DESIGN ANALYSIS AND FABRICATION OF A SEWAGE CLEANING SYSTEM

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ABSTRACT

The present project proposal concept is to replace the manual work in drainage cleaning through mechanical system. Now a day's even through automation plays a vital role in all industrial applications in the proper disposal of sewages from industries and commercials are still a challenging task. Drains are used for the disposal of waste and unfortunately sometimes there may be loss of human life (Man holes) while cleaning the blockages in the drainage pipes. To overcome this problem and to save the human life we implement "sewage cleaning system". We designed the project to use this in efficient way to control the disposal of wastages and in regular disposal of wastes.

Keywords: Sewage Cleaning System, Fabrication.

I.INTRODUCTION

1.1 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 bottle, polythene bags, papers. These impurities present in drainage water can cause blockage of the drainage system. The drainage system can be cleaned time to time manually or such a system can be designed that will clear out wastages and will keep the water to flow. This project is designed to keep clean the drainage system and helps smooth working of the system. This project automatically cleans the water in the drainage system each time any waste appears and this form an efficient and easy way of cleaning the drainage system and preventing the blockage. It also reduces manpower If the garbage is allowed to flow the will end up flowing down recreational beaches used for tourism purposes making a scene not pleasurable to the eyes else these garbage flow to residential sites where they are burnt in a way of getting rid of them, thereby causing climate change. The drainage systems are cleaned when there is no water in them i.e. when it is not raining, but when it is raining the drainage systems cannot be cleaned because of the harsh conditions of the rain which no one would volunteer to endure to ensure garbage does not enter into the drainage systems. Automatic drainage water cleaning and control system using auto mechanism proposed to overcome the real time problems.

As this project is very compact as compared to other municipal machineries used to drain out the wastes. As the big machineries causes traffic jams on the roads and highways, but by using this we can easily remove waste easily and without causing any traffic jams. Our proposed system is to cleaning and control the drainage level using auto mechanism technique. Auto mechanism is the major controlling unit and the drainage level a monitor by municipal. In this system we used motor, chain, driver, bucket, frame. The devices is place across drain so that only water flow through lower grids, waste like bottle, etc. Floating in drain are lifted by bucket which is connected to chain. This chain is attached by gear driven by motor. When motor runs the chain starts to circulate making bucket to lift up. The waste materials are lifted by bucket and are stored in waste storage bin.

II. DESIGN OF PEDAL POWER HACKSAW:

2.PRINCIPLE AND PROPOSAL DESIGN

2.1 THEORY AND CONCEPTS

Wastewater is defined as the flow of used water from homes, businesses, industries, commercial activities and institutions which are subjected to the treatment plants by a carefully designed and engineered network of pipes. There are large number of machines used for removing out the wastes from drains.

2.2 WORKING PRINCIPLE

The devices is place across drain so that only water flow through lower grids, waste like bottle, etc. Floating in drain are lifted by bucket which is connected to chain. This chain is attached by gear driven by motor. When motor runs the chain starts to circulate making bucket to lift up. The waste materials are lifted by bucket and are stored in waste storage tank.

2.3 OBJECTIVE

The major objectives of the proposed work are, Design of mechanical drainer, considering the various factors that might affect the functionality of the equipment. Fabrication of the model and Assembling of the model carried out, then process are studied and optimized for effective automatic drainer for sewage water treatment for floating materials.

2.4 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 buckets 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 bucket and stored in storage or collecting bin. Once the collecting bin is full, the waste materials are removed from the bin.

Methodology used for whole processing of Drainage cleaning Machine is given below; this methodology gives way about how work is to be carried out in systematic way. It is standard process of describing process, how it is done in simplest manner.

2.5 SOR

In its most simple form, a schedule of rates can be a list in a contract setting out the staff, labour and plant hire rates the contractor will use for pricing cost reimbursable instructed day work.

