"DESIGN AND FABRICATION OF PEDAL OPERATED WATER PURIFIER''

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Abstract:
Pure, clean drinking water is a need of every household as humans can't live without it. Electricity at rural and remote areas is extremely erratic, thus making conventional water purifiers almost redundant for use. Thus, this project is specifically aimed at such areas and conditions of the world where water supply is erratic or non-existent and access to clean drinking water is sometimes at long distances. A pedal operated water filtration system is a water filtering apparatus which can filter water by using human muscle power via a pedal operated mechanism, it consist of a piston cylinder assembly which use the human foot power to reciprocate. Due to this reciprocating action it forces water through the filtrating unit. After that purified water store in storage tank This apparatus is preferably mounted on a supporting frame for increased portability. It will be specifically designed to perform three important functions. Storing water, filtering. the aim of this project is to solve purifying drinking water by creating a durable apparatus which is cheap to manufacture and to buy, which can last for a long time in rural conditions and which can be detachable so that it can be mounted on any frame.

Keywords – Piston, Cylinder, Water purifier, Storage tank, etc

1. INTRODUCTION

Safe drinking-water and adequate sanitation services to all is perhaps the greatest development failure of the 21st century. The most egregious consequence of this failure is the high rate of mortality among young children from preventable water-related-diseases. Water is essential to sustain life, and a satisfactory (adequate, safe and accessible) supply must be available to all. Improving access to safe drinking-water can result in tangible benefit to health.

Nearly, one billion people suffer needlessly without access to safe drinking water and over five thousand children die each day because of water related diseases. Water-related diseases: caused by insect vectors, especially mosquitoes, that breeds in water; include dengue, filariasis, malaria, trypanosomiasis and yellow fever. Drinkable water sources are distant from most villages in India. Women and children especially spends hours of labour just to meet the basic needs of their families walking five miles and more to nearby towns just to have access to drinkable (purified) water. Some well to do inhabitants in these villages travel long distances with motor bikes and trucks which consume fuel and pollute the air. Moreover, a family of five needs a minimum of fifteen gallons of water each day. The only way to sanitize the stream water available to these villages is by boiling which also consumes precious resources and contributes to deforestation since the only source of energy for boiling this much water is firewood and charcoal. However, a number of studies from low-income countries have indicated that improved access to water – and the resulting increases in the quantity of water or time used for hygiene are the determining factors of health benefits, rather than improvements in water quality. The objective of this work is to design a mechanism to be used with water filter to supply purified water for villages and remote places by harnessing the human foot power.

2. METHODOLOGY:

In our discussion Design and fabrication of Pedal operated water purifier following process we follow them.

i. Selection of material:

Firstly we discuss material for body frame material. We choose mild steel for fabricating this structure because of his good mechanical properties.

ii. Design:

Design and fabrication of Pedal operated water purifier for making design on CATIA drawing with all correct dimension

iii. Manufacturing:

Design and fabrication of Pedal operated water purifier for manufacturing, firstly we select proper material which fulfills our requirement which is mild steel after that we make frame along with suitable daimenstion by electric arc welding after that we assemble all the other component like as water filters, piston cylinder, storage tank on the frame.

iv. Assembly:

Then lastly assembly of component & fitting of Design and fabrication of Pedal operated water purifier. After that complete of assembly take testing on water purifier.

3. DESIGN:

Mechanical design phase is very important from the view of designer as whole success of the project depends on the correct design analysis of the problem. Many preliminary alternatives are eliminated during this phase Designer should have adequate knowledge above physical properties of material, loads stresses, deformation, and failure. Theories and wear analysis. He should identify the external and internal force acting on the machine parts.

3.1 Design component:

i. Cylinder -

Select standard length is 90mm

Force exerted by human foot = 2.4 kg (23.54N)

Pressure required to flow water through the filter =0.025N/mm^2

We know that P= F/A …….. (1)

Where

P= pressure

F =Force

A= Area of Cylinder

From equation 1

0.025= (2.4*9.81)/ (π/4)* D^2

From above equation we get diameter

D =34.62mm

Material for cylinder is brass because of that has good corrosion resistance.

