PVC Water Tank & Slurry Cleaning Machine

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Abstract. House hold PVC water tanks are normally 500 to 1000 L and it is very difficult to enter inside the tank and sometimes hazardous also for cleaning the surface. So a need for a machine arises which can operated easily by a common person for cleaning the slurry and the surface of the tank without getting inside the tank. Aim of this project is to develop a mechanical system for cleaning domestic cylindrical water tank. When the motor is started the linkage rotates and with the help of brushes, cleaning of wall and base of tank takes place. 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.

1. Introduction

1.1 Necessity of Cleaning Water Tank

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 deposition contaminates the water and makes it unfit for use. With time algae and bacteria grow and breed in this water infect it and could make us fall sick eventually. Hence water tank cleaning is very important.

1.2 Methods of water tank cleaning

Manual scrubbing in which wall and floor of tank are scrubbed to remove dirt, sediments, fungus and stains, but this method is more tedious and time consuming. 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.

1.3 Alternate Method

All methods of cleaning water tank as discussed above are time consuming and require more human efforts. So alternate method is required for cleaning purpose which will overcome the drawbacks of all other methods. Therefore we are developing water tank cleaning equipment which requires less time and human efforts for cleaning.
2 Main components

2.1 Pump

1A centrifugal type water pump is used to throw the dirty water out of the tank. The advantage of using rotary positive displacement pump is that it can pump out high viscous fluid with larger flow rate as viscosity increases.

![Water Pump](image1)

The specifications of pump are as follows:
- Material: Stainless steel
- Dimensions: 80 x 48 x 63mm
- Pump Inlet Diameter: 16 mm (outer), 12 mm (inner)
- Pump outlet Diameter: 12 mm (outer), 7 mm (inner)
- Voltage: 24 V
- Flow rate: 0.1 L/s
- Speed: 3000 rpm
- Material: Stainless steel

2.2 Secondary Motor

A DC geared motor is used to run the brush which is attached perpendicular to the axis of rotation of the pump. The main purpose of the motor will be rotate the cleaning brush at high torque at low rpm for effective cleaning of the water tank surface.

![Secondary Motor](image2)

Specifications:
- RPM: 200 rpm
- Voltage: 6-12 V
2.3 Cleaning Brush
A nylon bristle brush is attached to the motor which is used to clean the bottom and side surface of the water tank.

![Cleaning Brush]

**Figure 3: Cleaning Brush**

2.4 PVC Pipe
A PVC pipe of 1 inch diameter is used to hold the pump and motor housing together. It also acts as a housing for the connecting wires which are connected to the pump and motor. Along the PVC pipe a water pipe will run which will carry the water lifted by the pump outside the water tank.

2.5 Knuckle Joint
A knuckle joint is used to connect the PVC pipe and the pump and motor housing together. It acts as a bridge between the two. The main purpose of the joint is to change the axis of rotation of cleaning brush. An attachment is made on the joint which will keep the joint in steady position at different angles. Knuckle joint will help in cleaning different faces of the water tank.

![Knuckle Joint]

**Figure 4: Knuckle Joint**

2.6 Initial Sketching and 3D design:
The initial 3D model consisted of single motor mounted on a casing. This casing will be attached to a knuckle joint which will be used to change the axis of rotation of the motor. This knuckle joint will be further attached to a vertical shaft which will be held by the operator for performing cleaning operation.

3. Procedure
3.1 Market Survey:
In market survey we were not able to find what we were looking for which led to changes in the design of the project.
3.2 Changes in the Design:
Due to unavailability of the material proposed earlier following changes were made in the design of the model. Two motors are used instead of a single motor. The primary motor i.e. the water pump will lift the dirty water outside the water tank and the secondary motor will run the cleaning brush for cleaning the dirt inside the tank.
3.3 A pump and motor housing is made instead of making a casing for the motor. The purpose of the housing is to keep the pump and motor intact and sealed. The pump and motor housing will not allow the water to rush inside the motor and prevent any kind of catastrophic failure.
3.4 Final Design:

![Fig 6: 3D model of final design](image)

3.5 Bill of Materials:

| Part               | Specification                      | Price(Rs) |
|--------------------|------------------------------------|-----------|
| Pump               | 3000 rpm, 6Ltr/min, 24V            | 900       |
| Secondary Motor    | 6-12V, 200rpm                      | 180       |
| PVC Pipe           |                                    | 160       |
| Cleaning Brush     | Dia: 5 Inches, Material: Nylon Bristle | 180     |
| Knuckle Joint      | Fabricated                         | 250       |
| AC adapter         |                                    | 350       |
| End Cap            | Dia: 4 inches                      | 2*200     |
| Connector          | I.D=1 inch, t=2mm                  | 2*50      |
| Water Pipe         | 2m long                            | 50        |
| Connecting wires   | 3m long                            | 20        |
| Miscellaneous items|                                    | 300       |
| Total Cost         |                                    | 2890      |
3.6 Making of pump and motor housing:
Two pipe end caps of 4 inches diameter are used to make the housing for pump and motor. The pump is attached to the bottom of the end cap and the secondary motor is fitted perpendicular to the axis of rotation of water pump. Necessary holes are drilled on the housing for passing of the connecting wires connected to the pump and motor. A hole is drilled for the pipe on the top surface of the end cap which will run along the PVC pipe for carrying the dirty water out of the water tank. A connector is also attached to the top surface of the housing to connect to the knuckle joint.

