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Peddle Power Reverse Osmosis Fabrication and Development Using a Booster Pump in conjunction with a DC Dynamometer

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Abstract— **The purpose of this paper is to learn about human-powered reverse osmosis systems and Peddle Power Reverse Osmosis systems. Using a Dc Dynamometer and a Booster Pump. It is the most suitable and cost-effective method for generating potable and safe drinkable water in rural and remote hilly areas where water purifying resources are limited and overhead tanks are not available. In this project, a sprocket connected to a DC Dynamo provides electricity, which is then stored in a battery, which is then connected to a Booster Pump for water suction and delivery from the suction tank to the delivery tank.**

Index Terms: **Booster pump, DC dynamo, Sediment filters.**

1.INTRODUCTION

Not only for humans, but for all living organisms on the globe, water is the most important resource. Water has been polluted in recent decades as a result of industrialisation and poor hygiene practises, resulting in a slew of water-borne diseases. To address this problem, particularly in rural areas where there are little resources available to convert polluted water to drinkable water, our solution will undoubtedly solve the problem. Lakes, rivers, ponds, and bore wells are common sources of water in rural settings. utilising our project Peddle Power Reverse Osmosis Fabrication And Development People can absolutely purify water and live disease-free lives by employing a booster pump with a Dc Dynamometer.. According to numerous studies, when compared to other current water purification procedures such as distillation, ultra violet light, and boiling bottled water, reverse osmosis is one of the most cost-effective processes for addressing significant potable water challenges. To remove fluoride, sodium, completely dissolved salt, nitride, arsenic, and other contaminants from water, reverse osmosis is required [3].

The alternator or dynamo we placed is charged by human power cycling and supplies current to the battery to do necessary work. The battery powers the Booster Pump, which draws water from the suction tank and delivers it to the semipermeable membrane and filters..

RO systems are simple to construct and operate, need little maintenance, and are modular in nature, making system extension straightforward.

2. RO membrane methods may remove both inorganic and organic contaminants at the same time.
3. RO systems enable the recovery and recycling of waste process streams without affecting the substance recovered.
4. When compared to other technologies, RO systems use less energy.
5. RO processes can significantly reduce the volume of waste streams, allowing other processes, such as incineration, to treat them more efficiently and cost effectively.
6. It can be utilised in enterprises that filter water.
7. This technique benefits from a membrane-based approach that allows for concentration and separation without changing the state of the system.
8. Can Placed or Installed at gram panchayat or remote and hilly areas for betterment of people

2. LITERATURE REVIEW

Dustin Drake suggested a paper to see if human-powered reverse osmosis is a viable option for underdeveloped countries to provide drinkable water.

Through a numerical study, a gadget was created to assess the viability of this concept. The technology works by harnessing human motion and converting it into useable electricity to operate a reverse osmosis filtration system using a bicycle. According to information provided by the reverse osmosis manufacturer, the flow rate was calculated. It showed that a human could easily supply enough electricity to run a reverse osmosis system like this. The flow rate was then utilised to estimate the utility of this power by taking into account how quickly it could create clean drinking water and how much water a person needs to consume on a daily basis

Finally, based on the findings, it was established that human-powered reverse osmosis is not only a realistic option, but also a very cost-effective and efficient method of providing drinkable water to underdeveloped countries. [1]

This research, which examines the design of a pedal-operated water filtration system for use by local residents, was examined by Anusha and Yash. It operates on the premise of creating negative pressure in a tube, which draws water from the sump into the pump while rollers push the water through to the filter, where adsorption takes place to cleanse the water. A peristaltic pump, a filter, and a hose or flexible tube are all included in the design. The pedal crank sends motion to the rotor, which squeezes the rollers and the tube to move the fluid as the operator sits on the seat and pedals. This design will reduce the labor, cost and weariness caused by transporting and sanitizing drinkable water for use. [2],

Anand and Ramprasad gave a seminar report that included a review of the literature on a variety of portable water purification techniques such as 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 primarily used at the household level. The literature provided the majority of the data on the performance of these purifiers in terms of cost, availability, convenience of use, utility dependence, and microbiological efficacy. This report's goal was to investigate, describe, and compare various portable water purifiers. The criteria for drinking water quality were described, as well as the challenges surrounding water quality in India. After that, an appropriate classification mechanism and a suitable classification algorithm must be developed. [3],

Jayant et al. gave a talk about PPWP manufacturing. And analyses the operation of a Pedal Powered Water Pump (PPWP) and its purification, which is used for pure drinking water supply and garden irrigation. A centrifugal pump will be used in the PPWP, which will be powered by pedals. The centrifugal pump was mounted on its pedestal with its driving shaft butted against the bicycle wheel. The centrifugal pump is rotated by pedalling the bicycle, and the water from the sump is discharged. In locations where energy is not available, PPWP offers drinking water and irrigation. PPWP helps to cut down on rising energy prices. PPWP will be designed as a portable irrigation system that may be deployed in a variety of locations. The experimental inquiry was completed, and the PPWP performance was tested at various rpms. The PPWP uses solely manual power, resulting in a significant reduction in utility costs. [4]

Garud and Kulkarni discussed and presented a study in which Reverse Osmosis (RO) is a membrane-based process technology for purifying water by separating dissolved solids from the feed stream, resulting in permeate and reject streams for a variety of applications in home and industrial settings. RO technology is used to remove dissolved solids, colour, organic pollutants, and nitrate from the feed stream, as evidenced by a review of the literature. As a result, RO technology is utilised in the treatment of water and hazardous waste, as well as separation processes in the food, beverage, and paper industries, as well as the recovery of organic and inorganic components from chemical processes.

