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Pedal Powered Water Filtration System- A Review

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Abstract: This paper focuses on the design of a pedal powered water purifier which can be used in rural areas for the filtration of water at small scale. It works on the principle of alternate compression and relaxation of tube resulting in negative pressure in the tube and creating a seal between suction and discharge side of the pump. Upon restitution of the tube a strong vacuum is formed drawing water into the pump and the roller passes along the length of the tube totally compressing it and pushing the water through the filter where adsorption takes place to purify the water. Thus, making water purified without the help of the electricity. The proposed design consists of a peristaltic pump powered by pedaling, a filter and a flexible tube. This setup is optimized in such a way that it is user friendly and produces no pollution. And also reduces the overall cost used in transporting and sanitizing drinkable water.

Keywords: peristaltic pump, negative pressure, filter, sanitizing drinkable water.

I. INTRODUCTION

Various statistics show that there are many villages in India that do not have the facility of clean and safe drinking water. And 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 of converting the pedal energy into useful energy which can be utilized to purify water. It basically consists of a positive displacement pump (peristaltic pump).A peristaltic pump is a type of positive displacement pump used for pumping a variety of fluids. This peristaltic pump is positioned in such a way that the shaft of the pump can be driven with the help of pedals, thus utilizing pedal energy. It can be used not only to purify water but also for irrigation purposes & always possess a positive impact on health. The Reverse osmosis filter is used which purifies the water to a greater extent & further more filters which help purify it more. Further filters include sediment filter & activated carbon filter. The experimental investigation can be carried out at different rpm which can be helpful in determining the adequate flow rate required & therefore, the amount of power required. Thus, manual power can be harnessed to purify water & make it suitable for drinking purpose.

A. Working

In Pedal powered water purifier, mechanical power is transmitted to the shaft, and the shaft is connected to pump which is mounted on bicycle. Thus the power is transmitted to the peristaltic pump. The attachment of the peristaltic pump helps to create the required amount of pressure, also known as osmotic pressure, by reducing pressure on the opposite side. This pressure helps water to move forward & go through the semi permeable membrane. The smaller impurities that can't be separated via sedimentation in the tank itself, will be separated with the help of this membrane. Further, the water goes to sediment filter which increases it purity level more. The remaining impurities can be removed with the help of carbon filter. Carbon filtering is a method of filtering that uses a bed of activated carbon to remove contaminants and impurities, using chemical adsorption. Sedimentation & normal filtration are important processes required before reverse osmosis purification as they remove comparatively larger particles which can damage the semi permeable membrane. The smaller & lesser the amount of impurity interacting with RO membrane, the longer is the life of the membrane which increase the efficiency, effectiveness & life of the system. After passing through all the filters, pure water is stored for drinking in another container, which can be used for drinking purpose. Or, if we remove filter assembly, this system can also be used for irrigation purpose. Water stored in containers can be pressurized with the help of pump attached to the sprocket &

directly being able to be watered in field as enough pressure has been generated with the help of pump. Thus, this model of water purifier can help to solve the drinking problem in the rural areas which are still lacking the proper electricity supply.

B. Filters

Activated carbon filter: It uses the phenomena of adsorption. The water flowing through it contains impurities which are harmful for us. The impurities in the low pressure water are adsorbed on the surface of the activated carbon. The large surface area provided by the each particle Activated carbon also removes smells in water and makes cloudy water clear by removing color causing compounds in the water. While going through the activated carbon filter, each water molecule gets sufficient space for adsorption. Pedal powered water filtration system lowers down the turbidity & the TDS value under the acceptable range. *Sedimentation filter:* It is used to reduce the turbidity of the water. Is consists of suspended solids, such as silts, sand or clay. All the insoluble impurities gets separated by this filter.

C. Proposed Design

The exact model of the PPWP is still under progress, however, the attachment of the peristaltic pump has been designed well. This is shown in figure 1 & 2 with isotropic view. This attachment is attached on the sprocket of the bicycle. Three long 10mm bolts can be used to attatch the attachment with sprocket. These rollers are in contact with the pip that will be used to transport water. As the pedals rotate, & the rollers move, negative pressure is created & the water is forced to move forward, helping in reverse osmosis. The proper selection of the design that provides the best overall benefit and versatility will consequently be the one we choose. A rough sketch is shown in figure 3.

