

# Design And Fabrication of Pedal Operated Water Filtration System

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**Abstract-** Reverse osmosis is a separation process that uses pressure to force a solvent through a membrane that retains the solute on one side and allows the pure solvent to pass to the other side, meaning it allows the passage of solvent but not of solute. In reverse osmosis, the idea is to use the membrane to act like an extremely fine filter to create drinkable water from salty water. Reverse osmosis (RO) is a membrane-technology filtration method that removes many types of large molecules and ions from solutions by applying pressure to the solution when it is on one side of a selective membrane. 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. To be "selective," this membrane should not allow large molecules or ions through the pores (holes), but should allow smaller components of the solution (such as the solvent) to pass freely

**Keywords-** Chain, sprocket, Filters, Pipes, Reciprocating Pump, Reverse osmosis

## I. INTRODUCTION

The process of osmosis through semi permeable membranes was first observed in 1748 by Jean-Antoine Nollet. For the following 200 years, osmosis was only a phenomenon observed in the laboratory. In 1949, the University of California at Los Angeles (UCLA) first investigated desalination of seawater using semipermeable membranes. Researchers from both UCLA and the University of Florida successfully produced fresh water from seawater in the mid-1950s, but the flux was too low to be commercially viable until the discovery by Loeb and Sourirajan of techniques for making asymmetric membranes characterized by an effectively thin "skin" layer supported atop a highly porous and much thicker substrate region of the membrane. By the end of 2001, about 15,200 desalination plants were in operation or in the planning stages worldwide.

Improving access to safe drinking-water can result in tangible benefit to health. Nearly, one billion people suffer needlessly without access to safe drinking water and over five thousand children

die each day because of water related diseases. Water-related diseases: caused by insect vectors, especially mosquitoes, that breeds in water; include dengue, filariasis, malaria, onchocerciasis, trypanosomiasis and yellow fever. (Peter H.G., 2002). Drinkable water sources are distant from most villages in India. Women and children especially spends hours of labour just to meet the basic needs of their families walking five miles and more to nearby towns just to have access to drinkable (purified) water. Some well to do inhabitants in these villages travel long distances with motor bikes and trucks which consume fuel and pollute the air.

## II. LITERATURE SURVEY

Atul.P.Ganorkar, K.S.Zakiuddin, H.A.Hussain conducted an experiment on "Development of pedal operated water pump". Their machine consists of three subsystems namely (1) Energy Unit : Comprising of a suitable peddling mechanism, speed rise gear pair and Flywheel conceptualized as Human Powered Flywheel Motor (HPFM) (2) Suitable torsionally flexible clutch and torque amplification gear pair and (3) a water pump unit. Though human capacity is 0.1hp continuous duty, the processes needing power even upto 6.0 hp can be energized by such a machine concept.

Vishal Garg, Neelesh Khandare, Gautam Yadav conducted an experiment on "Pedal powered water pump". They found pedal operated pump can be construct using local material and skill. This bicycle pedal operated pumps water at 2-3 gallons per minute from wells and boreholes up to 23 in feet depth. Provides irrigation and drinking water The Pedal Operated Water Purifier.

Ademola Samuel Akinwonmi, Stephen Kwasi Adzimah, Fredrick Oppong conducted an experiment on "Pedal powered centrifugal pump for pure water supply device". This paper analyzes the design of a pedal powered purified water supply device 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.

Bryan Lee has prepared a conceptually “Simple water pump” that will be easy to maintain and repair using basic tools while providing enough water flow to irrigate a small plot of farmland. The report outlines the design process that has been followed and a description of the agreed model that is to be constructed, cost analysis and timeline.

M.Serazul Islam, M.Zakaria Hossai and M.Abdul Khadir conducted an experiment on “Design and development of pedal pump for low lift irrigation”. A study was undertaken to design and construct a low-lift pedal pump for use in small irrigation project areas. For this purpose, different types of piston valves and check valves were constructed and tested at different suction heads in the laboratory to evaluate their performances. During pedal pump operation, less input power was needed and it can be operated by one adult man for a long time (more than 2 hours) continuously without being tired.

