

Semi-Automatic Water Tank Cleaner

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Abstract : The aim of the project is to develop a mechanical system for cleaning domestic cylindrical water tank. The mechanical system includes two main mechanism which is a worm gear mechanism and reciprocating four bar linkage mechanism. The worm gear mechanism is used to move whole mechanical system up and down for cleaning cylindrical tank. PVC brushes are attached to the end of the four bar linkage. Four bar linkage is made in such that it can be adjusted according to inside diameter of the tank. When the motor is actuated 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.

Index Terms – Cylindrical Water Tank, Four Bar Linkage, Electric motor, Worm Gear.

I. INTRODUCTION

Cleaning is the process of removing unwanted substances, such as dirt, infectious agents, and other impurities, from an object or environment. The health of your water largely depends on how clean your water tank is. Hence, cleaning overhead water tank is very necessary. Therefore, it is our duty to save water, keep the fresh water as much clean possible, and also to keep it free from water pollutants. Every day we use the tank water for brushing and bathing, for cleaning and moping, for washing clothes and in other household chores. If it is not hygiene which results damages the skin and it will effects on the health. Hence water tank cleaning is very important.

Manual Cleaning water tank method is the traditional method of cleaning the water tank where a person would get into tank and scrub the wall. The water tank can also be cleaned by using chemicals to remove the dirt and sediments. 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 a number of hazards that in some cases have led to injury or even death.

II. LITERATURE REVIEW

Shubham Shrivastava [1] designed and developed a cylindrical water tank cleaner consisting of mechanical system with two main mechanisms which are gear mechanism and reciprocating four bar linkage mechanism. The gear used is worm gear which is used to reciprocate whole mechanical system up and down according to the height of cylindrical tank. Four-bar linkage is attached to the main shaft and its other end is attached to PVC brushes. Four bar linkage is designed in such a way that it adjust according to inside diameter of the tank. When the a.c motor is switch on the main shaft rotate in turn the linkage rotates and with the help of brushes, the wall and bottom of tanks gets cleaned. He conclude that overhead water tanks cleaning equipment's was conceived and developed. This equipment was found to be effective in cleaning cylindrical overhead tanks. During cleaning the rotating brush needs to move up and down manually for complete cleaning with the help of rotating handle of worm gear. The cleaning is carried out by rotating brushes at constant speed (120rpm).

Shelke Prasad.K [2] designed 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. 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. He concludes that the water tank cleaner was used to clean the water tanks by using rotating brushes. This method was more effective and safe than the conventional methods. This method is capable to clean water tanks within less time and human efforts.

S. Abhishekh [3] designed and fabricated automatic system for overhead tank cleaning using a concept of the mechatronics system consisting of a grooved gear rod attached to two arms with brushes at ends. The two arms are connected to the gear rod by nut. By rotating the gear rod, the up and down motion of the two arms is achieved. The gear rod is rotated with the help of a d.c gear motor. The main grooved shaft is powered by an a.c motor. The motor and the shaft are connected by a rubber belt. The clockwise rotation of the main shaft will make the arms move and vice versa. The whole operation is controlled by a circuit consisting of relay switches, buttons, and pic microcontroller. The number of times for the operation to repeat can be fed into the circuit. He concludes that advanced model for tank cleaning system is cleaning the tanks thus making the operation user friendly. The working prototype is promising both in terms of imparting cleanliness and avoiding excess manpower.

Smita Gour khede [4] designed & fabricated drain cleaning machine in which drain cleaning mechanism is very simple and the equipment required for the machine are less. It mainly consists of electric motor, bearing, belt and pulleys, and other small materials like angular bar, etc. Using this equipment the garbage is cleared from the drains which somewhat cleans the water. The main purpose of the machine is to clean the garbage from choked drains and increase the flow of drain water from flowing through them. In our drain cleaning mechanism two electric motors are used, one electric motor is used to rotate the pulley with the help of belt. The other motor is used for uplifting the garbage from drain through a plate.

