



WATER PURIFICATION SYSTEM USING PEDAL POWER

- AN ALTERNATIVE TO COMMERCIAL PURIFIER

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Abstract

This paper analyses the fabrication of water purification system using pedal power which can be an alternate source to the commercial purifier. Due to limited source of water available purification is required to fulfill the need of drinkable water. RO and UV purifier most commonly used for purification which are expensive and require electricity for working. In India, during shortage of electric supply this system becomes ineffective. Pedal powered water purification is an alternative to this which consists of a centrifugal pump operated by pedal power. Power generated via pedal is transmitted to the centrifugal pump, which in turn discharges water from a sump and transports it to the filter for purification. Some changes in the design can lead to the hybridization of a commercially available and pedal-powered purification system. Which could be beneficial in the future. Thus, during power cut (shortage of electric supply) water purification problem will not arise.

Keywords: water purifier, alternate source, conventional purifier, hybrid system

1. INTRODUCTION

Pure, safe and clean drinking water is a need of every household. Human can't live without it. Electricity in rural and remote areas is extremely erratic, which makes conventional water purifiers almost redundant for use. This pedal-powered water purification system is specifically aimed at such areas and is conditioned for the world where water supply is less and electricity is erratic or non-existent.

A pedal-operated water filtration system is a water filtering apparatus which can filter water by using human muscle via a pedal-powered mechanism. 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 it and transporting it to the final destination. The aim of this water purification system is to solve purifying drinking water problems in remote areas.

It is a durable apparatus which is economical to manufacture and eco-friendly. Which can last for a long time in rural conditions which can be detachable so that it can be

mounted on any frame. The system works on a sprocket chain and a pulley belt mechanism. A pulley is attached to the shaft of a centrifugal pump with a supporting frame interface where a cycle ring and pulley are connected via a V-belt for transmission of power. Filters and a reservoir are installed to achieve this system development. The overall apparatus design is to be as light weight and as cheap as possible so as to make it easily accessible to a very wide range of people. The apparatus is also designed to be made portable or detachable so that it can be shifted easily from one place to another with minimal modifications.

2. LITERATURE REVIEW

Atul P. Ganorkar., (2014) has studied on the development of a pedal-operated water pump which will be used in small scale irrigation, garden irrigation and pumping out water from a reservoir. The pedal-operated pump can be constructed using local materials and skill. The water pumping system includes a centrifugal pump operated by pedal power, the pump stand includes housing in which a foot pedal and a rotating drive shaft will be attached. It works on the principle of compression and sudden release of a tube by

creating negative pressure in the tube and this vacuum created draws water from the sump. This bicycle pedal operated pump pumps water, at 25 to 30 per minute from wells and bore holes up to 23 in feet depth. It provides irrigation and drinking water.[1]

Jayant Gidwani , Ratnesh Mishra , Rahul Lowanshi
 This paper presents fabrication and experimentally investigate the working of Pedal Powered Water Pump (PPWP) along with its purification which had used for pure drinking water supply and garden irrigation. PPWP will consist of a centrifugal pump operated by pedal power. The centrifugal pump is positioned on its stand in such a way that driven shaft of the centrifugal pump was butted to the bicycle wheel. By pedaling the bicycle, the bicycle wheel rotates, thereby rotating the centrifugal pump which in turns discharges water from the sump. PPWP provides drinking water and irrigation in 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. PPWP will design as a portable one which can be use for irrigation in various places. The experimental investigation was execute and performance of the PPWP had carried out at different rpm. The results indicate that the PPWP will give a considerable amount of discharge and head. The PPWP requires only manual power thereby reducing the utility bill considerably. Experimental result shows that discharge of about 0.0025m can be obtained for around 140rpm.[2]

4.DESIGN AND DEVELOPMENT

Pedal powered water filtration system mainly consist of following parts :-

- centrifugal pump
- Rare wheel of bicycle with chain-sprocket arrangement
- Sediment, carbon and RO-filter

Problem statement :-

- Use of sproket-chain mechanism consumes more oxygen in other words increases human effort
- centering of the axis of the driver to the driven sprocket is difficult causing whirling
- Do not provide required efficiency as efforts are getting waste in overcoming friction
- Discharge pressure is less than the required for RO purification

Problem definition :-

To overcome above said problem :-

- Belt drive is used to drive the shaft of pump instead of chain drive utilizing maximum effort, which has previously getting waste in overcoming friction also whirling problem is resolved
- Bearing are used to free the wheel decreasing human effort

- Reservoir is mounted some distance above the land leads to gravitation force coming into account increasing the discharge pressure of water required to RO system

Specification of components :

1. Diameter of sprocket (driver)	0.168m
2. Diameter of sprocket(driven)	0.065m
3. Center distance between driver and driven	0.48m
4. No. Of teeth on driver	48
5. No. Of teeth on driven	18
6. Discharge diameter	0.02m
7. Suction Diameter	0.05m
8. Bore of pulley	60mm
9. Size of v-belt	A-96
10. Bearing number	6200
11. Centrifugal pump	½ hp
12. Sediment Filter	Maximum flow 1.0 GPM Maximum pressure 125 psi Maximum temperature 100 f Service life 1500 GAL
13. Carbonated filter	Maximum flow 0.50 GPM Maximum pressure 125 psi Maximum Temperature 100 f Service Life 2500 GAL
14. Ro membrane	75 GPD Dimension 29.6 x 7.4 x 5.4 cm Weight 222g
15. Ro housing	Capacity 170 psi Size 13 inch Body material : ABS food grade plastic Weight 250g
16. Flow restrictor	Flow : 450 -800

Table-1: Specification of components

Material used

1. M.S flat plate	Tensile strength (ultimate)	440 Mpa
	Tensile strength (yield)	370 Mpa
	Bulk Modulus	140 GPA
	Young's modulus	205GPA
	Machinability	70%
	Shear modulus	80GPA
	Welding type	Conventional welding

Table-2: Material Used**Development Procedure (construction) :**

- The first step of making pedal powered water filtration system is the installation or mounting of pump, which can be done by making M.S flat plate into sufficient pieces and welded together to get the frame which attached horizontally inclined to a degree ___ on the back frame of the bicycle.
- By considering the space between wheel and rotor shaft, centrifugal pump is mounted on the frame using nut and bolts.

