DESIGN AND DEVELOPMENT OF ENERGY CONSERVATIVE WATER PURIFIER

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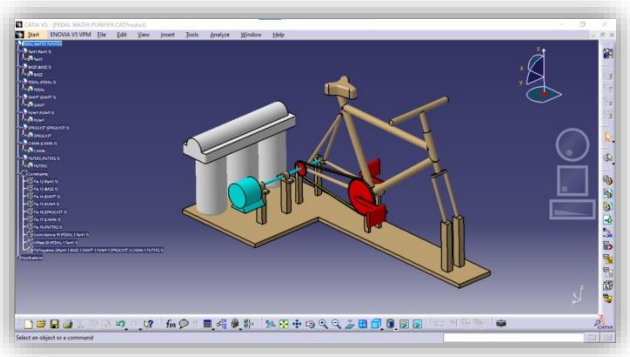
ABSTRACT:

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. 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. 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. The apparatus is also designed to be made detachable so that it can be easily shifted from one place to another with minimal modification.

INTRODUCTION

There are many villages in India that do not have the facility of clean and safe drinking water & that is because they lack proper sources for the purpose of filtered water and one major source is electricity. Water can contain many impurities, chemicals and various bacteria's. Such contaminants can cause serious health issues and thus is totally unsafe for drinking. People have to walk miles just to reach to a source of water and that too is not necessarily potable. Thus, the pedal powered water purifier is a decent step towards helping people to get purified water without much sources The pedal powered water filter works mainly on mechanical energy thus cutting down the need of electricity for the process of water filtration which make it more useful for the areas where electricity

is still a major issue. Pedaling is free from pollution, thus it is an eco-friendly system and along with that it also provide healthy exercise. The main objective of this water purifier is to provide clean water by the means ofconverting the pedal energy into useful energy which can be utilized to purify water.



WORKING PRINCIPLE :

In operation by pedaling the cycle man power is converted into mechanical energy which is further converted into electric energy in pump. Rotorof the pump is attached to rare wheel of bicycle which runs due to friction. Pump pumps the water to filter with pressure where dissolved inorganic solids are removed from water.then water is pumped to carbon filter which removes organic matters, chemicals, containments and chlorides using chemical absorption. After carbon filter water is passes through the RO membrane. Here water is converted into pure water, where impure water is collected in container.

Water is present everywhere on earth, but it needs to be purified before it can be consumed. Here comes the difficult part. It needs electricity to or fuel along with large systems to purify it and make it consumable. So here we propose a pedal based water purification system that uses pedal power to purify water and make it available for drinking. The design and fabrication of pedal powered water purifier includes sprocket chain system with power generator dynamo along with supporting frame, filters, container with integrated heating element and supporting circuit to achieve this system development. The system uses a pedal fixed sprocket with chain attached to supply circular force to the dynamo to be driven. The power generated by dynamo is then used to store in batteries. The water before getting pressurized is passed through filters to remove large particles and basic filtering. The

container on the other end is used to draw pure water from it using a tap. Thus we achieve a pedal powered water purification system as a renewable water purifier.

DESIGN OF THE DRIVER FORCE REQUIRED

Material selection: -

Cross section of link may be determined by considering lever in bending;

The linkage has an section of (25 x 10)mm

Let; t= thickness of link

B= width of link

Bending moment;

Section modules; $Z=\frac{1}{6}tB^2$

$$Fb=\frac{m}{z}=\frac{PL}{\frac{1}{6}tB^2} = \frac{6PL}{tB^2}$$

Maximum effort applied by hand (P)= 200 N

$$\Rightarrow fb= \frac{6 \text{ X } 200 \text{ X } 120}{10 \text{ X } 25^2}$$

fb =23.02 N/mm^2

As $fb_{act}<fb_{all}$

Thus, selecting an (25 x 10) cross-section for the link.

DESIGN OF SHAFT.

Material selection : -

Since the loads on most shafts in connected machinery are not constant, it is necessary to make proper allowance for the harmful effects of load fluctuations

According to ASME code permissible values of shear stress may be calculated form various relations.

