

## “Automated Drain Cleaning System Under Swachh Bharat Abhiyaan”

Prof.Mrs. Shubhangi Gondane

Department Of Mechanical Engineering

(TULSIRAMJI GAIKWAD-PATIL COLLEGE OF ENGINEERING & TECHNOLOGY, NAGPUR)

Students Name :- 1) Tushar Shirpurkar 2) Sailesh Raut 2) Anup Mistry

**ABSTRACT:** The proposed concept is to replace the manual work in gutter cleaning by Automated gutter cleaning system. Now-a-days even though mechanical drainage plays a vital role in all domestic and industrial applications in the proper disposal of sewages from domestic, industries and commercials are still a challenging task. Drainage pipes are using for the disposal and unfortunately sometimes there may be loss of human life while cleaning the blockages in the drainage system.

The Automated Gutter Cleaning system is a machine which helps to protect the environment from different kinds of environmental hazards through the promotion waste management by the removal of garbage from the drainage system.

These wastes when not removed end up settling in residential places where these wastes are burnt thereby causing climate change otherwise these wastes block the drainage systems thereby causing flooding. In this project the proposal concept is to replace the manual work in drainage cleaning by automated system. The gutters get blocked due to these wastes in water. To overcome this problem and to save human life we implement a design “Automated Gutter Cleaning system” and we have designed our project to use this in efficient way to control the disposal of wastages and with regular filtration of wastages.

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### I. INTRODUCTION :

Water is being used very fast in today. The significance of water is mainly used for cooking, cleaning and drinking in our lifestyle. The water used in the factory and the house comes from the drains and reaches in the rivers, in the ponds and in the oceans. In which more solid ingredients (polythene, bottles etc)along with water also reaches. We have built Automated drain cleaning machine with the main purpose of removing these solid materials from drains. This machine can be established at any point of drain very easily. It has been design in such a way that its lets water flow through it but collects all the solid substances and gives a group in the dustbin. This machine is able to do cleaning and moving process together on the drains/gutters.



### II. LITERATURE SURVEY

As we know the cleaning of water is our primary purpose so cleaning of water is done manually till now. When human clean gutters manually, then there are more health issue which damage the human health.

So we have invented a machine which clean gutters automatically and saves the human life and also various living organisms to many type of diseases.

□ We showed the usage of mechanical drainage cleaner to replace the manual work required for drainage cleaning system. Drainage pipes are very dirty. Sometimes it is harmful for human life while it is need for cleaning drainage system. To overcome this problem, they implemented mechanical semi-Automated drainage water cleaner and so the water flow is efficient because of regular filtration of wastages with the help of that project. Different kinds of environment hazards reduced with the help of Drainage system machine.

□ Proposed the design and construction of a new test machine configuration that offers same advantages over the traditional one. The new machine and attendant instrumentation provide more realistic chain loading and allow link tension and roller sprocket impact monitoring during normal operation. The incorporation of idle sprocket allows independent adjustment of test on length and preload.

□ Proposed with the automatic cleaning of waste water in order to prevent global warming and melting of glaciers. The results emphasize the need of waste water treatment plants, through which the water is treated before suspending in rivers. Firstly power is generated and that power is used for waste water cleaning process.

□ Reviewed about drainage cleaning to replace manual work to automated system because manually cleaning system it is harmful for human life and cleaning time, is more so to overcome this problem they implemented a design “Automated drainage water pump monitoring and control system using PLC and SCADA”. PLC and SCADA were designed. In this project, to use efficient way to control the disposal of wastage regularly, treatment of disposal in different way toxic and nontoxic gases. PLC controller from Siemens was used in the treatment system of drainage wastewater control by the stepper motor, compressor, gas exhauster, pressure valve and the liquid level, flow and other analog variables to achieve Automated control of sewage waste water treatment.

□ Showed the Drainage system cleaner machine used to remove garbage and sewage automatically which helped to protect the environment from different kinds of environmental hazards. The drainage system cleaner has three major parts which are the Propeller, the Cleaner and the Pan all makes up for its effective functioning.

### **III. METHODOLOGY**

The device is place across a drain so that only water flows through the lower basement. Floating waste like bottles, plastic cans, covers.....etc. is lifted by lifters which are connected to the chain. The chain revolves with the sprocket wheel which is driven by the motor. The energy provided to the motor is electrical energy.

When motor runs the chain starts to circulate making the lifter to lift up. The wastage material are lifted by lifter teeth and stored in storage or collecting bin. Once the collecting bin is full, the waste materials are removed from the bin.



