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DESIGN AND DEVELOPMENT OF AUTOMATED DRAIN SEWAGE CLEANER

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ABSTRACT

Drain cleaning job is denigrating and dangerous as workers are exposed to harmful gases like methane and ammonia. Workers are also at the risk of bacterial infections. This study is to replace the manual work in drainage cleaning by automated system. Also, water is of great importance to humans. The water in the is drain full of solid wastes like polythene, bottles and other harmful chemicals. The drains get blocked due to these solid wastes in water. In quest to find a way out from this problem, this study on "Automatic sewage cleaning system" has been carried out. This study has enabled to segregate solid wastes with minimal human intervention. This work can serve the society the process of cleaning the drainage system, in turn reduces spreading of disease to mankind.

KEYWORDS: *Drainage system cleaning, Sewage cleaners, Automated sewage cleaners*

I. INTRODUCTION

Water, running through drainage system usually carries along waste materials, most of which are non biodegradable. Overflow of drainage water through drainage system occurs when there is a blockage at an end of the drainage system forcing the water to find its way elsewhere apart from the mapped out drainage system. The running water spills over the horizontal height of the drainage system spreading to regions alongside the drainage system, thereby causing problems such as pushing down of structure such as fences, water logging of farm lands and residential building. Drainage system get blocked most times by garbage like nylon, plastic, bottles and empty cans which cluster together and find their way into the drainage system. If this garbage is allowed to flow, it blocks the system due to which water flow gets distracted and it comes out of the drainage cover. The method followed nowadays to clear these blockages are either by using suction machine which is a costly method way or by road sweeper or an unskilled worker who has to enter the drainage hole and clean it manually which is dangerous for their health. 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 severe conditions of the rain which no one would volunteer to endure to ensure garbage does not enter into the drainage systems. These solid wastes separated either by suction machine or manually are not properly disposed they are allowed to litter in the nearby areas. Also, non uniform size of the drainage lines is one of the major issues for designing a universal cleaning machine.

II. 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 liters 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. Ones the collecting bin is full, the waste materials are removed from the bin.

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III. MODELING

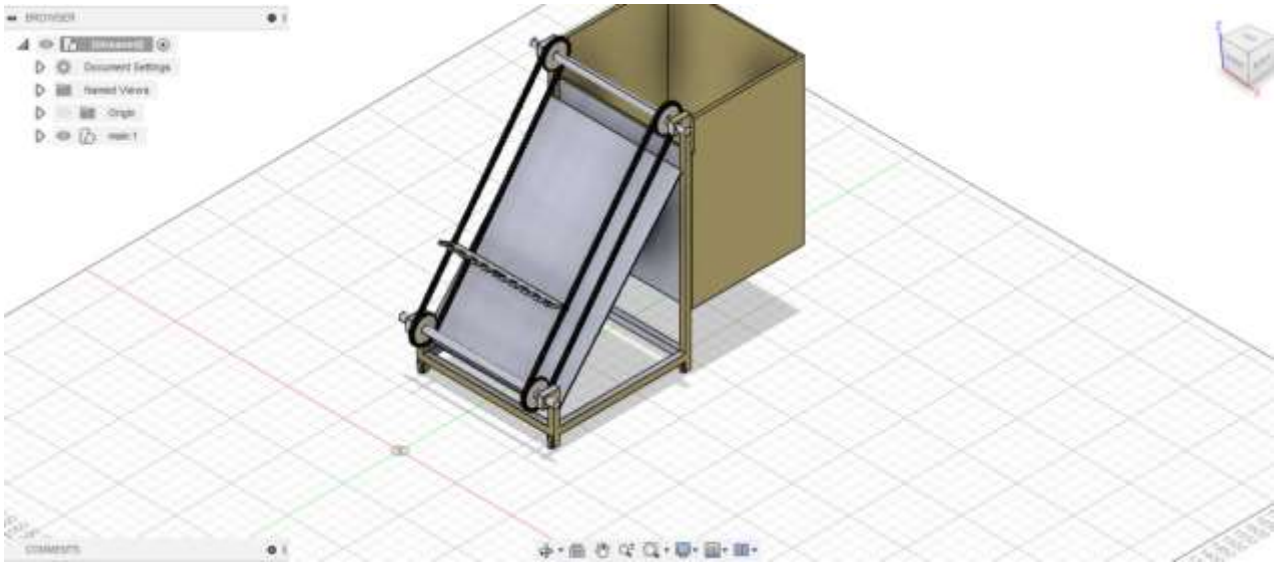

Figure1: CAD Model of Automated Sewage Cleaner
(Model created on Autodesk Fusion 360 Software)

