

DESIGN AND DEVELOPMENT OF SOLAR BASED AUTOMATIC DRAINAGE CLEANING SYSTEM

¹Shaikh Nasir Sabdar, ²Patil Vishvajeet Kalyan, ³Shaikh Sahil Lala, ⁴Sirsat Vaibhav Bhausahab, ⁵Amrutkar Kiran Bhagwan

¹Student, ² Student, ³Student, ⁴Student, ⁵Student

^{1, 2,3,4,5} Department of Mechanical Engineering,

^{1, 2,3,4,5} G.H Raisonni college of engineering and management, Chas, Ahmednagar, India

Abstract: Water is the basic need for the existence of life on earth. In spite of 70% water on earth majority of water is not suitable for drinking purpose. There is a huge demand of clean water as it is used for a variety of purpose such as drinking, bathing, cleaning, cooking etc. Impurities present in water can cause serious health issues that can damage the life of human beings. The chief function of the automatic drainage system is to collect, transport, as well as dispose the solid waste in the waste bucket by the help of claws. Solid waste in drainage water contains garbage, sludge empty, bottles, plastic carry bags, papers etc. these Impurities in drainage water can lead to blockage of the drainage system. This project automatically cleans the water in the drainage system each time any impurity comes near the drainage system claws grasping the solid waste which is driven by the chain sprocket and throwing into the waste bucket to keep away from blockage. It even reduces the cost of manual labour as well as reduces the threat to human life. In the proposed concept is to replace the manual work in drainage cleaning by automated system. Drainage pipes are using for the disposal but in some cases due to clotting or blocking of waste need to clean the pipes of drainage every time To overcome this problem and to save human life. The device is placed across drain so that only water flow through lower grids. Waste like bottle, etc. Floating waste in drain is lifted by teeth which are connected to chain. This chain of the sprocket is connected by gears driven by motor. The energy provided to motor by solar panel in which photovoltaic cell connected to motor. When motor runs the chain starts to circulate making teeth to lift up. The waste materials are lifted by teeth lies on the bucket and are stored in waste storage tank.

Keywords- waste management, disposal cleaning, solar panel

1. INTRODUCTION

Now a day's necessity cleaning of drainage is increasing so we need to make it advance i.e. Automatic drainage water cleaning and control system using auto mechanism which is proposed to overcome the real time problems like blockage of solid waste. Clean water is more important if it is used for domestic or any other purpose. The impurities present in water can cause hazardous and disease. As long as the draining system is considered the function of the main drainage system is to collect, transport and dispose of the water through an outfall or outlet. Impurities in drainage water can be only like empty bottles, polythene (plastic) bags, waste paper etc. These impurities present in drainage water can cause blockage or the drainage system. The drainage system can be cleaned time to time manually or such a system can be designed that will automatically throw out wastages and will keep the water clean. Main moto of this project is developed to keep clean the drainage system and helps the smooth working of the system cleans the water in the drainage system each time any wastage appears and this form an efficient and easy way of cleaning the drainage system and preventing the blockage. It also reduces labour and improves the quality of water that is cleaned. In this system we used motor, chain, driver, bucket, and frame. Second Important thing is waste management system by which worker can maintain all his health and work good through application maintain that reporting worker don't need to wait and get in to drainage. One more very useful and important advantage of our system is that the worker to replace the manual work in drainage cleaning by semi mechanical drain cleaner. And can access them very easily

2. DESCRIPTION OF COMPONENTS

2.1 DC Motor

.A DC motor in simple words is a device that converts electrical energy (direct current system) into mechanical energy. If a current carrying conductor is placed in a magnetic field perpendicular, after the conductor experience a force in the direction mutually perpendicular to both the direction of field and the current carrying conductor, DC motor working on Fleming's left hand rule. The DC or direct current motor works on the principal, when a current carrying conductor is placed in a magnetic field, If the direction of current in the wire is reversed, the direction of rotation also reverses. When magnetic field and electric field interact they produce a mechanical force, and based on that the working principle of DC motor is established.



