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Sewage Waste cum Blockage Cleaning Machine - A Review

Avinash Kumar Thakur[1], Mehfooz Alam[2], Durgesh Nand Chaudhary[3], Kapil Dev Sharma[4], Manash Dey[5]
[1, 2, 3]*UG scholar Department of Mechanical Engineering,* [4, 5]*Assistant Prof. Department of Mechanical Engineering, JIMS Engineering Management Technical Campus, Greater Noida, India*

Abstract: ***This undertaking thought processes is to propose the idea of semi-computerized sewage cum blockage cleaning machine, to supplant the manual exertion in cleaning septic tanks, sewers, channels and so forth. Waste and sewer blockage are significant reason for spreading sicknesses to human. Thus, this orderly machine utilizes a proficient method to control the transfer of wastage in sewer pipelines. Inverter is another power source if there is an occurrence of rustic regions.***
Keywords: Drainage, Blockage, Blade cutter, Water Jetter, Power source, Battery

I. INTRODUCTION

Sanitation is the main area that is missing with the utilization of high advances of the present world. This has turned into a reason for significant worry to the world. Sewers, septic tanks and waste are constructed just to give the entire sanitation in rustic and urban regions. Squander water through these sewers can be reuse by the procedure of waste water treatment however non-biodegradable debasements like polybags, plastics and so on present in these sewers make blockage and cause numerous maladies and to clean this manual searching is finished. In this way, our principle design is to stay away from manual endeavors in cleaning blockage of sewers and waste. This manual exertion in cleaning sewers has raised a few issues including casteism and racialism. This Manual exertion is legitimately named as Manual Scavenging which is the dangerous procedure of evacuation of human waste and excreta from cans or different compartments that are utilized as toilets or from the pits of lavatories. The International Labor Organization depicts three types of manual searching: Removal of human feces from open avenues and "dry lavatories" (which means straightforward pit restrooms without a water seal, yet not dry toilets by and large).

Cleaning septic tanks, Cleaning canals and sewers. More than 50 million individuals in urban India poo in the open each day. Sixty-six percent of the ladies in Delhi ghettos are verbally manhandled, 46 percent are stalked and more than 30 percent are physically struck while getting to toilets.80% of India's surface water contamination is by virtue of sewage alone. Upwards of 4,861 of 5,161 urban areas the nation over doesn't have even a halfway sewerage arrange. Around 1,000 youngsters beneath the age of five pass on consistently in India from the runs, hepatitis-causing pathogens and other sanitation-related sicknesses, as per the report of United Nations Children's Fund. Anybody, who has ever needed to manage a sewer or even private septic tank, thoroughly understands obstructs and back-ups. Cleanser rubbish buildup, oil, hair, nourishment, mineral stores and more would all be able to make a deplete back up. As much as individuals attempt to be watchful with what they send down the tube, it is relatively inescapable that these things will sooner or later go through inevitably causing stops up. Indeed, even as watchful as you are with oil you may not specifically dump it down the deplete but rather the rest of the oil on pots, skillet and plates can cause a film that throughout the years can develop and cement. Some of the time a basic unclogging could do yet after masses of develop and excessively visit blockages, maybe great sewer jetters would be a more powerful strategy that will likewise last bounty longer.

II. LITERATURE REVIEW

[1]Prof. P.R. Sirsat [1], showed literature paper content which focuses on Fully Automation cleaning device of River. Waste debris is collected from the river shore and the waste collecting capacity of machine is limited at a time also this machine is able to collect the waste which is only floating on water level.

[2]Prof. Ajay L. Krishnani [2], reviewed about drainage cleaning to replace manual work to automated system. This helped us in reviewing to semi automatic way. Their proposed system is used to clean and control the drainage level using auto mechanism technique.

[3]Prof. Nitin Sall, [3] showed blockage is the major cause of the pollution and flooding in various cities majorly including residential area of cities. they tried to explain about the design of the cost effective, easy method to control the water level of the tank wirelessly and automatically. Hence, they have designed the drainage blockage detection system to avoid such blockage problems.

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III. DESIGN CALCULATION

A. Selection of Pulley

P = 0.5HP = 746/2=373 W = 0.373kW

(Induction Motor of 380W is available in single phase with 1500 rpm speed and three phase with 2100 rpm speed; Domestic purpose we are using Single phase Induction Motor and further calculation is done with 1500 rpm speed.)

