

Design and Fabrication of River Cleaning Machine

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Abstract - This project emphasis on design and fabrication of the river waste cleaning machine. "River cleaning machine" a machine which involves the removing the waste debris from water surface and safely dispose from the water body. The work has done looking at the current situation of our national rivers which are dump with crore liters of sewage and loaded with pollutants, toxic materials, debris etc. Due to increase in water pollution in the form to waste debris; it is hampering the life of aquatic animal and make their life in danger. A machine will lift the waste surface debris from the water bodies, this will ultimately result in reduction of water pollution and lastly the aquatic animal's death to these problems will be reduced. The main aim of the project is to reduce the man power, time consumption for cleaning the river. In this project we have store the energy in the battery and used this energy for river cleaning with the help of a motor and chain drive arrangement.

Key Words: Motor, Chain drive, Propeller, Conveyor, River, wastage, garbage, pollution

1. INTRODUCTION

The "River cleaning machine" used in that places where there is waste debris in the water body which are to be removed. This machine is consist of waterwheel driven conveyer mechanism which collect & remove the wastage, garbage & plastic wastages from water bodies. This also reduce the difficulties which we face when collection of debris take place. A machine will lift the waste surface debris from the water bodies, this will ultimately result in reduction of water pollution and lastly the aquatic animal's death to these problems will be reduced. It consists of Belt drive mechanism which lifts the debris from the water. The use of this project will be made in rivers, ponds, lakes and other water bodies for to clean the surface water debris from bodies.

1.1 Aim and Objectives

The main aim of the project is to reduce the man power, time consumption for cleaning the river. To reduce the pollution in water bodies. Facility of removing waste particulate floating on water surface. To maintain the automation during working towards cleaning River. To perform the fast & reliable operation during cleaning River. Improve the water quality of a water bodies. To work for society for clean up a section of a stream or river. To record the amount of garbage removed from the

waterway & give solutions to local to provide better environment to aquatic animals and human life.

1.2 Need

Waste water is defined as the flow of used water from homes, business industries, commercial activities and institutions which are subjected to the treatment plants by a carefully designed and engineered network of pipes. The biggest impact of cleaning the chemical wastes can cause respiratory diseases and it plays a challenging issue for the municipality officers. Nowadays, even though automation plays a vital role in all industrial applications in the proper disposal of sewages from industries and sewage cleaning is still a challenging task. Drainage pipes are used for the disposal of sewage and unfortunately sometimes there may be loss of human life while cleaning the blockages in the drainage pipes. As such condition the river cleaning machine is used to solve such type of problems.

2. LITERATURE REVIEW

2.1 Design and Fabrication of Remote Controlled Sewage Cleaning Machine

The motive of the project is to automate the sewage cleaning process in drainage, to reduce the spreading of diseases to human. The black water cleaning process helps to prevent pest infestations by reducing the residues that can attract and support pests. It also improves the shelf life and sensory quality of food products. In the proposed system, the machine is operated with remote control to clean the sewage. Hence, this system avoids the impacts from the sewage waste and its harmful gases. This helps to prevent the mosquito generation from the wastage.

2.2 Review on Advance River Cleaner

River water is used for irrigation which in return gives food to the people. They also maintain the ecology of region and bring prosperity. We made this project to clean the river. After implementing this project we can control the pollution of river it is very beneficial for our society. In this project turbine rotates by flow of river water and through the mechanical gear arrangement we arrange two conveyor belts. The first conveyor belt is used to pick solid waste from river and the second conveyor belt is used to draw solid waste out of river for solid waste management.

2.3 Efficient Lake Garbage Collector by Using Pedal Operated Boat

The most sacred river in the world and the national river of India "Ganga River." Ganga is the soul of India and is Holly River in India. Our main motive is to clean the lake water for that purpose we are making efficient lake garbage collector by using pedal operated boat. In this we are using pedal operated boat with the conveyor attached to it for collecting garbage from the lake. Several companies offer equipment to garbage out of river lakes and harbors .The water surface trash collection boat can work in river or lake, it can collect the floating garbage and some other equipment for weed cutting, it harvest the aquatic weed from lake.

2.4 Design and Fabrication of River Waste Collector

The "River Waste Collector" used in that places where there is waste debris in the water body which are to be removed. This machine consist of different size of Fins in which garbage's are going to collect in between them. This also reduce the difficulties which we face when collection of debris take place. In this machine one end of fins is fixed and another side is movable, with the help of servo motors we lift the fins from movable side. All the waste debris are get collected at tank placed at the end of boat.