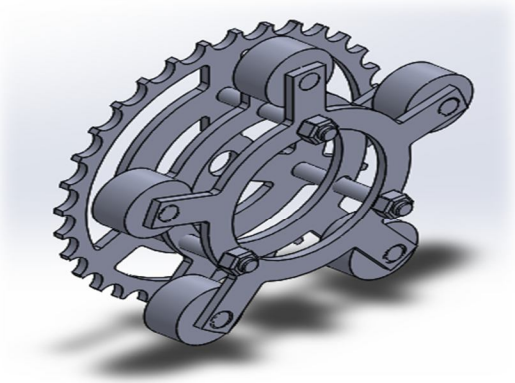

Fig 1: Isotropic view of the attachment

Fig 2: Front view of the attachment

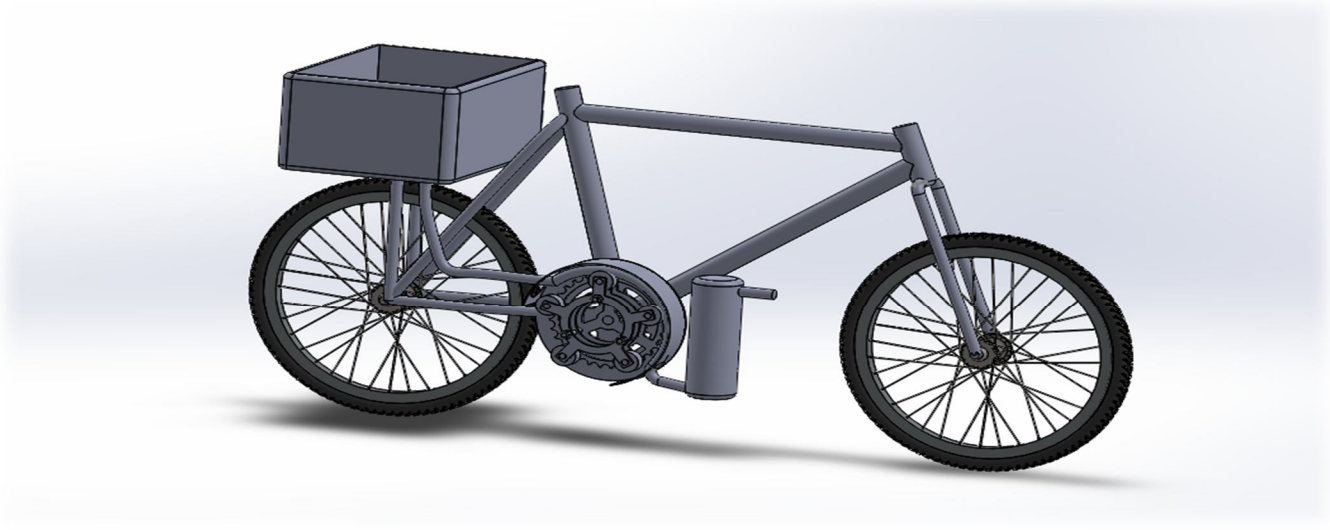

Fig 3: Assembly

II. LITERATURE SURVEY

Literature survey is usually based on what earlier progress has been done on this system and by closely studying it, what further modification can be done to improve the output.

1) Vishal Garg et. al (2013) worked on to reduce the effect of water pump by using belt drives in bicycle. Belt drive is better way for transmission of power from pedal to the shaft of centrifugal pump.

2) Dhruv Duggal et al., (2014) worked on the enhancement of "Bicycle operated pump filter". Their main objective was to pump the water with the help of centrifugal pump for the purpose of irrigation. By pedaling the bicycle at particular rpm water can be lifted to a certain height, thus can also be used at places where water is present at lower ground levels. Physical parameters were determined using various calculations.

3) Pratik S. Nagrare et. al (2017) created the design of a filter operated by pedaling the pedals attached on a frame by using the principle of Bernoulli. The design was optimized such that it's a stable frame rather than a bicycle so that there would be no mechanical disturbances during the filtration process.

4) Sanjay N. Havaldar et. al (2016) prepared the design of pump filter by taking mathematic modeling into consideration. They emphasized on the selection of materials based on the dependent variables like flow rate, speed and power. Frictional head loss was included to find out the nature of flow, turbulent or laminar. Forces were resolved to calculate the exact power required to overcome the friction. Designing by such parameters gave the delivery by pump and thus an estimate time to filter the water.