= 0.18 x 800

= 144 N/mm^2

fs_{max} = 0.3 fyt

=0.3 x 680 =204 N/mm

Considering minimum of the above values ;

$\Rightarrow fs_{max}$ = 144 N/mm^2

Shaft is provided with key way; this will reduce its strength. Hence reducing above value of allowable stress by 25%

Design of Roller

We know that;

$$A = \frac{(R-d)}{2}\cos\frac{d}{2}$$

Where; R= $\frac{Do}{2t}$

t =thickness of ring

T= $\frac{C_2}{2} + \sqrt{C_2 D}$

&C_2 = $\frac{3C_2F}{b}$

= C_3 F/b

Width of roller clutch = Length of roller = 1.4

= 1.4 cm

Torque =Force x radius

5.968=$\frac{FD_o}{2}$

⇒F = 1.705 Kgf

C_2 = C_3 x$\frac{F}{b}$

C_2 =$\frac{1.61 \text{ X } 1.705 \text{ X } 10^{-4}}{1.4}$(for 5 rollers)

⇒ C_2 = 1.96 x 10^{-4}

⇒t = C_2 + $\frac{\sqrt{C_2 D}}{2}$

=1.96 x 10^{-4} +$\sqrt{1.96 \text{ X } 10^{-4} \text{ X } 56}$

t = 1.048 mm.

But the standard thickness available for the roller clutch ring is

⇒ t = 5mm, 6mm, 8mm.

Selecting t = 5 mm .

R=$\frac{D_o - 5}{2}$

R =30 mm

Now;

⇒a =$\frac{(R-d)}{2}$ cos∝ - $\frac{d}{2}$

a = 18.77

18.77 =$\frac{(30-9)}{2}$ cos∝ - $\frac{9}{2}$

∝ = 28.89^0

Torque transmitting capacity of clutch

Mt = Ft x Z x R

Where Ft = F sin β

But β = ∝ =$\frac{14.445^o}{2}$

Ft = 0.425 kgt

Mt = 0.425 x 5 x 3.0

⇒ Mt = 6.37966 Kgf /cm^2

⇒Torque transmitted capacity of clutch is 6.37966Kgf/cm^2&

as it is larger than the actual torque 5.968 Kgf/cm^2

⇒clutch is safe.

Check for bending failure

Mb_1 = C_1X F X Rm

Where Rm =$\frac{1}{2}$(D + t)

$= \frac{1}{2}(56 + 5)$

R = 30.5 mm

R= 3.05 cm

C_1= 0.1076

Now,

Mb_1 = 0.1076 X 3.05 X1.705

Mb_1 = 0.5595 Kgf /cm^2

Now fb_{act}= Mb = $\frac{Mb}{z_1}$

$= \frac{Mb}{\frac{bt^3}{12}}$

$= \frac{0.5595 \text{ X } 12}{14 \text{ X } 5^3}$

fb_{act} = 0.0038 Kgf /cm^2

As value of (actually induced Stress)is far below the permissible value the clutch is safe in

bending.

SELECTION OF BEARING

Spindle bearing will be subjected to purely medium radial loads; hence we shall use ball bearings for our application.

$P = X F_r + Y F_a$

Neglecting self weight of carrier and gear assembly

For our application F_a=0

$\Rightarrow P = X F_r$

whereF_r= Ra

As; $F_r < e \Rightarrow X = 1$

$\Rightarrow$P = 198.54 N

Calculation dynamic load capacity of bearing

L= $\frac{(C)^p}{P}$, where p= 3 for ball bearings

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The fork pin supports the fork end and is supported in the lever at other end hence will be subjected to a single shear failure