3. PROBLEM STATEMENT

In the absence of garbage disposal facilities, the practice of dumping garbage into nearby water bodies has become quite common in recent years and has posed long-term negative impacts both on biodiversity of the area and as well as on the local environment

Less human interference: - The very basic idea should be satisfied that is to avoid the interference of the operator. This will happen only by the adoption and sustained usage of technology in the workspace. Collect more amount of waste: Very firstly it must collect around 5kg of waste at a time when it is being left to the water.

Easy disposal of waste: Another important thing is easy removal of wastes which are collected in the collecting box.

It must be stable: To make the product stable it must get through with proper design calculations. It should withstand extreme conditions such as additional load exerted by the water waves and as well as by the wastes which are being collected.

Safety for the user: The product must be user friendly.

Environmental friendly: It should not harm the aquatic animals. It must not have any property that has adverse effect on the water source.

4. EXPERIMENTAL DETERMINATION OF RIVER CLEANING MACHINE

This machine is consist of waterwheel driven conveyer mechanism which collect & remove the wastage, garbage & plastic wastages from water bodies.



Fig- 1: Experimental model of River Cleaning Machine



Fig-2: Experimental model of River Cleaning Machine with tube

5. CALCULATION AND DESIGN

5.1 motor calculation

Type: - DC Motor

Power= $V \times I$ Where,

Volt= 12V Amp=7.6-Amp

Power= 12×7.6, Power= 91.2 watt

5.2 Design of Spur Gear

Design power Pd=PR × Ki

Where,

Ki=1.25 for light shocks (8 to 10 hrs a day)

Pd=85×1.25= Pd=114 watt.

Total Load

Total load Ft=Pd/Vp

Where,

Ft= tooth load

Vp= pitch line velocity

Pitch Line Velocity

Vp= (πDpN)/ (60)

Vp= (π*0.045*50)/ 60

Dp =m*18=18m

Where, Dp=m×tp

tp= pinion teeth=18

Vp= (π× m×18×50)/ 60

Vp=0.047m

Total Load

Ft=Pd/Vp

Ft=114.37/0.047m

Ft=2425.53/m

Bending Strength by Lewis Equation

FB= So×Cv×b×y×m

Where,

So=Basic strength Mpa So=245Mpa SAE 1045 heat treated Cv=0.4(assume)

b=Face width= 10m

Modified Lewis factor 20o full depth

Yp=0.485-(2.87/tp) for pinion,

Yp= 0.3667

Yg=0.485-(2.87/tg) for gear,

Yg= 0.42583

Fb= So×Cv×b×y×m,

Fb= 245×0.4×10×m×0.3667×m

Fb= 359.36m

Using criteria,

Ft= FB 2832.31/m=359.36*m²

m=2.5 mm Dp=45mm

Dg=118 mm

Fb= So×Cv×b×y×m

b=1993.75/245×0.4×0.3255×2,

b= 10 mm

Now, checking face width

Ft= Fb

Ft= 2832.31/m= 1416.15N Ft

= 1370.2 N

Fb=359.36m²

Fb=2246 N

Ft< Fb

∴ Design is Safe

Dynamic Load

Fd= Ft+(21Vp(Ceb+Ft)/21Vp+√Ceb+Ft)

Vp=0.047*m m/sec

Vp=0.1137 m/sec

Where,

C=Deformation Factor,

C=11800-(20o full depth)

b=10 e= error in profile= 0.05

Fd=1416.15+21×0.1137(11800×0.05×10+1370.2)/×21*0.1

137+√11800×0.05×10+1370.2)

Fd=220.30 N

Fd> Ft

∴ Design is safe

Limiting Wear Strength

Fw=Dp×b×k×Q

Q = 2tg/tg+tp

= 2×44/44+18

Q =1.41

Fw =45*20*K*1.41

Fw=1269K N

Using Criteria,

Fd=Fw

220.30=1269K

K=0.17

BHN core=150 For pinion 20° full depth involute profile

Fw=1276×0.17 Fw=215.39 N Fd >Fw

Design is safe

Endurance Strength

Fen =Seb×b×Yp×m

Where, Seb= 84mpa, Yp=0.3667, b=10, m=2.5

Fen =84×10×0.3667×2.5,

Fen= 770.07 N

Fen> Fd

Hence design is safe

Gear Ratio

N1=rpm of pinion N2 = rpm of gear

T2=teeth of gear T1 = teeth of pinion

Where,

N1/N2=T2/T1

T2/T1=44/18=2.44

5.3 Design Procedure of Belt Drive

Power output of driven gear=power of driving pulley

PR=90 watt, N1=25 RPM

Determination of Design Power

Kθ=1.1, KL=1.05

Pd= PR* Kθ* KL

Pd =0.09*1.1*1.05

Pd =103.95 KW

Determination of Pulley Diameter

Consider for long life of belt

Neglecting the slip

D1=60 mm, D2= 60mm

Determination of Belt Tension

(F1-F2)= Pd/Vp

(F1-F2)= 103.95/750/60

(F1-F2) = 8.316 N(1)