![Figure 7: Pump & Motor Housing](image)

A knuckle joint mild steel made is fabricated according to our specifications. The fork end of the knuckle joint was purchased from market whereas the eye end was fabricated. A straight Clamp is attaches on the top of knuckle joint using welding and screw and nut. This arrangement will allow the joint to stay fixed at different positions. After the final fabrication of knuckle joint it is fixed with the pump and motor housing from one end and PVC pipe from the other end.

3.7 Final Assembly:
Holes are drilled on the side of the PVC pipe through which the connecting wire is passed which are then connected to an AC adapter of 24 V. The water pipe is attached alongside of the PVC pipe. All the holes and openings are sealed after final assembly to prevent entry of water into the machine.

![Figure 8: Final Assembly](image)

4. Existing Technology
4.1 Sedimclean
Sedimclean Water Tank Cleaning machine is the existing technology in the market. This machine is used to sweep out the sediments.

4.1.1 Specifications:
4.1.1.1 Pumping unit capacity: 2000 L/hr
4.1.1.2 Material: Plastics, stainless steel & rubber components
4.1.1.3 Life: 5 to 10 years.
4.1.1.4 Weight: 2.4 kg

4.1.2 Features:
4.1.2.1 Allows continuous water consumption
4.1.2.2 Avoids wastage of water
4.1.2.3 No need of additional chemicals or consumables

4.1.3 Drawback:

a) This machine is used to sweep out the sediments deposited at the bottom of the tank.
b) The major issue occurs with this product is that the filter component will have to change on regular basis.

4.2 Water Tank Cleaning Equipment

Water tank cleaning equipment are rendered in accordance with the guidance of experienced professionals as per the international quality. The products are available in high quality clean-up of capacious and huge industrial tanks that are used for various storage purposes and do require a timely clean up. These products are made and developed from high quality materials. The 6 stage water tank clean process has been developed through research and development to arrive at a fool-proof process that involves latest state-of-the-art imported equipment and proprietary anti-bacterial agents that are safe, effective and eco-friendly.

4.2.1 Drawbacks:
The major drawback of this product is that it is very costly and professional aid is required to carry out the water tank cleaning process. Therefore, a need arises for development of a cheap, household and easy operated water tank cleaning machine

4.3 Automatic Water Tank Cleaning Machine

A mechanical system for cleaning domestic cylindrical water tank. The mechanical system includes two main mechanisms which are rack and pinion gear mechanism and reciprocating four bar linkage mechanism. The rack and pinion arrangement is used to move whole mechanical system up and down for cleaning the cylindrical tank. The rack is fixed on the motor and the four-bar mechanism is attached to the motor shaft. PVC brushes are attached to the ends of the four-bar linkage. Four bar linkage is made in such a way that it can be adjusted according to inside diameter of the tank. When the motor is started the linkage rotates and with the help of brushes, cleaning of wall and base of tank takes place. The purpose is to reduce the human efforts and to avoid the chemical influence on health of person entering the tank for cleaning.

When we switch on the electrical supply to the secondary motor the cleaning brush attached to it will rotate and clean the dirt and slurry kept on the bottom of the surface of water tank. A Knuckle joint is provided for changing the axis of rotation of secondary motor. This knuckle joint will clean the water tank in different directions. When the dirt particles settle down in the tank and get dissolved with the water the supply to secondary motor is cut off. Now we turn on the electrical supply to the water pump which will suck the dirty water from the tank and lift it upwards and carry it out of the tank via a water pipe. Hence, the cleaning of water tank is accomplished with less effort.

5. Result and Discussion:

On Performing the Cleaning of water tank the machine was capable of cleaning the bottom surface as well as the side surface of the water tank. With the help of knuckle joint this axis of rotation of the brush can be changed.

The pump is capable of lifting the water at 2m height with a flow rate of 0.1L/sec. The operating procedure of the machine is quite simple which makes it easier for a layman to operate it. There is not entry of water inside the machine. Therefore, catastrophic failure is avoided. The machine is not heavy which makes it user friendly So, it can be concluded that a hand driven user friendly PVC water tank and slurry cleaning machine is constructed.
6. Conclusion & Recommendation

The machine made by us is semi-automated machine. Further advancements can be made in it by adding a soap solution to the brush which will clean the tank surface more effectively. Automatic soap producer can be engaged which will clean the settle dust and slurry inside the water tank. A fully automated cleaning system can be developed which will aim to replace the men at work to “no man at work.” The surface cleaning machine will be able to clean of surfaces and vertical walls. The automatic surface (anti-gravity) cleaning system will have an advantage of providing efficient surface cleaning which can be performed semi-manned or fully automated.

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