

Pedal Operated Water Pumping And Purification System Using Reverse Osmosis

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ABSTRACT

Water is the most basic necessity for life yet nearly one billion people in the world lack access to it. In many developing countries, people walk many miles to reach a source of water that is not necessarily potable. Not only is distance and portability an issue, but the average water collecting container in India, the can, weighs over 40 pounds when full. This project proposes to take on challenges associated with the accessibility and cleanliness of water in developing countries by designing and building a filtration system that can be operated by pedaling the machine. The project involves fabrication of water purification system in which the water is pumped from the impure side using a pedal operated mechanism wherein it passes through the filter unit to give clean potable water. This system not only serves as a means of getting pure water but can also act as pedal powered pump. The Reverse osmosis process is used for the purpose of water purification.

Keywords: Pump, Potable, Purification, Pedal, Reverse Osmosis etc.

I.INTRODUCTION

The Earth is covered by 75% water, yet one of the world's greatest issues is a lack of drinking water. Every year, almost four million people die from water-related diseases and 98% of those occur in the developing world. In response to such a need, this idea is proposed to produce clean drinking water by reverse osmosis filtration by means of human power. There are several means to purify water; however, because of its incredible thoroughness, a reverse osmosis system has been preferentially selected for this design. According to a 2007 World Health Organization (WHO) report, 1.1 billion people lack access to an improved drinking water supply, 88 percent of the 4 billion annual cases of diarrheal disease are attributed to unsafe water and inadequate sanitation and hygiene, and 1.8 million people die from diarrheal diseases each year. The WHO estimates that 94 percent of these diarrheal cases are preventable through modifications to the environment, including access to safe water.

Reverse Osmosis (RO) system

Reverse osmosis (RO) is a water purification technology that uses a semi permeable membrane to remove larger particles from drinking water. In reverse osmosis, an applied pressure is used to overcome osmotic pressure, a colligative property, that is driven by chemical potential, a thermodynamic parameter. Reverse osmosis can remove many types of molecules and ions from solutions, including bacteria, and is used in both industrial processes and the production of potable water. The result is that the solute is retained on the pressurized side of the membrane and the pure solvent is allowed to pass to the other side. Reverse osmosis is most commonly known for its use in drinking water purification from seawater, removing the salt and other effluent materials from the water molecules. The availability of fresh and good quality drinking water to all Indians remains a concern.

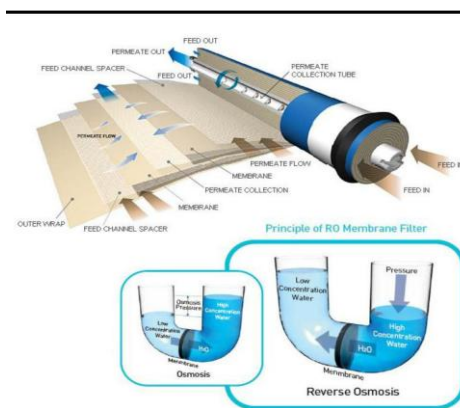


Fig. REVERSE OSMOSIS SYSTEM

As such we decided to design an apparatus that could produce clean and safe drinking water at low cost and effectively and also without using electricity since majority of the remote areas of our country still don't have access to electricity. Pedal Powered Water Pump along with water purification is an eco friendly system. The unit works only on mechanical energy without electricity. This system provides drinking water and irrigation in remote areas where electricity is still a major problem .along with providing eco friendly environment it also helps to regulate a good health while pedaling is not only free from pollution but also provide healthy exercise. The System Produces the rising energy costs.

II. LITERATURE REVIEW:

Dustin Drake create the device. The device was designed to test the practicality of human powered reverse osmosis through a numerical analysis. The device uses a bicycle to harness human motion to convert it into usable power to run a reverse osmosis filtration system.[2]

Sunil J. Wimalawansa's paper gives that approximately 25% of the world's population has no access to clean and safe drinking water. The traditional methods, including domestic water filters and even some of the newer

methods such as ultra-filtration, do not remove most of the heavy metals or toxic chemicals from water than can harm humans. The latter is achieved with the use of reverse osmosis technology and ion exchange methods. Properly designed reverse osmosis methods remove more than 95% of all potential toxic contaminants in a one-step process.[3]

Paper of S.S.Phuseshowswater purification is the process of removing undesirable chemicals ,biological contaminants suspended solids and gases from contaminated water .Propose water purification system for remote areas focus on providing a pure drinking water at low cost with high reliability to the rural families. It involves the research, design and manufacture of water purification system using renewable energy. It consists of a combination of solar pasteurization, reverse osmosis (RO) and ultraviolet (UV) lamp sterilizer system with power supplied by photovoltaic (PV) modules.[4]