Given, N_1 = 1500 rpm

N_2 = 1100 rpm (Minimal Speed reduction Due to several losses.)

1) Diameter of Smaller & Bigger Pulley.

$V = (\pi.d.N_1) / (60 \times 1000)$

$d = [60(1000) \times 18] \div (\pi \times 1500)$

(Using average belt speed = 18 m/s)

= 229.29mm ≈ 224 mm = 22.4cm

$D = d \times (1500/1100) = 305.45 \approx 315$mm = 31.5cm

(Closest pulley values are selected from Table 13.4 - 13.5 of machine design book V.B. Bhandari)

2) Maximum Power for Selection

(From Table 13.1, the Load correction factor for the light machine tool is 1.2)

Max. Power = 1.2 × 0.380 = 0.4476 kW.

3) Arc of Contact factor (F_d)

$2_s = 180° - 2.\sin^{-1}$ (D-d / 2C)

$= 180° - 2.\sin^{-1}$ (315-224 / 2 × 500) = 169.55° (From Table 13.2 of Design data Book of V.B. Bhandari)

$F_d = 1.08$

4) Corrected Power

Corrected Power = 1.08 (0.4476) = 0.4834 kW

5) Corrected Power Rating of Belt

Selecting a HI-Speed belt, the corrected rating at a belt speed of 17.58 m/s is given by:

Corrected belt rating = (0.0118 × 17.58) / 5.08 = 0.0406 kW.

6) Belt Length

$L = 2C + \pi(D+d)/2 + (D-d)^2/4C$

$= 2\times500 + 3.14(315+224)/2 + (315-224)^2/4\times500$

= 1000 + 846.23 + 4.1405

= 1850.37mm = 1.85 m. = Belt specification Length.

B. Design of Shaft

P=373 watt N=65 rpm

Ds=65 mm Dc=150 mm

1) Step 1: Selection of Material

From Design Data Book (DOB)

Table 2-7 Properties & uses of typical plain carbon steel.

For the application of shaft 1 selection is of c-30 (SAE 1030).

Soft material

Se = 527 Mpa Syt = 296 Mpa.

Sys =183 Mpa G = 79 Gpa.

2) Step 2: Permissible Shear Stress (Z Max

According to ASME Code

The permissible shear stress Z max for shaft without keyways is taken as 30% of yield strength in tension or eighteen percent of the ultimate tensile strength of the material or whichever is minimum.

Therefore

Z_{ind} = 0.3; S_{yt} = 0.3 * 296 = 88.8 N/mm2

Z_{ind} = 0.18; Sut = 0.18 * 527 = 94.86 N/mm2

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Take Z_{ind} = 88.8 N/mm2)
But the cutter and sprocket are keyed on the shaft therefore according to the ASME code.
Z_{ind} value reduced by 25%
Z_{max} = 0.75 N/mm2; Z_{ind} = 0.75 * 88.8
Z_{max} = 66.6 N/mm2

3) Step 3: Torque Transmitted (T)

$P = 2\pi N T_{mean} / 60$
$7373 = 2\pi * 65 * T_{mean} / 60$
T = 54.78 N-m
As the sprocket and cutter are mounted on same shaft
Ts = Tc = 54.78 N-m
Ts = Fs * Rs → 54.78 = Fs * 0.065 / 2
Fs = 1685.53 N
Tc = Fc* Rc → 54.78 = Fc * 0.15 / 2
Fc = 730.4 N

4) Step 4: Bending Moment (M)

Calculating the resultant bending moment from dig.
Vertical Loading Diagram (VLD)
Vertical Load acts due to only cutter.
Ra + Rb = 730.4 N
Ra = Rb = 730.4/2 (Due to Symmetric Loading)
Ra = Rc = 365.2 N
Vertical Bending Moment Diagram (VBMD)
V.BMD = Ra x Ld = 365.2 x 0.16
V.BMD = 58.423 Nm
Horizontal Loading Diagram (HLD)
The horizontal load acts only due to sprocket
Fs = 1685.53
Ra + Rb = 1685.53 N (1)
Taking moment about point (A)
O = 1685.53 * 0.08 – Rb * 0.32
Rb = 1685.53 * 0.08 / 0.32
Rb = 421.38 N
Ra = 1685.53-421.38 from equation 1)
Horizontal Bending Moment Diagram (HBMD)
H.BMC = Ra * Lc = 1264.14 * 0.08
H.BMC = 101.13 N-m

