International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 05 | May 2024 www.irjet.net p-ISSN: 2395-0072

DEVELOPMENT OF ADVANCED TWO-WAY AUTOMATIC SAND FILTERATION SYSTEM

VIRAJ DUSANE 1., YASH DHAGWALE 2., GAURAV GAIKWAD 3, SHUBHAM HAVALE 4., VAIBHAV DORKAR 5., DR. VIDYA SARAF 6,

[1]Final year Civil Engineering student at Government College of Engineering Jalgaon affiliated to KBCNMU,
[2] Final year Civil Engineering student at Government College of Engineering Jalgaon affiliated to KBCNMU,
3 Final year Civil Engineering student at Government College of Engineering Jalgaon affiliated to KBCNMU,
4 Final year Civil Engineering student at Government College of Engineering Jalgaon affiliated to KBCNMU,
5 Final year Civil Engineering student at Government College of Engineering Jalgaon affiliated to KBCNMU,
[6]Example: Assistant Professor, Dept. of Civil Engineering, Government college of Engineering Jalgaon, Maharashtra, India

---

Abstract - *Sand is an important commodity for construction activity. It is available naturally in the river or ocean area. The sand we get from natural resources is not in the form to utilize for construction activities. Sand needs to filter from unwanted material and gravels, sieving process also converts sand into the required particle size. After achieving a specific size of sand, it gets helpful in construction activities. There are ways to filter sand, commonly used method is manual filtration through a filtration net, it is a labor-intensive technique hence the need to replace it with automated sand filtration for less requirement of manpower and speed production. We can see various automated sand filtration in the market. The automated sand Filtration available market is of different types but the most common is a one-way horizontal sand filtration machine. The horizontal sand filtration generally uses a slider-crank mechanism to translate mesh. So, we come up with up gradation in this machine by facilitating the user to add one more mesh to the existing setup for filtering more sand and to increase its better work transfer to the mesh by using the scotch yoke mechanism.*

Key Words: [Sand, properties, Separation, Mechanism, Construction]

1.INTRODUCTION

Automatic filtration of sand reduces labor efforts due to the automatic sieving of the sand. It would increase overall sieving productivity and reduce the time of sieving. Innovation is happening continuously better methods are accepted for better quality and reduced cost. There are many types of automated sand filtration machines available in the market like one-way horizontal sand filtration, rotary type sand filtration, vibrating separator machine, etc. Each type has its own advantages and disadvantages, but among this one way, sand filtration is widely used.

The one-way sand filtration is generally the most used type of automatic sand filtration machine. Innovation is happening continuously better methods are accepted for better quality and reduced cost. The one-way horizontal sand filtration available in the market has generally used a slider- crank mechanism if we replace it with a scotch yoke mechanism it provides better work transfer to the mesh. The use of the scotch Yoke mechanism facilitates the user to add one more mesh so

The mechanism used has the following benefits:

1. Mechanism can be used to convert one-way sand filtration to two ways.

2. Mechanism provides a better alternative to the slider-crank mechanism.

3. It delivers power to mesh more than the slider-crank mechanism.

1.1 Systematic Approach of the Scotch Yoke Mechanism: -

1. A scotch yoke mechanism is one that translates rotary to linear movement or vice versa, by using a pin moving in a slot.

2. A slider-crank is a mechanism is one which translates linearly to rotary movement using an oscillating link or con-rod.

3. The fork mechanism creates simple harmonic vibrations like sin waves. Since velocity and acceleration are the results of the change-time curve, these graphs also have excellent patterns.

4. The motion made by the slider-crank mechanism is a slight distortion of the perfectly simple harmonic oscillation. This is because when the connecting rods are angled, the axially measured distance decreases.

