International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 04 | April -2020 ISSN: 2582-3930

Aqua Filter Bicycle

Yakin N. Pokiya[1], Hitesh P. Tailor[2], Fenil P. Tandel[3], Keval D. Tarsariya[4], Daxesh S. Vanani[5]

Guide: Prof. Manish D. Savaliya & above listed from Department of Mechanical Engineering
Shree Swami Atmanand Saraswati Institute of Technology, Surat, Gujarat, India.

Abstract - Water is the most basic necessity for life yet nearly one billion people in the world lack access to it. In many developing countries, people walk many miles to reach a source of water that is not necessarily potable. Not only is distance and portability an issue, but the average water collecting container in India. This project proposes to take on challenges associated with the accessibility and cleanliness of water in developing countries by designing and building a filtration system and which is portable, durable, and cost-effective. A piston cylinder will be used to pull unsafe water out of well, river, etc and that will collect in unpurified water tank than it will pass through a filtration system, and onward into a clean tank, here filtration of water is done due to gravity effect and involvement of piston cylinder for suck the unpurified water from source . Entire system is portable and it can be easily retrofitted to most standard bicycles. The functionality of the pump and filter system needs to require as little maintenance as possible. The design must also be user. Once the design is optimized, materials within the build will be considered to find the most cost-effective method of manufacturing.

Key Words: Water, Bicycle, Reciprocating Pump, Water purifier pipe, Cotton cloth, Sprocket, Carbon filters

1. INTRODUCTION

1.1 Problem Statement

Developing countries around the world face debilitating challenges accessing safe and clean drinking water. Alarming statistic led us to the idea that that we could use a simple mechanism of transportation that is common in these areas, such as the bicycle, to help aid their water and sanitation struggles. Our goal is to design a bicycle attachment to purify and transport water from contaminated sources that is activated while the rider is pedaling. This attachment, though not a permanent solution, would be a contribution to the improvement of their quality of life.

1.2 Motivation

The objective of providing pure drinking water throughout the world is one that has been an ongoing process for the past decades. Although we fully support the work done by charities such as The Water Project and Water.org, we believe that it will be a very long time until water can be provided as a clean source located locally throughout all developing countries. Therefore, our motivation was stemmed from the idea of aiding those less fortunate areas, as well as providing a backup should those regions run into contamination problems within their local wells. In addition our solution will exponentially reduce the time taken to retrieve the water, and allow time for more beneficial tasks to be accomplished in their native area. With our model we will be able to provide a working solution that mends the problem until permanent clean water well can be produced within that community.

1.3 History / Background

- In the face of this growing water crisis, this data is related to struggle against safe and secure drinking water.
- It is pedal driven pump to drive water from trunk through filter by system and that clean water store in storage tank.
- Due to this we solving problem of transportation of water, get clean water and reduce health issue.
- This project is related to water crisis, unfiltered water and health issue.
- So our aim is to develop a product which is economically and technologically that addresses challenges such as cost, suitable purification and issues.
- Water quality remains a major issue, with several populous states reporting no reduction in quality incidents.

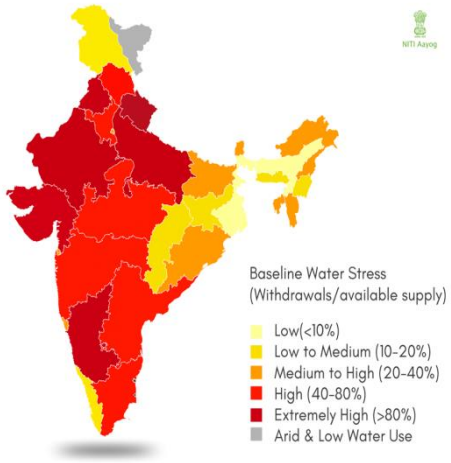

Fig. 1 Shows the Data-based decision making will be a critical lever for effective water management in India

- 600 million people face high-to extreme water stress.

- 75% of households do not have drinking water on premise. 84% rural households do not have piped water access.
- 70% of our water is contaminated; India is currently ranked 120 among 122 countries in the water quality index.