Peramanan et. al ,2014 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.

### III. OBJECTIVES

- Pedal power water purification by RO method meets the needs of people without requiring any electrical energy.
- The filtration system could be brought into remote areas and emergency conditions like fllood, famine earthquakes etc.
- identify major technologies in water purification market using financial market activities.
- understand the investment landscape in water purification.
- identify major companies, start-ups and university research in the Nanofiltration segment of water purification.

### IV. COMPONENTS

#### Pneumatic cylinder

An air cylinder is an operative device in which the state input energy of compressed air i.e. pneumatic power is converted in to mechanical output power,.

#### Single acting cylinder:

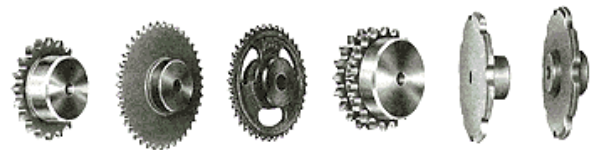
Single acting cylinder is only capable of performing an operating medium in only one direction. Single acting cylinders equipped with one inlet for the operating air pressure, can be production in several fundamentally different designs.

#### Double acting cylinders:

A double acting cylinder is employed in control systems with the full pneumatic cushioning and it is essential when the cylinder itself is required to retard heavy messes.

#### CHAIN SPRACKET

This is a cycle chain sprocket. The chain sprocket is coupled with another generator shaft. The chain converts rotational power to pulling power, or pulling power to rotational power, by engaging with the sprocket.



#### HOUSE AND FITINGS:

It is provided for the passage of compressed air from the compressor outlet to the operating valve.

Two separate pipes also connect the operating valve with the working cylinder pressure drop through and air line depends on the flow rate, pipe diameter, pipe length and pipe geometry. It can be determined directly for straight pipes of any given length.

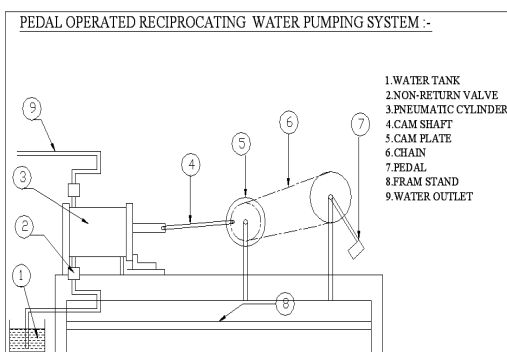
Pressure drop through bends and fittings can only be determined by empirical tests, since it is specific to the internal geometry involved. Rigid pipes however are less manipulated through remain form of bends with arrangements increase and variable air have to flow and the flow itself may be of fluctuating or pulsating nature. In this case it is thus normally based on practical recommendation.

### V. WORKING PRINCIPLE

The pedaling operation done by manually with the help of man and this power is transferred to the Cam mechanism. This Cam and cam shaft is used to activate the pneumatic cylinder. The pneumatic cylinder forward stroke is suction the water and return stroke will deliver the water.

The membranes used for reverse osmosis have a dense barrier layer in the polymer matrix where most separation occurs. In most cases the membrane is designed to allow only water to pass through this dense layer while preventing the passage of solutes (such as salt ions). This process requires that a high pressure be exerted on the high concentration side of the membrane, usually 30-250 psi for fresh and brackish water, and 600-1000 psi for seawater. Reverse osmosis (RO) is used to reduce dissolved solids from feed waters. Municipalities and industrial facilities are able to use RO permeate as a consistently pure drinking water supply and to transform drinking water to high purity water for industrial use at microelectronics, food and beverage, power, pharmaceutical facilities, and can be used for removing bacteria, pyrogens, and organic contaminants.

