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Design of Automatic Water Tank Cleaning Machine using Catia Software

Mahadev Chavan[1]* Dr. R. J. Patil[2] Prof. Pankaj Bhokare[3]

[1,2,3] U.G. Student of Mechanical Department, Navsahyadri Group of Institutions, Naigaon, Pune, India

Abstract – In this modern world, cleaning of overhead tanks manually is a tedious job. It is observe that the cleaning of cylindrical tank is sometime difficult and peoples hesitate to clean although it's dirty. Clean water supply is important in ensuring good health of people. Water supply is distributed from water storage tanks. Sediment that accumulates over time in water storage tanks will deteriorate the water quality used by consumers. Purpose of this project is to clean domestic cylindrical water tank with the help of mechanical system consists of motor, brush, rack and pinion, lead screw etc. The rack and pinion arrangement is used to move whole mechanical system up and down for cleaning of cylindrical tank. Our aim behind this project is to reduce the human efforts and to avoid the chemical influence on health of person entering the tank for cleaning. We assemble the system so that there will be no need of human interaction while cleaning the tank.

Key Words – Cylindrical Water Tank, Motor, Shaft, Micro-Controller, Rack and Pinion.

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1. INTRODUCTION

In recent studies it has been found that no automation based machine used in cleaning of overhead tank. This is because of the irregular shape and various heights of the tank locations Cleaning is the process of removing unwanted substances, such as dirt, infectious agents, and other impurities, from an object or environment. This can eventually clog pipes. It is not hygiene which results damages the skin and it will effects on the health. The success of a tank cleaning job depends on many factors such as thorough planning of the cleaning job, the design of tanks, cleaning machines and their operation, design of piping, heating capabilities etc. So came to a conclusion that cleaning the overhead tank using automation process can be useful to solve all these problems. In this case, machine has the capability to clean the tank easily and quickly. Designing of our machine is based on the survey report conducted. Hence water tank cleaning is very important. The main objective of this paper is to develop an automated water tank cleaning device. This device contains rotating and revolving brushes for cleaning of tank. It reduces human efforts and time required for cleaning.

1.1 Necessity of Cleaning Water Tank

Every day we use the tank water for drinking, 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 is 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. LITERATURE SURVEY

This section presents the critical analysis of existing literature which is relevant to overhead water tank cleaning system and its mechanisms. Though, the literature consists of a lot many research contributions, but, here, we have analyzed around eight research and review papers. The existing approaches are categorized based on the basic concepts involved in the mechanisms. The emphasis is on the concepts used by the concerned authors, the database used for experimentations and the performance evaluation parameters. Their claims are also highlighted. Finally, the findings are summarized related to the studied and analyzed research papers. Section concludes with the motivation behind identified problem.

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Sr. No.	Ref. Concerned Author(s) and years	Concept used	Claimed by concern authors (s)	Our findings
1	Thonge Suraj , Shelke Prasad, Wakte Vaibhav , Thonge Sharad , Prof. Shinde ,(2017) [1]	A mechanical system which clean the tank mechanically using brush, rack and pinion , bar linkage and motor.	The authors observed that the Cleaning is done more effective than the conventional methods.	Adjustment of the system inside the tank is difficult.
2	S. Abhishek, D. Kiran, P. Praveen and Dr. K. L. Senthilkumar (2017) [2]	A mechanical system which clean the tank mechanically using brush, rack and pinion, bar linkage and motor.	The authors observed that the Cleaning is done more effective than the conventional methods.	Cleaning of the tank using this system is not effective.
3	Shubham Samrit, Divyaraj Singh Mandale, Mr. Aniket Rokade(2018) [3]	Design and Development of Cylindrical Water tank cleaner.	Easy to use and effective cleaning of the water tank is done	It is large in size and Heavy in weight.

3. 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 advantage of automated tank cleaning equipment is that it saves you time. In addition, you do not need to enter the water tank to clean it. Selection of the appropriate tank cleaning nozzle allows for efficient cleaning. Be sure to use the filter to prevent particles in the liquid from clogging the nozzles or stopping their rotation. The process of automatic tank cleaning begins with the cleaning of the manhole and dirt, mud and surrounding algae. Then, using a special high-pressure jet wall, all interiors are cleaned. Dirt and sludge are removed using a vacuum pump and an industrial pump.

