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Design and Fabrication of Semi - Automatic Tank Cleaner

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Abstract

Cleaning becomes tedious when mankind cleans either chemical tanks or water tanks manually. This problem becomes the key idea for us to bring out this eco-friendly equipment. The entire machine works on the basic principle of "Centrifugal Force". As it is a simple equipment consisting of motor attached with regulator to control its speed., AC connection is required to run the motor. The motor shaft is connected with two ball bearing of size 2 inches to steady the motor from slip. This primary construction rests above the cap of the tank. The secondary construction consists of hallow shaft (Stainless Steel) of about 65cm connected to the motor. With some basic dimensions, brake cables are attached to the hallow shaft using brass welding. A ball gross is fitted to another end of the cables along with the scrubbers. Square plate is welded and scrubbers are attached to clean the bottom surface. As soon as the power supply is given, motor speed is regulated and required speed is obtained. Now the hallow shaft starts rotating and due to centrifugal force, the brake cables rotates outwards which in turn, the ball gross obtains a twisting moment by touching the inner surface of the tank. Thus, the impurities get removed when the scrubber wipes the surface of the tank. At the same time, bottom surface is cleaned with the bottom scrubber. The gap between two ball bearing ball is cleaned by loosening the cap outwards so that the entire set up will be lifted to some amount. Hence the impurities are removed through the discharge valve present at the bottom of each tank. The material used for fabricating the blades in Wind Turbine is Glass Fiber Reinforced Plastics with the diameter of 500mm, length of the blade is 600mm with chord length of 100mm and the blade profile is NA CCA 0015. It may be utilized in the houses for power generation to reduce the cost for being economical. It also plays a vital role in reducing utilization of conventional energy and mobility to utilize the power.

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I. INTRODUCTION

1.1 GENERAL

This project deals with the fabrication of semi-automatic tank cleaning machine. The aim of this project work is to develop and modernised process for cleaning the chemical waste, algae, fungus and various dust particle present inside the tanks used either in chemical industries or water tanks. It is very useful for cleaning the tanks. It is mainly useful in chemical industries and widely used in houses, hospitals, auditorium, shop, malls, etc. In modern days we never find time to clean the tanks which leads to unhealthy life.

Cleaning of dust particle from water tank is essential for our generation to lead a healthier life. Every day the tank becomes dirty and stores different types of dust particles in it.

Using this requirement entire chemical sediments and dust particle can be removed. In our project tank is cleaned automatically by inserting the equipment inside the tank. Hence our project is very useful in day to day life.

Semi-Automatic tank cleaner is very much useful in chemical industries and widely used in houses, hospitals, auditorium, shop, malls, etc. It is very simple in construction and easy to operate.

Anybody can operate this machine. Skilled labours are not required to operate it. Time taken for cleaning and cost is very less.

1.2 IMPORTANCE OF CLEANING

The goal of this project “Semi-Automatic Tank Cleaner” is to develop and modernized process for cleaning the chemical waste, algae, fungus and various dust particles present inside the tanks used either in chemical industries or water tanks. It is very useful for cleaning the tanks.

It is very simple in construction and easy to operate. It consists of scrubbers mounted on the ball bearing balls which is easily replaceable if it is worn. Its time consumption is very less and cost effective. Maintenance cost is also less. But there is several tank cleaning equipment which has lots of drawbacks.

The size of the machine is also portable and a person can do this equipment with initial amount and can start a small-scale business using it and can fix a certain amount for cleaning in industries, houses, shops, etc.

1.3 PLACES WHERE SATCs ARE USED

1.3.1 CHEMICAL INDUSTRIES

Storage of chemicals in chemical industries are only in tanks of cylindrical shape. These tanks are to be cleaned for the next storage of chemicals in the same tanks.

With these types of machines these tanks can be cleaned with less labour and less cost also thereby maintain clean surroundings.

1.3.2 HOUSES

Nowadays majority of families are middle class families. 85% of them will have overhead water tanks for drinking and other purpose. They don't have time to clean it

To lead a healthy life those tanks should be cleaned twice a month and our machine fulfils this need with less labour cost.

1.3.3 SHOPPING MALLS

In this modern life people spend their leisure time mostly in malls. Approximately more than 1000 people gather every day in every mall. So, cleaning of water tanks once in a week is must in malls and also mall contains a greater number of tanks.