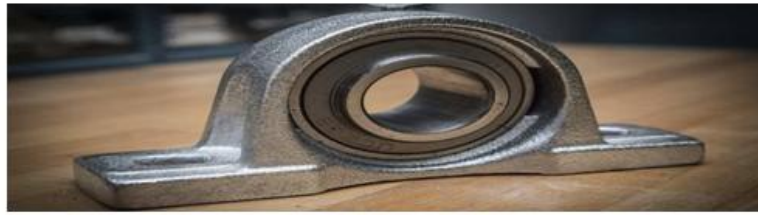
#### **COMPONENT USED**

##### **A. Shaft**



A shaft is a rotating machine element, usually circular in cross section, which is used to transmit power from one part to another, or from a machine which produces power to a machine which absorbs power. The various members such as pulleys and gears are mounted on it.

## B. Bearing



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. Bearings are classified broadly according to the type of operation, the motions allowed, or to the directions of the loads (forces) applied to the parts. 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. The simplest form of bearing, the plain bearing, consists of a shaft rotating in a hole. Lubrication is often used to reduce friction.

In the ball bearing and roller bearing, to prevent sliding friction, rolling elements such as rollers or balls with a circular cross-section are located between the races or journals of the bearing assembly. A wide variety of bearing designs exists to allow the demands of the application to be correctly met for maximum efficiency, reliability, durability and performance.

## C. Sprocket



A sprocket or sprocket-wheel is a profiled wheel with teeth, or cogs, that mesh with a chain, track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth. 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. Sprockets are of various designs, a maximum of efficiency being claimed for each by its originator. Sprockets typically do not have a flange. Some sprockets used with timing belts have flanges to keep the timing belt centered. Sprockets and chains are also used for power transmission from one shaft to another where slippage is not admissible, sprocket chains being used instead of belts or ropes and sprocket-wheels instead of pulleys. They can be run at high speed and some forms of chain are so constructed as to be noiseless even at high speed.

## D. Battery



Battery used A rechargeable battery, storage battery, secondary cell, or accumulator is a type of electrical battery which can be charged, discharged into a load, and recharged many times, as opposed to a disposable or primary battery, which is supplied fully charged and discarded after use. It is composed of one or more electrochemical cells. The term "accumulator" is used as it accumulates and stores energy through a reversible electrochemical reaction. Rechargeable batteries are produced in many different shapes and sizes, ranging from button cells to megawatt systems connected to stabilize an electrical distribution network. Several different combinations of electrode materials and electrolytes are used, including lead-acid, nickel-cadmium (NiCd), nickel-metal hydride (NiMH), lithium-ion (Li-ion), and lithium-ion polymer(Li-ion polymer).

#### E. Chain



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.

#### F. Lifter Mounts



Lifting equipment, also known as lifting bin, is a general term for any equipment that can be used to lift loads. This includes sewages like polythene, plastic bottles, wastage which generally occurs in the water, thermocol, and other dusty and sewage partials which comes in the contact with that equipment. In our project we used two lifter for better performance, and it also help for balancing the model.

The dimension of the lifter are as follows

Lifter of width-12.7cm, Total length of lifter-60cm, Weight of lifter-150gram, Thickness of lifter- 2cm

#### G. Collecting Bin





Collecting bin is the rectangular hollow box which is situated behind the model. It is used for the purpose of collecting the sewage which comes in the contact of the lifter. When the lifter completes its cycle it reaches to the bin and removes all sewage in the collecting bin. The collecting bin is made up from sheet metal. Dimension of the collecting bin Width of collecting bin-30cm Depth of collecting bin-38cm Length of collecting bin-75cm

#### H. Solar Panel



Photovoltaic solar panels absorb sunlight as a source of energy to generate electricity. A photovoltaic (PV) module is a packaged, connected assembly of typically 6x10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications.

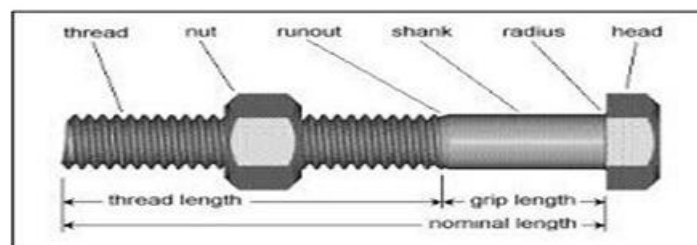
Here, the solar panel is being used to power the battery which is used for the application of power to the mechanism of Automated Gutter Cleaning system. It is a panel of 10 watts consisting of photovoltaic solar cells. Per hour solar panel charges 10 watts of power. Since to charge the panel of 25 watts it will consume 150 minutes approximately depending on the sunrays falling on the panel.