Components



1. Bicycle



4. Belt and pulley

Figure-1. Components of water purification system

- Suction and delivery pipes are then connected to the suction and delivery ports of centrifugal pump respectively.
- Rear wheel and shaft of pump is connected using belt and pulley arrangement.
- Delivery or discharge pipe of the motor is then connected to the inlet of filter.
- Discharge or outlet of the filter is connected to the reservoirs. one is of pure water and other contains waste water

5. WORKING

- In pedal powered water purification system, power is given to the shaft of pump. The pump is then connected to the purifier which simultaneously purifies water.
- Power getting via pedaling is transmitted from front end to rear sprocket through chain drive mechanism. The same rpm is then transmitted through rear wheel to the pulley which is attached to the shaft of pump using belt drive mechanism.
- Pump sucked the water from reservoir and delivers it with high pressure to the inlet port of sediment filter where dust, sand, particles and others organic impurities are removed from water. Then this water passes through the carbonated filter where chemical reaction takes place, killing the bacteria from the water and then this water is passed through RO housing with high pressure for further purification. Waste water is removed from waste water discharge and pure water collected in reservoir for drinking purpose.

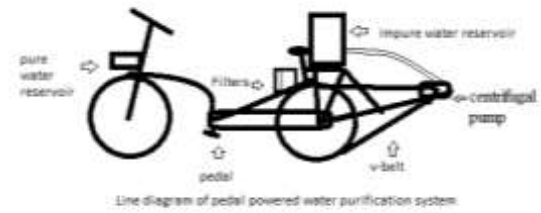


Figure-3. Water purification system using pedal power

6.CALCULATIONS

Discharge = 12 liter in 15 sec

15 = 12/1000

= 0.00080 m³/sec

= 0.800 lit/sec

Waste water Discharge : 5m

Pure water discharge : 1.2m

Oxygen consumption (for 30

Before pedalling

98

98

97



Table-3:Oxygen consumption

6. Pipe , Nozzle , elbow and key



Pulse rate (for 30 sec)

Before pedalling

82.87

After pedalling

120

TDS level

Before purification

698

300 sec- 79



Table-5:TDS level

8. Purified water storage

7.RESULT AND CONCLUSION
9. Football valve and other useful equipment

We know that amount source which can be used for drinking purpose are limited. Also health issues due to

Figure-2. Accessories

consumption of impure water are increasing rapidly. This water purification is require for safe and clean drinking water.

Available conventional purification systems are expensive and requires electricity which limits its used in wide variety of people and areas. Pedal powered water purification system meet these problems. It's cheap and works without electricity. Thus can be used in rural and remote areas where electricity is erratic or nonexistent. Also it is accessible to wide variety of people.

Pedal powered water purification system reduces the rising energy cost. Saves electricity. It is not only free from pollution but also provide healthy exercise. Reduce TDS of the water to the range 60-70 thus it can be economical and Ecofriendly alternative to the conventional purifier.

8. FUTURE SCOPE:

Some changes in the design can lead to the hybridization of conventional and pedal powered purification system. Thus purification problems during power cut may eradicate completely. Also changes in the design can make this system portable. Reducing extra efforts required for purification. It can be used for exercise and purification simultaneously .Also it is used as water pump to lift the water and purify it. And can be economical and eco friendly alternative two commercial purifier.

REFERENCES

[1] Atul.P.Ganorkar, K.S.Zakiuddin, H.A.Hussain, “An Experiment on Development of Pedal Operated Water Pump”, IOSR, e-ISSN:2278-1684,(2014).

[2] Vishal Garg, NeeleshKhandare, Gautam Yadav, “An Experimental Setup and Design of Pedal Powered Water Pump”, International Journal of Engineering Research and Technology (Vol.2, Issue.1) (2013).

[3] Tuzson J.(2000) “Centrifugal Pump Design” John Wiley and Sons. New Jersey, United States.

[4] Sermaraj M. (2006): Design and Fabrication of Pedal Operator Reciprocating Water Pump.

[5] Amy G, Bull R, Craun G F, Gunther F , Pegram R A & M Siddiqui (2000), Disinfectants and Disinfection by- products 1st draft, WHO Geneva, Switzerland

[6] Ademola Samuel Akinwonmi, Stephen Kwasi Adzimah, Fredrick Oppong, “An Experiment on Pedal Powered Centrifugal Pump for Purified Water Supply Device” ISDE (Vol.3, No.11) (2012).

[7] Bryan Lee, “A Design of Simple Human Powered Water Pump”, International Journal of Technology(2007).

[8] M.Serazul Islam, M.Zakaria Hossai and M.Abdul Khadir, “Design and Development of Pedal Pump for Low Lift Irrigation”, JARD, 5(1&2)116-126 (2007).

[9] March 13,2007. “Clean water for people.” The ministry of foreign affairs Japan.

[10] Helmeinstine , Ph.D , Anne Marie. , “What is reverse osmosis?..How does it work?”