1.3.4 EDUCATIONAL INSTITUTIONS:

Our country is one of the best countries in education when compared to other part of the world and it has more schools and colleges. By cleaning the water tanks here, students are prevented from diseases and infection

1.3.5 HOSPITALS:

Water in the hospitals must be clean which is drunk by the patients and outsiders. cleaning of tanks is must in these places to lead a healthy life for patients.

II. LITERATURE SURVEY

THE tank must be cleaned to ensure that water stored in the tank does not become contaminated by dirt or traces of the substance the tank previously held. This can be achieved by our equipment. The health effects of drinking contaminated water can range from no physical impact to severe illness or even death.

Some of the effects of drinking contaminated water can be immediate, or not noticed for many years. These include gastrointestinal and stomach illnesses like:

- Nausea
- Vomiting
- Cramps
- Diarrhea

Sayasin Khongsavath, World Vision Laos' water and sanitation coordinator says" drinking unclean water puts children at risk. As children in danger of deadly bouts of diarrhoea, parasites and other water related diseases,"

During rainy season also it is difficult to clean the tanks manually. These are reason which became the main idea to invent a tanks cleaning equipment which is useful for both industries and houses, hospitals, etc.

2.1 MANUAL METHODS IN CHEMICAL INDUSTRIES

In manual methods workers are engaged with their body fully covered special dress also face must be covered. It becomes highly dangerous in those chemicals strikes the body surface. Also, there is a chance of inhaling hazardous gases by the labour.



2.1.1 DEMERITS:

- Consumers more time.
- Requires skilled labour
- Charges for the labour is high
- Huge risk factor is there if chemicals strikes the body

2.2 MANUAL METHODS IN HOUSES, HOSPITALS AND MALLS

This is the general and basic method which is in practice. Also this is the ancient method of cleaning the tanks. In this method labour enters inside the tank and cleans the tank either by coconut scrubber. brushes also used for cleaning purpose



2.2.1 DEMERITS:

- Labour cost is high
- Scratches are highly possible inside surface of tank
- Time consuming process

2.3 USING WATER GUNS:

This is the better modern method of cleaning the tanks this method is preferred more than manual cleaning. But it requires more water to clean the tank.

2.3.1 DEMERITS:

- More amount of water is required for cleaning
- Labour and machine cost are high
- Cost is high

III. DRAWBACKS OF THE EXISTING SYSTEM

3.1 BY MANUAL METHODS

- Time consuming
- Requires more labour
- Affects labour hand
- Not more efficient

- Chemicals may affect the labour
- Less area is cleaned for more time

3.2 BY USING MACHINERIES

- Complicated in design
- Minimum a single labour is required to operate it
- Difficult for the users the operate
- More amount of water is required
-

IV. FIELD STUDY

For designing the semi-automatic tank cleaner, filed study has been done in our collage, nearby schools and houses in Pondicherry

The following inferences were made based upon the field study:

- Manual methods of tank cleaning.
- Time for cleaning the tank.
- Period of working hours for the sweepers
- Cleaning methods of the existing the processes

4.1 MANUAL METHODS OF TANK CLEANING

This is the general and basic method which is in practice. Also, this is the ancient method of cleaning the tanks. In this method labour enters inside the tank and clean the tank either by coconut scrubber or by normal scrubber. Brushes also used for cleaning purpose.

4.2 TIME TAKEN FOR MANUAL WORKERS TO COMPLETE WORK

The stages of work for manual workers are given in the tables 4.1

Stages of work for manual workers

APPROX CLEANING TIME(MINS)	NO. OF LABOURS	DESCRIPTION
40	2	For cleaning the tans in our houses.
70	3	For tank cleaning in school & collages

4.3 COST OF LABOUR WORK

All the details given below are approximate values of the measurement.

- Overall cost of labour for cleaning the big tanks manually in collages is 1000Rs for a single cleaning and for the small tanks manually it is about 500Rs.

If machine is used, for big tanks it is 1300Rs and for house hold tanks it is 600Rs.

V. MATERIALS AND METHODS OF THE PROSPOED SYSTEM

5.1 DESIGN OF PROPOSED SYSTEM

Our machine is suited to operate at any seasons. “semi-automatic tank cleaner” is to develop and modernized process for cleaning the chemical waste, algae, fungus and various dust particles present inside the tanks used either in chemical industries or water tanks. It is very simple in construction and easy to operate. It consists of scrubbers mounted on the ball bearing balls which is easily replaceable if it is worn.

