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Automated Sintex Water Tank Cleaning Device Design And Manufacturing

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ABSTRACT
The Water tanks are usually left alone, they are not cleaned on a regular basis and the effect of this is recurring illness from water borne diseases such as diarrhoea, amoebiasis, cryptosporidiosis, giardiasis, and other gastrointestinal diseases caused by swallowing contaminated water. It is already uncomfortable to get into the sintex tank and clean it. Hence, we have come up with a customized design of a motorized sintex cleaner that will reduce the human effort and will efficiently clean the sintex.
Hard brushes are used in this cleaner which will clean the walls and bottom of the sintex water tank effectively. The purpose of this project is to reduce the human efforts and to avoid the chemical influence on health of person entering the tank for cleaning. In this modern world, cleaning of overhead tanks manually is a tedious job. To overcome this, we have aimed at tackling the disadvantages of cleaning overhead tanks, so an automatic system overhead tank cleaning is designed to provide high safety, high efficiency, less time for cleaning and to avoid environmental pollution problems.

The water tank cleaner is used to clean the water tanks by using rotating brushes. This method will be more effective and safer than the conventional methods. This method is capable to clean water tanks within less time and human efforts advanced model for tank cleaning system is cleaning the tanks thus making the operation user friendly.

The future scope of the project is to extend it with auto feeding mechanism by which the manpower involved in feeding gets removed.

Keywords—water tanks ,Automatic motorized sintex water tank cleaning instrument ;

I. INTRODUCTION
Water is one of those natural resources, which is essential to every human being for many purposes, especially for drinking. We already know that earth is composed of water (three-fourth of the earth), but the entire three fourth isn't fresh water. Therefore, it is our duty to save water, keep the fresh water as fresher as possible, and to keep it free from water pollutants. The water that's pumped to our home is undoubtedly clean, but is the place where it gets stored clean as well? Yes, we are talking about the overhead water tanks. The health of your water largely depends on how clean your water tank is. Hence, cleaning overhead water tank is very necessary.

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Every day we use the tank water for brushing and bathing, for cleaning and moping, for washing clothes and in other household chores. With the passage of time, sediments scale and algae get deposited on the walls, ceiling, and floor of the water tank. This can eventually clog pipes. Hence water tank cleaning is very important. Manual Cleaning water tank method is the traditional method of cleaning the water tank where a labour would get into tank and scrub the wall. The water tank can also be cleaned by using chemicals to remove the dirt and sediments. The chemicals used may affect the human health. Pressurized water can be sprayed on the walls of the tank which will remove the dirt from the tank surface.

These methods are time consuming and require more efforts for cleaning. Tank cleaning is extremely hazardous activity. When working in confined space personnel are exposed to several hazards that in some cases have led to injury or even death. There is various definition of a 'confined space' through are consistently applied. "a place which does not have benefit of natural ventilation" and, "a place which difficult to enter therefore present hindrance to rapid escape in case of an emergency." Cleaning overhead water tank on your own may be difficult because you need different types of tools, equipment and most importantly the time. But overhead water tank cleaning is important too and it must be cleaned at least once or twice a year. Design and fabrication of motorized sintex water tank cleaning instrument (1000 litres.)

A Dirty overhead tank can be terrible because it will accumulate dirt that can easily dissolve in the water contained in it. Frequency of overhead water tank cleaning completely depends on the quality of the water being supplied in your area. If you are supplied with hard water or water containing solvents, then you need to clean your tank more often, at least more than once or twice a year. And to ensure better and effective cleaning you can hire professional water tank cleaners, because they have trained employees and proper equipment to clean overhead water tank.

Water tanks are usually left alone, they are not cleaned on a regular basis and the effect of this is recurring illness from water borne diseases such as diarrhoea, amoebiasis, cryptosporidiosis, giardiasis, and other gastrointestinal diseases caused by swallowing contaminated water.

It is already uncomfortable to get into the sintex tank and clean it. Hence, we have come up with a customized design of a motorized sintex cleaner that will reduce the human effort and will efficiently clean the sintex. Hard brushes are used in this cleaner which will clean the walls and bottom of the sintex water tank effectively.

II.Methodology

This is a design for machine that can clean the overhead storage tank within several minutes effectively. It consists of a frame made of mild steel which sits on top of the tank neck concentrically, a support rib is made at the centre of the frame, a vertical slot in the block is made in which the rack is made to translate in vertical direction (y-axis).
A brush holder is fitted at the bottom portion of the rack where two brushes are mounted on its lateral surface and a custom-made flexible brush is fixed directly below the holder. This brush is made from materials like sponge, foam, and bristle sheet. A small motor is also mounted at end of rack where a spur gear set is used to rotate the brushes which will clean the walls of the tank.

