PROJECT REPORT

Design of Smart Water Tank (1000 Lt) for Indian Household

Under:

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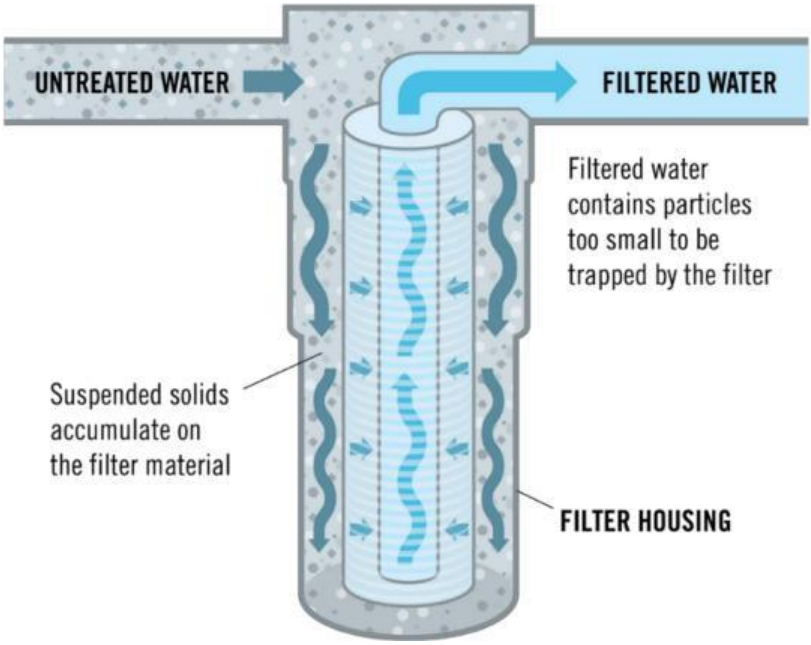
PREFACE



Mechanical engineering is the discipline that applies the principles of engineering, physics, and materials science for the design, analysis, manufacturing, and maintenance of mechanical systems. It is the branch of engineering that involves the design, production, and operation of machinery.

A water tank is a container for storing water. The need for water tanks is as old as civilization. Tanks were used to provide storage of water for use in many applications, drinking water, irrigation agriculture, fire suppression, agricultural farming, both for plants and livestock, chemical manufacturing, food preparation as well as many other uses.

MATERIAL

Linear low-density polyethylene

Linear low-density polyethylene (LLDPE) is a polymer (polyethylene) that is largely linear and has a significant number of short branches. It is often produced by copolymerizing ethylene with longer-chain olefins. In general, LLDPE is created by copolymerizing ethylene with higher alpha-olefins like butene, hexene, or octene at lower temperatures and pressures. An LLDPE polymer with a narrower molecular weight dispersion is created during the copolymerization process.

Production and properties- Transition metal catalysts, especially those of the Ziegler or Philips variety, start the production of LLDPE. Reactors in the gas phase or the solution phase can carry out the actual polymerization process. Typically, butene and hexene are copolymerized with ethylene in a gas phase reactor, while octene is the comonomer in solution phase. LLDPE is more impact and puncture resistant and has better tensile strength. It is extremely malleable and lengthens under pressure. With improved resistance to environmental stress cracking, it can be used to create thinner films. It is chemically resistant in a positive way.

Physical Properties:

Properties	Nominal Values
Density	0.88 – 0.915 gm/cc
Tensile Strength	30 MPa
Flexural Modulus	0.35 GPa
Izod Impact (Notched)	1.06 KJ/M
Elongation at Break	400%
Heat Distortion Temp. (Load@ 1.80 MPa)	37 Deg C
Flammability UL94	HB
Melting Temperature	130-160 Deg C
Mould Shrinkage	Max. 3%
Mould Temperature	20-60 Deg C
Operating Temperature	Max. 50 Deg C
Water Absorption	0.01%
Oxygen Index	Max. 17%

Manufacturing- LLDPE is manufactured in the form of granules or powder, and different kinds of additives, such as anti-block agents, antioxidants, and UV stabilizers, are usually added to them.