Fig.no.1 D.C Motor

2.2 Sprockets

A sprocket or sprocket-wheel is a profiled wheel with teeth, cogs, or even sprockets that mesh with a chain (or) indented material. The sprocket wheel engage a chain and run over it. Sprockets are used in bicycles, motorcycles, cars, tracked vehicles, and other machinery either to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track, tape etc. Perhaps the most common form of sprocket may be found in the bicycle, in which the pedal shaft carries a large sprocket-wheel, which drives a chain, which, in turn, drives a small sprocket on the axle of the rear wheel . Early automobiles were also largely driven by sprocket and chain mechanism, a practice largely copied from bicycles.They can be run at high speed and some forms of chain are so constructed as to be noiseless even at high speed



Fig.no.2 sprocket mechanism

2.3 Roller Chain

Roller chain is the type of chain drive most commonly used for transmission of mechanical power on many kinds of domestic, industrial and agricultural machinery, including conveyors, wire- and tube-drawing machines, printing presses, cars, motorcycles, and bicycles. It consists of a series of short cylindrical rollers held together by side links. It is driven by a toothed wheel called a sprocket. It is a simple, reliable, and efficient^[1] means of power transmission.The roller chain design reduces friction compared to simpler designs, resulting in higher efficiency and less wear. The original power transmission chain varieties lacked rollers and bushings, with both the inner and outer plates held by pins which directly contacted the sprocket teeth.



Fig.no.3 roller chain

2.4 Chain Drive

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. Most often, the power is conveyed by a roller chain, known as the drive chain or transmission chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force into the system. Another type of drive chain is the Morse chain, invented by the Morse Chain Company of Ithaca, New York, United States. This has inverted teeth.

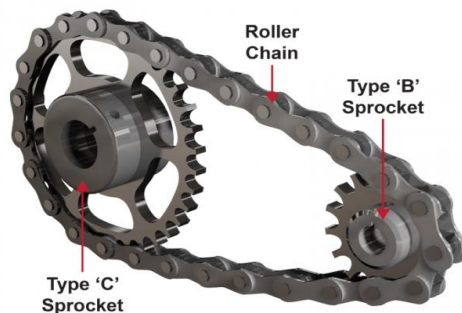


Fig. no.4 chain drive

2.5 Bearings

A **bearing** is a device to permit fixed direction motion between two parts, typically rotation or linear movement. Bearings may be classified broadly according to the motions they allow and according to their principle of operation. The most common of the many types are plain bearings, roller bearings. A **bearing** is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may *prevent* a motion by controlling the vectors of normal forces that bear on the moving parts. Most bearings facilitate the desired motion by minimizing friction. Rotary bearings hold rotating components such as shafts or axles within mechanical systems, and transfer axial and radial loads from the source of the load to the structure supporting it.



Fig. no.5 bearing

2.6 Battery

Batteries convert chemical energy directly to electrical energy. A battery consists of some number of voltaic cells. Each cell consists of two half-cells connected in series by a conductive electrolyte containing *anions* and *cations*. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work



Fig.no.6 battery

2.7 Solar Panel

Solar panels are those devices which are used to absorb the sun's rays and convert them into electricity or heat. A solar panel is actually a collection of solar (or photovoltaic) cells, which can be used to generate electricity through photovoltaic effect. These cells are arranged in a grid-like pattern on the surface of solar panels. Most solar panels are made up using crystalline silicon solar cells. These days, solar panels are used in wide-ranging electronic equipments like calculators, which work as long as sunlight is available. However, the only major drawback of solar panels is that they are quite costly. Also, solar panels are installed outdoors as they need sunlight to get charged



