PEDAL POWERED WATER PURIFICATION - A Survey

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Abstract - *An Most of the earth is covered by Water, but it needs to be purified before it can be consumed. Generally water purification needs electricity or fuel along with large systems making purified water more costly. But there are several water purification methods which needs no electricity with less cost. One of the purification method is pedal powered water purification (PPWF). In this purification process mainly basic Bernoulli's principle is used which states that an increase in the speed of a fluid occurs simultaneously with a decrease in pressure or a decrease in the fluid's potential energy. Many people worked on this type of water purification system and came up with different designs. So here we are reviewing different pedal powered water purification (PPWF) methods proposed by several authors.*

***Key Words*: Water1, Purification2, Pedal Power3, Pre-Purifier4, Purifying Chamber5, Drinkable Water6.**

1. INTRODUCTION

The Earth is covered by 75% water, yet one of the world's greatest issues is a lack of drinking water. Water is vital element on earth and is very essential to sustain life, and a satisfactory and safe supply must be available to all. But nowadays, the water is getting contaminated due to industrialization which produce large amount of wastes which contains toxic chemicals and pollutants which leads to many water related diseases. They contain pollutants such as sulphur, asbestos, nitrates and harmful chemicals. In many developing countries, people walk many miles to reach a source of water that is not necessarily potable.Water can contain dirt, minerals, chemicals and other impurities that make it smell and taste bad. Some of these contaminants can endanger health, especially when they include microscopic organisms and bacteria that can cause serious illness. Humans can live for weeks without food, but only a few days without water (Water.org Inc., 2009). Many people in developing countries barely have access to any water source at all and for those that do, the water is completely filthy and disease-ridden.

To decrease the contamination of water, we can use different processes such as boiling, distillation, water chlorination, sedimentation, reverse osmosis, solid block activated carbon, granular activated carbon, water softeners, sediment filters, boiling, bottled water, ozonation, ion exchange and filtration. Among all the above process mentioned Reverse Osmosis is best suited for issues which were originally designed for mainly two things, they are: Desalination of brackish water or sea water and Reducing very specific chemical contaminants. Reverse Osmosis is needed to remove Fluoride, sodium, total dissolved salts, or chemicals like arsenic, radium and nitrates.

The water purification system can be operated by means of many ways like electrical energy, solar energy, thermal energy, gravitational potential energy, magnetic energy etc but needs much resources making the process costlier. But there are newer methods like pedal powered water purification (PPWF) which makes process less costlier and several authors worked on it.

2. LITERATURE REVIEW

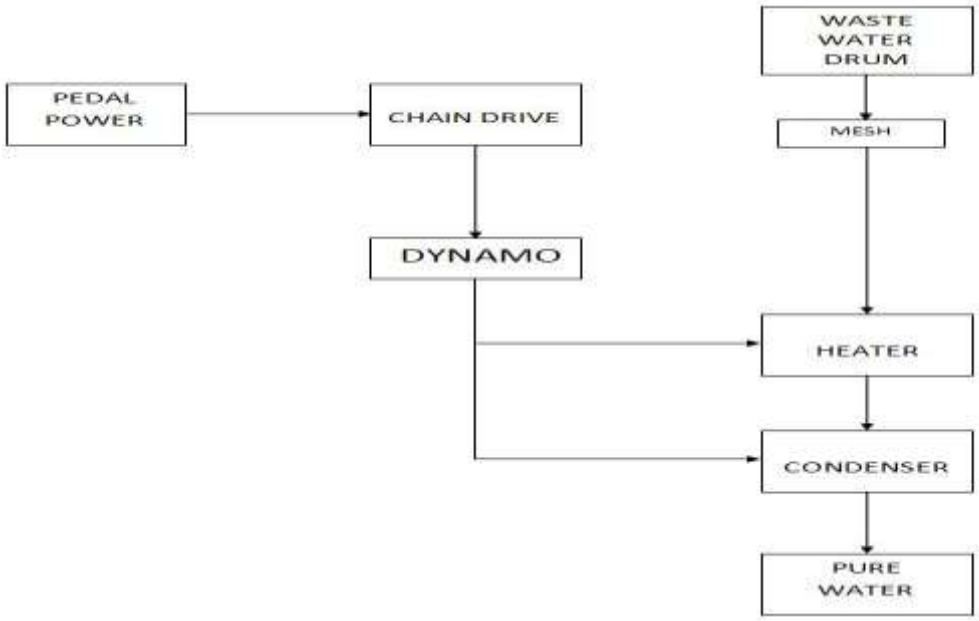
Irjet Pratik s. Nagrare et al 2017 [1] proposed a pedal powered purified water supply device. It works on the principle of compression and sudden release of a tube by creating negative pressure in the tube and this vacuum created draws water from the sump into the pump while rollers push the water through to the filter where adsorption takes place to purify the water. This paper proposes to take on challenges associated with the accessibility and cleanliness of water in developing countries by designing and building a filtration system and sidecar that are portable, durable, and cost-effective. Vishal Garg, Neelesh Khandare et al 2013 [2]. In this paper author mentioned Ademola Samuel Akinwonmi et. al 2012 [3] have conducted a experiment on pedal power water purification and design was focused on process of conception, invention, visualization,