Our main aim of the proposed design is to minimize the man power in cleaning process and reduces the time of work. One of main drawback of the existing system is, it creates health problem when he sent inside the tank for cleaning. Also cleaning requires larger workers. Our proposed idea comprises of:

Stage 1: some amount of water in filled inside the tank and cleaning powder is also mixed with it.

Stage 2: entire setup is inserted into the tank for cleaning.

Stages: AC source is connected to the regular which is connected to motor for further operation.

Stage 4: on this stage the hallow shaft starts rotating so that the scrubber cleans the inner surface.

Stage 5: all this operation will come into action only when the regulator is pressed at required speed.

5.2 3D DESIGN OF SYSTEM USING PRO-E SOFTWARE

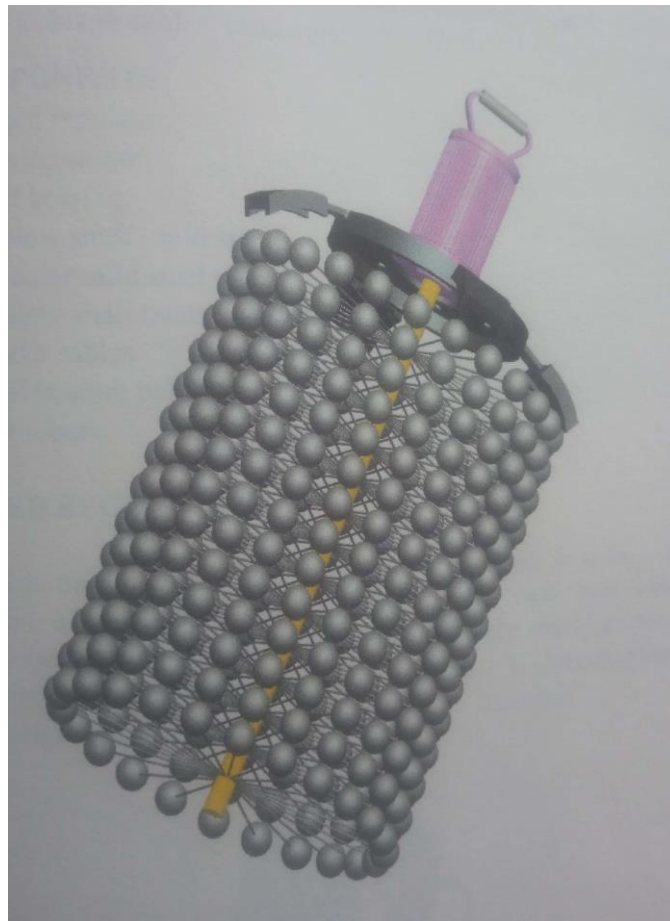
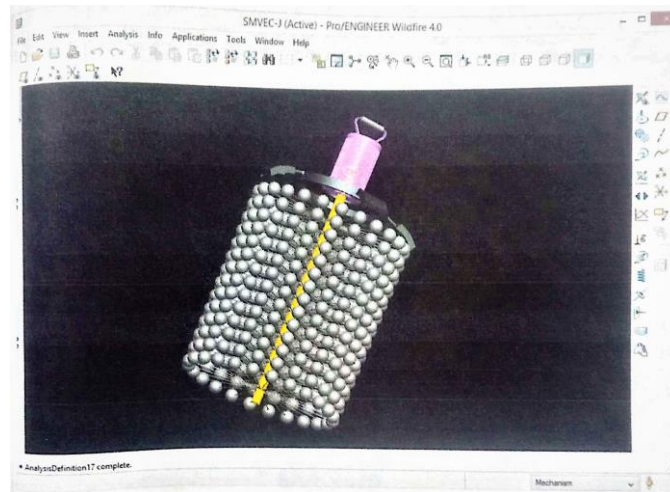
PTC Creo, formerly known as Pro/ENGINEER, is a 3D CAD/CAM/CAE feature-based, associative solid modelling software. It is one of the suites of 10 collaborative applications that provide solid modelling, assembly modelling, 2D orthographic views, finite element analysis, direct and parametric modelling, subdivisional and NURBS surfacing, and NC and tooling functionality for mechanical designers

Creo Elements/Pro offers a range of tools to enable the generation of a complete digital representation of the product being designed. In addition to the general geometry tools there is also the ability to generate geometry tools there is also the ability to generate geometry of other integrated design disciplines such as industrial and standard pipe work and complete wiring definitions. Tools are also available to support collaborative development.