For rubber belt and plastic pulley

μ = 0.5

F1/F2= e^{μθ}

θ= 0.52 rad/ sec

F1= 1.29 F2(2)

By putting value of F1 in eqⁿ (1)

$$1.29 F_2 - F_2 = 8.316$$

$$F_2 = 28.6785 \text{ N}, F_1 = 36.99 \text{ N}$$

Determination of Initial Tension

$$2\sqrt{F_i} = \sqrt{F_1} + \sqrt{F_2}$$

$$F_i = 32.7 \text{ N}$$

Belt Cross Section

$$S_{cf} = \rho * V^2 * 10^{-6}$$

$$= 970 * (750/60)^2 * 10^{-6}$$

$$S_{cf} = 0.15 \text{ MPa}$$

$$B_t = F_1 / (S_d * n_i - S_{cf})$$

$$B_t = 57.31 \text{ mm}^2$$

Then,

$$S_i = F_i / b * t$$

$$S_i = 1.4 \text{ from DDB}$$

$$1.4 = 32.7 / b * t$$

$$B_t = 23.357 \text{ mm}^2 \quad B = 380 \text{ mm} \quad T = 8 \text{ mm}$$

Design of Shaft

For driving shaft

$$P_R = 2\pi * N_1 * T_R / 60$$

$$T_R = 10.39 \text{ N-m}$$

$$= 10.39 * 10^3 \text{ N-mm}$$

$$T_d = T_R * K_i$$

$$= 10.39 * 10^3 * 1.05$$

$$= 10.39 * 10^3 \text{ N-mm}$$

$$T_d = \pi / 16 * \tau * (D_1^3 - d_1^3)$$

$$D_1 = 20 \text{ mm}, d_1 = 18 \text{ mm}$$

Same for driven shaft

$$D_2 = 20 \text{ mm}, d_2 = 18 \text{ mm}$$

Design of Pulley

$$W = 1.1 * 380$$

$$W = 420 \text{ mm}$$

Capacity of Conveyor Belt

Capacity is material carrying capacity that can carry a material in Kg or Tonnage. (m)

$$M = \rho * K * (0.9B - 0.05)^2 * V$$

Where,

$$\rho = \text{density of belt material} = 1500 \text{ Kg/m}^3$$

5. 4 Design Procedure of Chain drive

1) Determine the velocity ratio of the chain drive

$$\text{Velocity ratio} = N_1 / N_2$$

So,

$$N_1 / N_2 = T_2 / T_1,$$

$$\text{velocity ratio} = 0.4$$

2) Select the minimum number of teeth on the smallest sprocket or pinion Minimum Number Of Teeth On The Sprocket = 18

3) Determine the design power by using the service factor, such that,

$$\text{Design power} = \text{Rated power} * \text{Service factor (Ks)}$$

$$= 106.25 * \text{Service factor (Ks)}$$

$$= 106.25 * (\text{Load factor (K1)} * (\text{Lubrication factor (K2)}) * \text{Rating factor (K3)})$$

$$= 106.25 * (1.5 * 1 * 1.25)$$

$$\text{Design power} = 0.20 \text{ kW}$$

K=Flow ability factor

$$\text{for } 26^\circ \text{ inclination angle of belt} = 2.5 * 10^{-4}$$

$$b = \text{width of belt} = 380 \text{ mm}$$

$$V = \text{velocity of belt} = 0.0785$$

$$= 1500 * 2.5 * 10^{-4} * (0.9 * 380 - 0.05)^2 * 0.0785$$

$$= 2.8289 * 10^{-3} \text{ Kg/sec}$$

$$= 2.8289 * 10^{-3} * 3600$$

$$M = 10.1841 \text{ Kg/sec}$$

4) Choose the type of chain, number of strands for the design power and RPM of the sprocket

Types of chain = simple roller chain (06B)

Power rating (in kW) = 0.25

Speed of sprocket or pinion (RPM) = 30 5

Note down the parameters of the chain, such as pitch, roller diameter, minimum width of roller.