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The rack and the brush holder are connected through a joint. This joint has two bearing which are used to impart smooth rotational motion, both of the parts are held at the joint with a key at each end refer fig.2.1.

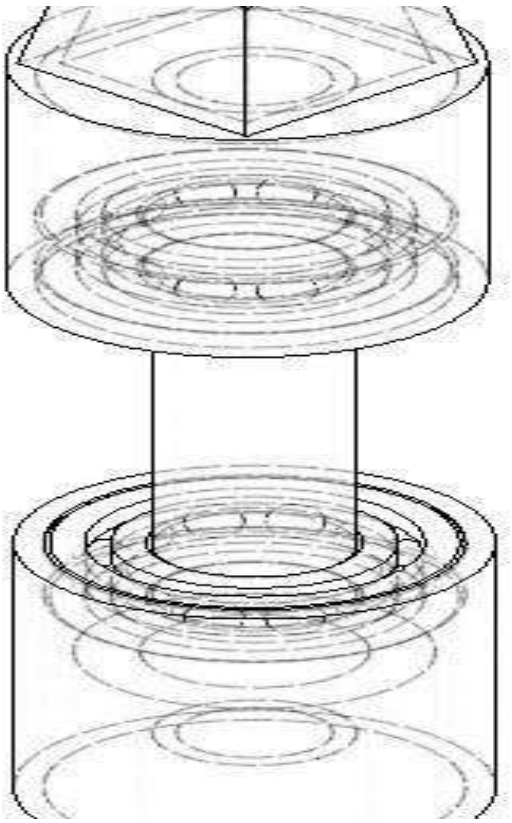

Figure 2.1 – join

THE WHOLE ROTATING MECHANISM IS MADE TO GO DOWN STEADILY USING THE RACK AND PINION ARRANGEMENT. AND ONCE IT REACHES THE BOTTOM OF THE TANK IT CLEANS THE BOTTOM PART IN 5-10 ROTATIONS. AT THE END A SUCTION PIPE IS USED TO SUCK OUT ALL THE MUDDY WATER THAT IS PRESENT AT THE BOTTOM OF THE TANK

1. WORKING PRINCIPLE.

First, the water from the tank is completely drained out. Detergent or any other cleaning solution is then sprayed on the inner wall of the tank for easy removal of dirt. The assembled machine is then inserted into the tank, but the brushes are in retracted position until it enters the tank. The brushes are attached to the ends of telescopic rod. The telescopic rod is then adjusted according to the tank diameter in such a way that brushes at end of the shaft meets the wall of the sintex tank.

After the proper instalment of the machine into the tank the motor is now switched ON. The motor is responsible for the rotation of the brushes and this causes the scrubbing of inner wall of the tank. For cleaning the bottom portion of the tank, the whole mechanism is reciprocated

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along the guide ways with the help of handle connected to the rack and pinion arrangement. In this way the tank gets cleaned within minutes.

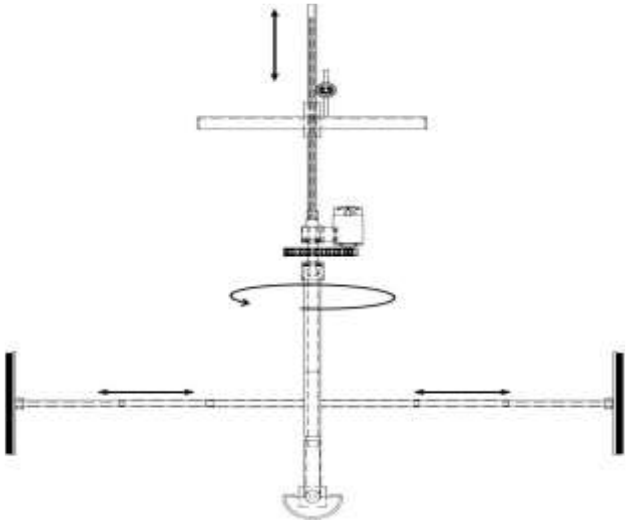

Figure3.1 Working principle of the machine

2. DESIGN.

RACK AND PINION

A rack and pinion are a type of linear actuator that comprises a pair of gears which converts rotational motion into linear motion. A circular gear called "the pinion" engages teeth on a linear "gear" bar called "the rack". Rotational motion applied to the pinion causes the rack to move relative to pinion. Thus, the motor attached to the rack is moved in vertical direction along the guide way with the help of hand attached to the pinion.

