Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 03, March -2018

DESIGN AND DEVELOPMENT OF PORTABLE AND ECONOMIC WATER PURIFIER.

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Abstract —*The provision of clean water is an important issue to solve. In this research paper, a portable and economic water purifier will be made with the help of Hollow Fiber Membrane. The portable water purifier comprises of hollow fiber membrane along with an activated charcoal. The plan to use activated charcoal is to trap big size particles and reduce other impurities such as chlorine, volatile organic compounds. In this filter, no use of batteries or chemicals is required.*

Keywords-*Hollow Fiber Membrane, Piston Plunger, Slider Crank Mechanism, Water Purifier.*

I. INTRODUCTION

In the present world, there are so many water purifiers available in the market, that are bulky and some of them run with the help of electricity. Thus there should be need of portable and economic water purifier, for those people, who live in far-flung areas, where there is no mode of electricity and cannot afford such type of costly water purifier. The process of removing undesirable chemicals, biological contaminants, suspended solids and gases from water is called water purification. The Process of purification is to produce water ,fit for living beings and it all started during the World War-2.THe British scientist invented the process of purification of water through biological process,which became so famous, that in mid 50's it was used in every individual's house in england.Now a days there are various methods of water purified ion.

II. LITERATURE REVIEW

2.1. Hiroshi Nagai and Tadamassa Hayashi of Japan gave information about hollow fiber filter device[1]. In this section they give close information about the working of hollow fiber membrane and how it works, during the flow of water through it. The case which is provided round the membrane, helps in holding the membrane stir, and avoids the risk of being damaged by the incoming pressure of water.

2.2. Shweta Chauhan and KC Gupta of India provided the research paper in which purification of drinking water with the application of natural extracts was done.In this paper, the work has been carried to improve the quality of water with the help plant extracts of Moringa Oleifera,Arachis Hypogaea(peanuts),Vigna Unguiculata(lowpeas) and Zeamays(Corn)[2].With the use of all these elements, the results that obtained shows the significance decrease in microbial counts up to 92%.Besides this arrangement also helped in reducing the Total Bacterial Count(TBC).95% of heavy metals were also reduced

2.3. Yoshio Sunaoka and Keisuke Kitazato of Japan gave information about purification process using hollow fiber membrane module[3]. In this process, the filter is cleaned by allowing the cold water to pass through the filter, the water that goes through inside of the membrane is cleaned, while the water that is outside goes inside which makes the filter cleaned, by just shrinking so that the granule's, that is attached with the membrane falls down.

2.4. Deepti Mishra, Manish Mudgal of India gave information regarding the assessment of ground water in bhavnagar which is necessary for the project[4].Analysis of ground water samples collected from various locations of bhavnagar revealed that water quality parameters(turbidity, manganese, zinc and copper) were within PL. However , TDS, Total Hardness, chloride, fluoride and chromium were observed beyond PL in most samples.

2.5. Venkatesh Vandekar of India provided research paper on Manufacturing of Hollow Fiber Membrane[5]. The polymer liquid used can be polysulphone (PSF), polyethersulphone (PES), polyacrylonitrile (PAN), polyvinyl alcohol (like PVC) and Polyvinylidene fluoride (PVDF) any one of them is used or they can be used in different ratios. After manufacturing of membranes, potting is done on them. After potting the membranes are sealed in the module/cartridge. These modules/cartridge are then used in various industries.

2.6. Jing-Liang Li , Bing-Hung Chen gave information about Review of CO absorption using chemical solvents in hollow fiber membrane contactors[6]. Separation of CO from a gas stream, using a hollow fiber membrane contactor, is a

promising alternative to conventional techniques such as column absorption. The major advantages of the membrane absorption are the larger interfacial area, a better device-modularity and more operational flexibility.

2.7. Yuexia Lv , Xinhai Yu , Shan-Tung Tu gave information regarding Experimental studies on simultaneous removal of CO and SO in a polypropylene hollow fiber membrane contactor[7]. Membrane gas absorption technology is a promising alternative to conventional technologies for the mitigation of acid gases. Simultaneous removal of SO and CO from coal fired flue gas was carried out in a polypropylene hollow fiber membrane contactor using aqueous monoethanolamine as the absorbent.