Fig.no.7 solar panel

3. WORKING PRINCIPAL

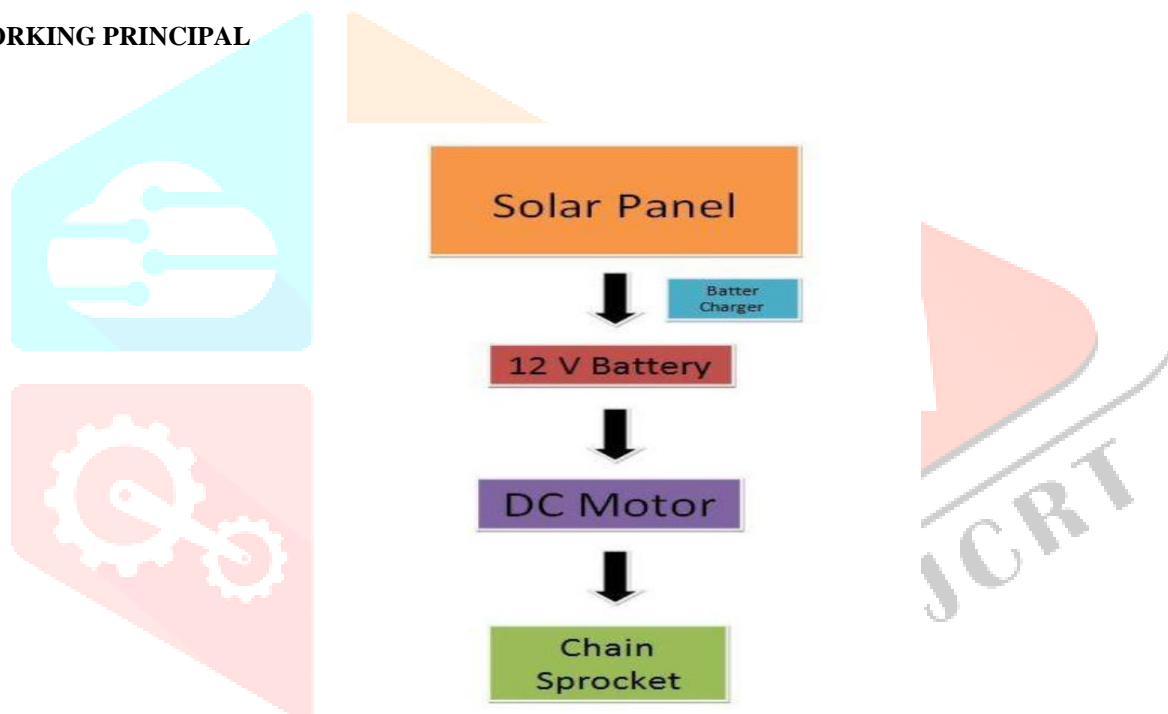


Fig. no. 8 block diagram of working principle

Light from the sun is incident on the solar panel in order to generate power in terms of solar energy which is then transmitted into chemical energy of the battery by the help of battery charger which is connected to the solar panel as well as the battery. Battery is connected to the DC motor and the battery is charged chemical energy is converted into electrical energy and is supplied to DC motor which rotates the armature of coil (a revolving structure in an electric motor or generator wound the coil that carry the current) which in turn the chain & sprocket drive mechanism. Chain is proper lubricant is used. Finger shaped clasp is connected to the chain which is used to pick up the solid waste from drain and carries it and throws it away in waste bucket attached at backside of drainage system model. This process continues automatically till the energy is imparted to the motor by the help of battery in order to avoid blockage of drains and enhance sewage treatment system

4. DESIGN AND CALCULATIONS

Shaft Material used=Mild steel.

Length=910mm

Inner Diameter=21mm

Outer Diameter=24mm

Length between shaft to shaft=930mm

Power transmitted by the shaft = 108577.5105watt

Maximum Bearing Load $L * g = 248.256 * 9.81 = 25.3064\text{Kg}$

If the weight exceeds more than the calculated weight the load on the bearing will increase due to which there will be improper rotation of the chain occurs.

Chain Drives $P=11.372\text{mm}$.

Chain length = $L = pLp = 2057.4 \text{ mm}$

Lifter Length=610mm Breadth =120mm

Gap between each lifter=700mm

Collecting Bin Length =920mm

Breadth =610mm

Height =340mm

Area of the collecting bin = $1.2 \times L \times B = 280600\text{mm}$

Chain Drives

$P=11.372\text{mm}$.