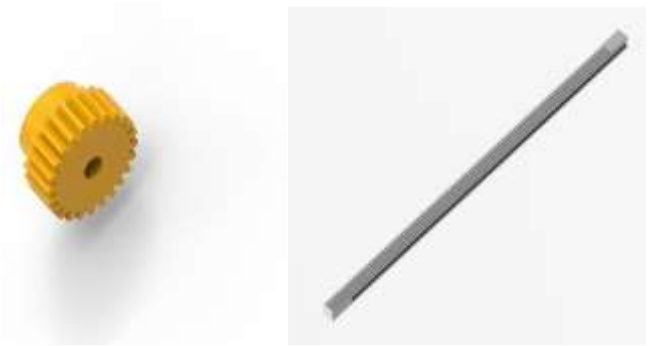

Fig 4.1 (a) Pinion ; (b) Rack

SPUR GEAR

A gear is a rotating machine part having cut teeth which mesh with another toothed partto transmit torque. Spur gear teethare manufactured by either involute profile or cycloidalprofile. Most of the gears are manufactured by involute profile with 20° pressure angle.When two gears are in mesh at one instant there is a chance to mate involute portion withnon-involute portion of mating gear.

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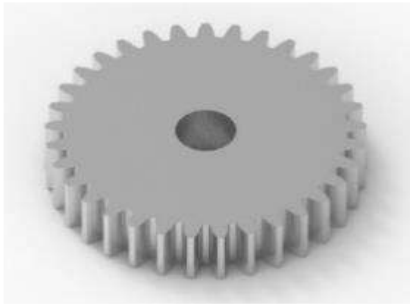

Fig 4.2 Gear

FRAME

Frame is an open structure that gives shape and support to something, such as the transversestiffening ribs of a ship's hull or an aircraft's fuselage or the skeletal beams and uprights ofa building.[9] The frame is manufactured completely out of mild steel; the dimensions arebased on the dimensions of the manhole of the sintex tank of 1000L capacity. A guide is

also provided on which the rack travels carrying the cleaningattachment

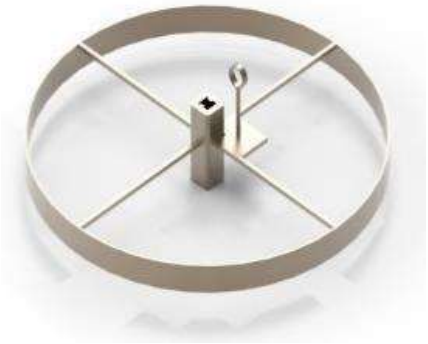

Fig 4.3 Frame.

RACK FIXTURE

A fixture is a work-holding or support device. Fixturesare used to securely locate (position in a specific location or orientation) and support the work. It holds the rack and keeps it in the position throughout the operation.

Fig 4.4 Rack fixture

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SIDE BRUSH

The brushes are made up of Poly Vinyl Chloride (PVC) polymer. Brushes attached to the ends of telescopic rod revolve due to rotation of motor shaft to clean the inner surface of the tank.

Fig 4.6 Side brush

BALL BEARING

A ball bearing is a machine element that constrains relative motion to only the desired motion and reduces friction between moving parts. 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.

Fig 4.7 Ball Bearing

MOTOR

A machine that converts electrical energy into mechanical energy by means of the forces exerted on a current-carrying coil placed in a magnetic field.[9]A commercially available motor of 12V DC and 350 rpm is used in the machine. On this motor a pinion is mounted and then this is meshed with the gear to rotate the cleaning attachment.

Fig 4.8 Motor

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BOTTOM BRUSH

The bottom brush is made from foam material, sponge, and bristle sheet / cover. The sponge in the brush's core gives its flexibility and easy to clean after use. The foam material is just provided for some more flexibility which will help to clean the floor of the tank moreefficiently. The overall dimensions are taken from the tank itself keeping in mind of clearances required for safe operation of the machine.

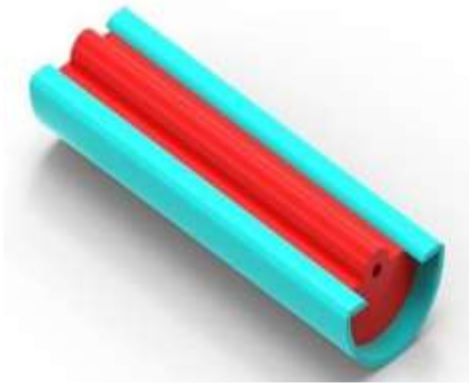

Fig 4.9 Bottom Brush

BOTTOM BRUSH HOLDER

At the cylindrical rod it is fixed to the rack as extension part at bottom a bottom brush is fixed with the help of fasteners.