ISO chain number = 06B (35)B.D. Shivalkar

Pitch (mm) = 9.525, Roller diameter (mm) = 6.535

Minimum width (mm) = 5.72

Braking load (simple type roller chain) in k N = 8.9

6) Determine the load (W) on the chain by using the following relation,

$$\text{Pitch line velocity} = 3.14 \text{ dN} / 60$$

$$= (3.14 * 0.06 * 30) / 60$$

$$\text{Pitch line velocity} = 0.0942 \text{ m/s}$$

W= Rated power/pitch line velocity

$$W = 0.25 / \text{pitch line velocity}$$

$$W = 0.25 / 0.0942$$

$$W = 2.65 \text{ KN Load on the chain } W = 2650 \text{ N}$$

7) Calculate the factor of safety by dividing the breaking load (WB) to the load on the chain (W). This value of factor should be greater than the value.

$$\text{Factor of safety} = (WB/W)$$

$$= 8.9 / 2.65$$

$$\text{Factor of safety} = 3.358$$

6. FABRICATION PROCEDURE

The basic step is to fabrication of base frame of the project by using hand cutting machine and electric welding machine to withstand the model and its operation. The base frame is made of square channel.

1. Hollow pipe is assembled at the base frame with the help of L- section through nut and bolt. It is made of PVC pipe by using fastening operation. The purpose of this pipe is to float on water, carrying the project weight as compressed air is placed in pipe creating a differential pressure head, causing the machine to float on water.

2. L- Section is welded in base frame which is used to hold the hollow pipe with the help of nut and bolt.

3. T section is welded on base frame to support the bearing and shaft.

4. T- Section is assembled on base frame by welding. It is used to support the pulley with the help of bearing and shaft.

5. Conveyor belt is used to transmit the torque from motor to chain drive. There is two shaft assembled in machine. Shaft 1 is mounted at the front chain drive of machine and shaft 2 is mounted at the rear chain drive with the help of inclined selection and T- section respectively.

6. One plate of 200*150 mm is welded at T section from 170 mm from base for mount motor for driving pulley of belt drive

7. The drive source of our project is an electric motor having 12V and 7.6 ampere current which is used to drive gear train, for collecting mechanism.

8. Gear is welded on pulley shaft and another gear is weld on motor shaft drive used to transmit the power from motor to conveyor belt pulley. Drive is required to carry a load as desirable to complete the project objective.

10. Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to propeller, particularly bicycles and Motorcycles. It is also used in a wide variety of machines besides vehicles. The power is conveyed by a roller chain, known as the drive 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.

11. Collecting Mechanism is used in our project to collect a garbage and debris. By using circular bar we made one frame for bin. And cover its five side with the square mesh net

12. Propeller is bolted on shaft which is placed on base frame. The purpose of water wheel is to move the machine forward or backward on water. Motor is used to rotate the water wheel with the help of chain drive mechanism.

7. COMPONENTS AND SPECIFICATIOIN

7.1 Base Frame

A frame is often a structural system that supports other components of a physically. Bed frame, the part of a bed used to position the mattress and base.

Specification-Length=1220 mm, Width=480 mm, Square Pipe of 2 mm thickness



Fig-7.1: Base Frame of River Cleaning Machine

7.2 Hollow Pipe -2 No

These are two hollow pipe joint together by permanent fastening with the help of M-seal.

Specification Length=1220mm

D1=2000mm

D2=180mm



Fig-7.2: Floating Pipe

7.3 T Section -2 No

T sections are welded on base frame to mount the bearings

Specification-Width =200mm

Height=375mm



Fig.7.3: T-Section

7.4 Shaft

Hollow shaft used to transmit the power with the help of belt drive

Specification- D1 =20mm D1 =18mm



Fig-7.4: Shaft

7.5 Motor

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields.