IV. CALCULATION

1. Calculation for base frame

Assumptions
Total load on frame is about 10kg
$F = m\ x\ g$ = 10 × 9.81 = 98.1 N
This load is applied at the center.

2. Selection of motor

Speed (N)= 30 rpm
We suppose the weight of garbage = 4kg
Pulley distance is =320mm
FOS = 1.5
Force = 4× 9.81 = 39.24 N
Torque = Force × Distance = 39.24 × 320 = 12556.8 N-mm = 12.5568 N-m
Therefore,
Maximum Torque = 12.5568 × 1.5 = 18.8352 N-m
Now,
Power = (2πNT)/60 = (2π × 30 ×18.8352)/60 = 59.17 watts.
Therefore, Selecting motor of power of 84 watts so losses can be avoided.
Voltage: 12 volt
Current: 7 amp
Speed: 30 rpm

3. Shaft calculation

power: 84 watt
speed: 30 rpm
assume load factor Kl: 1.75 (from design data book ,assuming electric motor)
T=60×Pr×Kl/2×π×N

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=60×84×1.75/2×π×30
T=46.79 Nm
Assuming SAE1030 as material for shaft having Syt=296 mpa.(from design data book)
Take FOS=2.5
τ=syt/2×fos
τ=296/2×2.5
τ=59.2 mpa.
Now,
Applying maximum principle shear stress theory.
τ=16Td/π×d³
59.2=16×46.79×10³ /π×d³
D=15.90 mm.
Considering bending stresses
D=15.90×1.5
D=23.85 mm.
Selecting standard diameter of shaft from design data book.
Therefore
D=25 mm.

4. Calculation of Bearing

Bearing selection completely depends on shaft diameter, here we have selected the perfectly safe shaft of diameter 25mm. Since the shaft is of diameter 25mm so we have used the bearing of 25mm ID. The bearing no. 204 pedestal bearing is used because it is self-aligned bearing.

V. COMPONENT SPECIFICATIONS

Sr.No.	Component Name	Specification	Quantity
1.	Frame	M.S.60*40 cm	1
2.	DC Motor	12V,60 RPM	1
3.	SMPS	230V to 12V,1A	1
4.	Roller Chain	----------	2
5.	Chain Sprocket		4
6.	Lifter		1
7.	Push ON Switch	----------	1
8.	Shaft	25mm Diameter	2
9.	Bearing	Inner Diameter	2
10.	Collector Bin		1

Table 1: Component Specifications

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VI. DEVELOPED MODEL

It is a main part of machine which holds all other parts on it. It is made up of mild steel because it satisfies all the conditions required. Also,it is easily available in the market.

Automated Drain Sewage Cleaner

VII. RESULT AND DISCUSSION

- The result of this design and fabrication indicates that while cleaning drain, front two are uniform flow rate of water, depth of the channel is 1 feet and height of the channel is 3 feet, rate of disposal of waste is uniform, lifter speed and motor speed is constant.
- 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 half day. Quantity of waste collecting in the collecting bin is nearly 5-6 kilograms.

VIII. CONCLUSION

- In the treatment system of drainage, waste water control by the machine and the collecting bin to activate 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 rain which has more volume of running water with garbage and high velocity. Risk of labors catching infections or poisoning due to large amount of waste and chemicals will reduced.

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IX. FUTURE SCOPE

- These cleaners are easy cheapest way to fix drainage problems. Easy to operate, as no special skill is required.
- Reduction of labor oriented method of cleaning, thus upgrading dignity of labor.
- Light weight and easily portable. Requires nearly 12-24 volts of power

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