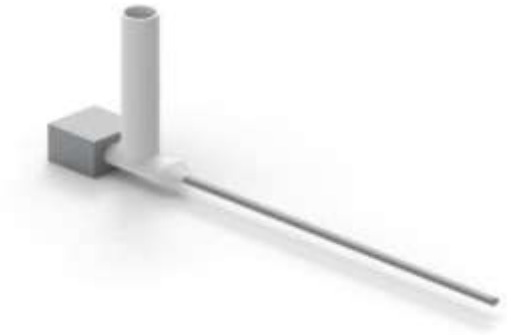

Fig 4.10 Bottom Brush Holder

Brush holder

The brush holder is designed and manufactured from aluminum and sheet metal. On each lateral surface a telescopic rod is attached, at the other end of these telescopic rods, brushes are attached. Below this attachment a provision is made to assemble the bottom brush before inserting it into

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the tank. As this attachment rotate due to the motor the bottom brush also rotates and cleans the floor of the tank.

Fig 4.11 Brush holder

CONNECTOR

It joins the telescopic rod and rack bottom end.

Fig 4.12 Connector

TELESCOPIC ROD

Used to increase or decrease the length of a rod to ensure the contact between brush and wall of the water tank.

Fig 4.13 Telescopic rod

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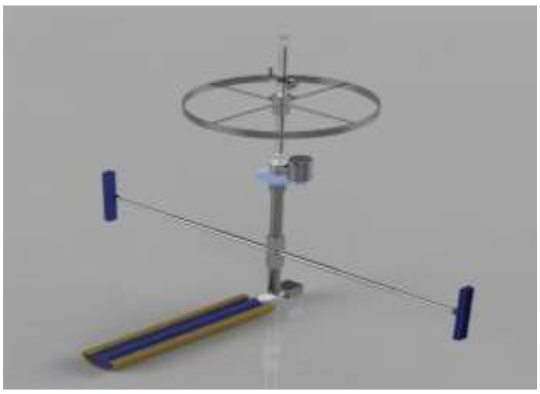

Fig 4.14: Assembled view of the machine

V SELECTION OF MATERIAL

Following engineering materials [7] are used based on strength, ease of manufacturing and cost. Most of the Design procedure is followed by referring the book Design of machine elements 1[6] and Design of Machine elements [8]

1. Mild steel (C40) 2. GI pipe 3. Foam and sponge
4. PVCpipe

1). MILD STEEL

Mild steel (iron containing a small percentage of carbon, strong and tough but not readily tempered), also known as plain-carbon steel and low-carbon steel, is now the most common form of steel because its price is relatively low while it provides material properties that are acceptable for many applications. Mild steel contains approximately 0.05–0.30% carbon making it malleable and ductile. Mild steel has a relatively low tensile strength, but it is cheap and easy to form; surface hardness can be increased through carburizing. In applications where large cross-sections are used to minimize deflection, failure by yield is not a risk so low-carbon steels are the best choice, for example as structural steel. The density of mild steel is approximately 7.85 g/cm3 (7850 kg/m3 or 0.284 lb/in3) and the Young's modulus is 200 GPa. These properties are suitable as, all the strength values of the design lie within this limit. Most of the industries readily accept the orders for rack cutting in this material which saves the cost and after heat treatment it can be very durable for strenuous operation. Refer fig. 5.14

Figure 5.1:- Mild steel

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2). GI PIPE

Standard iron consists entirely of the metal element iron, whereas galvanized iron has an added layer of zinc to it. When iron is galvanized, it's submerged in a bath of liquid zinc. The zinc is heated so that it changes from a solid state to a liquid state. The iron is then dipped into the bath of molten zinc, after which it's allowed to cool. Once the zinc cools, it hardens to form a protective shell over the surface of the iron. Galvanized iron is essentially iron that's been coated with a protective zinc layer on the outside. Iron itself is susceptible to weather-related degradation. When exposed to moisture and oxygen, for example, iron will rust andcorrode. Over time, the presence of the rust and corrosion can eat through the iron, essentially jeopardizing its structural integrity.[12]

GI pipe has adequate strength for holding the brush attachment of the machine in place during operation. Refer fig 5.15

Figure 5.2:- GI Pipe

3). FOAM AND SPONGE

Foam rubber (also known as cellular, sponge, or expanded rubber) refers to rubber that has been manufactured with a foaming agent to create an air-filled matrix structure. Commercial foam rubbers are generally made of either polyurethane or natural latex. Latex foam rubber, used in mattresses, is well known for its endurance. Polyurethane is a thermosetting polymer that comes from combination of Methyl di- isocyanate and polyethylene and some other chemical additives.

