

Design and development of automated overhead tank cleaner

¹Vishal J, ²Supreeth Gurkar R, ³Amith S J, ⁴Meghana H, ⁵Prof. Jayashankar N
¹Student, ²Student, ³Student, ⁴Student, ⁵Associate Professor
Department of Mechanical Engineering
Vidyavardhaka College of Engineering, Mysuru, India

Abstract

The use of overhead tanks has been common in India. These tanks have very small necks which makes it physically impossible to get in to clean it. The formation of bacteria in the tank due to the stagnant water can cause numerous diseases. The project we have done has a mechanical system which 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. Four bar linkage is made in such a way that it can be adjusted according to inside diameter of the tank. The purpose of this project is to make the cleaning of the overhead cylindrical tank easier because it's physically impossible for a human being to get into the small space and clean the tank and the influence of chemicals can cause various health problems for the worker.

Keywords: Cylindrical water tank, four bar linkage, motor shaft, rack and pinion, PVC brush

1. Introduction

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.

In a recent research it was discovered that no robot-based machine is used as part of cleaning the upper tank. This is the result of the unpredictable shape and the different dimensions of the tank areas. With previous reviews it has affected the effort to build a machine through the mechanization process to clean the tank. A replacement has reached to an agreement to address this problem. In India, the use of tanks by the general population is about 71% after the examinations have made data that have faced a significant amount of problems, such as persistent work in disordered places, sporadic delivery and different reasons. Constant work and unpredictable installation can also be the important purpose behind this effort.

So we came to the conclusion that cleaning the upper tank using the mechanization process can be invaluable for tackling each of these problems. For this situation, the machine has the ability to clean the tank effortlessly and quickly. The planning of our machine depends on the direct study relationship. In this avant-garde world, the physical cleaning of overhead water tanks is a repetitive activity. We can solve the disadvantages of cleaning the overhead tanks, by automising cleaning of the upper tank of the system is designed to provide high safety, high efficiency, less time for cleaning and avoid problems of environmental contamination. The aim of this project is to clean the domestic cylindrical water tank with the help of a mechanical system.

The path to a long life for your tank cleaning machine will, rely on maintenance that has been a precisely organized for various parts like framework; You will appreciate that a tank cleaning has a dirty and difficult task requires more consideration than one that works in perfect condition.

2. Methodology

- Firstly, whole water is removed from the tank. Detergent is then sprayed on the inner wall of the tank for easy removal of dirt.
- The whole system is inserted in retracted position into the tank.
- The four-bar linkage is then adjusted according to the tank diameter in such a way that brush at end of the shaft touches the bottom of tank.
- The motor is mounted on the square threaded shaft that also supports the brushes and the other components.

- The motor causes the square threaded shaft rotates which causes the reciprocating action like the drilling machine.
- As the change in the diameter of the tank takes place the four-bar linkage causes the change in the overall cleaning diameter of the brushes.
- The nozzles spray the water with soap liquid and the brushes causes rubbing on the walls while removing the scales and other formation on the walls of the tank.
- As the brushes move downwards it cleans the bottom of the tank thereby cleaning the tank without leaving any residual matter.
- The bushes move up after finishing the job and the components can be removed from the tank by a single person. The used up water is removed by the outlet valve provided in the bottom of the tank.
- In this way the tank gets cleaned within minimum time.

3. Literature survey

In a paper published by Shelke prasad k. “automatic water tank cleaning machine”, Feb 2017. He mentions about an automated overhead tank cleaning system using rack and pinion mechanism.

When the motor is started the linkage rotates and with the help of brushes, cleaning of wall and base of tank takes place. He concludes that the water tank cleaner was used to clean the water tanks by using rotating brushes.

In consideration to traditional methods where high pressure water jets are used, this method causes less damage to the tanks.

3.1 Hardware Requirements

- Car Wiper Motor
- Mild Steel Or Low Carbon Steel
- Hollow Shaft
- Nylon Brushes
- Arms
- Connecting Lever
- Bearing
- Bush

3.2 Software Requirements: SOLIDEDGE

component	specifications
Water tank	Vol- 300 L Dia- 787mm Height- 686 mm
Gear motor	single phase 220V, 15A which produces power of 0.35 HP and frequency of 50 Hz and the shaft speed is 75 rpm.
Four bar linkage	A plane linkage consisting of four links pinned tail to head in a closed loop with lower or closed joints. It is a plane mechanism consisting of four links that form rotating kinematic pairs.
Shaft	Dia- 15mm Type of thread- square

Brush	Material- PVC
Nozzles	The ones used for watering gardens

4. Calculations

Specifications

- Height of tank= 686mm
- Diameter of tank =787mm
- Capacity of tank = 300lit
- Square threaded shaft pitch=2mm
- Single start thread
- Speed (N) = 50 rpm

Lead= pitch (∵ single start thread)∴lead = 2mm/rev

Linear distance= lead distance*no of rotation

Linear distance= 2*343=686mm

If shaft rotates at 50 rpm to make 343 rev it takes 6.86min or 6min51sec to clean the tank of 300liters

Pump discharge, Q=4lit / min

Total water required to clean 300 lit tank = pump discharge * time consumed

$$= 4 * 6.86 = 27.44 \text{ lit}$$

The total time taken to clean the tank is 6.86min

∴volume of water required =0.02744m³ or 27.44lit

5. Results

Automatic tank cleaning machines that work the same way as a wall cleaner. In this project, a DC motor of about 12 V, which operates at 50 rpm, is used to rotate the lateral axes continuously. The shaft is mounted on the motor. The machine is connected to the top of the tank. After complete configuration, the motor rotates and the brushes rotate on the surface of the tank. Finally, the water is drained by the outlet of the tank.

6. Conclusion

In this work the automated water tank cleaner was successfully developed to clean the water tanks using rotating brushes. This strategy is more effective and safer than the conventional methods of cleaning which takes less time and human effort. Water splashes everywhere along the dividers in the tank and the rotating brushes clean the external separators.

References

1. Occupational Safety & Health Administration (OSHA) (2008-01-30). "Process: Tank Cleaning". Shipbuilding and Ship Repair - Hazards and Solutions. Department of Labor. Archived from the original on 1 April 2008. Retrieved 2008-04-08.
2. Shubham Shrivastav, Hari Om Kumar, "Design and Development of Cylindrical water tank cleaner", vol 6,2016,pp 262-264
3. Butterworth, Inc. (2001). "Butterworth Tank Cleaning Machines". Butterworth, Inc. Archived from the original on 31 March 2008. Retrieved 2008-04-09.
4. S. Abhishekh, "Design and Fabrication of Automatic System Overhead Tank Cleaning" Volume: 9, Issue: 4, April 2017.