Chain length = $L = pLp = 2057.4 \text{ mm}$

4.3.3 Lifter

Length=610mm

Breadth =120mm

Gap between each lifter=700mm

4.3.4 Collecting Bin

Length =920mm

Breadth =610mm

Height =340mm

Area of the collecting bin = 1.2

2

$L \times B = 280600\text{mm}$

Chain Drives

$P=11.372\text{mm}$.

Chain length = $L = pLp = 2057.4 \text{ mm}$

A. Frame

Assumptions

(Area of frame = $610 \times 610 \text{ mm}^2$) 610

Total load on frame is about 10kg

$F=10 \times 9.81=98.1\text{N}$

$R_1 + R_2 = F$ and $\Sigma MR_1 = 0$

$F \times 305 - R_2 \times 610 = 0$ Therefore,

$R_2 = 49.05$ and $R_1 = 49.05$

$M_b = 49.05 \times 305 = 14960.75$

$Y = b/2 = 25/2 = 12.5\text{mm}$

$I = bd^3 / 12 = (25) \times 4^3 / 12 = 32552.333$

Stress on frame,

$$\sigma = M_b y / I = 21.75 \text{ N / mm}^2$$

$$\sigma = S_{yt} / \text{FOS therefore,}$$

$$S_{yt} = \sigma \times \text{FOS}$$

$$= 21.75 \times 3 \dots\dots\dots (\text{Assume. } fos = 5)$$

$$= 65.75 \text{ N / mm}^2$$

Selecting material GCI 15 having Tensile strength (min) = 150 N / mm²

For safer design considerations as 65.75 N / mm²

Therefore all assumptions are in safer state.

B. Shaft

We select material for shaft 45C8 from DDB of V.B.Bhandari (2.15)

$$S_{ut} = 640 \text{ N/mm}^2 \text{ and } S_{yt} = 380 \text{ N/mm}^2$$

A.S.M.E. Code for design of shaft by using Design of Machine Element-I TMX

1) Permissible stress –

$$\tau_{all} = 0.75(0.3S_{yt}) = 85.5 \text{ N/mm}^2$$

$$\tau_{all} = 0.75(0.18S_{yt}) = 86.4 \text{ N/mm}^2$$

Torque of shaft-

$$P = 2\pi NT / 60000$$

$$= 15278.8 \text{ N-mm}$$

C. Bending Moment on Shaft

$$M@F = 14960.75 \text{ N-mm}$$

D. Diameter of shaft

$$T_e = \sqrt{(K_b.M)^2 + (K_t.T)^2}$$

$$= 32075.74 \text{ N-mm}$$

$$\tau_{max} = 16T_e \pi * d^3$$

$$85.5 = (16 * 32075.74) / (3.14 * d^3)$$

$$D = 12.4 \text{ mm}$$

But as per design data standard size available are 20 mm , so aesthetically

We choose it.