2.8. Xiaoyao Tan , S.P. Tan gave information on Polyvinylidene fluoride (PVDF) hollow fiber membranes for ammonia removal from water[8]. Polyvinylidene fluoride (PVDF) hollow fiber membranes with asymmetric structures and good hydrophobicity have been prepared by a phase-inversion method and have been applied to removal of ammonia from water. Aqueous solution containing sulfuric acid was used as stripping solution to accelerate the removal of ammonia.

III. DESIGN PROCEDURE

3.1. Principle
Our model is based on the principle of slider crank mechanism as in figure 1. It consist of one sliding pair and three turning pair. It is usually found in reciprocating steam engine mechanism. This type of mechanism converts rotary motion into reciprocating motion and vice versa.

3.2. Components
The first part of our model is piston. One end of the piston is connected to the hand wheel and the other end is kept closed through sealing. In order to create friction between outer O ring, grooves are made on the piston surface as in figure 1.

3.3. Hand Wheel
The most important part for filter is hand wheel, due to which the model becomes manual. The diameter of the hand wheel is approximately 25cm which is connected to the piston via a rectangular link as in figure 2.

3.5. Connecting Rod
This rod consist the piston and the circular hand wheel. The length of this rod is approximately 11.5cm.The stroke length of the piston is based on the length of the rod as in figure 3.

3.6. O-Ring
There are 3 O-Rings on the piston in order to create the required suction. The diameter of each of the O-Ring is 20mm each as in figure 4.

3.7. T-Connector
The T-Connector is used to connect the casing in which the piston is mounted and in other two slots, two check valves are used through which one check valve, the impure water comes in and once sucked it is pushed back from another check valve, where the hollow fiber membrane is fitted and in this way water is filtered as in figure 5.

3.8.Filter
On one end of the filter there is hollow fiber membrane attached through which the impure water is passed and thus it gets purred as in figure 6. Below are some of the specifications of the filter. The filter removes 99.999999% of waterborne bacteria, including E. coli and salmonella ,waterborne protozoa, including Giardia and Cryptosporidium. Also the turbidity(NTU) is less than 15. The Total Dissolved Solids is <1000 (mg/L). Also the Total Suspended Solids(TDS) is <500 (mg/L).

Maximum Flow: 3L/min. Maximum Pressure: 0.52mps.