MANUFACTURING PROCESSES: -

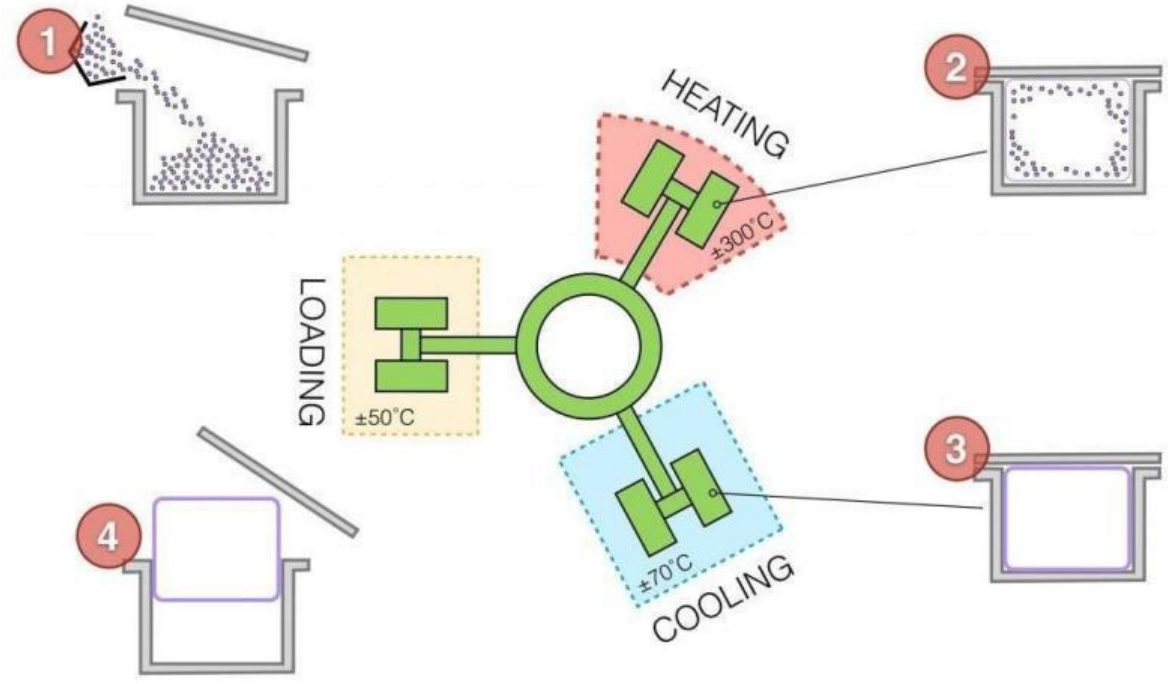
There are a wide variety of methods used to produce plastic tanks with polyethylene being the most common raw material. As with most plastic components and parts, plastic tanks are produced using **injection**, **blow**, or **rotational moulding** with other methods being variations of these common ones.

We will be using Rotational or roto moulding as it offers Low-cost tooling, consistent wall thickness, Double-wall constructions, High Durability, high stability and high strength. Rotational moulding is less expensive as compared to injection moulding and produces one piece seamless, leak proof tanks.

Rotational Moulding

Rotational or roto moulding uses low pressure and high temperature combined with a mould that is rotated at multiple axes to evenly distribute the polymer material. The mould for plastic tanks is a large steel shell at the dimensions of the final tank. It involves different stages which includes

1. Loading
2. Tank Oven
3. Cooling
4. Moulded tank Removal



STRESSES IN THE WATER TANK:-

- **Hoop Stress**

  The hoop stress is acting circumferential and perpendicular to the axis and the radius of the cylinder wall. The hoop stress can be calculated as

  $\sigma_h = p\ d\ /\ (2t)$

  where;
  σ_h = *hoop stress*

  p = internal pressure in the tube or cylinder

  d = internal diameter of tube or cylinder

  t = tube or cylinder wall thickness

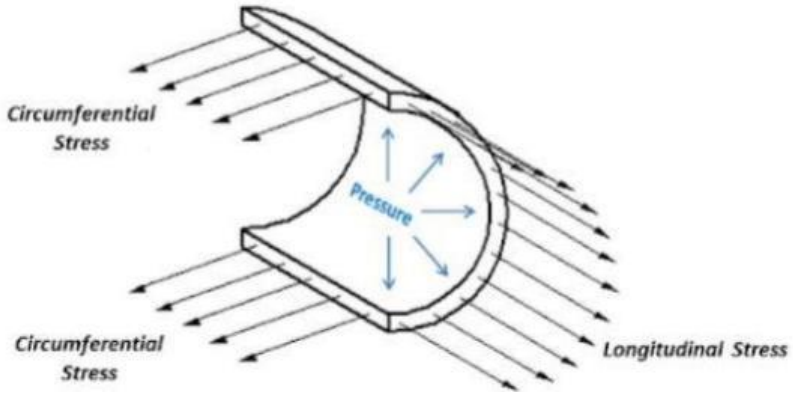
- ***Longitudinal Stress***

  For a cylinder closed in both ends the internal pressure creates a force along the axis of the cylinder. The longitudinal stress caused by this force can be calculated as

  $\sigma_l = p\ d\ /\ (4\ t)$

  where; σ_l = *longitudinal stress*

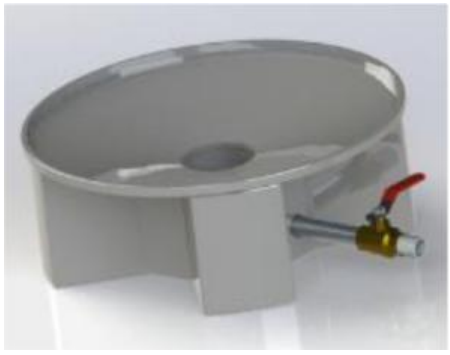
- Circumferential stress (Hoop stress)
- Longitudinal stress