4. MATERIALS SELECTION

4.1 Main Components

4.1.1 Gear Motor

Gear motor is used to produce high torque with low speed motor used has specifications as single phase 220V, 15A which produces power of 0.35 HP and frequency of 50 Hz and the shaft speed is 75 rpm. [1]

2.1.2 Rack and Pinion

A rack and pinion is 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 handle attached to the pinion. [1]

2.1.3 Shaft

The brushes are made up of Poly Vinyl Chloride (PVC) polymer. Brushes attached to the ends of horizontal shaft at the bottom end of the vertical rotating rod revolve due to rotation of motor shaft to clean the inner vertical surfaces of the tank. [3]

Shaft made up of mild steel of diameter 15mm is used to transmit rotary motion from motor to the four bar linkage. Holes provided on the shaft, adjust the four bar linkage according to the diameter of the tank [4].

2.1.4 Brush

4.2 Screw Mechanism

A screw mechanism is that converts rotational motion to linear motion, and a torque (rotational force) to a linear force. When the shaft of the screw is rotated relative to the stationary threads the screw moves along its axis relative to the medium surrounding it. In screw mechanisms, either the screw shaft can rotate through a threaded hole in a stationary object, or a threaded collar such as a nut can rotate stationary screw shaft. Geometrically, a screw can be viewed as a narrow inclined plane wrapped around a cylinder [2].

4.3 Selection of Nut

The most common shape is hexagonal, for similar reasons as the bolt head - 6 sides give a good granularity of angles for a tool to approach from (good in tight spots), but more (and smaller) corners would be vulnerable to being rounded off. It takes only 1/6th of a rotation to obtain the next side

of the hexagon and grip is optimal. However polygons with more than 6 sides do not give the requisite grip and polygons with fewer than 6 sides take more time to be given a complete rotation [2].

5. DESIGN MODEL

A design of the prototype has been made with the CATIA software.

CATIA (Computer Aided Three dimensional interactive Application) is mechanical design computer software. It is a feature based, parametric solid modeling design that makes advantages of the easy to learn windows graphical user interface.

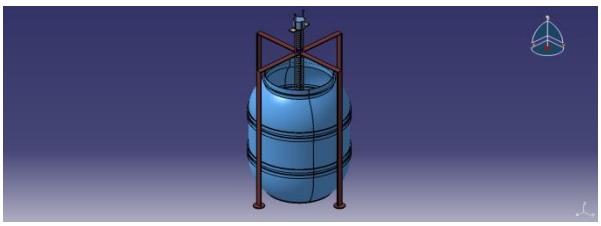

Figure: Design Of prototype External View

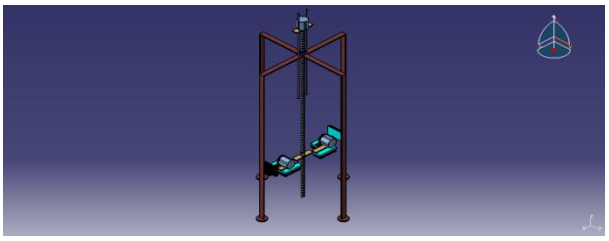

Figure: Design Of prototype Internal View

6. FUTURE SCOPES

The machine can be operated on solar energy. It can be fully automated by using sensors. Timer can be used for stroke of motion, during toggling of motions. The mechanism can be remotely operated. The horizontal shaft having brushes on the ends can be fitted with nozzles, which can provide continuous little amounts of water on the walls to enable smooth flow of dirt.The future scope of the project is to extend it with auto feeding mechanism by which the manpower involved in feeding gets removed.

► In future the advance system may also be invited like the vacuum cleaner type system that can clean the tank without removing the water from the tank.

7. CONCLUSIONS

► The water tank cleaner is used to clean the water tanks by using rotating brushes. This method was more effective and safe than the conventional methods.

► 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.

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Corresponding Author

Mahadev Chavan*

U.G. Student of Mechanical Department, Navsahyadri Group of Institutions, Naigaon, Pune, India

rupesh1002001@yahoo.com