$$D = 20\text{mm}$$

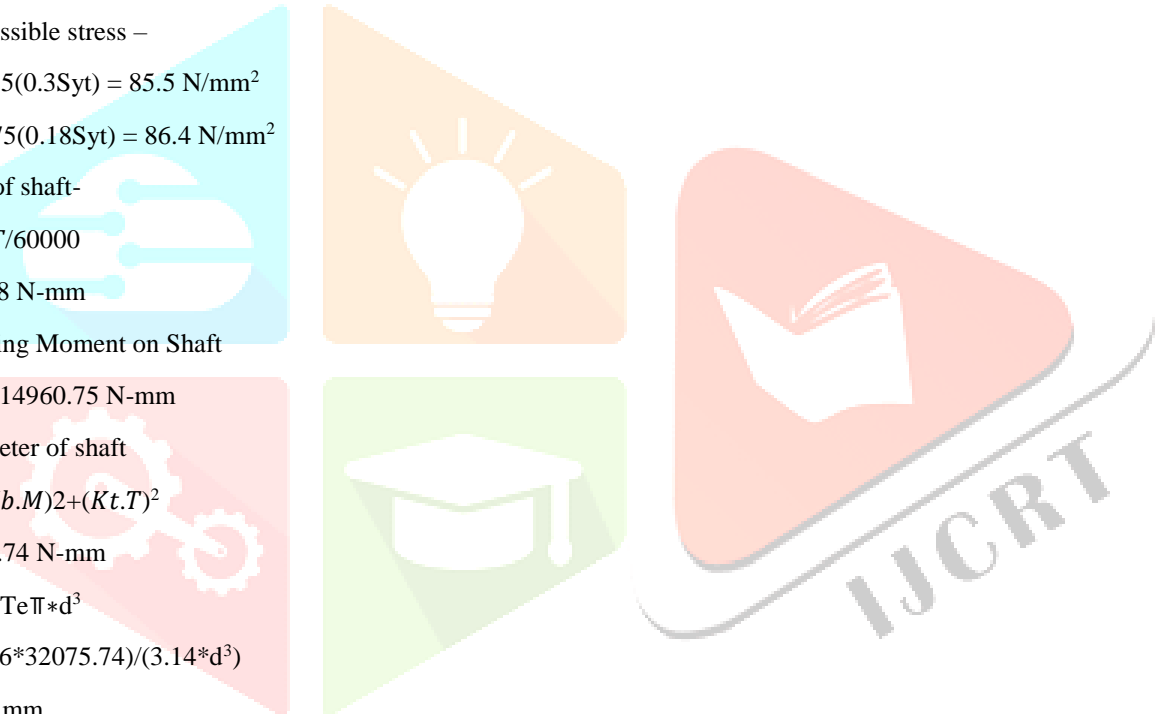


Fig.no.9 under fabrication model

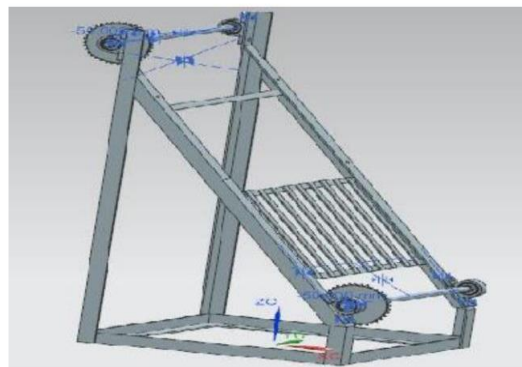


fig. no.10 design of model

5 .RESULT

While conducting the experiment the parameters considered are uniform flow rate of water, depth of the channel is 1feet and height of the channel is 3feet, rate of disposal of waste is uniform, lifter speed and motor speed is constant.

- Alarm will turn on when the collecting bin is filled.
- Lifter speed is constant and it regularly lifts the waste.
- Cost of the machine is economic and it requires only 12-24 volts of current.



Fig no.11 graph of time v/s collecting bin.

- Time taken by each lifter to lift each object from bottom to top is 11.46 seconds.
- Minimum time taken by collecting bin to fill completely is 1day.
- Quantity of waste collecting in the collecting bin is nearly 8-9 kilograms.
- The below graph which is drawn time v/s collecting bin explains that how much waste is collected in the bin with respect to time.

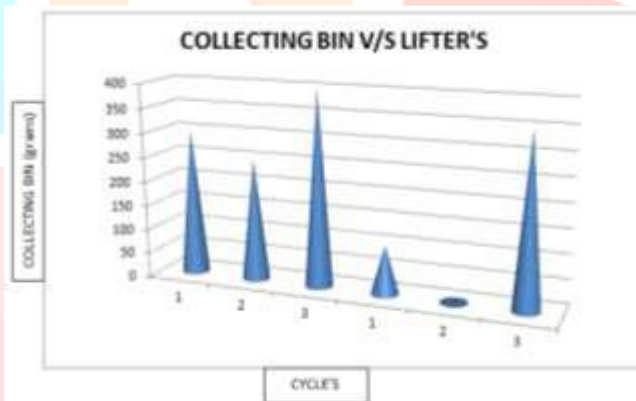


Fig no.12 - graph of cycle v/s collecting bin

While considering the above graph collecting bin v/s one complete cycle indicates that the rate of lifter lifting the waste is directly proportional to the storage of waste in the collecting bin.