Pramod B Jachaket [5] designed a computerized underwater robot to clean water tank. Cleaning of storage water tanks is a tedious job. The entire work needs to be done manually, and when manual work is considered, it is a risky task. Considering height of water tanks the shortage of oxygen can be a major issue. Hence the need for use of underwater robotic systems has become more apparent. They have developed a system in which user will remotely navigate the robot the way he wants as well as control certain operations like cleaning, brushing, sucking etc. This paper surveys a state of art for underwater robotic technologies. This project aims to provide key reference for future development in automated underwater cleaning. Hence we are implementing a new idea for wireless robot control system which will clean water tank efficiently without any human intervention in addition to that it will also save manual work, avoid accidents. This automated task is efficient to brush up impure water or bacteria at the core of water tank and suck the impure water for proper reuse or disposal.

Ahmad Athif Mohdfaudzi [6] discussed the importance of clean water supply ensuring good health of people. Water supply is distributed from water storage tanks and sediment that accumulates over time in water storage tanks will deteriorate the water quality used by consumers. Water storage tanks are required to be cleaned once in every three years by water utility operators or tank cleaning service providers. Water supply disruption can be prevented and cleaning process will be more efficient and cost effective. Anrov is built to operate underwater and vacuum out sediments from water tank. Rovs development has been an on-going research and development area. Several university students, researchers and even companies are constantly improving current rovs system that can be suitable to use in various tank-cleaning applications. Rov is able to suck out small amount of sediment from water tank with tank depth of 1 m.

Dhiraj M. Bankar [7] design and fabricated floor cleaning machine, The conventional floor cleaning and machines is most widely used in airport platforms, railway platforms, hospitals, bus stands, malls and in many other commercial places. These devices need an electrical energy for its operation not user friendly. In India, especially in summer, there is power crisis and most of the floor cleaning machine is not used effectively due to this problem, particularly in bus stands. Hence it is a need to develop low cost, user friendly floor cleaning machine. In this project, an effort has been made to develop a manually operated floor cleaning machine so that it can be an alternative for conventional floor cleaning analysis of the floor cleaning machine was done using suitable commercially available software.

III. PURPOSE OF PRESENT STUDY

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. Hence water tank cleaning is very important. The five main reasons why cleaning your water tank is necessary are:

- a) Waterborne internal diseases
- b) Skin diseases
- c) Bad taste of water
- d) Different shades

IV. METHODOLOGY

Drain all the water from the tank by opening the tap. The semi-automatic machine is mounted at the top of the tank. The width of the four bar linkage is adjusted according to the width of the tank. Four bar linkage is taken at the bottom of the tank using the worm gear. Cleaning agent with hot water is applied at the surface of the tank. Power is supplied to the motor, the brushes attached to the linkages start rotating at the wall surface and at the bottom surface.

Slowly with the help of worm gear the four linkage can be moved upward or downward and tank can be cleaned with the help of brushes. In bottom the agent is applied to the tank to clean it properly. After the cleaning, remove the machine setup from the tank and put water into the tank and leave the water in the tank for some time. After the certain interval of time drain the water from the tank and tank will be ready to use. It is not only for the household tank, in industries also if the tank is less than 500litres can be cleaned by using semi-automatic water tank cleaner.