5) Step 5: Resulting Bending Moment (M)

Select max. Value of BM from the VBMD & HBMD.
Note - Select always the Like BM
We get from diagram
$M = \sqrt{(58.4.32^2 + 101.13^2)}$
M = 116.79 N-m

6) Step 6: Diameter of Shaft (d)

As per ASME Code
Kb = 1.5; Kt = 1 (For gradual Load application)
Te = M + T
Te = √(M2 + T2)
$\pi/16 * Z_{max} * d3 = \sqrt{(M*Kb)2 + (T * Kt)2}$

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$\pi/16 * 66.6 * d3 = \sqrt{}[(116.79000 * 1.5)2 + (1* 54.78000)2]$
D = 24.12 mm = 25 mm
So the diameter of shaft is 25mm.

IV. MECHANICAL COMPONENTS

A. Adjustable Head

It is the main designed and modified part of the whole cleaning machine. It comprises of three parts i.e. rotating cutter, a water nozzle to get the water jet stream and an adjustable frame support.

B. Cutter

Opening clogged drains calls for tough equipment. That's why sewer and drain cleaning equipments are made with the most durable components. They are high quality tools and are designed to be dealt as replacement tool units.

Fig.1: A three blade cutter.

C. Water Jet nozzle

Use of water jets is best described as the process of using high-pressure water to blast through soil, cement, roots or rock causing blockage so as to create pot holes or to create pathways for further easing the work load on cutters by removing soap scum residue, grease, hair and food blockages in drains as well as for maintaining and cleaning product conveyance lines. Nozzles are also great for cutting root, removal of mineral deposits and corrosion, tube cleaning and industrial pipe. Smaller nozzles, typically about 1/8th" are the best size to use for such application. Also, this application requires special spray patterns using multiple jets that has range from 0 to 25 degrees.

D. Adjustable Frame Support

Adjustable Frame support of head is design in such a way that cutter can insert in different diameter pipe, outer peripheral of cutter is flexible which change its shape according to the diameter of pipe in which it would insert, so we don't have to change cutter for different diameter size of pipelines.

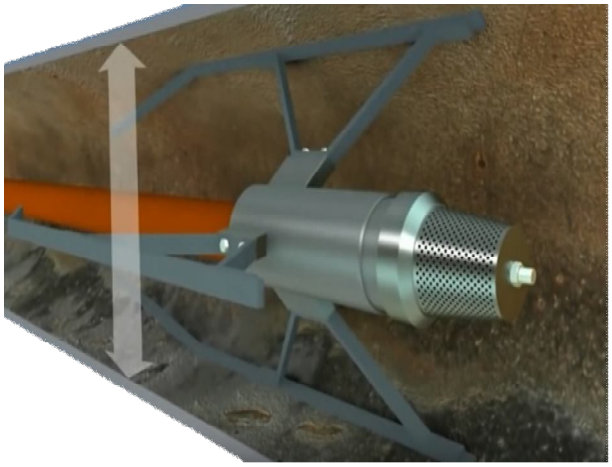

Fig.2: An adjustable frame support for the head

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E. Belt Drive

In this a belt is a looped which is a strip of flexible material used to mechanically link two or more rotating shafts. It offers smooth transmission of power between shafts at a considerable distance. Belt drives are used as the source of motion to efficiently transmit power or to track relative movement.

Fig.3: A belt drive.

1) Advantages

a) Belt drives can transmit power over considerable distance between the axis of driving and driven shafts.
b) The operation of belt drives are smooth and silent.
c) They can transmit only a definite load, which when exceeded, will cause the belt to slip over the pulley, thus protecting the parts of the drive against overload.
d) They have the ability to absorb the shocks and damp vibration.
e) They are simple to design.
f) They are low in initial cost.

2) Disadvantages

a) Belt drives are of large dimensions and occupy more space.
b) The velocity ratio of belt drives are not constant due to belt slip.
c) They impose heavy loads on shafts and bearings.
d) There is considerable loss of power resulting in low efficiency.
e) Belt drives have comparatively short service of life.

V. ACKNOWLEDGMENT

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VI. CONCLUSION

In the project we have designed such an arrangement of sewage cleaning system which is quite important for the safety purpose and also the operational cost have been reduced which also eliminates human labor which makes it less time consuming and also effective way of collecting the wastage and the Blade cutter design with water jetting combination is important part in this project. This modification is the new Design idea on which this project is majorly based.