6 ADVANTAGES

- These cleaners are easy cheapest way to fix drainage problems. Easy to operate as no special skill is required.
- Reduction of labour oriented method of cleaning, thus upgrading dignity of labour.
- Light weight and easily portable. Requires nearly 12-24 volts of power.
- Large amount of garbage will collect which can be remanufacturable

7 APPLICATIONS

- It is used almost in all types of drainage (Large, Small, and Medium).
- Project to use this in efficient way to control the disposal of wastages and with regular filtration of wastages.
- Cleaning and maintenance of sewer lines drains of mechanical drainer.

8. CONCLUSION

- In the treatment system of drainage Waste water control by the motor, roller chain and sprocket, lifter and thecollecting bin to achieve semi-automatic control of sewage waste water treatment.
- Drainage from industries is treated through this project to meet the national emission standards, with stable operation, low cost and good effect.
- Drainage wastewater control is treated by this method to irrigate plants, clean toilets, etc.
- The cleaner functioned move effectively during the heavier rains which had more volume of running water with garbage and high velocity.

9 REFERENCES

1. R. Sathiyakala, S. Flora Grace , P.Maheswari,. S. Majitha Bhanu, R.Muthu Lakshmi Vol. 4, Issue 2, February 2016.
2. Department of Civil Engineering Michael Okpara University of Agriculture Umudike Abia State March 2014.
3. Prof. Nitin Sall, Chougale Mohammed Zaid Sadique,Prathmesh Gawde,Shiraz Qureshi and Sunil Singh Bhadauriya Vol.4 Issue 2, February 2016.
4. Dr .K.Kumaresan m.e, ph.d...,Prakash S, Rajkumar. P, Sakthivel.C, Sugumar.G issn: 2349 - 9362 (iceiet - 2016)
5. Yadav, D. (2009). Garbage disposal plant mired in controversy. India Times, TNN, 19 Feb 2009. 61 Bharat, K. and G.A. Mihaila, when experts agree: using non-a_liated experts to rank popular topics . ACM Trans. Inf.Syst., 20(1), (2002), pp.47-58.
6. Astrup, T., J. Mollee, and T. Fruergaard (2009b). Incineration and co-combustion of waste: accounting of greenhouse gases and global warming contributions. Waste Management & Research: 2009: 27: 789-799
7. R. Sathiyakala, S. Flora Grace ,P.Maheswari,. S. MajithaBhanu, R.Muthu Lakshmi Vol. 4, Issue 2, February 2016.
8. Department of Civil Engineering Michael Okpara University of Agriculture UmudikeAbia State March 2014.
3. Prof.NitinSall, Chougale Mohammed Zaid Sadique,PrathmeshGawde,Shiraz Qureshi and Sunil Singh Bhadauriya Vol.4 Issue 2, February 2016.
4. Dr .K.Kumaresanm.e, ph.d...,Prakash S, Rajkumar. P, Sakthivel.C, Sugumar.Gissn: 2349 - 9362 (iceiet - 2016)
5. Yadav, D. (2009). Garbage disposal plant mired in controversy. India Times, TNN, 19 Feb 2009. 61 Bharat, K. and G.A. Mihaila, when experts agree: using non-a_liated experts to rank popular topics . ACM Trans. Inf.Syst., 20(1), (2002), pp.47-58.
6. Astrup, T., J. Mollee, and T. Fruergaard (2009b). Incineration and co-combustion of waste: accounting of greenhouse gases and global warming contributions. Waste Management & Research: 2009: 27: 789-799.