$$P = \frac{180/3}{\frac{\Pi}{4}d^2}$$

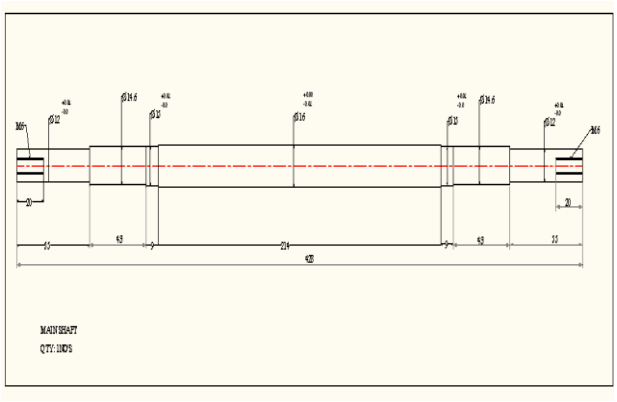
Connecting pin minimum section is 6mm for mounting in in top casing hole.

$$P = \frac{180/3}{\frac{\Pi}{4}6^2}$$

shear stress = 0.535 N/mm^2

As fsact<fsall

hence pin safe.



ADVANTAGES

- No Electricity Needed
- Villages Water Purification
- Cruises
- Boats
- Trekking/Hiking
- Life Saving Equipment

APPLICATION

- Pedal Operated System can be use for power generation for household functions & also for drip system for agriculture, sprinkler for gardening etc. by Add-Ons
- As designed especially for villages and rural areas of the country where farming and animal husbandry is the main occupation for many, the research on producing a large scale system with low cost and higher efficiency is being studied.
- The major requirement of filters such as sediment filter and carbon filter can be replaced by a single candle purifier known as “life-straw” which consist of physical filtration systems and are tested to kill even protozoans and viruses.,
- With the growing rates of impurities and pollution in the environment which directly affects the natural and underground water. A simple purification system without the use of electricity is of a great advantage.

CONCLUSION

DESIGN AND DEVELOPMENT OF ENERGY CONSERVATIVE WATER PURIFIERis a new system that is useful in developing countries like India to have daily access to safe drinking water all by harnessing the energy of pedal power.

REFERANCE

DhruvDuggal “Bicycle operated pump filter” Publisher IJMERR, Vol. 3, No. 3 e-ISSN: 2278-0149(2014)

JayantGidwani, AmitKesheorey, Ratnesh Mishra “Pedal powered water pumping and purification” Publisher IJSART-Vol. 2, Issue 5, e-ISSN: 2395- 1052(2016)

Vishal Garg, NeeleshKhandare, GautamYadav “Design and experimental setup of pedal operated water pump” Publisher IJERT-Vol.2, Issue 1, e-ISSN: 2278-0181(2013)

Curtis, V. And Cairncross (2003), S. Effect of Washing Hands with Soap on Diarrhoea Risk in the Community: A Systematic Review. Lancet Infectious Diseases 3, pp. 275– 281. Howard, G(2006).

Groundwater and Public Health, In: Schmoll O. et al. (eds). Protecting Groundwater for Health:Managing the Quality of Drinking-Water Sources, London, International Water Association Publishing, pp. 3−19.

Payment, P., Hunter, P. R. (2001), Endemic and Epidemic Infectious Intestinal Disease and Its Relationship to Drinking Water, In:

Fewtrell L., Bartram J. (eds), Water Quality Guidelines, Standards and Health, London, International Water Association (IWA) Publishing, 61−88pp. Garneau, C.

McNamara, K. and Chung J. (2008), Peristaltic Pump Project, Unpublished Final Project Report, Team D, ME 340.4, 41pp.

B. Gonzalez ,S. Alzate, J. Cromartie ,K. Hernandez, Advisor: Dr. Andres Tremante (April 7, 2014), Bicycle Powered Water Filtration System, A B.S. Thesis prepared in partial fulfillment of the requirement for the Degree Of Bachelor Of Science In Mechanical Engineering, Florida International University A. S. Akinwonmi, S. K. Adzimah, F.

Oppong, Department of Mechanical Engineering, University of Mines and Technology, Tarkwa, Ghana. 2012,Pedal Powered Centrifugal Pump Purified Water Supply System, Innovative Systems Design and Engineering ISSN 2222-1727 (Paper) ISSN 2222-2871 (Online) ,Vol 3, No.11