This project is very much beneficial to that area where manpower is unable to do the cleaning work and collecting the wastage. So, we have developed such system which not only helps in cleaning the wastage but also saves lot of time and money as its operational cost is very minimal. In the generation to come the use of plastics and reusable items are going to increase tremendously so keeping that in mind the concept of our project is to produce a clean area so that our younger generation gets a better world to survive.

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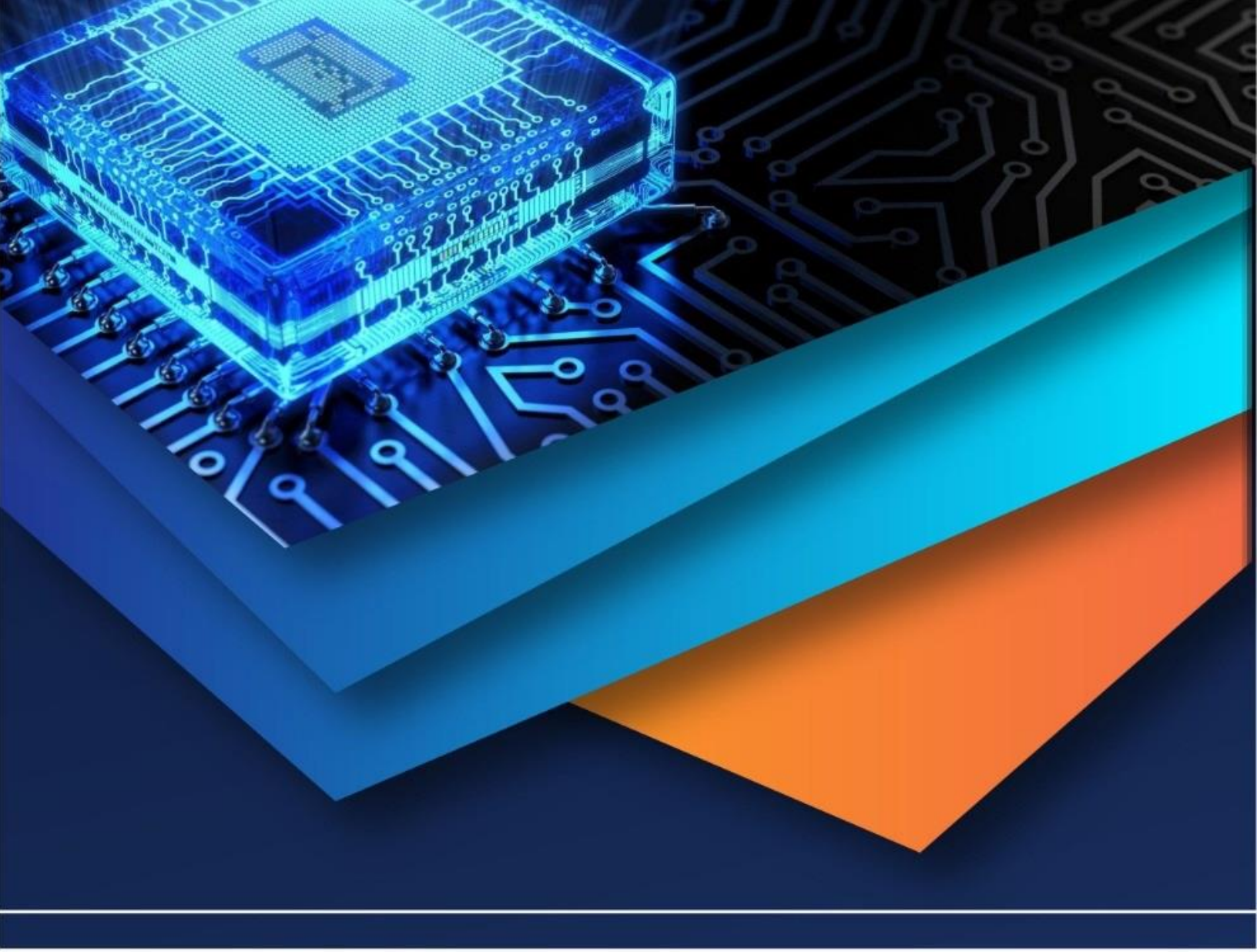

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