#### I. Gears



A gear or more correctly a "gear wheel" is a rotating machine part having cut teeth, or cogs, which mesh with another toothed part in order to transmit torque. Two or more gears working in tandem are called a transmission and can produce a mechanical advantage through a gear ratio and thus may be considered a simple machine. Geared devices can change the speed, magnitude, and direction of a power source. The most common situation is for a gear to mesh with another gear, however a gear can also mesh a non-rotating toothed part, called a rack, thereby producing translation instead of rotation.

#### J. Fasteners



##### □ A Nut

A nut is a type of fastener with a threaded hole. Nuts are almost always used opposite a mating bolt to fasten a stack of parts together. The two partners are kept together by a combination of their threads' friction, a slight stretch of the bolt, and compression of the parts. In applications where vibration or rotation may work a nut loose, various locking mechanisms may be employed: Adhesives, safety pins or lockwire, nylon inserts, or slightly oval-shaped threads. The most common shape is hexagonal, for similar reasons as the bolt head - 6 sides give a good granularity of angles for a tool to approach from (good in tight spots), but more (and smaller)

corners would be vulnerable to being rounded off. Other specialized shapes exist for certain needs, such as wing nuts for finger adjustment and captive nuts for inaccessible areas.

□ **Screw Or Bolt**

A screw, or bolt, is a type of fastener characterized by a helical ridge, known as an external thread or just thread, wrapped around a cylinder. Some screw threads are designed to mate with a complementary thread, known as an internal thread, often in the form of a nut or an object that has the internal thread formed into it. Other screw threads are designed to cut a helical groove in a softer material as the screw is inserted. The most common uses of screws are to hold objects together and to position objects.

**K. Dc Motor**



Windshield wipers are powered by a small electric motor, usually mounted on the firewall or under the cowl (the area under the windshield’s base). The motor activates linkage that moves the wiper arms back and forth. On vehicles with a rear window wiper, a separate motor powers the one in the rear. Signs that a wiper motor is about to fail include slow or intermittent operation, wipers that will operate at only one speed, or arms that stop in the middle of the windshield when turned off. If your wipers don’t work, the fault could also lie with other parts of the wiper system. In the winter, for example, trying to use the wipers when the blades are stuck to the windshield because of ice or snow can blow the fuse for the motor or trip a circuit breaker. Other possible causes are the interior switch that controls the wipers failing, wires in the system being damaged, or the linkage that pushes and pulls the wiper arms breaking. Moving parts in the linkage may also be stuck from corrosion and/or gunk and need lubrication.

**CALCULATION**

□ **DC Motor**

The motor is being used of 12 volts and 15 watts. Since the motor is of 15 watts and from battery it requires the power of 15 watts .hence the battery can deliver the power to the motor if it charged completely for 90 mins approximately to rotate the motor

Motor speed=N=60 rpm  
Power=15 watts

$P=2\pi NT/60$   
 $T=P \times 60 / 2\pi N$   
 $= 15 \times 60 / 2\pi \times 60$   
 $T=2.387N\text{-m}$   
 $T=2.3875 \times 1000 \text{ N-mm}$   
Force acting on the shaft of the motor  
Diameter of shaft “d”=6mm

Torque developed  
 $T = F \times r$   
 $F = T/r = 2387.5/3$   
 $F=795.8N$   
The material being used for the shaft is mild steel  
Yield stress  $\sigma_y=380 \text{ Mpa}$  for M S Material

Shear stress  $f_s = \sigma_y / FOS$   
 $= 380 / 2$   
 $= 95 \text{ Mpa}$   
Load acting on the motor shaft=3kg=30 Newtons  
Stress =Force/area  
 $\sigma = 350 / \frac{\pi \times d^2}{4}$   
 $d= 1.53 \text{ mm}$   
taking diameter of shaft as 6mm for the motor  
Hence the design of the motor shaft is safe.

Torque acting on the motor for load of 30N

$T = (\pi/16) \times \sigma_s \times (d^3)$   
 $= (\pi/16) \times 95 \times 6^3$   
 $= 4029 \text{ N-mm}$   
Torque =force \*radius  
Force=  $T/r=4029/3$   
 $=1343N$

**Design of shafts**

Load acting on the shafts=30 N  
 Shear strength  
 $\sigma_s = \text{force/area}$   
 $380/2/2 = (30/(\pi d^2/4))$   
 $d=2\text{mm}$   
 taking 6mm  
 hence the design of the shaft is safe  
 it can the load of the entire machine easily

Checking for crushing stress  
  
 Stress = load/ area  
 $380/2/2 = 30/(\pi \times D \times L)$   
 $95 = 30/(\pi \times D \times 1.5D)$   
 $D=0.82\text{mm}$   
 Taking 6mm  
 Hence the design for crushing is also safe.