This paper aims to give a broad overview of RO technology as a potential alternative for treating waste water in a variety of industrial applications. The current review reveals that RO systems can be used to treat beverage industry effluents, distillery wasted wash, ground water treatment, phenol chemical recovery, wastewater reclamation, and sea water reverse osmosis (SWRO) treatment, demonstrating RO technology's effectiveness and applicability[5]

A pedal-powered filtered water supply apparatus was proposed by Irjet Pratik s. Nagrare et al in 2017. It operates on the premise of creating negative pressure in a tube, which draws water from the sump into the pump while rollers push the water through to the filter, where adsorption takes place to cleanse the water. This study aims to address the difficulties of water accessibility and purity in underdeveloped countries by designing and creating a portable, robust, and cost-effective filtration system and sidecar. [6]

Ademola Samuel Akinwonmi conducted a pedal power water purification experiment, and the design was focused on the process of idea, invention, visualisation, and computation, among other things. He also conducted a force study to ensure that the performance standards were met. The physical design parameter was calculated using a combination of calculations and practical considerations, as well as certain fair assumptions. As can be observed from the easily available materials employed, the design is basic, inexpensive, efficient, and affordable. With the use of a peristaltic pump, it also uses the Bernoulli's principle for flow computation. [7],

At a technological show in Tokyo, the president of Nippon Basic Company was the first to demonstrate the "Cycloclean" Portable Water Purifying System, which uses a pedalling bicycle to produce 5 litres of clean water in a minute. To pump water through a succession of filters, it takes manpower to crank a bike chain-driven engine (without the use of electricity). For home purposes, clean water can be used.. [8],

Peramanan et al., PerDhruvDuggal Et al. (2014) examined the design and construction of a bicycle-operated pump filter that is utilised in small-scale irrigation and filtration. [9]

According to S. Ikechukwu et al. (2016), the design was created to address the energy demands of persons living in rural areas who lack access to power, as well as to serve as a model for gym facilities and bike workout studios. The majority of people in these rural locations own a cell phone, but they do not have access to a charging station. The goal of this research was to design and build a pedal-operated power generator that would burn fat while also producing electricity. The power generator was created with the goal of being simple, inexpensive, long-lasting, and simple to maintain.

It was made from locally produced materials with the goal of encouraging local inventiveness and empowering budding entrepreneurs, particularly in underdeveloped nations. Its goal is to drive a 24V DC permanent magnet generator with less than 60 rpm human foot motion through a treadle and sprocket-chain step-up. The inverter converts direct current (DC) to alternating current (AC), which is required to charge low-voltage devices such as cell phones and laptop computers. [10]

3. METHODOLOGY

The alternator or dynamo is charged and supplies current to the battery as a result of the human cycling peddle movement. The booster pump is then powered by the battery, which allows it to complete a certain task. Following steps takes place after the suction of water from suction tank by booster pump .

Step 1 - The first stage we utilized pedal power to generates the electricity for charging of battery to run the booster pump.

Step 2 - In second stage removes any very heavy sediment down to fine microns still left in the water that the first set of filters did not catch.

Step 3 - The third stage removes any unwanted color, taste and odor. These two stages prepare the water for the most crucial step Reverse Osmosis. Without these previous two filters, the RO membrane could easily be destroyed by certain chemicals that may be in the dirty water with the help of 10 microns in size of filter.

Step 4 - The fourth stage is the heart of the system as it removes all particles down to 0.5 micron in size

Step 5 - The fifth and final stage is a repeat of the second stage, purely to optimize water quality. From here, the water exits the system as potable water and rinse water. The purest water is used for drinking and the rinse water can be used in many ways other than drinking such as irrigation, cleaning etc. so that water can never get wasted

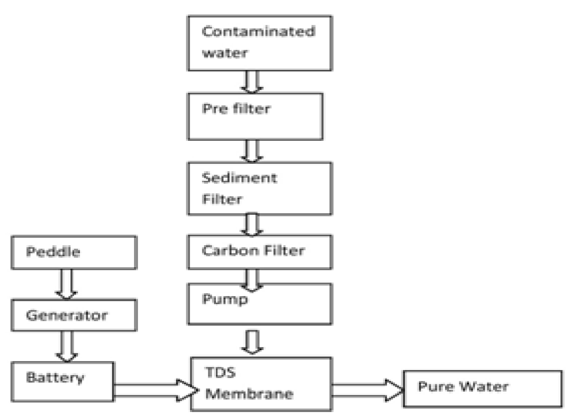


Fig: Process chart

Fabrication

Fig – Chain Sprocket Arrangement

Selection of material

1 Factors determining the choice of materials

The various factors which determine the choice of material are discussed below.