1.4 Effect of water crises

- India has made improvements over the past decades to both the availability and quality of municipal drinking water systems, its large population has stressed planned water resources and rural areas are left out.
- One concern is that India may lack overall long-term availability of replenish able water resources.

Fig. 2 Water crises on India in 2030 [Expected]

- India's water crisis is often attributed to lack of government planning, increased corporate privatization, industrial and human waste and government corruption.
- On a positive note, some areas of India are fortunate to have a relatively wet climate, even in the most arid regions.
- Regardless of improvements to drinking water, many other water sources are contaminated with both bio and chemical pollutants, and over 21% of the country's diseases are water-related

1.5 Objective

- **Reliability** – Our product is intended for third world use where tools and electricity may not be readily available. Our product must therefore be durable and able to withstand extended use.
- **User Friendliness** – We want to keep our design simple and effective so that people of various education levels will be able to operate and maintain it. We also want the product to be usable by kids and adults alike.
- **Portability** – The filtration system must be easily transported to and from water sources.
- **Cost Effectiveness** – Cost must justify production.
- **Life Expectancy** – Our filtration system must be adapted for extended use and must be easily maintainable

2. FILTRATION PROCESS

2.1 Working system

- Here reciprocating pump working through chain and sprocket arrangement, than inlet of pump suck the water from reservoir (river, pond, well and spring etc source.)And that outlet insert in unhygienic water tank.
- First dirty and unhygienic water filter by cotton cloth put on the bucket that remove large suspended particle.
- A second stage, water particle chemically by add potassium permanganate into bucket and removes some amount of waste from it.
- Third stage, water passes into bottle of sand filter and purifies almost 75% of water with removing wastages.
- Forth stage remaining water passes into main filtration (R-O filter) and purifies water almost 90% and it can ready for drinking purpose safely.
- If here eliminating the third and fourth stage than insert only single filter or combine both stage than also get good efficiency of the water.

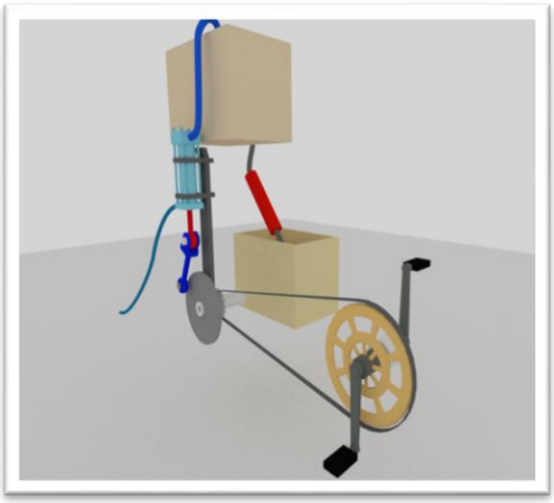

Fig. 3 Arrangement of component and flow of water in circuit

- First unhygienic water filters by cotton cloth and also filters by potassium permanganate.
- Then this water directly passed into series of multiple portable water filter and it can be directly use with purify water and for safe drinking.

2.2 Advantages of Water Filtration

- Water filtration is cost effective, and it does not require a lot of money to maintain.
- The odour [aroma] and taste of the water will improve.
- Walter filtration also gets rid of chlorine in the hard water.
- The method also ensures that harmful toxins are removed from the hard water.

2.3 Disadvantages of Water Filtration

- When the process is taking place very, small particles can pass through the membranes used to perform water filtering.

- Thorough cleaning and care of the equipment is very vital so that they can carry out the water softening process without any hitch whatsoever.
- All the cartridges must be disposed of after the water softening process.
- These cartridges contain harmful toxins that were purified from the hard water.

If they are thrown anyhow they might end up being pollutants to the environment.