A sponge is a tool or cleaning aid made of soft, porous material. Typically used for cleaning impervious surfaces, sponges are especially good at absorbing water and water- based solutions. Since the bottom brush is designed in-house, common materials are considered such as foam, since it is soft and can be easily given a shape of suitable dimensions. On which a material with bristles can be fixed and use for cleaning the bottom surface. The sponge will be used to make the inner body, so that even with overtravel of the rack won't cause damage neither to machine nor the tank which is being cleaned. Refer fig 5.16 (a) & (b)

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Figure 5.3:- (a) Rubber Foam (b) Sponge

4) PVC PIPE

Polyvinylchlorideis the world's third-most widely produced synthetic plastic polymer. About 40 million tons of PVC are produced each year. PVC comes in two basic forms: rigid (sometimes abbreviated as RPVC) and flexible. The rigid form of PVC is used in construction for pipe and in profile applications such as doors and windows. It is also used in making bottles, non-food packaging, food-covering sheets, andcards (such as bank or membership cards). It can be made softer and more flexible by the addition of plasticizers, the most widely used being phthalates. In this form, it is also used in plumbing, electrical cable insulation, imitation leather, flooring, signage, phonograph records, inflatable products, and many applications where it replaces rubber. With cotton or linen, it is used in the production of canvas.
PVC is a lightweight and durable material for this project as it is used as a holder or body for the bottom brush. It is easily available and economical also. Refer fig.5.17

Figure 5.17:- PVC pipes

VI CONCLUSION

The water tank cleaner was used to clean the water tanks by using rotating brushes. This method was more effective and safer than the conventional methods. This method is capable to clean water tanks within less time and human efforts. For cleaning the tank, we need one worker which take more time as well as water. As we know, now a day's wastage of water is a great issue. To resolve these issues, we made this machine at great priority.

• The water tank cleaner will be used to clean the water tanks by using rotating brushes. This method will be more effective and safer than the conventional methods

• This method is capable to clean water tanks within less time and human efforts, thus making the operation user friendly.

• The working prototype is promising in terms of imparting cleanliness.

References

[1] https://www.ngwa.org/what-is-groundwater/About-groundwater/information-on- earths-water

[2] ShubhamShrivastav, Hari Om Kumar, "Design and Development of Cylindrical Water tank cleaner" Int. j. emer. technol. adv. Eng. (IJETAE), Volume 6, Issue 1, January 2016.

[3] ThongeSuraj D, Shelke Prasad K, WakteVaibhav B, ThongeSharad A, Prof. Shinde R.S "Automatic Water Tank Cleaning Machine", Int. res. j. eng.Techno;. (IRJET), pp1674-1676 Volume: 04 Issue: 02 Feb -2017.

[4] Mr.Yogesh K. Chaudhari, Mr.Nitesh B. Patil, Mr.Sachine A. Khangal, Mr.Nisar

S. Shaikh, Mr.ShrikantU.Nagare "Design & Fabrication of Water Tank Cleaning Machine" Int. j. res. appl. sci. eng. technol. (IJRASET), pp278-282 Volume 6 Issue V, May 2018.

[5] Rohit R. Dabhade, Shubham V. Lasankute, Sanket P. Wankhade, Shubham G. Darokar, Prof. Vikramsingh R. Parihar, "Automatic Overhead Water Tank Cleaning System: A Review and an Approach", Int. j. adv. res. sci. eng. technol. (IJAERS), pp- 185-194, Vol-5, Issue-10, Oct- 2018.

[6]J.B.K Das and P.L.Srinivasanmurthy, "Design of machine elements-2", Sapna Book House (P) Ltd, (2012).

[7]Bhandari, V.B., 2018, "Engineering Materials", Design of Machine elements 4/e, McGraw Hill Education (India) Private Limited, Chennai, pp 19-50.

[8] Bhandari, V.B., 2018, "Spur Gears", Design of Machine elements 4/e, McGraw Hill Education (India) Private Limited, Chennai, pp 634-676.

[9] Collins English Dictionary.

[10] K. Mahadevan, K. Balaveera Reddy, 2018, "Design Data Handbook for Mechanical Engineers in Si and Metric Units", 4the (revised), CBS Publishers & Distributors, Patparganj, Delhi, 110092.

[11] https://www.sintexplastics.com/products/water-storage-solutions/sintex-water- tanks/

[12] https://monroeengineering.com/blog/what-is-galvanized-iron/