CATIA part design of cylinder

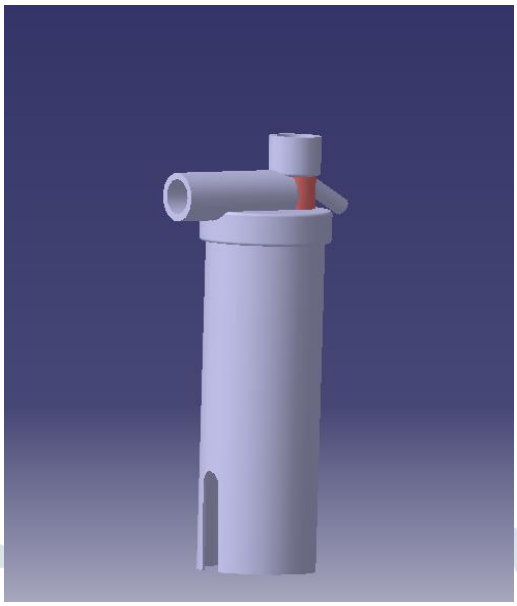

Fig.3.1. part drawing of cylinder

ii. piston–

From the above calculation we choose the diameter of piston d= 34mm.

Material for piston is polyethylene plastic because of their good environmental properties

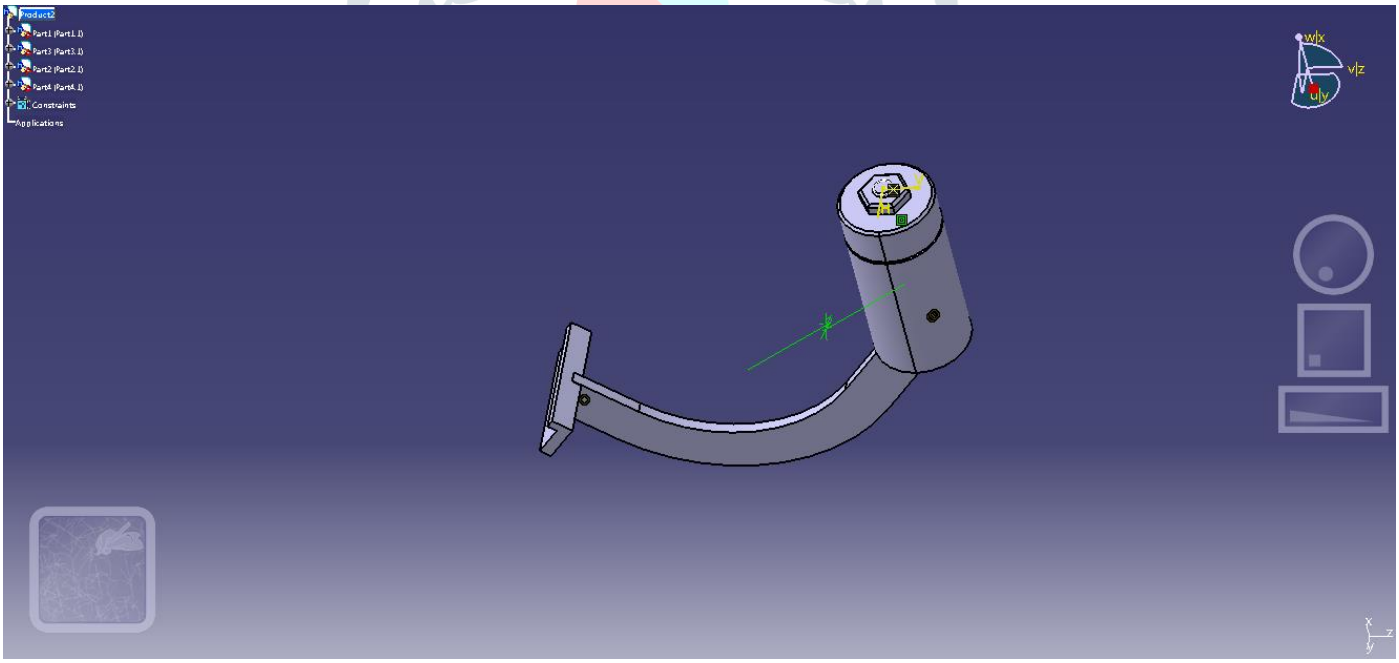

Fig.3.2 part drawing of piston

iii. Frame –

It is mild steel material. Having height = 54inch=1371mm, width = 20inch=508mm, depth = 15inch=381mm