3. PRODUCT DEVELOPMENT

3.1 Designed of filter bicycle (Fabrication Work)

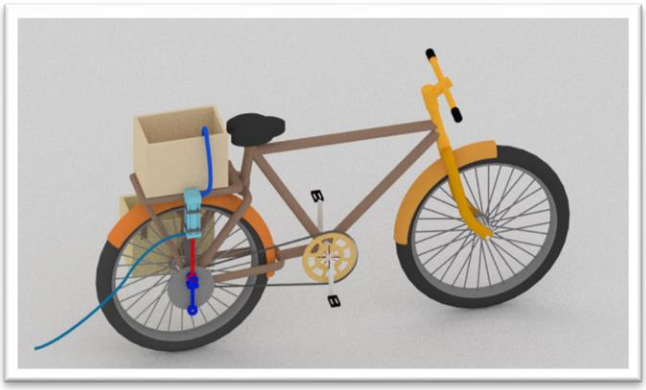

Fig. 4 System implemented in bicycle

3.2 Product Function

- Utilize manpower
- Pumping water
- Aesthetic design
- Save electricity
- Easy operating
- Low maintenance cost

3.3 Product Features

- Pedal operated
- Energy conservation
- Hybrid filtration process
- Energy producible system

3.4 Purpose & Use

Purpose;

- Hygienic water
- Save lives
- Water purification
- Time saving

Use for…;

- Villagers and general people.

3.5 Mathematical Modeling

1] Velocity Ratio,

$$V.R. = {}^{N1}/_{N2} = {}^{T2}/_{T1}$$

N1: Speed of smaller size sprocket

N2: Speed of big size sprocket

T1: No. of teeth on small sprocket

T2: No. of teeth on big sprocket

2] No. of chain link,

$$k = \frac{T1 + T2}{2} + \frac{2x}{p} + \frac{T2 - T1}{2\pi} * \frac{p}{x}$$

P = Pitch of chain (Normally take p=8)

X= Center distance

3] Length of chain,

$$L = K * p$$

4] Power transmitted by chain,

$$\text{Design power} = \text{Rated power} * Ks$$

Ks = Service factor= 2.25

5] Torque required for driving the pump during pedaling is obtained by,

$$P = \frac{2\pi NT}{60}$$

P = Design power

Fig. 5 Sketch view of product

6] Torque generated by human pedaling to pump is given by,

$$P = \frac{2\pi NT}{60}$$

P = Rated power (Normally 250 watt)

7] Pitch circle dia. For pinion and gear,

$$d = p\ Cosec\left(\frac{180}{T1}\right)$$

$$D = p\ Cosec\left(\frac{180}{T2}\right)$$

d = P.C.D. for small sprocket

D = P.C.D. for big sprocket

8] Pitch line velocity,

$$V1 = \frac{\pi dN}{60}$$

$$V2 = \frac{\pi DN}{60}$$

9] Load on chain,

$$W = \frac{\text{Rated power}}{\text{Pitch line velocity}}$$

10] Design for piston,

$$\text{Volume} = \text{Area} * \text{Length}$$

$$A = \frac{\pi d^2}{4}$$

d = Dia. of piston

l = Length of piston

11] Force on cylinder,

$$F = \frac{P\pi(d1^2 - d2^2)}{4} + \text{Force due to gravity}$$

P = Initial pressure (Normally 1bar)

d1 = Cylinder bore dia.

d2 = Piston rod dia.

12] Water discharge from pump,

$$Q = \frac{V}{t}$$

V = Volume

t = Time

13] Power required for suction of water,

$$P = \rho QgH$$

H = Total water head

14] Efficiency of pump,

$$\eta_{mech} = \frac{Q * \Delta P}{T * N}$$

P = Pressure rise

3.6 Components of product

1] Reciprocating Pump:

- Reciprocating pump is a positive displacement pump where certain volume of liquid is collected in enclosed volume and is discharged using pressure to the required application. Reciprocating pumps are more suitable for low volumes of flow at high pressures.

Fig. 6 Reciprocating Pump

2] Water purifier pipe:

- It is used transform water to one side to another side. Here we are used to connect the carbon filter portion and unpurified and Purified water bucket.

Fig. 7 Purifier pipe

3] Cotton cloth:

- It is used for removes large and suspended Particles form the unpurified water at being Stage.