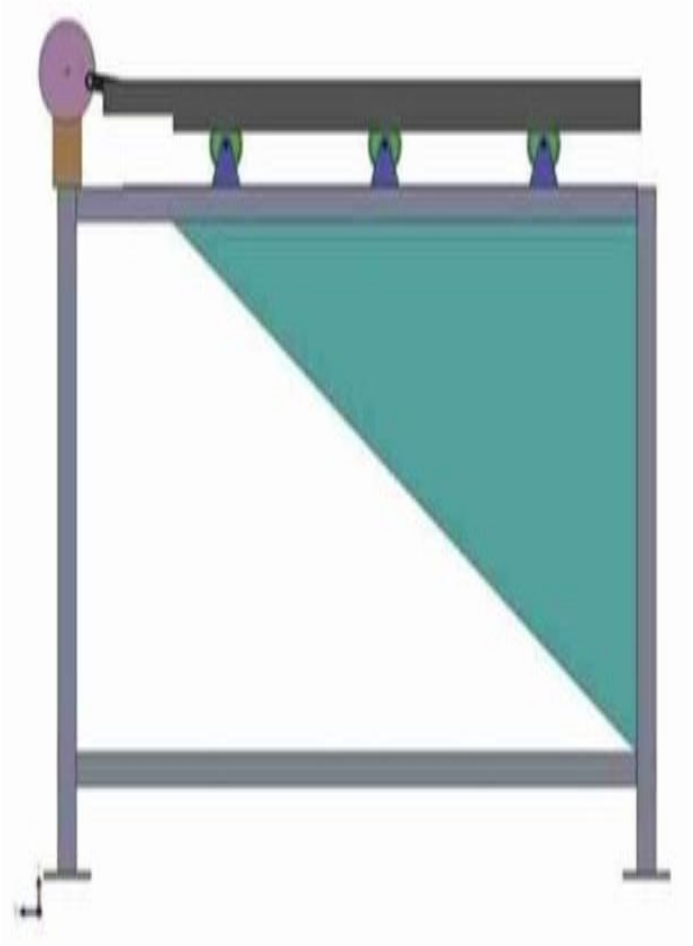

Figure 1: One Way Sand Filter

Figure 2: Two Way Sand Filter

Two sand separation machine works on the principle of the Scotch yoke mechanism. This scotch yoke mechanism coverts the rotation motion of the shaft into for means of horizontal rotational. There are various benefits of this sand filtration techniques, such as due to use of this technique it not only saves the efforts but also it saves the time, it's also reducing the dependencies of the skilled labor.

1.2 Innovative strategies in filtration: -

The shaft of the DC motor is connected to the disc when power is on the motor will start and the shaft starts rotating due to the rotation of the haft the circular dick also starts rotating, in this dick, the slot is provided for the pin, this slot is connected to two external arms called as yoke in the horizontal direction. When the disk starts rotating then meshes are also started sliding in the horizontal direction these meshes are placed on rollers which are placed on rectangular boxes. Now the sand is placed on both meshes, due to the sliding motion of meshes the sand separation starts in the machine, this filtered sand comes down through the mesh which is collected at bottom of sliding boxes, And the high-grade sand particle which still remains on meshes now we remove this high grad sand particle and further drop new sand for filtration. In this way, our two- way automatic sand separation machine works in an effective manner and filtered a double amount of sand compared to the one-way

2. Scotch Yoke Mechanism

The scotch yoke mechanism is a reciprocating machine mechanism converting the linear motion of slider into rotational or vice versa. The piston or other reciprocating part is directly coupled to a sliding yoke with a slot that engages a pin on the rotating part. The scotch yoke mechanism is considered to be a more efficient means of producing the rotational motion as it spends more time at the high point of its rotation than a piston & it has fewer parts.