DESIGN

<- FULLY EQUIPPED TANK

SIDE CROSS SECTION->



<- WATER TANK BASE

WATER FILTER->

DIMENSIONS:

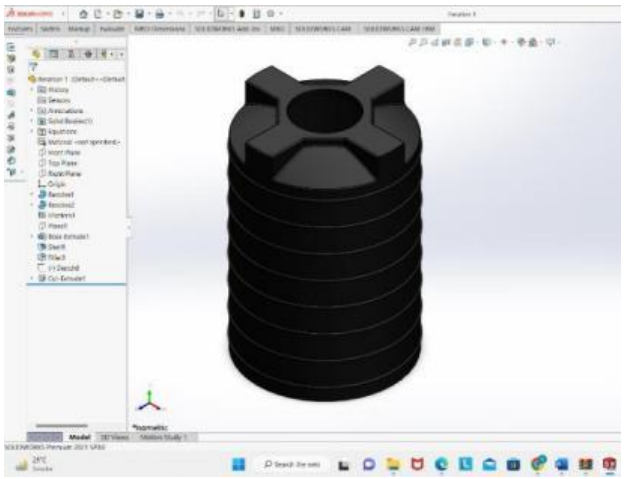
(TAPPERED FROM BENEATH)

HEIGHT -1.55M

DIAMETER – 1M

THICKNESS -4MM

VOLUME-



SOLIDWORKS CONSTRUCTION OF WATER TANK

MAINTAINENCE

Regardless of the quality of the equipment purchased, it will not perform properly unless managed in accordance with the manufacturer's recommendations for maintenance, cleaning, and part replacement. Keep a logbook to record water test results, equipment maintenance, and repairs.

- **After installation, test both the raw water (before filtration) and the treated water to ensure that it is working properly and removing the contaminants.**
- **Continue to test the quality of both the untreated and treated water annually. This annual test will also help you determine how well your treatment system is working and whether maintenance or replacement of components may be necessary.**
- **Replace or clean the cartridge when there is a noticeable drop in water flow through the device—this will depend on the number**

REF: https://extension.uga.edu/publications/detail.html?number=B15

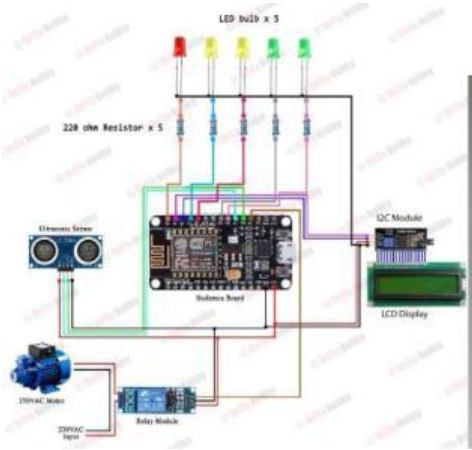
MEASURING TURBIDITY

Turbidity is the measure of relative clarity of water. Technically, it is an expression of the amount of light that is scattered by the materials contained in the water when a light is shined through the water sample. The higher the intensity of scattered light, the higher the turbidity. Materials that cause water to be turbid include clay, silt, finely divided inorganic and organic matter, algae, soluble coloured organic compounds, and microscopic plants (not visible by naked eye) and other microscopic organism

SENSORS USED FOR MODERNIZATION

OPTIMIZATION(WATER LEVEL INDICATOR):-

- **IoT-based water monitoring system that measures the water level in real-time, using an ultrasonic distance sensor while calculating the volume of the water in real-time.**
- **The basic principle of the SONAR and RADAR systems.Here we use ultrasonic sensors HC_SR04 composed of an ultrasonic transmitter and receiver that provides 2cm-400cm non-contact measurement and accuracy to 3mm.**
- **Microcontroller NodeMCU (ESP 8266) is an open-source IoT platform and easily accessible Wi-Fi module.**
- **A NodeMCU can communicate with this module using I2C communication protocol and display on screen.**



Sensors – TDS SENSOR

PH SENSOR

COST ANALYSIS

- LLDPE mixed with additives (blue colour) rotor moulding powder 135.5*30=rs4065
- Material cost-HDPE 50 *29= 1450
- Fitting cost=500
- Labour cost=500
- Rotor moulding water tank machine price= 32lakh/piece(optional)
- Ball valve=rs60
- Nodemcu ESP8266-rs 400
- Relay module=Rs 500
- Ultrasonic sensor=rs1200breadboard
- 220ohm resistor-2*5=RS 10
- Jumper wire -RS 60
- Breadboard=RS 70

- Turbidity sensor= RS 700
- Water purifier= RS 1800
- Total electronic items cost-5390
- Cost of installation of features= RS 200
- Installation costs= RS 1500 (if buyer asks)

TOTAL COST: - RS 13665

CONCLUSION- This project gave us the first-hand knowledge of the household water tank. The tank should be cost effective, easy, and secure to use. It should be manageable for good health. Also, the issues dealt while using water tanks at home from installation to repair and maintenance is considered

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