Fig. 8 Cotton cloth

4] Sprocket:

- **Sprockets** are used in bicycles, motorcycles, cars, tracked vehicles, and other machinery to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track, tape etc.

Fig. 9 Sprocket

5] Carbon filters:

- Carbon filtering is a method of filtering that uses a bed of activated carbon to remove Contaminants and impurities, using chemical Adsorption. Active charcoal carbon filters are most effective at removing chlorine, Particles such as sediment, volatile organic Compounds (VOCs), taste and odder from water.

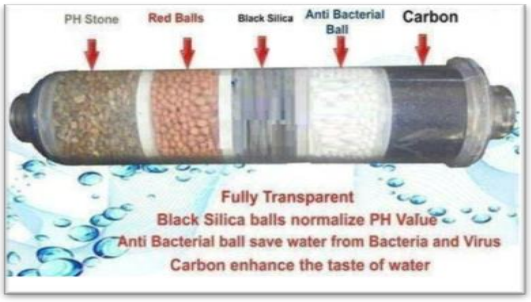

Fig. 10 Filter

4. PARAMETER OF WATER

4.1 Class of water

Classification	Type of use
Class A	Drinking water source without conventional treatment but after disinfection
Class B	Outdoor bathing
Class C	Drinking water source with conventional treatment followed by disinfection.
Class D	Fish culture and wild life propagation
Class E	Irrigation, industrial cooling or controlled waste disposal

Table No. 1 Class of water

4.2 Health Effects of Chemical Parameters

Parameter	BIS Guideline value (maximum allowable)	General & Health effect
Total dissolved solids	2000 mg/L	Undesirable taste; gastro intestinal irritations; corrosion or incrustation
PH	6.5-8.5	Affects mucous membrane; bitter taste; corrosion; affects aquatic life
Alkalinity	600 mg/L	Boiled rice turns yellowish
Hardness	600 mg/L	Poor lathering with soap; deterioration of the quality of clothes; scale forming; skin irritation; boiled meat and food become poor in quality
Calcium	200	Poor lathering and deterioration of the quality of clothes; incrustation in pipes; scale formation
Magnesium	100	Poor lathering and deterioration of clothes; with sulphate laxative
Iron	1.0	Poor or sometimes bitter taste, colour and turbidity; staining of clothes materials; iron bacteria causing slime
Manganese	0.3	Poor taste, colour and turbidity; staining; black slime
Aluminium	0.2	Neurological disorders; Alzheimer's disease
Copper	1.5	Liver damage; mucosal irritation, renal damage and depression; restricts growth of aquatic plants
Zinc	15	Astringent taste; opalescence in water; gastro intestinal irritation; vomiting, dehydration, abdominal pain, nausea and dizziness
Ammonia	-	Indicates pollution; growth of algae
Nitrite	-	Forms nitrosamines which are carcinogenic
Nitrate	100	Blue baby disease (methemoglobineamia); algal growth
Sulphate	400	Taste affected; laxative effect; gastro intestinal irritation
Chloride	1000	Taste affected; corrosive
Fluoride	1.5	Dental and skeletal fluorosis; non-skeletal
Phosphate	-	Algal growth
Arsenic	0.05	Toxic; bio-accumulation; central nervous system affected; carcinogenic
Mercury	0.001	Highly toxic; causes 'minamata' disease-neurological impairment and renal disturbances; mutagenic
Cadmium	0.01	Highly toxic; causes 'itai-itai' disease-painful rheumatic condition; cardio vascular system affected; gastro intestinal upsets and hyper tension
Lead	0.05	Causes plumbism-tiredness, lassitude's, abdominal discomfort, irritability, anaemia; bio-accumulation; impaired neurological and motor development, and damage

		to kidneys
Chromium	0.05	Carcinogenic; ulcerations, respiratory problems and skin complaints
Pesticide	0.001	Affects central nervous system
Detergent	-	Undesirable foaming

Table No. 2 Parameter for drinking water

5. PRACTICAL EXPERIMENT (TECHNICAL MERITS)

5.1 According to model, testing the water sample of water purifier.

- Based on above design data analyze rainy water added with river water, that sample which is unpurified water take as a raw water for villager's. That sample is known as Unpurified water Sample Test-A.
- That water purified by single filter and its result of that water sample is known as water Sample Test-B.
- Finally two filters are in series than its give water sample Test-C.
- Based on that three test easily identified above system of water filter will give appropriate result.