A number of concept design tools that provide up-front industrial design concepts can then be used in the downstream process of engineering the product. These range from conceptual industrial design sketches, reverse engineering with point cloud data and comprehensive free-form surface.

Creo Elements offers a range of tools to enable the generation of a complete digital representation of the product being designed. In addition to the general geometry tools there is also the ability to generate geometry of the other integrated design disciplines such as industrial and standard pipe work and complete wiring definitions. Tools are also available to support collaborative development.

The below screen shoot implies the design of our equipment using pro-e modelling software and analysed using it.



5.3 MATERIALS OF THE PROPOSED SYSTEM

The main component of the semi-automatic tank cleaner is sewing motor, brake cables, scrubbers.

5.3.1 COMPONENTS

- 1) Speed regulator
- 2) Sewing motor
- 3) Ball bearing
- 4) Hollow shaft
- 5) Circular mild
- 6) Hollow shaft

- 7) Brake cables
- 8) Ball bearing balls
- 9) Scrubbers

5.3.2 SPEED REGULATOR

This is the important part of the entire machine. It is the primary construction of the entire setup and this is the only part which is connected through the wire and kept away from the machine. Speed of the motor is regulated by this machine. AC source is directly connected to it and then the power is directly transmitted to the motor



5.3.3 MOTOR

It is the primary construction of the machine which is attached to the entire set up itself. It is rested above the circular mild steel plate. Shaft of the motor is connected to the hollow shaft by welding process.

SPECIFICATION

TYPE : ¼ HP motor with regulator
 POWER : 65W
 SOURCE : AC OR DC SOURCE
 RPM : 10000 rpm
 PHASE : single



5.3.4 BALL BEARING

The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. It achieves this by using at least two races to contain the balls and transmit the load through the balls. In most applications, one race is stationary and the other is attached to the rotational assembly. As one of the bearing races rotates it

causes the balls to rotate as well. Because the balls are rolling, they have a much lower coefficient of friction than if two flat surfaces were sliding against each other.

Generally speaking, a bearing is a device that is used to enable rotational or linear movement, while reducing friction and handling stress. Resembling wheels, bearings literally enables devices to roll, which reduces the friction between the surface of the bearing and the surface it's rolling over. It's significantly easier to move, both in a rotary or linear fashion, when friction is reduced this also enhances speed and efficiency.

Here we have used two ball bearing inside the hallow shaft. These bearings hold the shaft of the motor for steadiness and stiffness



5.3.5 HALLOW SHAFT (Mild Steel)

Here mild steel hallow shaft is used whereas the ball bearing is present inside it. Mild steel is used because it is present outside the cap of tank. It acts as a casing for the ball bearing. Gas welding is used and it is attached with the circular plate.

Mild steel is normally used for creating pipes, bullets, armor, chains, nuts, and bolts, hinges, magnets, cable, wires and knives. Mild steel can also be made stronger if more carbon is added to it. Also, there are modern treatments that can be applied to mild steel which can delay or even entirely prevent corrosion in it.



5.3.6 CIRCUALR MILD STEEL PLATES

Mild steel is a type of steel alloy that is composed of high amounts of carbon as one of its ingredients, companies such as mild steel will tell you. Alloy is essentially a mixture of metals and non-metals which are created to have certain specific properties. Mild steel is different from stainless steel due to its chromium content.

When the two are compared stainless steel contains a lot of more chromium. Two circular plate is used in upwards and downwards of the cap. Both plates are locked together with the nuts and bolts. This is mainly used for the balance and stiffness of the entire set up to rest on the cap.



5.3.7 BRAKE CABLES

Brake cables are always acts as a spring type and it is the main equipment where centrifugal force is acted in it while the brake cables are attached to shaft by brass welding.



5.3.8 BALL BEARING BALLS

Here about 20 balls are used that is attached to the other end of the brake cables by brass welding for more stiffness and attachment of the balls.



5.3.9 SCRUBBERS

Using a tag these scrubbers are held above the ball bearing balls. These are easily replaceable when it is torn. It is the only object which have the contact between machine and inner surface of the tank.