However, on a much larger scale, a 'schedule of rates term contract', 'term contract' or 'measured term contract' may be used when the nature of work required is known but it cannot be quantified, or if continuity of programme cannot be determined. In the absence of an estimate, tenderers quote unit rates against a document that is intended to cover all likely activities that might form part of the works. As the extent of the work is unknown the unit rates include overheads and profit. General preliminaries such as scaffolding, temporary power, supervision and temporary accommodation will also have rates. On projects longer than say 18 months there might be escalation provisions based on annual percentage increase.

The design has been made taking standards specifications of SOR Municipal Corporation and set to fabricate.

III. DESIGN

3. <u>DESIGN OF SEWAGE CLEANING MACHINE</u>

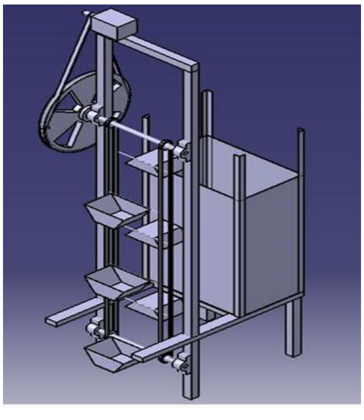

Figure 3.1 Proposed Design for Closed Drain

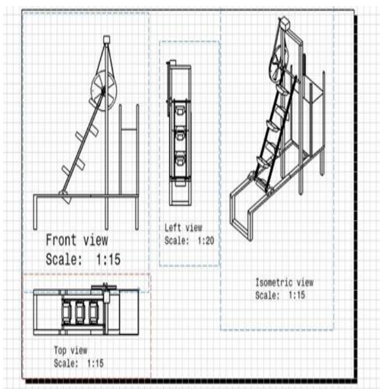

Figure 3.2 Drafting of Proposed Design for Open Drain

4. CALCULATION AND RESULTS:

While conducting the experiment the parameters considered are uniform flow rate of water, lifter speed and motor speed is constant.
Before going to find the final output, we need to check that whether our system is with stand the load conditions or not.
A. Stress calculations for stand base – The base is of the material mild steel and its yield strength is 248 MPa. The major loads acting on this base are listed below

Material	Quantity	weight
5 feet low carbon square hallow channels	2	7 Kg
Motor	1	5 Kg
Bin	1	8 Kg

The loads like Motor clamp, Journal bearing, Bolts and Nuts may be negligible because those loads are below 1 Kg.
Now,

Stress= load/area
Total load = 20 Kg + negligible loads
= 25 Kg
⇨ 25 kg = 20*9.81
Total load =196.2 Newtons
Area = l*b
= 176 $inch^2$
= 176* (25.4) mm^2
= 0.11354816 m^2
Stress = 196.2 / 113548.16

= 0.00172 KN/mm^2
= 196.2 / 0.011354816
= 1727.90 KN/m^2

Hence results show that it is safe.
Though the load conditions satisfy for stand base, here is a point to note that the load regarding Stand and motor mainly subjected directly on area of 38.1*38.1 mm^2 of the frame so as to support this frame base supports of length 13 inch are added on each corner of the frame to reduce stress or for additional support.
B. Stress and vibrations due to motor
The motor specifications ¼ H.P, 220v and50Hz
Clamping of motor done by M. S. strip to the M. S. plate. Here we noticed the vibrations are negligible by the following calculations
Fatigue limit for stress = ½ tensile strength
= 240mpa (max)
Which is a huge comparison value for¼ H.P motor
C. Stress due to rotation
The bodies like rings, circular discs, cylinders, flywheel, Etc. invariably rotate at high speeds and due to rotation, they are subjected to large magnitude of centrifugal forces. So here due to low speed stresses due to rotation is negligible.
Hence for considering all the above the design is said to be safe.
Now we have to calculate the output results based on some conditions.