2. Properties

The material selected must possess the necessary properties for the proposed application. The various requirements to be satisfied can be weight, surface finish, rigidity, ability to withstand environmental attack from chemicals, service life, reliability etc.

The following three types of principle properties of materials decisively affect their selection

1. Physical
2. Mechanical
3. from manufacturing point of view

Melting point, thermal conductivity, specific heat, coefficient of thermal expansion, specific gravity, electrical conductivity, magnetic purposes, and other physical properties are all involved. Different mechanical properties Tensile strength, compressive shear strength, bending, torsion, and buckling load, fatigue resistance, impact resistance, elastic limit, endurance limit, modulus of elasticity, hardness, wear resistance, and sliding characteristics are all factors to consider. From a manufacturing standpoint, the various qualities in question are,

1. Cast ability
2 .Weld ability
3. Surface properties
4. Shrinkage
5. Deep drawing etc.
6. Manufacturing case

Sometimes the demand for lowest possible manufacturing cost or surface qualities obtainable by the application of suitable coating substances may demand the use of special materials.

7. Quality required

This generally affects the manufacturing process and ultimately the material. For example, it would never be desirable to go casting of a less number of components which can be fabricated much more economically by welding or hand forging the steel.

8. Material accessibility

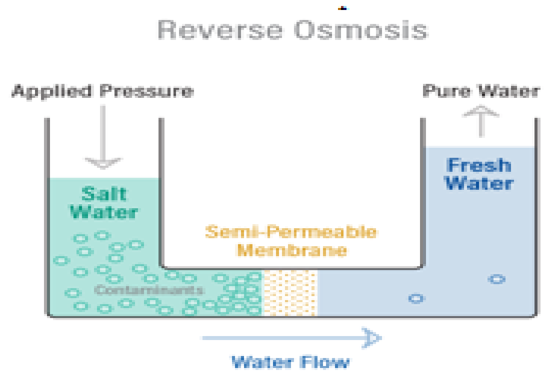
When certain materials are scarce or in short supply, the designer is forced to employ a substitute, which may or may not be a perfect match for the original material. It's also important to consider the arrival of materials and the product's delivery date.

9. Consider the available space.

Because the forces involved are strong and there are space constraints, high-strength materials must sometimes be chosen.

3.1 Reverse Osmosis –

Reverse osmosis is a water purification technology that removes ions, molecules, dust, pollen, and big particles from water using a semipermeable membrane. The process by which liquid flows from a higher layer to a lower layer through a semipermeable member is known as reversed osmosis. Reduces the concentration of the solution and allows for more efficient filtering of contaminants. Membrane is highly useful in the direction of liquid flow and can be used for purification.



3.2 Design Calculation –

The chains are constructed up of a number of rigid links that are pin-jointed together to provide the flexibility needed to wrap around the drive wheels. These wheels have specific profile projecting teeth that fit into the matching grooves in the chain links. Sprocket wheels, or simply sprockets, are toothed wheels with teeth. As a result, the sprockets and chain are forced to move together without slipping, ensuring a perfect velocity ratio. The velocity ratio calculated using the equation

Velocity Ratio Of chain Drive Is Given By – N1/ N2 = T2 / T1

Where N1 – Speed Of rotation of smaller sprocket in RPM

N2- Speed Of rotation of Larger sprocket in RPM

T1 – Number Of teeth Of Smaller Sprocket

T2 - Number Of teeth Of Larger Sprocket

The Average Velocity Of Chain Is given by – π D N / 60 = T P N / 60

Where D = Pitch Circle Of Diameter In Meter

P = Pitch Of chain in meter

Velocity Ratio For Chain Drive Given By – N1/N2 = T2/T1

44/18 = 2.44

Now, V.R = N1/N2

N1 = 2.44*50

N1 = 122.22 `~ 123 Rpm

AVARAGE VELOCITY

V = πDN / 60 m/s

D = 177.8 mm

N1 = 50

V = 0.467 M/S

4. RESULTS AND CONCLUSION

We can tackle non-potable problems not only in rural locations, but also in distant and hilly areas where overhead tank facilities are not accessible, by using a booster pump and a dc Dynamometer. Non-potable water is transformed into potable water very efficiently using only human labour while saving electricity. Because this is a mobile project, transporting is simple. With this effort, we will undoubtedly raise health awareness among people in remote areas. We can surely turn highly TDS water into drinkable TDS water using calculations and results.

5.FUTURE SCOPE

One of the key benefits is that we can set this model in a gram panchayat region where people can come with a water container, pour water into the container, go through the required process to filter the water by cycling action, and take the filtered water with them. Alternatively, by dividing the village's population, a group of individuals can be given to avoid long queues for water purification.

By deleting the peddle sprocket arrangement and charging the batteries with solar or wind power, this device can be rebuilt.

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