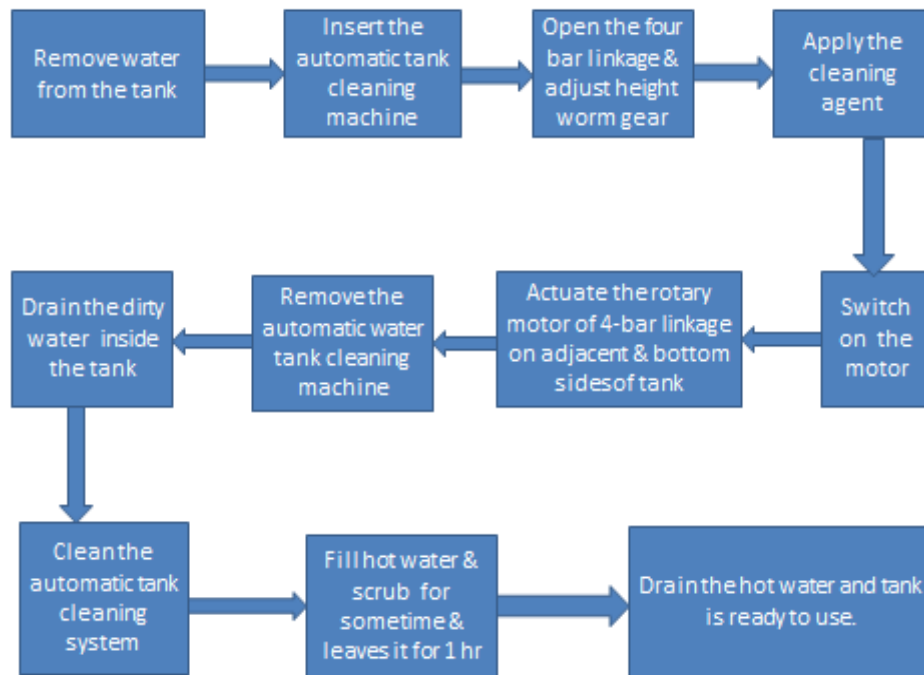


Figure.1 Methodology of cleaning tank

V. EXPERIMENTAL WORK

An automated tank cleaning machine is a machine used to clean the overhead tanks such those found to store the water. Tanks must be cleaned from time to time for various reasons. The main reason to clean the tank is due to fungus. Thus the tank is to be inspected or maintenance to be performed regularly. Semi-Automated tank cleaning machines work in a manner similar to a wall cleaner. It consists of motor, worm gear, cylindrical water tank, brushes, four bar linkage. When the handle of the worm gear is rotated the wire which is attached to the worm gear through the pulley, makes to move the shafts up and down continuously. An AC motor of about 0.25HP which runs at 300rpm is used for rotating the shaft at the fixed speed. The shaft is mounted on the motor. The machine is mounted at the top of the tank as shown in figure 4.

Then the brushes are mounted at the bottom of the shaft and also two brushes at the sides of the tank through the four bar linkage. After the complete setup, if the supply is given to motor, the motor starts rotating through motor the shafts also rotates. The shafts contains four bar linkage in it. The brushes are held in the sides and also in the bottom of the tank. After the supply, the brushes starts rotating and we can adjust the length and width through manually by the help of worm gear and adjustment of four bar linkage.

5.1 SPECIFICATION

- MS square pipe for frame 1 inch and $\frac{3}{4}$ inch pipe.
- MS flat 1 inch 3mm thick.
- Roller with ball bearing for 15mm shaft.
- Steel wires.
- Medium hard plastic brush
- Ac motors 0.25hp
- Overhead water tank 500litres