Initial conditions:
Condition 1: Steady state of sewage
Condition 2: Dynamic motion
a) Parallel Flow
b) Counter Flow

Here we need the bucket elevator capacity and the time required to fill our bin regarding to above conditions and also calculations are done for the different pulley size and for the different chain sprockets.
The cases are as follows.
Case 1: pulley diameter = 8 inches & Sprocket diameter = 2.677165 inches
To figure out the capacity of a bucket elevator we have to calculate
1. Capacity of each bucket at water level (cubic inches).
2. Spacing of the buckets on the chain (centres)
3. Number of rows of buckets on the chain.
4. Speed of the belt or chain (feed per minute).
5. Product weight per cubic foot (Only if result is derived in tons or metric tons).
(A) Capacity in cubic inches of each running foot of the belt or chain = capacity of bucket water * spacing multiplier * number of rows of buckets.
(B) Capacity discharged per minute = capacity in cubic inches of each running foot of chain * speed of chain.
(C) Capacity Discharged per hour = Capacity discharged per min * 60

Standards:

Spacing multiplier (inches)	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5
Multipliers	3.43	3	2.67	2.4	2.18	2	1.85	1.71	1.6	1.5	1.41

Spacing multiplier (inches)	9	9.5	10	10.5	11	11.5	12	13	14	15
Multipliers	1.33	1.26	1.2	1.14	1.09	1.04	1.00	0.092	0.86	0.80

INITIAL REQUIREMENTS AND CALCULATIONS:

A. Bucket capacity
Length (l) = 8.5 inches
Width (a) = 6 inches width (b) = 2.5 inches
Depth (h) = 4.5inches
Bucket Volume = [l*h*(a+b)]/2 (shape of the bucket – trapezoid)
=101.5374 cubic inches
We know that 1ltr = 1000 cubic cm
= 61.023744 cubic. Inches
Capacity of Bucket= 1.6639 ltr
But here is an observation that, depending upon the conditions as previously said and considering the vibrations of the machine the bucket can't be fully loaded. So, a volume of 26.82% can be neglected for a safety factor.
Volume capacity of bucket can be fixed to 0.91 ltr
Number of buckets
Here the number of buckets = 6
For one complete revolution of chain the total volume = 6*0.91 litres
= 5.46 litres
B. Pit capacity
Pit capacity = length*width*depth
=11.5*20*30
=6900 inch^3
In terms of litres = 6900/61.023744
= 113.0707 litres
Now coming for conditions
Conditions 1 – static
Conditions 2 – dynamic
The above conditions calculations be done for the following
1) Sewage
2) Mango pulp

3) Sand
Sewage conditions 1: If the sewage is static and it is of full in the drain then it will collect a 3/4th part completely due to only of a driving force of bucket
Condition2: In parallel flow of sewage less than 3/4th of bucket is filled and in counter flow more than 3/4th of bucket is filled
However, these results can impact only the amount of sewage collected per minute but not on ultimate safe conditions because we are already checked the safe parameters for the maximum load conditions
Now let us consider the 4 cases one by one.

Case 1: pulley diameter = 8 inches & sprocket diameter = 2.677165 inches

Belt Drive
Motor – 1350 rpm with a pulley of 1 Inch diameter
8 Inch Diameter pulley is attached to shaft
Reduction of Speed Ratio = 1:8 = 168.75 rpm
2. Chain Drive
The Chain rotation can be calculated in two ways

I. Sprocket based calculations
II. Chain based calculations

Sprocket Diameter = 6.8 cm
Number of teeth of sprocket = 12

I. Sprocket based calculations

Number .of gaps in between chain links = 142
142/12 =11.8921
So by 11.8921 revolutions of sprocket can drive one complete rotation of chain
Revolution of chain = 14.190rpm

II. Chain based calculations

Perimeter of the circle = 2*π*r
Chain Length = 8.4 ft = 2560.32 mm = 256.032 cm
Perimeter of the sprocket = 2*π*3.4
Where R = 3.4 cm of sprocket

⇨ Perimeter of the sprocket = 21.352 cm.