calculation etc. he also made a force analysis to check performance criteria. The physical parameter of design was determined by the appropriate calculation and the practical consideration with some reasonable assumption. It is discovered that the design is simple, cheap, efficient and affordable as could be seen from the readily available materials used. It also use the Bernoulli's principle for the flow calculation with the help of peristaltic pump. Yuichi katsuara et. al 2011 [4]president of Nippon basic company was the first company to give Portable Water Purifying System "Cycloclean" powered by pedaling bicycle to make 5 liter(max.) of clean water in a minute at a technology fair in Tokyo. It need man power to turn a bike chain driving motor to pump water through series of filter (without the use of electricity). Clean water can be utilized for domestic purpose. Peramanan et. al 2014 [5] has studied the fabrication of Human Power Reverse Osmosis Water Purification Process. The device use pedal to harms human motion to convert it into usable power to run a reverse osmosis filtration system. Osmosis is a natural process in which a liquid from a less concentrated solution flows through a semi permeable membrane to more concentrated solution. Reverse osmosis is an effective method of reducing the concentration of total dissolved solid sand many impurities found in water. The project has been carried out to make an impressing task in the field of water purification method. Betzabe Gonzalez et. al 2014 [6] has analyzed and studied on the design and he used peristaltic pump with silicone tubing. This tubing was visually better suited for our project having no kinds to reduce flow, easy to clean and flexible enough to create suction between rollers. Sidecar is added to the bicycle for the two tanks setup one of dirty water & other of clean water tank for utilization around the home. Filtered water we get through this design. M venkata praveen kumar et al 2017 [7], given his idea on purification of water by bicycle to harness human motion to convert it into usable power to run a reverse osmosis filtration system. The flow rate was determined according to given information from the reverse osmosis manufacturer. Anusha Pikle, Yash Siriah et al 2017 [8], gave a paper which analyzes the design of a pedal operated water filtration system to be used by local dwellers. 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 into the pump while rollers push the water through to the filter where adsorption takes place to purify the water. Anand and ramprasad et al 2017 [9], reviewed the literature regarding a variety of portable water purification techniques like boiling, solar water disinfection, sedimentation and ceramic filters coagulation, adsorption (activated carbon), chlorination, uv irradiation, ultra filtration, reverse osmosis and other combined methods that have been predominantly used at the household level. Jayant Gidwani et al 2016 [10], In this paper author mentioned about fan pump (ppwp) along with its purification which has been 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. PPWP provides drinking water lubrication of ppwp. And experimentally investigates the working of pedal powered water and irrigation in remote areas where electricity is not available. Garud and kulkarni 2017 [11], gave a paper in which reverse osmosis (RO) is a membrane based process technology to purify water by separating the dissolved solids from feed stream resulting in permeate and reject stream for a wide range of applications in domestic as well as industrial applications. It is seen from literature review that ro technology is used to remove dissolved solids, color, organic contaminants, and nitrate from feed stream. Hence RO technology used in the treatment of water and hazardous waste, separation processes in the food, beverage and paper industry, as well as recovery of organic and inorganic materials from chemical processes as an alternative method . This paper intends to provide an overall vision of RO technology as an alternative method for treating waste water in different industrial applications. Mogaji p. B. Et al 2016 [12] has analyzed & studied the development of an improved pedal powered water pump, can be used for irrigation and drinking water purposes. It is more productive operated pumping system and is time saving. The system is composed of a reciprocating pump powered by pedaling. The pedal power is being transmitted to the pump via a chain drive. Eric Harshfield, Ana Jemec Et al 2009 [13] gave a paper on Water Purification in Rural South Africa The authors present the design and constructed process for a slow sand filtration system intended to provide clean drinking water to most households in the community. The paper ends with a reflection examining aspects of engineering community engagement projects including site assessments prior to project implementation, project timeframes, and cross-cultural institutional collaborations. Sonal P. Thomas, Noble Patrick K. Et al 2014 [14] has analyzed on Pedal Powered Centrifugal Pump. The objective of the is paper was to design, fabricate and experimentally investigate die working of Pedal Powered Centrifugal Pump (PPCP) which used in small drinking water supply and garden irrigation. PPCP consists 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 is butted to the bicycle wheel. The experimental investigation was executed and performance of the PPCP was carried out at different rpm. The results indicate that the PPCP had given 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 /sec. It can be obtained for around 140rpm. M. Jayamoorthy, B. Sridhar et al 2017 [15] mentioned about the Purification system of water by cycling pedaling is useful in purifying the water by means of a cycle operated with reverse osmosis process. It includes the cycle pedal being rotated and inlet being connected to the membrane of the reverse osmosis setup. It is used to increase the discharge level of the water involved in purification. Hence the amount of water used can be purified and used by these means of purification with a lots of water borne diseases. This method is used inproviding he purified water that can be available for all people in a very low cost. M. Jawahar, G. Venkanna Et al 2014 [16] discussed the mechanism of Pedal Operated Centrifugal Pump for Low-lift Applications rare wheel of the bicycle is rotated with the help of driver and driven gear of the bicycle. The chain drive of the centrifugal pump is connected to the rare wheel hub of the bicycle, it also rotates when the rare wheel of the bicycle is rotated with the help of the rotation system. The shaft of the centrifugal pump rotates up to 3700rpm.With the rotation of the great speed the vacuum is created in the centrifugal pump and this vacuum in this centrifugal pump suck the water from the water tank and it discharge the water through outlet with some amount of pressure. Sreejith K., Martin O.J. Et al 2014 [17] reviewed on design, fabricate and experimentally investigate the working of Pedal Powered Centrifugal Pump (PPCP) which used in small drinking water supply and garden irrigation. PPCP consists 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 is 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. PPCP provides drinking water and irrigation in remote areas where electricity is not available. PPCP is not only free from pollution but also provide healthy exercise. PPCP reduces the rising energy costs. PPCP is designed as a portable one which can be used for irrigation in various places. The experimental investigation was executed and performance of the PPCP was carried out at different rpm. Dustin Drake, Michael Solley Et al 2011 [18] discovered whether human powered reverse osmosis is a viable option for producing potable water for developing countries. 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 device was designed to test the practicality of this idea 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. This was used to calculate the power needed to power such a design and was then compared with researched data of available power from humans. It indicated that a human could easily provide enough power to run a reverse osmosis system such as this. The flow rate was then used to determine how useful this power was by considering how fast it could produce clean drinking water and how much water a person needs to drink daily. Anyanwu, S. Ikechukwu Et al 2016 [19] mentioned that the design was originally conceived to meet the energy needs of those living in rural areas, due to poor access to electricity and also as a model for gym centers and cycle workout studios. Most persons living in these rural areas possess at least a cell phone but lack the means to charge them. This study focused on the design and fabrication of a pedal operated power generator, for the intents of burning fats while yet generating electricity. The power generator was designed to be simple, cheap, durable and easily maintained. It was fabricated using locally sourced materials and is intended to encourage local ingenuity and empower aspiring entrepreneurs especially in developing countries. Its purpose is to efficiently transfer human foot motion less than 60 rpm via a treadle and sprocket-chain step-up to drive a 24V DC permanent magnet generator. The inverter converts the direct current (DC) into alternating current (AC) which is needed to charge low voltage devices like mobile phones, laptops etc. Dhruv Duggal Et al [20] 2014 reviewed the design and construction of bicycle operated pump filter is explained which is used in irrigation and filtration at small scale.