Specification-DC Motor- RPM=50

Shaft diameter=10 mm

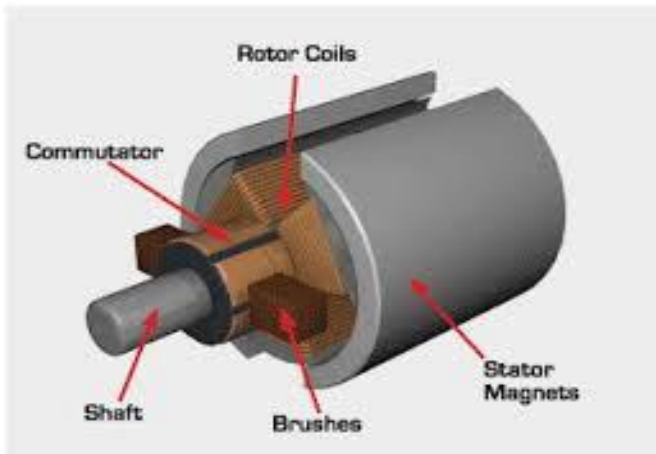


Fig- 7.5: DC Motor

7.6 Gear

Spur gears are the most common type of gears. They have straight teeth, and are mounted on parallel shafts. Sometimes, many spur gears are used at once to create very large gear reductions. It also increases the stress on the gear teeth.

Specification -The Gear has a pressure angle of 20° full depth.



Fig-7.6: Spur Gear

7.7 Chain & Sprocket

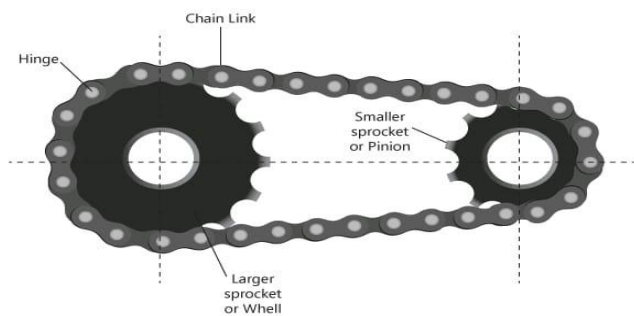


Fig-7.7: Chain & Sprocket

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. Sprockets typically do not have a flange.

Specification- No. of Links =108

No of Teeth on upper Sprocket=44T

No of Teeth on lower Sprocket=18T

7.8 Ball Bearing

A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races. The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. However, they can tolerate some misalignment of the inner and outer races.

Specification-

Deep Groove Ball Bearing 6920



Fig-7.8: Ball Bearing

7.9 Collecting Tray

It is used to collect waste garbage from the river.

Specification-

Length = 450 mm, Breadth = 300 mm, Height = 360 mm



Fig-7.9.: Collecting Tray

7.10 Conveyor Belt

It is carrying medium of a belt conveyor system

Specification- Length =1700mm, Width=400mm



Fig-7.10: Conveyor Belt

7.11 Propeller

It is a mechanical device used to develop thrust inside the water for propelling the floating body.



Fig-7.11: Propeller

7.12 Battery



Fig-7.12: Battery

The purpose of the battery in a series circuit is to give the circuit a source of energy. The purpose of a switch in a series circuit is to make it easy to open or close the electrical circuit, turning the flow of electricity on or off.

Specification-12v 7.5 amp ups battery

7.13. RF Control

RF module -RF remote control (radio frequency remote control) a wireless device used to operate other electronic equipment using radio frequency transmission.