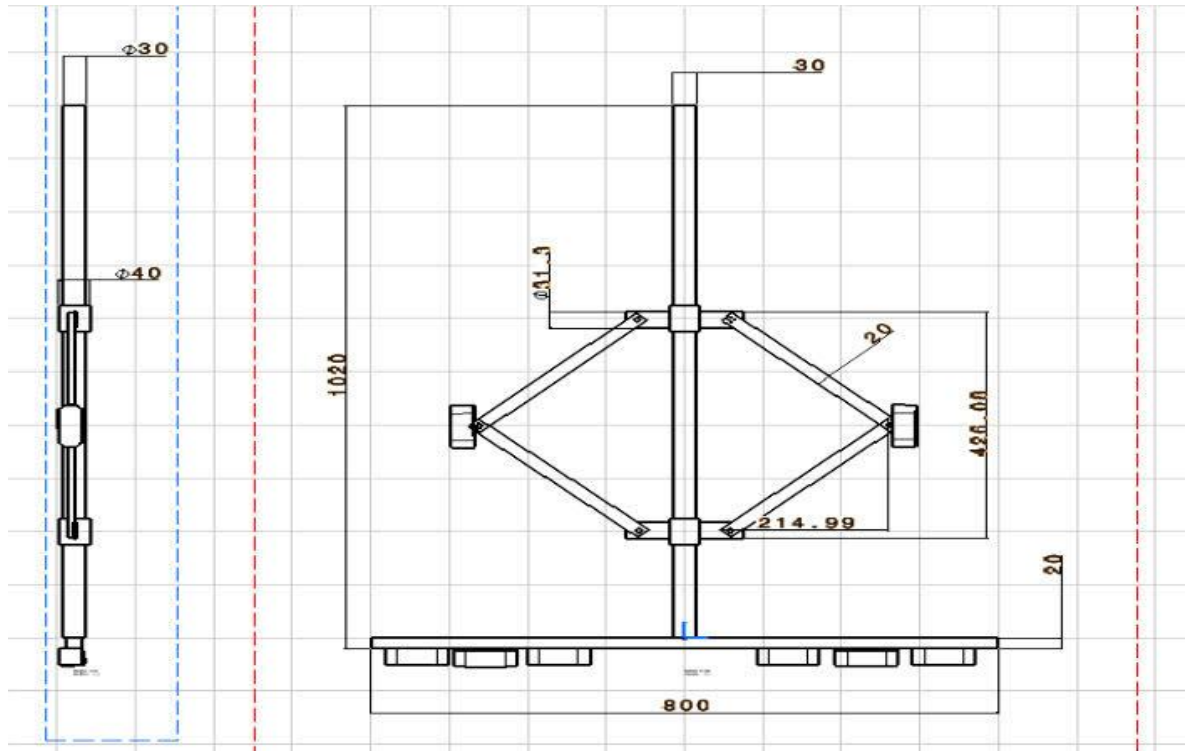


Figure. 2 2-D Drawing of experimental set up

5.2 PROCEDURE

The procedure of the cleaning of the water tank by semi-automatic water tank cleaner are follows:

- Completely drain the water from the tank.
- Sprinkle the cleaning agent solution on the inner wall of the tank.
- Mount the semi-automatic water tank cleaner at the top of the tank.
- Open the four bar linkage and adjust the width according to the tank.
- Adjust the bottom plate by the help of worm gear.
- Switch on the motor which actuates the scrubbing of 4 bar linkage on interior of wall and bottom surface.
- Remove the setup
- Drain completely the dirty water from the tank.

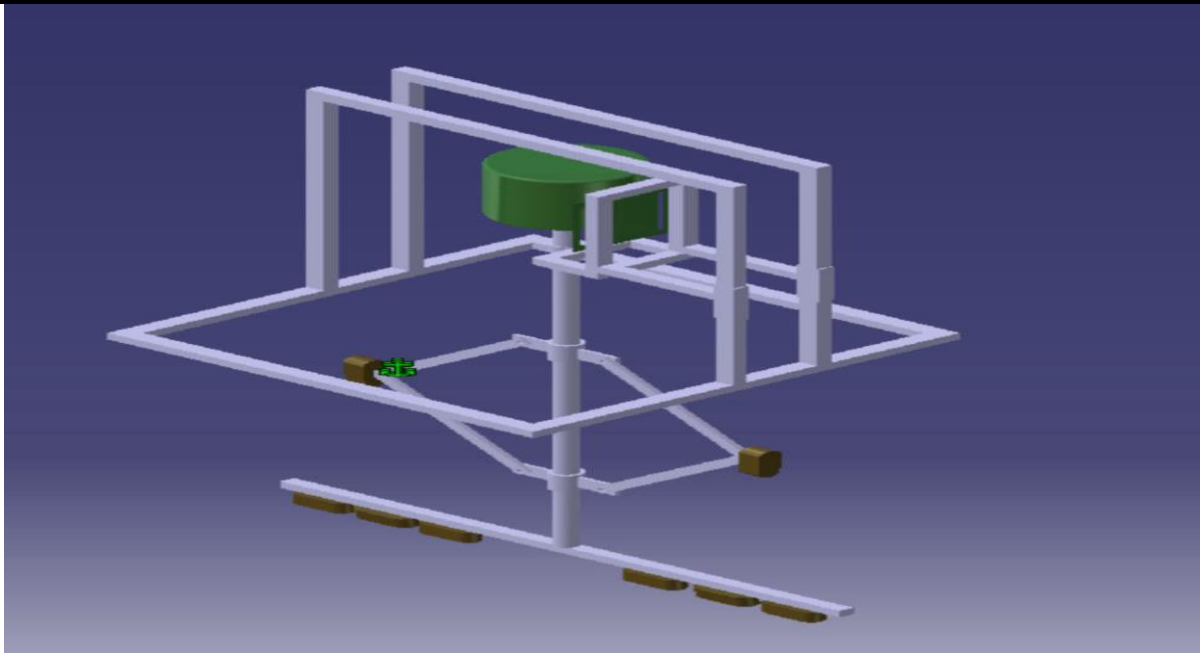


Figure. 3 CATIA model of Experimental Setup

5.3 CALCULATIONS

The torque acting on the motor shaft is determined as follows:

- Power of motor (p) = 0.25 HP
- $P = p \times 0.736$
- $P = 0.25 \times 0.736$
- $P = 0.184 \text{ KW}$
- $P = \frac{2\pi NT}{60,000} \dots\dots (1)$
- $0.184 = \frac{2\pi \times 300 \times T}{60,000}$
- **Torque = 5.85 N-m**

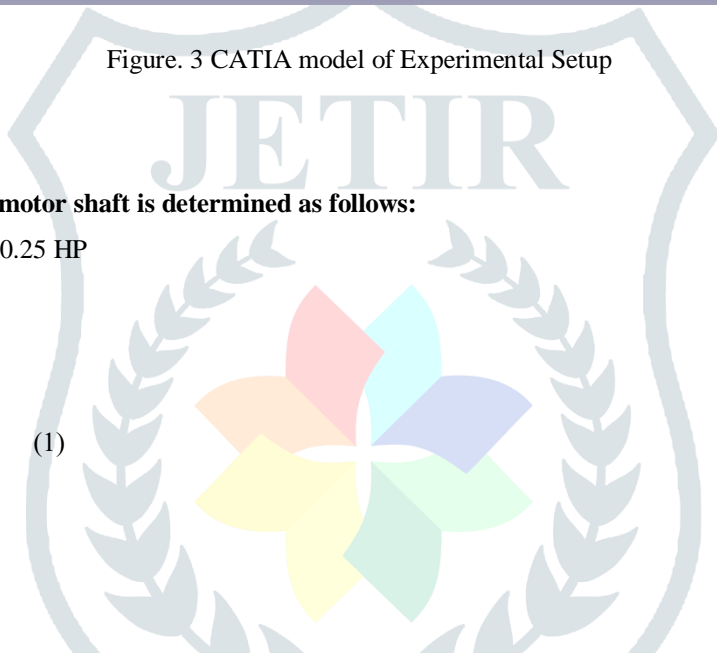


Figure. 4 Semi-Automatic Water Tank Cleaner

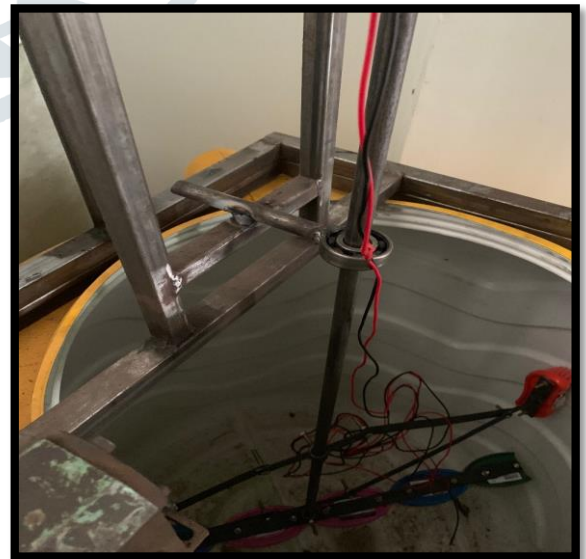


Figure. 5 Four Bar Linkage

VI CONCLUSIONS

The conclusions of the project work are as follows:

- The rotating brushes are used to clean the water tanks by automatic water tank cleaner which is more effective and safe than the conventional methods.
- This method is capable to clean water tanks within less time and human efforts thus making the operation user friendly.
- This prototype can also be used to clean small chemical /oil storage tanks in industries.
- The working prototype is promising both in terms of imparting cleanliness and avoiding excess manpower.

VII. Acknowledgment

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