III. EXPECTED OUTCOME

Suitable level of TDS in water.

Level of TDS(Milligrams per liter)	Rating
Less than 300	Excellent
300-600	Good
600-900	Fair
900-1200	Poor
Above 1200	Unacceptable

The water that we take to purify has a general TDS of around 800, which after purification becomes around 300-600.

1) *Level of pH:* pH of impure water is generally around 6-8.5. After purification, pH becomes 7.

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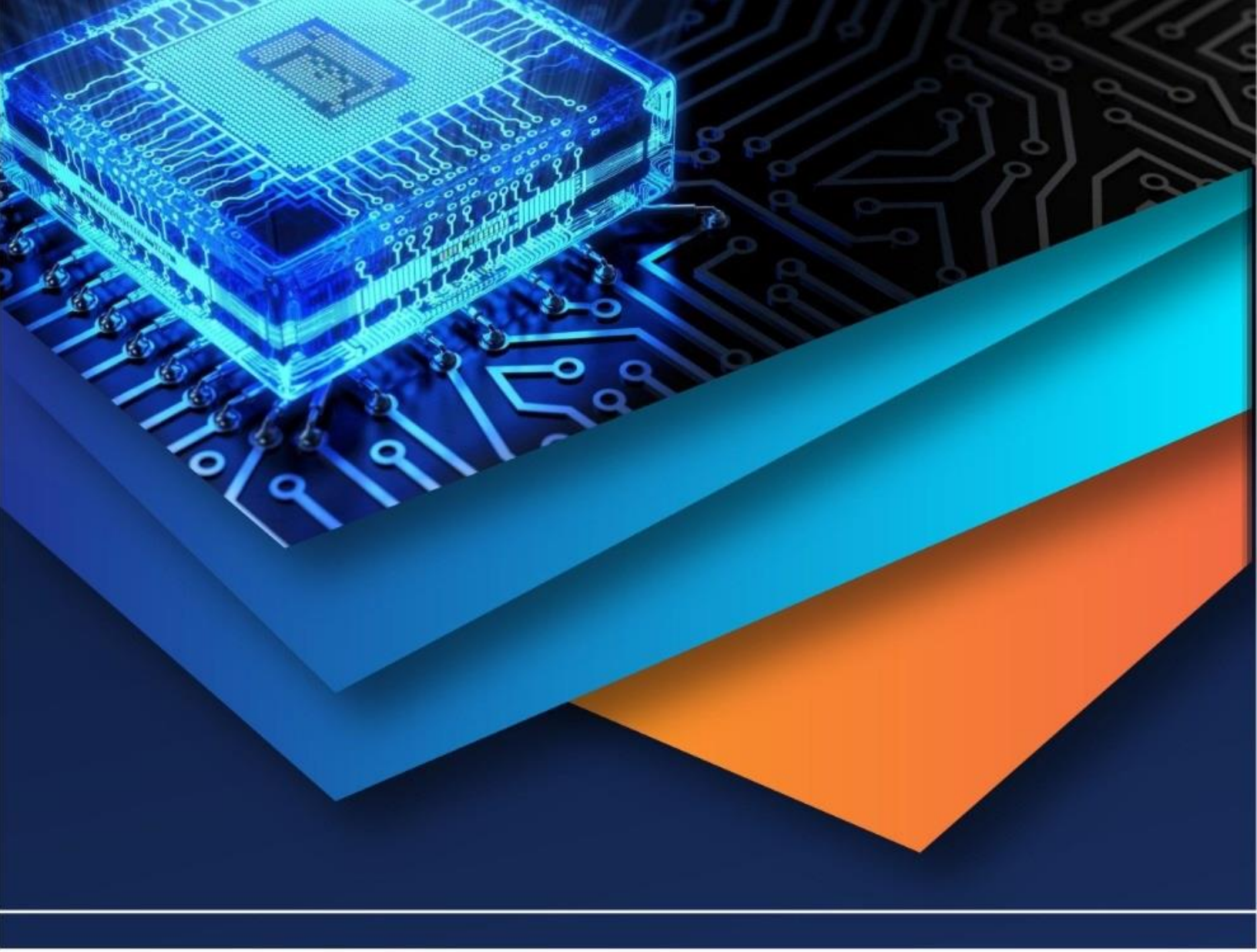

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