IV. MODELLING

Figure. 1Piston

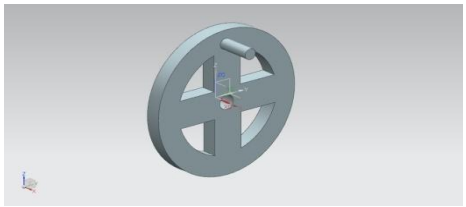

Figure. 2 Hand wheel

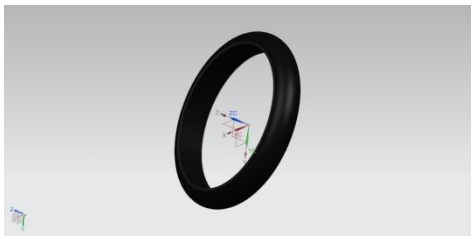

Figure. 3 Connecting Rod

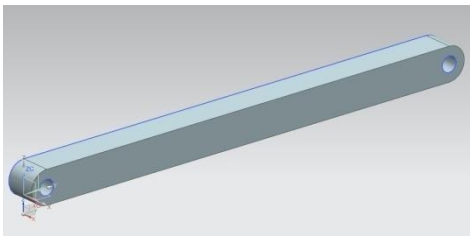

Figure. 4 O-Ring

Figure. 5 T-Connector

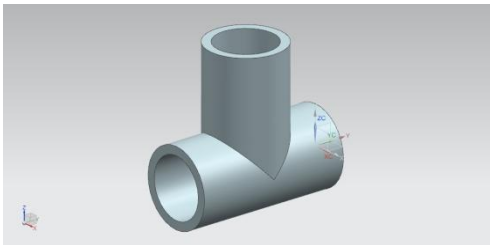

Figure. 6 Membrane

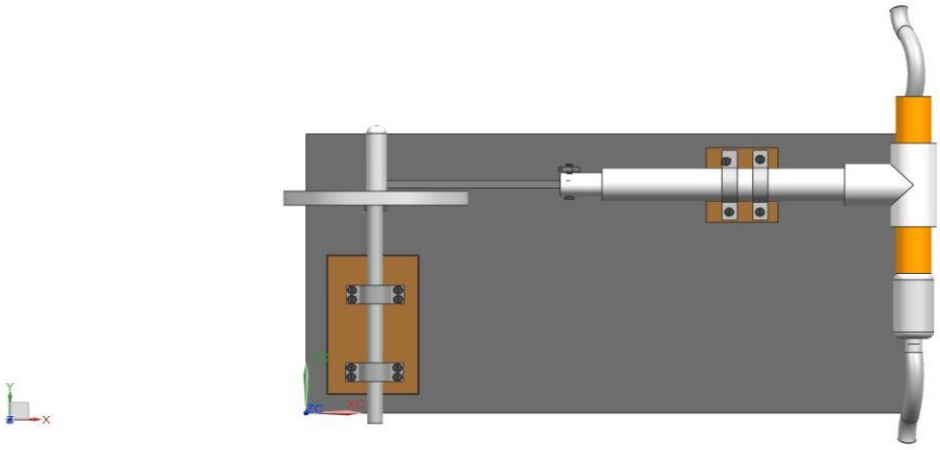

Figure. 7 top view of Final Assembly.

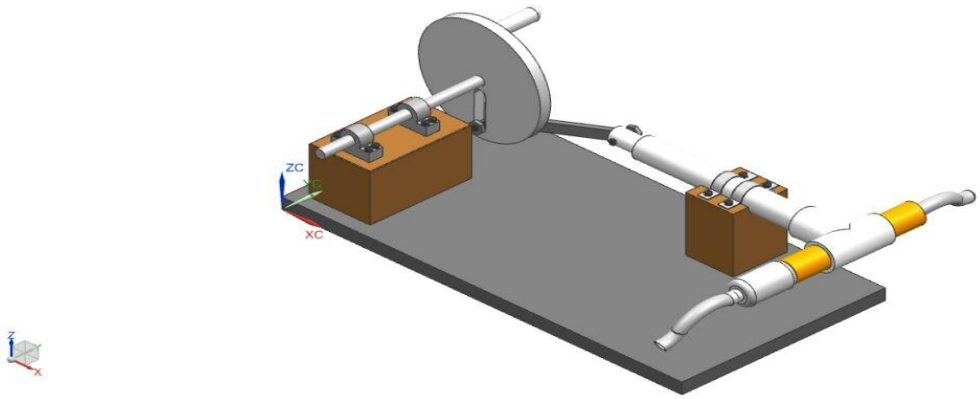

Figure. 8Final Assembly.

V. CALCULATION

By using the below formula we get the Flow Rate required
$Q = A$* V ,m^3/s

where A=$\frac{1}{4} * \pi *(D)^2$,m

$Q = \frac{1}{4} * \pi *(D)^2 * V$,
where Q= Flow Rate of water in m^3/s.
V= Velocity of water in m/s
D= Diameter of Pipe in mm.

1. We take the pipe diameter as 25mm.
2. We get the Velocity of 0.18m/s.

Now we calculate flow rate,
$Q = \frac{1}{4} * \pi *(25)^2 * (0.18)$
$=1.4726 cm^3/s$.
The Flow Rate that is calculated by the above method is $1.4726 cm^3/s$.

VI. CONCLUSION

From the above calculation, it is clear that this device is beneficial for the people lives in far flung areas especially hilly areas. Requires no electrical power, batteries.. The filter doesn't require electricity to purify water and this is the main advantage of it. Also no chemical are required. More ever, it is also helpful in the family consisting 3-4 members. However the membrane needs to be replaced after 3800 liters of filtered water usage or one year whichever is earlier.

VII. REFERENCE

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