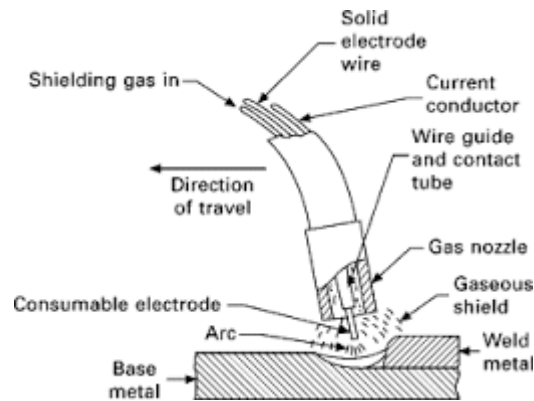
5.4 WELDING PROCESS

In our machine welding plays a vital role to complete the machine setup. For this purpose we have used two types of welding. Such as:

5.4.1 GAS METAL ARC WELDING

Along with the wire electrode, a shielding gas feeds through the welding gun, which shields the process from contaminants in the air. The process can be semi-automatic. A constant voltage, direct current power source systems, as well as alternating current, can be used. There are four primary methods of metal transfer in GMAW, called globular, short-circuiting, spray, and pulsed-spray, each of which has distinct properties and corresponding advantages and limitations.

GMAW is fully used in the primary arrangement since it consists of only mild steel where GMAW is only highly suitable for it.



5.4.2 BRAZING

Brazing is a metal joining process in which two or more metal items are joined together by melting and flowing by melting and flowing a filler metal into the joint, the filler metal having a lower melting point than the adjoining metal.

Brazing differs from welding in that it does not involve melting the work pieces and from soldering in using higher temperatures for a similar process, while also requiring much more closely fitted parts than when soldering. The filler metal flows into the gap between close-fitting parts

TANK AND ITS PROPERTIES

Semi-automatic tank cleaner is very much helpful in chemical industries and widely used in houses, hospitals, shops, malls, etc. it is very simple in construction and easy to operate.

Anybody can operate this machine. Skilled labours are not required to operate it. Time taken for cleaning and cost is very less.

Some of the basic properties of these tanks are:

- Light weight and durable
- Hygienic
- Quality tested and approved by high laboratories
- Maintenance free
- Rust free

5.5 TANK CAPACITY

- Loft water storage tanks (Capacity: 100-1000 litres)
- SINTEX -RENO Cylinder vertical water storage tanks (capacity:200-25000 litres)
- Cylindrical vertical triple layer white water storage tanks (capacity: 500-10000 litres)
- Underground water storage tanks (capacity: 1000-6000 litres)
- Septic tanks (capacity: 1000- 5000 litres)
- FRP underground water storage tanks (capacity: 10000-50000 litres)
- SMC panel tanks (capacity:8000-1200000 litres)
- Household drums (capacity:50-225 litres)
- Water bins
- MCGM(BMC) Approved SMC lids (covers)

VI. SELECTION OF MATERIAL

Mild steel, also known as plain carbon steel, is now the most common form of the steel because its price is relatively low while it provides material properties that are acceptable for many applications. Low-carbon steel contains approximately 0.05-0.25% 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. It is often used when larger quantities of steel are needed, for example as structural steel. The density of mild steel is approximately 7.85g/cm³ and the young's modulus is 210 GPa.

Stainless steel differs from carbon steel by the amount of chromium present. Unprotected carbon steel rusts readily when exposed to air and moisture. Unprotected carbon steel rusts readily when exposed to air and moisture. This iron oxide film is active and accelerates corrosion by forming more iron oxide; and because of the greater volume of the iron oxide, this tends to flake and fall away.

6.1 FABRICATION OF STATIC EQUIPMENT

In general, the machine is created by selecting material and then welding process is done. It is done by the following procedure.

- Stainless steel shaft is selected because of its high yield strength.
- One channel of hollow shaft 65cm long and 5cm outside diameter.
- Gas cutting is employed to cut the channels to the required dimension
- Brazing is used to join the channels at the required spot
- Brake cables are cut using cutting plyer.
- Ball bearing balls are attached with it.
- Finally, the lower part is finished and the upper part is joined using coupling work.
- The upper part is completed by gas metal arc welding with motors fixed.
- Ball bearing is used and this acts as a primary arrangement

Mild steel has relatively low tensile strength, but it is cheap and easy to form, surface hardness can be increased through carburizing.