3. METHODOLOGY

In this purification process mainly the basic Bernoulli's principle is used which states that an increase in the speed of a fluid occurs simultaneously with a decrease in pressure or a decrease in the fluid's potential energy. The main setup of the entire design is divided into three different stages used to purify the water. The stages are Generator, Boiler and Condenser. Initially the water which is contaminated is purified by allowing the water into pump with the help of chain drive. In this arrangement generally chain drive is used to transmit mechanical energy from driver shaft to driven shaft. Chain drives efficiency is more as compared to belt drives. Chain drives can maintain the velocity ratio constant and can be suits for small and large distances from 3mts to 8 mts. Chain drives can produce less load on shaft so that we can do effective pedaling with low overall maintenance. So that we prefer chain drive as a transmission system to 12v DC Pump as well as generator. The contaminated water is drawn to Boiler with the help of pump. The generator is used to develop the mechanical energy to electrical power so that the contaminated water is heated in the boiler. The boiler is essentially a closed vessel inside which water is stored. As the generator gives the input the boiler heats the pollutant water. After heating the water in the boiler, it turns in to vapour and then it goes to condenser. The condenser is used to cool down and condense the water which comes from the boiler. Then the clean water which is condensed is stored in a container. The steps are as fallows.



Flow chart-1: Layout of the process

4. CONCLUSION

Water is the vital source to live the life in comfort zone. So water must be needed to each and every living being and in any situation. But due to increasing in pollution due to various issues water is getting contaminated. The massive pollution of water is therefore emerging as a global challenge that requires a global response. But the purification of water became much costlier with the increasing need of it. At the same time, several people proposed different methods of water purification which consumes less resources. Out of all we studied pedal powered water purification (PPWF) method which needs very less resources and also echo friendly. This water system comprises of a centrifugal pump operated by pedal power. The pump stand is made up of a housing in which a foot pedal and a drive shaft rotates. 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. Thus, providing irrigation and drinking water where electricity is not available. The setup can be built using locally available materials and can be easily adapted to suit the needs of local people. Finally it is concluded that it is a new invention that utilizes simple equipment and puts them all together to help villages in developing countries to have daily access to safe drinking water all by harnessing the energy of pedal power. At the same time more laboratory tests are to be performed to ensure the safety of water generated from this process.

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