, University of Ilorin, Ilorin. 165–168.

Dathak, S. Kathmandu University (Nd). https://www.research.net/publication/ 349477063

Finnie, S., & Atwell, A.W. (2016). *Wheat and Flour Testing* (2nd ed.). AACC International, Inc., 63. Retrieved October 16, 2021, from bakerpedia.com

Gopal, R, & Rao, A.S.R (2000). *Basic and Applied Soil Mechanics* (rev., 2nd ed.). New Delhi, India.

Hagen, L. J., Skidmore, E. L., & Fryrear, D. W. (1987). Using two sieves to characterize dry soil aggregate size distribution. *Transactions of the ASAE, 30*(1), 162-0165.

Keslun, L. (2009). Some Factors Affecting Sieving Performance and Efficiency. *American J. Powder Tech., 193*, 208-213.

Khurmi, S., & Gupta, J. (2005). *A Textbook of Machine Design* (1st multicolour ed.). Eurasia Publishing House (PVT). New Delhi, India.

Ngabea, S. A., Okonkwo, W. I., & Liberty, J. T. (2015). Design, fabrication and performance evaluation of a magnetic sieve grinding machine. *Global Journal of Engineering Science and Researches (GJESR), 2*(8), 65-72.

Nwosu, M.C, & Co. (2020). *Design and fabrication of sieving machine*. Industrial and Production Engineering Department Nnamdi Azikiwe University Awka.

Oladeji, A.O. (2012). Design, construction and testing of the dry sand sieving Machine. *J. Apple. Sci and Environmental Management, 16*(3), 241-243.

Rajput, R.K. (2010). *Material Selection in Engineering*. Ketaria and Sons Publishing Co. ltd, New Delhi.

Rotary Garden Sieve (2021). Retrieved March 11, 2021, from https://cdn.manomano7022744-2jpg

Scott, B. & Tim, H. (2015). *Evaluating Particles Size*. Retrieved April 10, 2021, from www.citeseerx.ist.psu.edu

Shrestha, K. P., Parajuli, P., Baral, B., & Shrestha, B. P. (2017). Mathematical modeling, simulation and analysis of rice grain movement for design and fabrication of low-cost winnowing machine. *Journal of Mechanical Engineering Research*, *9*(1), 1-14.

Smith, G.N. (1990). *Elements of Mechanics* (6th ed.). Blackwell Series, London.

Simolowo, O. E., & Adeniji, O. O. (2011). Prototype design and performance analysis of a sieving machine for improved food-slurry processing in Nigeria. *Indian Journal of science and technology*, *4*(12), 1639-1643.

Trad. Method of Sand Sieving. Retrieved March 10, 2021, from https://www.ekshisha.org.in/chapter/77/images-of-separation-of-substances-VI/8.png.

Ujam, A.J. & Enebe, K.O. (2013). Experimental Analysis of particle Size Distribution Using Electromagnetic Sieve. *American J. Eng. Research*, *2*(10), 77-85.

Yusof, Y., Yahya, S. A., & Adam, A. (2015). Novel Technology for Sustainable Pineapple Leaf Fibers Productions. *Procedia CIRP*, *26*, 756–760.