RO systems are also now extensively used by marine aquarium enthusiasts, as the domestic water supply contains substances that are extremely toxic to most species of saltwater fish. In the production of bottled mineral water, the water passes through a RO water processor to remove pollutants and microorganisms, including the smallest microbe known, archaeobacteria. In the United States, house hold drinking water purification systems, including a reverse osmosis step, are commonly used for improving water for drinking and cooking.



**VI. SPECIFICATION OF COMPONENTS**

**1. Double acting pneumatic cylinder**

Stroke length : 160 mm  
 Piston rod : 18 mm  
 Seals : Nitride (Buna-N) Ela

Piston : EN-8  
 Media : Air  
 Temperature : 0-80 °C  
 Pressure Range : 8 N/m<sup>2</sup>

**2. Connectors**

Max working pressure : 10 x 10<sup>6</sup> N/m<sup>2</sup>  
 Temperature : 0-100 °C  
 Material : Brass

**3. Hoses**

Max pressure : 10 x 10<sup>6</sup> N/m<sup>2</sup>  
 Outer diameter : 6 mm = 6 x 10<sup>-3</sup>m  
 Inner diameter : 3.5 mm = 3.5 x 10<sup>-3</sup>m

**4. Piston rod**

Diameter of the Piston (d) = 40 mm  
 Pressure acting (p) = 6 kgf/cm<sup>2</sup>  
 Yield stress (σ<sub>y</sub>) = 36 kgf/cm<sup>2</sup>  
 Material used = C 45  
 Factor of safety = 2

**5. Cylinder**

Material used = Cast iron  
 Internal diameter = 75 mm  
 Ultimate tensile stress = 250 N/mm<sup>2</sup>  
 Factor of safety = 4

**VII. ADVANTAGES**

- Less Maintenance is enough.
- The oil or water pumped is of higher pressure.
- Quite running and smooth operation is achieved.
- Full efficient positive displacement pump.
- Effective working principle.
- It does not have any Prime mover, like electric motor related to the unit.

**VIII. LIMITATION**

- High pedaling power is needed to operate this unit
- Leakage of air affects the working of the unit.

**IX. RESULTS**

- Design Stress(σ<sub>y</sub>) = σ<sub>y</sub> / FOS  
 = 36 / 2

$$= 8 \text{ Kgf/mm}^2$$

- Minimum dia required to load  
 $d = \sqrt{4 p / \Pi [ \sigma_y ]}$   
 $= \sqrt{4 \times 75.36 / \{ \Pi \times 18 \}}$   
 $= \sqrt{5.33} = 2.3 \text{ mm}$
- PH of water  
 Experimentally = 6.8 – 7.2

## X.CONCLUSION

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between institution and industries.

We are proud that we have completed the work with the limited time successfully. The “PEDEL OPERATED WATER FILTRATION” is working with satisfactory conditions. We are able to understand the difficulties in maintaining the tolerances and also quality. We have done to our ability and skill making maximum use of available facilities. In conclusion remarks of our project work, let us add a few more lines about our impression project work.

Thus we have developed an “PEDAL OPERATED WATER FILTRATION” which helps to know how to achieve low cost automation with sensor arrangement. The operating procedure of this system is very simple, so any person can operate. By using more techniques, they can be modified and developed according to the applications.

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## 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, Neelesh Khandare, 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] **Ademola Samuel Akinwonmi, Stephen Kwasi Adzimah, Fredrick Oppong (2012),** “An Experiment on Pedal Powered Centrifugal Pump for Purified Water Supply Device” ISDE (Vol.3, No.11) 2012.
- [4] **Bryan Lee,** “A Design of Simple Human Powered Water Pump”, International Journal of Technology(2007).
- [5] **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).
- [6] **Yuichi katsuara (2011) president of Nippon basic company** “Japan Touts Pedal Powered Water Filtration” February 17, 2011.