No. of revolutions of sprocket for one revolution of chain = 256.032 / 21.352
= 11.9921
Total chain speed = 168.75 / 11.9921 = 14.071 rpm
To figure out the capacity of a bucket elevator we have to calculate
(A) Capacity in cubic inches of each running foot of the belt or chain = capacity of bucket water * spacing multiplier * number of rows of buckets.
(B) Capacity discharged per minute = capacity in cubic inches of each running foot of chain * speed of chain.
(C) Capacity Discharged per hour = Capacity discharged per min * 60
Note: You may have sludge level capacity of the elevator. Actual capacity would range from 10-20%. Let us take 10%.

A = 101.5374* 0.75 * 6
= 456.9183
B =456.9183*14.071
= 6428.8404
Capacity discharged per hour = 6428.8404*60
= 385730.4289
In cubic feet's = 385730.4289/1728
= 229.0106 cubic. Ft.

For actual capacity considering as +10%
= 229.0106*1.10 = 251.9117 Cubic. Ft/hr

Now for all above mentioned cases, considering actual capacity as 251.9117, then

⇨ Static = ¾*251.9117 = 188.9337 Cubic .ft./hr
⇨ Parallel < 188.9337

Counter > 188.9337
Similar calculations for pulp & sand. Here a change is that

1 bucket of sludge = 1.34 buckets of pulp
= 0.8 buckets of sand

Now we have to calculate the time required to fill the pit.
It's mainly depending upon sewage types
Sewage is mainly classified into two types

1. Muddy
2. Slurry

MUDDY TYPE SLUDGE CALCULATIONS
The calculations of actual capacity are same for this muddy type.
Hence we have to know the required time calculations
Chain rpm = 14.0107 rpm
For 1 rpm sludge collected = 0.91*6 = 5.46lts
Total pit capacity = 113.0707 lts
No. of rotations required = 113.0707/5.46 = 20.7089
Due to the heavy load the rpm of chain get reduced to 9 rpm.
Total time = 2.3009 minutes
SLURRY TYPE
Here a point to notice is that the problem is only due to the mud, because it struck and stop the flow so here water need to remove. Hence a small hole is presented below the pit.
If we consider 50% water as per mathematical calculations
100% mud = 2.3009 minutes
50% mud + 50% water = 2 minutes
Only 50% completed of pit is filled.
Hence 4.6019 minutes required to fill the pit.

5. RESULTS AND DISCUSSION:

Table 1: Analysis of various reduced speeds in small and large pullies:

S.no	Small pulley (inch)	Large pulley (inch)	Original rpm	Reduced rpm
1	1	8	1350	168.75
2	1	14	1350	96.42

Table2: time required to fill the bin

case	Mud (minutes)	Slurry (minutes)
1	2.3001	4.6019
2	3.45	6.90
3	0.8283	1.6852
4	1.8283	3.6566

Table 3: Time taken for discharging the bin.

Case	Capacity discharged per hour in cubic feet
1	229.0106
2	128.3332
3	591.296
4	371.889

Case 1: pulley diameter = 8 inches & Sprocket diameter = 2.677165 inches
Case 2: pulley diameter = 14 inches & Sprocket diameter = 2.677165 inches
Case 3: pulley diameter = 8 inches & Sprocket diameter = 7.0866 inches
Case 4: pulley diameter = 14 inches & Sprocket diameter = 7.0866 inches

From the calculations and it is identified case 3, the pully with 8 inches and taken diameter of the sprocket 7.0866 inches the discharge identified is higher when compared to case 1, 2 and 4. The amount of substances tend to discharge with respect to case 3 eventually evident practically.

6. CONCLUSION

The drain waste water cleaner machine is designed and manufactured by using gear changing and shaft coupling principle. It consists of mainly AC motor, shafts, waste removal buckets, collecting bin, bearings, sprocket and chains. Construction materials are easily available, creates employment (construction and maintenance), simple to construct. 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 was 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.

- In the treatment system of drainage Waste water control by the motor, roller chain and sprocket, lifter and the collecting 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.

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