Fig-7.13: RF Control

8. CATIA DRAWINGS

Various views of the River Cleaning Machine in CATIA

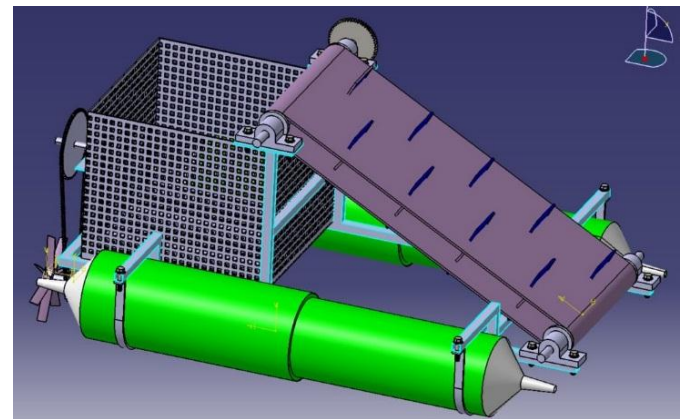


Fig-8.1: Isometric view of River Cleaning Machine

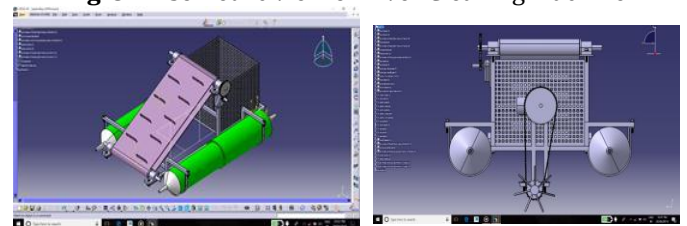


Fig-8.2: Isometric and Back view of River Cleaning Machine

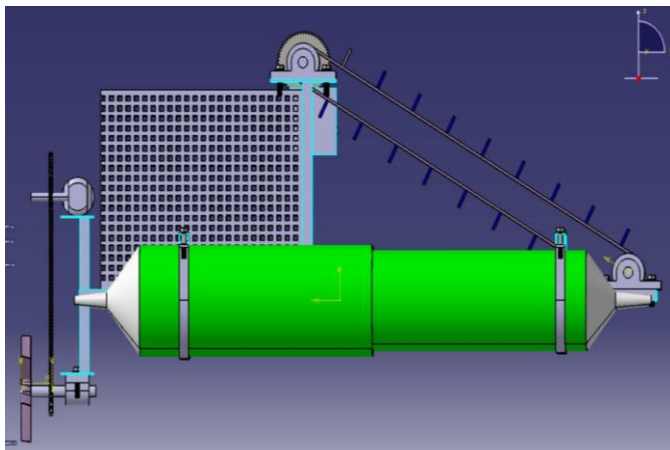


Fig-8.3: Side view of River Cleaning Machine

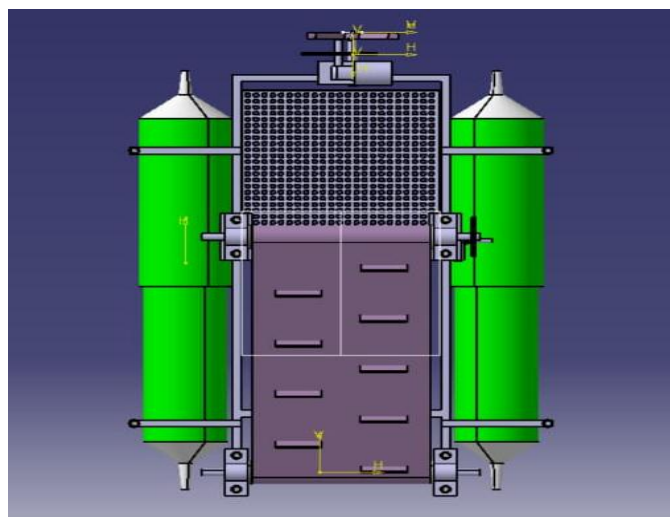


Fig-8.4: Top view of River Cleaning Machine

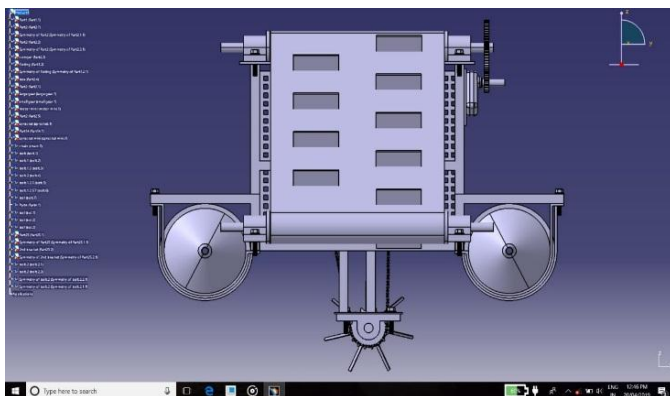


Fig-8.5: Back view of River Cleaning Machine

10. APPLICATIONS

- It is applicable to reduce water pollution in rivers & ponds.
- It is useful to reduce the environmental marine pollution at river, Lake.
- It is also useful in fishery plant to collect dead fishes and solid impurities in waste water.

- It is useful to remove the sediments present in swimming pool to keep it clean

11. FUTURE SCOPE

In future this project can be improved to sort more categories of waste. In this system we can use advance conveyor system and conveyor material for increasing the efficiency of collection of garbage. We can use the solar panel for providing power to the boat instead of battery operation. To modify the size of boat according to its waste collecting capacity is increases. This project makes only for small lake and by doing some modification in its size and capacity it can be used in big lake and river like Ganga

12. CONCLUSIONS

On Calculating and Experimenting the result are very satisfactory. On the basis of these result we can conclude that it is an innovative method of minimizing manual stress and thus very much reliably stabilizing the in the river. The project carried out by us made an impressing task in the environmental purpose and it is very useful for the small scale works. Although this system able to collect the garbage from the lake with human intervention. The objective of the project was successfully achieved.

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