

Cleaning Mechanism for Cylindrical Tank

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Abstract - The waste management is the one of the most important crises in current situation of the world. Now a day's everyone engaged in the field of waste management. In our project we also concern with waste management. The cleaning is removal of unwanted substances. They are many occupation categories related to cleaning. The aim of our project is to develop a mechanical system that use to clean tank or cylindrical vessel. Today the majority of cleaning process is undertaken by manual with some kind of brush and water jet. It is very ineffective due to various adverse conditions like toxicity of air which limited accessibility to the tank. So this project is use to reduce the human effort to clean the tank. We developed a mechanism that clean the tank in which the main part, threaded shaft provides rotational and linear motion. The brush mounted on the thread shaft which cleans the tank. For the effective cleaning of tank, system consists of a water jet provided using a pump.

Key Words: Cylindrical Water Tank, Thread Shaft, PVC Brush, Water Jet, Pump.

1. INTRODUCTION

Water tanks are liquid storage containers; these tanks are usually storing water for human consumption. A water tank provides for the storage of drinking water, irrigation agriculture, fire suppression, agricultural farming and livestock, chemical manufacturing, food preparation as well as many other possible solutions. Water storage tanks must be maintained so that the quality of water in the tank is clean. Because of contaminated water can lead to diseases that can harm consumers. Unscheduled tank cleaning will affect the health of users. Therefore, storage water tank cleaning should always follow the schedules that have ready set by the user. The development of this mechanism can solve one of the fundamental problems of clean and potable water to the people by cleaning the water storage tanks, which store water for long time and get sludge deposition at the bottom of the tanks. It is also an effective method to minimize time and danger thus saving human labour.

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 tank. This deposition contaminates the water and makes 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 Water Tank Cleaning Methods

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 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. To find such an approach, there is a need of studying the existing approaches and algorithms that had already been used for tank cleaning system.



Fig-1: Conventional Water Tank Cleaning

2. LITERATURE REVIEW

This section presents the critical analysis of existing literature which is relevant to water tank cleaning system and its mechanisms. Though, the literature consists of a lot many research contributions, but, here, we have analyzed around four 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.

Thonge Suraj et al [1] explains a mechanical system which clean the tank mechanically using brush, rack and pinion, bar linkage and motor. They claimed that the Cleaning is done more effective than the conventional methods. They also observed that the adjustment of the system inside the tank is difficult.

Bhaghat et al [2] describes about the use of water jet in cleaning process. It also explains the Jet Dynamics. The water may leave the nozzle as a coherent jet but as it travels towards the wall it will tend to breakup due to Rayleigh Instability.

Guha et al [3] describes experimentally, numerically and theoretically investigates the water jet cleaning process. Very high speed water jets (~80 to 200 m/s) are typically used in such cleaning operations. These jets diffuse in the surrounding atmosphere by the process of air entrainment and this contributes to the spreading of jet and subsequently decays of pressure.

W. S. N. Trimmer et al [4] describes design considerations for a practical electrostatic micro-motor. Easy to use and effective cleaning of the water tank is done. They claimed that it is large in size and heavy in weight.

3. COMPONENTS

3.1 Galvanized Iron (GI) Pipe

These pipes are widely used for conveying raw water & distribution of treated water in majority of rural water supply schemes, where the requirement of water is less. Mostly medium quality GI pipes are used. These pipes are cheap, light in weight and easy to handle & transport & easy to join. Their sizes vary from 15mm to 150mm. These pipes are manufactured conforming to IS-1239 (pt-I) 1990. Generally screwed & socketed pipes are used.

In our project we use 40mm diameter GI pipe of 1m length for the proper operation of mechanism. A groove is provided on pipe for the smooth movement of stationary bolt across the pipe on rotation.

3.2 Bearing

A Bearing is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts. The design of the bearing may provide for free linear movement of the moving part or for free rotation around a fixed axis or it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts. Most bearings facilitate the desired motion by minimizing friction. Bearings are classified broadly according to the type of operation, the motions allowed, or to the directions of the loads (forces) applied to the parts.

We use Shielded Deep Groove Ball Bearing so that it can withstand both radial and axial load acting on them. We take 6001 type bearing having 28mm outer diameter and 12mm inner diameter and a width of 8mm.

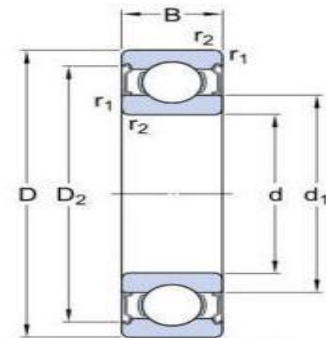


Fig-2: Schematic Diagram of Bearing

3.3 V-Belt

The V-belts are made of rubber with fabric cords to transmit power and it's covered with a protective layer. The cords transmit the force from the driver to the driven pulley, thereby transmit the power. The numbers of cords are increased based on the force requirements. The rubber layer transmits the force in cord to the side layers. V-belts are widely used in industry and automobiles because of its power transmitting capacity. The wedge shape of the belt increases the area of contact with the pulley there by increasing more friction which makes it to carry more power without slip.