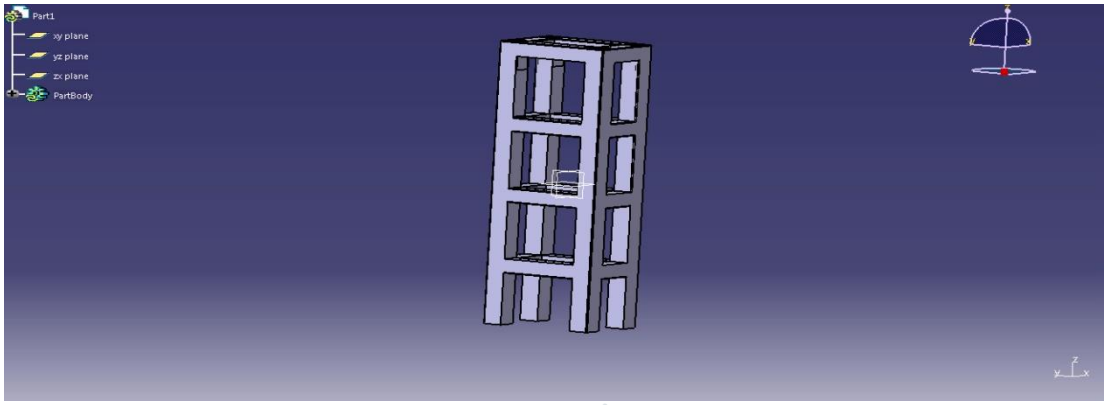

Fig. 3.3 part drawing of Frame

v. Spring

We have choose helical extension spring for lifting the pedal upward after pressing it downward by human foot

We required the spring which satisfies following parameters

Length (l) = 304mm

Load = 2.4kg

We choose cold drawn steel wired spring for this spring we choose the data from PSG design data book