6.2 ASSEMBLY ON SATC

Step 1: at first construction starts with stainless steel rod. Correct materials is selected at required dimension and using gas cutter it is made to cut

Step 2: here comes the brazing process, brake cable of 17 cm length is made to cut and attached to ss shaft at 20 different places with required dimension

Step 3: then at the other end of the cables ball bearing balls are attached and scrubbers are mounted above it using a tag.

Step 4: sewing motor is attached to a rod, bearing balls are attached that rod for steadiness of rotation.

Step 5: Casing is made with this of mild steel rod.

Step 6: those casing is attached with the circular plate above the tanks plate

Step 7: coupling is used to connect the SS shaft and motor shaft

Step 8: this becomes the primary arrangement with a speed regulator outside the machine

6.3 WORKING PRINCIPLE

The entire machine works on the basic principle of “centrifugal force”.

Considering the point of construction, it is a simple equipment consisting of sewing motor attached with regulator to control its speed. AC connection is required to run the motor. Now motor shaft is connected with two ball bearing of size 2 to steady the motor from slip. This primary construction rest above the cap of the tank.

Secondary construction consists of the hallow shaft of about 65cm connected to the motor. With some basic dimensions brake cables are attached to the hallow shaft using brass welding. Square plate is welded and scrubbers are attached to clean the bottom surface

As soon as the power supply is given moor speed is regulated and required speed is obtained. Now the hallow shaft starts rotating and due to centrifugal force, the brake cables rotates outwards which in turn, ball gross obtains a twisting moment by touching the inner surface of the tank. So, the impurities get removed when the scrubber wipes the surface of the tank. At the same time bottom surface is cleaned with the bottom scrubber. The gap between two ball bearing ball is cleaned by loosening the cap outwards so that the entire set up will be lifted to some amount. Hence the impurities are removed through the discharge valve present at the bottom of each and every tank.

Our main aim of this proposed design is to minimize the man power in cleaning process and to reduce the time of work. One of the main drawbacks of the existing system is it creates health problem when he sent inside the tank for cleaning. Also cleaning requires large workers.

VII. FEASIBILITY STUDY

Based on the information collected analysis between manual cleaning method and semi-automatic tank cleaner is made.

7.1 MANUAL METHOD

For larger tanks

No. of labour required = 3

Daily wage of each labour = Rs. 300

Total cost = Rs.1300

7.2 OUR PROPOSED CALCULATION

For larger tanks

No. of labour required = 1

Daily wage of labour = Rs.200

Total cost = Rs.500

7.3 COST ANALYSIS

Our project has taken total expensive of Rs.3600 for designing, fabrication and completion

Sl.NO	COMPONENTS	PRICE
1.	Ss hallow shaft	Rs.170
2.	Brake cables (4)	Rs.120

3.	Ball bearing Balls (20)	Rs.200
4.	Scrubbers (8)	Rs. 50
5.	Circular mild steel plate (2)	Rs.200
6.	Hallow mild steed plate (2)	Rs.60
7.	Ball bearing (2)	Rs.200

Total cost= Rs.3600

VIII.CONCLUSION

In manual methods workers are engaged with their body fully covered special dress also face must be covered. It becomes highly dangerous in those chemicals strikes the body surface. Also, it take huge time to clean it. Also, there is a chance of inhaling hilarious gases by the labour.

With the fabrication of semi-automatic tank cleaning machine. The aim of this projected work is to develop and modernized process for cleaning the chemical waste, algae, fungus and various dust particles present inside the tanks used either in chemical industries or eater tanks. It is very useful for cleaning the tanks

It is mainly useful in chemical industries and widely used in houses, hospitals, shops, malls, etc. In modern day we are in a search of money and don't have to clean the tanks which lead to unhealthy life.

Cleaning of dust particles in water tank is a very important for our health and reduces the man power requirement. Every day the tank becomes dirty and stores different types dust particles from the water itself

Using this equipment entire chemical sediments and dust particles can be removed. In our project tank is cleaned automatically by inserting the equipment inside the tank. Hence our project tank is very useful in day to day life semi-automatic tank cleaner is very much useful in chemical industries and widely used in houses, hospitals, auditoriums, shop, malls, etc. It is very simple in construction and easy to operate.

Anybody can operate this machine. Skilled labour are not required to operate it. Time taken for cleaning and cost is very less.