3.4 Pulley

A pulley may have a groove or grooves between flanges around its circumference to locate the cable or belt. The drive element of a pulley system can be a rope, cable, belt, or chain. A belt and pulley system is characterized by two or more pulleys in common to a belt. This allows for mechanical power, torque, and speed to be transmitted across axes. If the pulleys are of differing diameters, a mechanical advantage is realized.

3.5 Induction Motor

An **Induction motor** or a **synchronous motor** is an AC electric motor in which the electric current in the rotor needed to produce torque is obtained by electromagnetic induction from the magnetic field of the stator winding. An induction motor can therefore be made without electrical connections to the rotor. An induction motor's rotor can be either wound type or squirrel-cage type.



Fig-3: Induction Motor

3.6 Thread Shaft

A screw thread, often shortened to thread, is a helical structure used to convert between rotational and linear movement and force. A screw thread is a ridge wrapped around a cylinder or cone in the form of a helix, with the former being called a straight thread and the latter called a tapered thread. A screw thread is the essential feature of the screw as a simple machine and also as a fastener.



Fig-4: Threaded Rod

4. WORKING

Working of the mechanism is simply rotation of shaft according to the motor output of the motor. When shaft is rotating, rotation is done by the motor which is connected by the pulley which is bolted with the shaft. The apparatus consists of a tank (500L capacity) and a steel frame base means 4 legs connected at a point, that point will be a hole in which the shaft is lowered.

Shaft apparatus consists of a GI pipe which is groove cut, perfectly covers the threaded shaft, and threaded shaft carry a bolt, connected with brush. And the bolt rotates with the rotation of shaft voluntarily makes an upward and downward movement according to the clock wise and anticlockwise rotation of shaft. The turning between clockwise and anticlockwise rotation is done by switching the motor. Main working action of the mechanism means, work output gives the cleaning of tank is done along with voluntary upward and downward motion of bolt. As the bolt is connected with brush on both sides, during the rotation of bolt each brush leg makes 180° rotation each. During the upward and downward movement of bolt, brush makes two actions: one is cleaning the tank and another is vertical movement.

When we tried working of mechanism in pre-described method, without ejection of water jet, brushes rotated and rubbed toughly in the inner tank surface .It showed high friction between brush and tank surface. Water should be ejected between tank surface and the brush, and flowing water should act as lubricant It also makes the work output, more efficient. The water ejection, now a bigger problem ,because the water should be distributed, to the tank linings, through the pipes and needed a common water

distribution source and if efficient work action is needed, the problem of clear placing of water to the exact zone of brush rubbing. This need, pave the way to, how the water pipe, distribute the water through the tank opening and it cause the pipe lines trapped together. Solution of this problem comes with adoption from resemblance with car viper sprinkler system that also avoids the use of nozzles and even gives forced ejection of water. Adoption gives the result, a compact tank, of 1.5L capacity along with a pipe opening and a valve tube carries the water. Then a copper T pipe in between the valve tube just near outside of tank opening ,efficiently divides the water pipe into two .each carries the water toward each side of the shaft where the brush legs are located, and that tubes are flexible tied up in couple of areas. Thus a flexible pipe distribution system provides water for lubrication and it is needed for efficient cleaning of tank.

Work input of the mechanism is provided by AC motor. When the power is provided, the motor is starting its rotation and that rotates the belt which is connected with the pulley .that pulley rotates with the speed of motor rotation also rotates the shaft. Threaded shaft which carries the brush leg, makes the rotation and vertical movement. The groove cut GI pipe acts as a travel path for brush leg. The overall apparatus is supported on upper and bottom frame base Upper frame base means 4 stainless steel weldment legs, follows the corresponding support legs on ground. These upper support steel frames carry the motor on one side, its adjacent side carries water distribution tank (1.5L) for water distribution and it also contains a transformer. The bottom frame base consists of 4 leg pieces jointed on a point which is a socket for holding the shaft apparatus.

When the tank is located anywhere in place installation of the apparatus will be easy only with the groove cut pipe which carries the threaded shaft and a brush leg should be bolted on the threaded shaft for holding the brush. The frame base also gives the stability and strength. The necessity of a capacitor and transformer. Because input voltage given to motor is 230V. The motor doesn't carry and work under 230V. Hence there, need of capacitor and transformer.

Capacitors have a use of converting the 230v heavy input to 12 v input voltage for motor. Actually it's done by transformers but the capacitors have a use of storing the charge and release the same.



Fig-5: Final Project

5. 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. This method is capable to clean water tanks within less time and human efforts.

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. The future scope of the project is to extend it with auto feeding mechanism by which the manpower involved in feeding gets removed. Through the help of the auto feed mechanism it is easy to clean the tanks without excess man power. The project can be even extended to increase the cleanliness of the tank by insulating the frame and other components using stainless steel.

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