S_{ut} =1090 N/mm^2

G =81370 N/mm^2

τ =545 N/mm^2

P =23.5 N

C =6

Where

S_{ut} = Ultimate tensile strength

G= Modulus of rigidity

τ = Allowable sheer stress

P = Load

C = Spring index

To find wire diameter we know that

$\tau = K\left(\frac{8pc}{\pi d\text{^}2}\right)$ 1

Now find k by WHALS factor

$K=\frac{4c-1}{4c-4}+\frac{0.615}{c}$.....2

$K=\frac{4*6-1}{4*6-4}+\frac{0.615}{6}$

K=1.2525

Put this value in equation 1

$545=1.2525\left(\frac{8*23.5*6}{\pi d\text{^}2}\right)$

d=1mm

Mean coil diameter we know that

C= $\frac{D}{d}$

From above equation

D=6mm

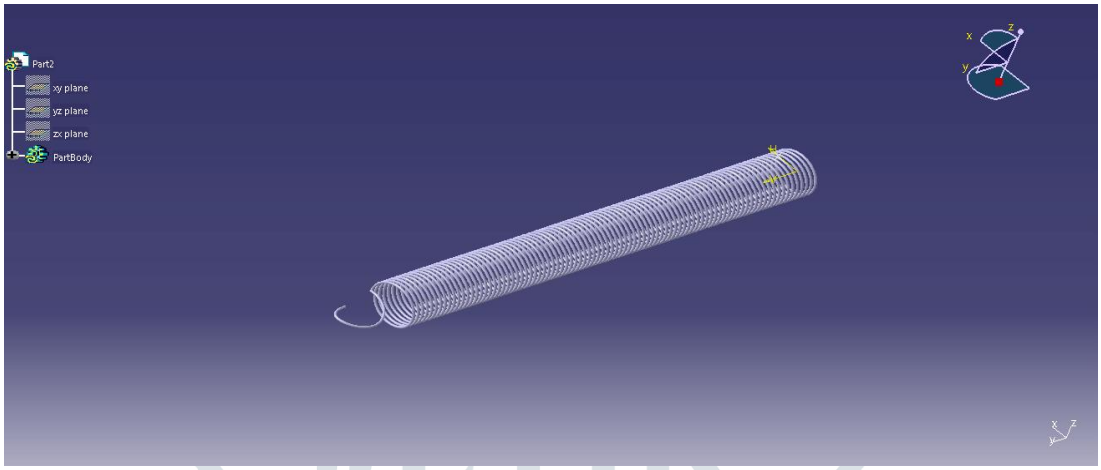

Fig. 3.4 part drawing of spring

4. Manufacturing of Water Purifier

i. Manufacturing of Frame :

We made this structure by using 1.5 inch and 1 inch square pipe due to his low weight And also good aesthetic view. For fabricating this structure we use electric arc welding.1.5 inch square pipe use for vertical member and 1inch pipe use for horizontal member

ii. Manufacturing of bush:

We make 10mm diameter bush by using solid shaft by lathe machine to support the connection rod of piston.

iii. Manufacturing the Cylinder and Piston :

From the calculation we get the diameter of the cylinder, this size of cylinder is available in market so we take it from market. The diameter of the cylinder is 34.62 and the material is brass. The piston of this size is also available in market, so we take it from market. The Diameter of the piston is 34mm.the difference in the cylinder and the piston is the clearance, it is 0 .62 mm.

5. Working:

Working principle there are only two major principles on which our working model generally works: 1. Power transmission through foot pedal mechanism. 2. Bernoulli's equation, foot pedal and the piston connecting rod is a way of transmitting mechanical power from foot to pedal .In brief when force transmitted from the pedal to the connecting rod of piston it reciprocates .due to this the piston has one compression and one suction stroke. During suction stoke when piston moves from TDC to BDC it creates negative pressure on top of the piston. On the top of the piston a small reservoir is placed. In between the cylinder and the reservoir there is one non return valve which does not allow to flow the water back to the

cylinder. During the compression stroke or upward movement of piston from BDC to TDC it compresses the water to the reservoir after several strokes of piston there is increased in volume of water in small reservoir due to this increased volume the water flows out at higher pressure. After that water conveyed by the hose pipe towards the screen filter which has permeability 500 micron which removes the coarse particle of sand, soil and any other foreign poetical which is seen by human eyes without any magnification. After that the water enters in the second stage of filtration known as sediment filter. In this stage it removes very fine partial which is in micron dimensions, which also remove which is very harmful to human being. After that the third stage is carbon filtration in that stage the water goes through the carbon cartridge in that the test of water changes also it removes smell of water. After that we get purified water that purified water stored in storage tank.

Fig. 5.1 Pedal operated water purifier.

6. Conclusion:

This paper presents fabrication and experimentally investigate the working of Pedal Powered Water purifier (PPWP) along with its purification which had used for pure drinking water supply. PPWP will consist of a reciprocating pump operated by pedal power. By pedaling the pedal, the driven shaft partially rotates, thereby reciprocating the pump which in turns discharges water from the sump. PPWP provides

drinking water and remote areas where electricity is not available. PPWP is not only free from pollution but also provide healthy exercise. PPWP reduces the rising energy costs.

7. References:

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