A.Peramanan's paper is to discover whether human powered reverse osmosis is a viable option for producing pure water. The matters at hand are to determine whether human power is enough to operate such a system, how much clean drinking water it will produce, and if it produces a reasonable amount for the work put in.[5]

III. PROBLEM STATEMENT

Developing countries around the world face debilitating challenges accessing safe and clean drinking water. Alarming statistic led us to the idea that that we could use a simple mechanism of transportation that is common in these areas, such as the bicycle, to help aid their water and sanitation struggles. Our goal is to design a bicycle attachment to purify and transport water from contaminated sources that is activated while the rider is pedaling. This attachment, though not a permanent solution, would be a contribution to the improvement of their quality of life.

IV. OBJECTIVES

- 1)A small scale water filtration system could be brought into remote areas and emergency conditions like flood, famine, earthquakes, and tsunami to provide the means of purifying contaminated water.
- 2)In other hand there are no proper water facilities and electricity in villages and these people are drinking hard water which is dangerous to health.
- 3)Filtering local sources of water would eliminate the need to import large quantities from elsewhere, saving relief funds for alternate uses.
- 4)To make the system portable and user friendly.
- 5)The purpose of this project is to design a small scale water purification kit which requires minimal maintenance and is cost efficient.

V. DESIGN OF MACHINE



VI. WORKING PRINCIPLE:

As shown in the figure, the project involves fabrication of pedal operated water pumping and purification unit. The energy obtained by pedaling the pedaling system is transferred to the drive train using the chain and sprocket drive. The chain and sprocket drive used is of required speed ratio so as the pedaling action of human being makes the required energy as well as speed to drive the pump. The pump is connected to the impure water tank. As the user pedals the impure water from the tank is pumped to the purification unit. The purification unit purifies the impure water and gives to the outlet. Thus this project can serve as a means to pump the water from the tank using pedal power as well as purify the water from the tank.

In addition to this the part of the drive is used to generate electricity. The project consists of a small Generator which is attached to the pedaling unit using a speed reduction drive. As the pedaling action takes place, the generator also rotates, thereby generating electricity. The generated electricity is stored in a battery which can be used in case of power cutoffs.

VII. DEVELOPING PROCESS OF THE MACHINE

- 1) The fabrication of frame:
- 2) It should be economical and should have long life.

- 3) The pedaling system fabrication:
- 4) The pump modification:
- 5) The water purification Unit.

VIII. CALCULATIONS

Design of scotch Yoke mechanism

$L = 2r$ where r = radius

Therefore, $r = 80\text{mm}$

Diameter of scotch disc

$$D = 160 \text{ mm}$$

Connecting rod length ,

$$L_r = 300\text{mm}$$

Thickness of disc,

$$T_s = 0.022D \text{ to } 0.033D$$

Considering standard size available in the market

$$T_s = 4\text{mm}$$

Inner diameter of yoke pin,

$$\begin{aligned} d_{ip} &= 2 \times T_s \\ &= 8\text{mm} \end{aligned}$$

Outer diameter of yoke pin,

$$\begin{aligned} d_{op} &= 2.5 \times T_s \\ &= 10 \text{ mm} \end{aligned}$$

Length of yoke,

$$L = 160 \text{ mm}$$

Angular velocity of scotch disc,

$$\omega = \frac{2\pi N}{60}$$

Where N = speed of connecting rod = 208 RPM

$$\omega = 21.78 \text{ rad/s}$$

IX. ADVANTAGES

- 1) Requires no electricity for purification.
- 2) Can be used even for pumping water at different heights.
- 3) Economical in construction.
- 4) Gives pure potable water.
- 5) Requires least pedaling efforts.
- 7) Since water is purified by pedaling, it also serves a way to stay healthy an fit.

X. LIMITATIONS

- 1) Requires human efforts.

XI. APPLICATIONS

- 1) Can be installed at schools and colleges.
- 2) Can be used by people in villages to get pure water as well as to pump the water.

XII. CONCLUSION

The project carried out by us made an impressive task in the field of water purification method. Through extensive work we found cost effective parts that will meet our goal of designing a portable filtration system that can be retrofitted to any standard bicycle and facilitate the transportation of water for the daily use of families in developing countries. Considering other water purification systems, a human powered reverse osmosis system is not only feasible, but quite an economical and effective means for providing potable water. In the coming days a prototype will be constructed which consists of a pressure pump, the filter and a stand. Each component will be thoroughly tested in order to provide the best product possible at the most reasonable price.

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