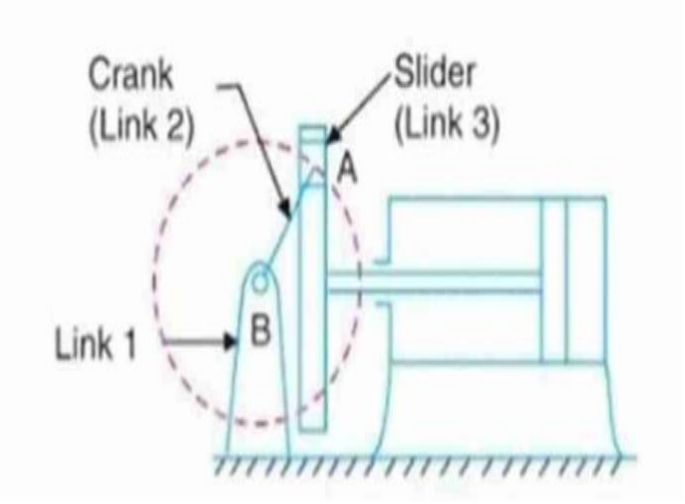

Figure 3: Scotch Yoke Mechanism

2.1 Working of Scotch Yoke Mechanism:

The Scotch Yoke mechanism is a simplest type of mechanism which converts circular motion into reciprocating motion as discussed in the construction part above. The power is supplied to the. A DC motor, spindle and crank are connected to the shaft to start rotation. As the crank turns, the pin slides into the yoke and moves the yoke forward. As the crank turns clockwise, the yoke will move forward

The maximum displacement will be equal to the length of the crank. The yoke returns to its original position when the crank completes its next rotation. On the next turn the yoke moves backwards. The yoke returns to its original position when the crank completes one full rotation. For one complete revolution of the crank, the yoke moves a length equal to twice the length of the crank. The change in magnetic field can be controlled by changing the length of the crack.

Figure 4: Mounting Of Mechanism

2.2Mounting Of Mechanism

The main parts of the scotch yoke mechanism include

L Circular Disk

II. Fixed link

Sliding pin

IV. Sliding yoke

V. Connecting rod

2.3 Arrangement of Mechanism in Machine: -

The disk is the base of the machine and is connected to the Johnson engine using a fixed linkage. @@mm drilling was done on the back of the disc. The sliding pin is fixed to the sliding yoke; The movement of the pin transmits motion to the sliding shaft. The sliding yoke is connected to a grid that transmits the movement

Assume block of mass 'M' on the surface applied with oblique push force 'F' which is same as force applied by connecting rod in slider crank to mesh.

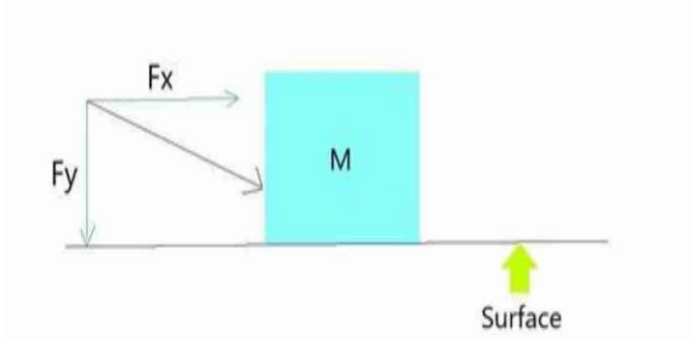

Figure 5: Forces on Mesh Slider Crane Mechanism

After separating force F into vertical and horizontal directions, we obtain the force Fx as the horizontal component of force F and the force Fy as the vertical component of force F.

Advantages: -

1) Automatic sand filtration can be done using sand filters and separators.

2) It can filter large sands.

3) Easy to use

4) Compared to manual sand saw, automatic sand saw requires less energy.

5) It is easy to use.

6) Time-saving equipment.

7) Size The number of particles in the sand filter can be changed as necessary by adjusting the mesh to the desired mesh size.

8) No skilled workers, workers who are unable to operate easily, should operate the machine.

9) Working change for scanning is better than using crank.

10) If it is determined that the sand can be improved, it can be improved if necessary.

2.4 Model Details

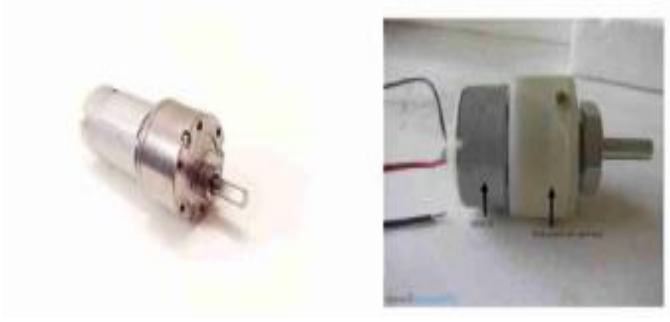

Figure 6: 12 v dc motor (Johnson motor)