**Design Of Gears**

Power 15 watts  
 14.5degrees(FDI)  
 Speed of pinion N1=60rpm  
 $Z1=54$  teeth  $Z2=35$ teeth  
 $I=Z2/Z1$   
 $=54/35$   
 $=2.5$

**Speed Of Gear**

$N2=N1/I = 60/2.5$

$N2=24\text{rpm}$

Stress in pinion and gear

$Sd1=140\text{Mpa}(\text{pinion})$

$Sd2=90\text{Mpa}(\text{gear})$

**Mean Velocity**

$V_m = (3.142 \times d^2 \times N2) / (60 \times 1000)$   
 $= (3.142 \times m^2 \times Z2^2 \times 24) / (60 \times 1000)$

$= (3.142 \times m^2 \times 135^2 \times 24) / (60 \times 1000)$

$= 0.169\text{m}$

**Velocity Factor**

$K_v = (3 / (3 + V_m))$

$= (3 / (3 + 0.169\text{m}))$

Assume  $\beta=4$

**Module**

$m^3 = (2T2) / ((\pi^2) \times \beta^4 \times Y2^2 \times Z2^2 \times Sd2 \times K_v)$

$= (2 \times 7.46 \times 1000) / ((\pi^2) \times 4^4 \times 0.1189^4 \times 135^2 \times 90^3)$

$= 0.64 = 1\text{mm}$

**Face Width**

$B = 4\pi m = 4 \times 3.142 \times 1$

$B = 12.56\text{mm}$

**Mean Velocity**

$V_m = 0.169\text{m}$

$= 0.169 \times 1$

$= 0.169\text{m/s}$

**Velocity Factor**

$K_v = (3 / (3 + V_m))$

$= (3 / (3 + 0.169))$

$= 0.946$

**Allowable stress**

**Torque Developed**

$T_2 = (955 \cdot 10^4) \cdot \text{Power} \cdot C_s / N^2$	<b>Diameters</b>	$S_{dall} = K_v \cdot S_d^2$
$= (955 \cdot 10^4) \cdot 0.015 \cdot 1.25 / 24$	Pitch diameter of pinion	$= 0.946 \cdot 90$
$= 7.46 \cdot 10^3 \text{ N-mm}$	$D_1 = m \cdot Z_1 = 1 \cdot 54$	$= 85.14 \text{ Mpa}$
	$D_1 = 54 \text{ mm}$	
	Pitch diameter of gear	
	$D_2 = M \cdot z_2$	
	$= 1 \cdot 135 = 135 \text{ mm}$	

### Induced stress

$$m^3 = (2T_2) / ((\pi^2) \cdot \beta \cdot Y_2 \cdot Z_2 \cdot S_{din} \cdot K_v)$$

$$S_{din} = (2 \cdot 7.46 \cdot 1000) / (\pi^2 \cdot 4 \cdot 0.1189 \cdot 135 \cdot (1^3))$$

$$S_{din} = 23.5 \text{ Mpa}$$

Since  $S_{din}$  is less than  $S_{dall}$

Therefore the design is safe.

### Solar panel

Battery

Voltage =  $V = 12$  volts

Current =  $I = 07$  amps

Power of battery

$$P = V \cdot I$$

$$= 12 \cdot 7$$

$$P = 84 \text{ watts}$$

To charge the battery of 84 watts . it takes nearly 8.4 hours approximately to charge the entire battery.

### Maintenance

Preventive Maintenance are as follows:

- 1) Charging of battery should be done regularly with solar panel.
- 2) Supply should be connected properly
- 3) Should take care from rusting of parts.
- 4) Each part should be sprayed with oil to prevent from corrosion.



#### **IV. CONCLUSION**

In the treatment system of drainage, waste water control by the machine and the collecting bin to achieve automatic control of waste water treatment. Drainage from domestic and industries is treated through this project to meet the national emission standards, with stable operation, low cost and good effect. The cleaner functions more effectively during the heavier rains which has more volume of running water with garbage and high velocity. Risk of Labors catching infections or poisoning due to large amounts of waste and chemicals will be reduced. Automation is a technology concerned with his application of mechanical, electronic and computer based systems to operate and control production. This system is used To Operate Automated Gutter Cleaning System.

This project may be developed with the full utilization of men, machines, and materials and money. Also we have followed thoroughly the study of time motion and made our project economical and efficient with the available resources. This system is Designed, Fabricated successfully and also tested. It works satisfactorily. We hope that this will be done among the most versatile and interchangeable one even in future. Thus we can able to obtain following through Automated Gutter Cleaning system.

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