The cap that accommodates the gear has an arc cut from its side to avoid frictional resistance forces with the bottom gear assembly:

Table:1 Tolls and Equipment

Sr NO	Operations	Tools/Equipment used
1	Measuring	Steel rule, measuring tape, tri-square, protractor
2	Marking Out	Scriber and punch
3	Drilling	Drilling Machine And Hand machine
4	Sawing and cutting	Electric saw, hacksaw, shears/snip
5	Filing	Files
6	Threading	Set of taps and dies
7	Grinding	Grinding Machine
8	Bending	Bending Machine, hammers, and pliers
9	Welding	Electric arc and gas welding equipment
10	Machining	Lathe Machine
11	Cleaning	Emery paper and wire brush
12	Spraying	Spraying equipment (Spraying gun and compressor)
13	Assembly	Spanners, screwdrivers, and pliers.
14	Holding	Bench vices

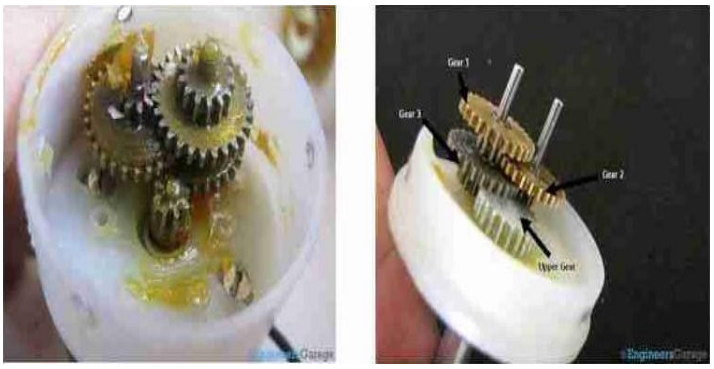

Figure7: Internal gearing of 12 v dc motor

The DC motor works over a fair range of voltage. The higher the input voltage more is the RPM (rotations per minute) of the motor. For example, if the motor works in the range of 612V, it will have the least RPM at 6V and maximum at 12 V.

2.5 Specification

Dimensions

A) Dimension of Supporting Structure:

Dimensions of supporting structure get fixed according to the size we want for the project.

Hence dimension of the supporting structure is:

Length (outer) = 12 lcm Breadth (outer) = 12 lcm

Height = 45cm

Length (inner) 112.4cm

Breadth (outer) 112.4cm

B) Dimension of mesh:

Mesh should fit inside the structure hence mesh should be less than and equal to each side of the structure dimensions.

Dimension for keeping mesh for each structure is:

Length (outer) = 45cm Breadth (outer) = 33cm

Length (inner) = 40.4cm

Breadth (outer) = 27.4cm

C) Dimensions of mechanism and motor mounting

Length = 15.3cm

Breadth = 3.5cm

D) Mechanism Dimensions

l. Circular crank disc

Diameter Of disk = 14.2cm

Thickness of disk = 0.5cm

2. Sliding Yoke

Height (total yoke) = 16.8cm Length (total yoke) 3.9cm Height = 45cm

Length (inner) 112.4cm

Breadth (outer) 112.4cm

Dimension of mesh:

Mesh should fit inside the structure hence mesh should be less than and equal to each side of the structure dimensions.

Dimension for keeping mesh for each structure is:

Length (outer) = 45cm Breadth (outer) = 33cm

Length (inner) = 40.4cm

Breadth (outer) = 27.4cm

Dimensions of mechanism and motor mounting

Length = 15.3cm

Breadth = 3.5cm

Mechanism Dimensions

l. Circular crank disc

Diameter Of disk = 14.2cm

Thickness of disk = 0.5cm

2. Sliding Yoke

Height (total yoke) = 16.8cm Length (total yoke) 3.9cm

3, Connecting rod

Length— 13.3cm

Specification of Motor RPM of the Motor = 45rpm

Voltage of the Motor = 12V DC Torque of the motor = 196N-mm mm

Figure:8 12 RT1245 battery

Table: 2 Table of Component

Sr No.	Component	Material selected	Reason(s) for Selection
1	Frame	Mild steel	high wear resistance, high strength, good rigidity.
2	Speed reducer Shaft	Carbon steel	high strength, good machinability, heat treatment properties, high wear resistance properties.
3	Sliding Yoke	Acrylic Material	Highly transparent, highly impact resistant, easy to clean and polish, high durability, light and easy to ort, more scratch resistant.
4	Plywood	Wood	high strength and stability, high resistance to impact, flexibility in size, shape, thickness.
5	Clamp	Mild steel	High wear resistance, high strength, rigidity.
6	Bolts and nuts	Stainless steel	high resistance to corrosion
7	Control switch	Plastic	ow cost and light weight, good insulating property.
8	Mesh	Stainless steel	High resistance to corrosion.

4. Future Scope:

Π Rice Threshing can be automated

Π Winnowing can be done by making automated sand filtration machine.

Π Corn Shelling and peanut shelling can be done with help of this setup.

Automated Baby cradle can be made by using same mechanism and concept.

Π Operating a Circular Saw

Π Water Pumping from a Shallow Well

Π Operating a Wood Working Lathe

Π for the larger demand horizontal sand separator is most efficient as its efficiency reduced as the amount of sand reduced and sand separators are used in small scale and mobile work, one way sand filtration technique available in market but requirement and advantages of two-way advanced sand filter is more in practical life.

5. Conclusions

A complex biogas production and utilization system was created by developing experimental biogas variants, and in such a way both the energy and the environmental goals can be achieved together, as the applied variants can provide favorable conditions for the production and the utilization of biogas. The methane content of biogas satisfies the conditions of utilization so that the heat engines can operate properly. Simultaneously, waste disposal can also be realized. In the interest of a near optimal solution, it is necessary to analyze the production and utilization functions together, considering that the principle of the complex optimization focuses just on the environmental-friendly energy utilization. Thus, if the quantity and/or quality of the input material necessary for developing variants cannot be provided, the energy output can decrease and waste disposal can be overshadowed too.

ACKNOWLEDGEMENT

This work was supported by Government College of Engineering Jalgaon and Civil Engineering Department and our guide Dr Vidya Saraf.

REFERENCES

[1] Review of Multi-level Sand screening Machin and Analysis of "Vibration mechanism “Swapnil Bandgarl, Dnyaneshwar Chate2, Vijay Dongare3, Dipak Mirpagar Vol-4 Issue-3 2018 IJARIIE-ISSN(O)-2395-4396

[2] "Traditional method of sand sieving." [Online].

Available: https://www.ekshiksha.org.in/chapter/77/images_of_Separation_of_substances VI/8.pn g. [Accessed: 10-Mar-2020]

[3] Design and Fabrication of Automatically Driven Sand Sieving Machine. R. Gajbhiyel Prashant Gawalkar2 Rahul Pache3 Rupesh Khode4 Vicky Chap l Vol. 7, Issue 01, 2019 | ISSN (online): 2321-0613

[4] Design and Fabrication of Inclined Trommel Automatic Sand Sieve Machine Sunil Chavhan1, Dilip Bhagat2, Ashwin Patil3, Pallavi Bisne4, Pratiksha shakhare5, Prof. Nehal Jadhao volume: 07 Issue: 05 May 2020 fabrication of sieving". V.P. Duriraj 2, J. Manikandan.

[5] Bureau of Indian standards IS: 383-1970, "Specification for coarse and fine aggregates from natural sources for concrete

[6] Design and Fabrication of Sand Sieving and Cement Mixing Machine Sai Karthik

[7] Design, Construction and Testing of a Dry Sand Sieving Machine, Oladeji Akanni Ogunwole Journal of Multidisciplinary Science & Technology Volume: 01 Issue: 03 | July -2016

[8] Design and Fabrication of Horizontal Sieving Machine, Nachimuthu A.K et International Research Journal of Multidisciplinary Science & Technology Volume: 01 Issue: 03 | July -2016

Nemcsics, Á.: Technical Ecology (A műszaki ökológia), Természetbúvár, Hungary, Vol. 1 (2003) p. 37

[9] Braun, R: Biogas-Methangärung organischer Abfallstoffe, Springer Wien (1982)