Unpurified water & Sample Test-A

Fig. 11 Unpurified water

RESULT OF ANALYSIS :

			Permissible limits of Drinking Water
1.	pH of Water	:- 7.1	7.0 - 8.0
2.	Total Solid	:- 184.00 ppm or mg/L	400 – 600 ppm or mg/L Approx.
3.	Suspended Solid	:- 3.17 ppm or mg/L	Nil
4.	Total Dissolved Solid	:- 180.83 ppm or mg/L	400 – 600 ppm or mg/L Approx.
5.	Alkalinity to Phenolphthalein	:- Nil	Nil
6.	Total Alkalinity as $CaCO_3$	:- 45.00 ppm or mg/L	100 ppm or mg/L Approx.
7.	Total Hardness as $CaCO_3$	:- 100.00 ppm or mg/L	50 – 100 ppm or mg/L Approx.
8.	Total Sulphate as SO_4	:- 8.24 ppm or mg/L	50 – 100 ppm or mg/L Approx.
9.	Total Chloride as Cl	:- 17.75 ppm or mg/L	50 – 100 ppm or mg/L Approx.
10.	Phosphate as P	:- 0.002 ppm or mg/L	Nil
11.	Silica as SiO_2	:- 6.27 ppm or mg/L	Below 10 ppm

Fig. 12 Unpurified water Test analysis

Remarks: - Above Sample is Slight Hazy in appearance. Therefore, it is not potable.

Partial Purified water & Sample Test-B

Fig. 13 Partial purified water

RESULT OF ANALYSIS :

			Permissible limits of Drinking Water
1.	pH of Water	:- 7.0	7.0 - 8.0
2.	Total Solid	:- 274.00 ppm or mg/L	400 – 600 ppm or mg/L Approx.
3.	Suspended Solid	:- 1.37 ppm or mg/L	Nil
4.	Total Dissolved Solid	:- 272.63 ppm or mg/L	400 – 600 ppm or mg/L Approx.
5.	Alkalinity to Phenolphthalein	:- Nil	Nil
6.	Total Alkalinity as $CaCO_3$	:- 78.00 ppm or mg/L	100 ppm or mg/L Approx.
7.	Total Hardness as $CaCO_3$	:- 135.00 ppm or mg/L	50 – 100 ppm or mg/L Approx.
8.	Total Sulphate as SO_4	:- 12.30 ppm or mg/L	50 – 100 ppm or mg/L Approx.
9.	Total Chloride as Cl	:- 28.40 ppm or mg/L	50 – 100 ppm or mg/L Approx.
10.	Phosphate as P	:- 0.003 ppm or mg/L	Nil
11.	Silica as SiO_2	:- 6.82 ppm or mg/L	Below 10 ppm

Fig. 14 Partial purified water Test analysis

Remarks: - Above Sample is Slight Hazy in appearance. Therefore, it is not potable.

Purified water & Sample Test-C

Fig. 15 Purified water

RESULT OF ANALYSIS :

			Permissible limits of Drinking Water
1.	pH of Water	:- 7.1	7.0 - 8.0
2.	Total Solid	:- 308.00 ppm or mg/L	400 – 600 ppm or mg/L Approx.
3.	Suspended Solid	:- 0.47 ppm or mg/L	Nil
4.	Total Dissolved Solid	:- 307.53 ppm or mg/L	400 – 600 ppm or mg/L Approx.
5.	Alkalinity to Phenolphthalein	:- Nil	Nil
6.	Total Alkalinity as $CaCO_3$	:- 92.50 ppm or mg/L	100 ppm or mg/L Approx.
7.	Total Hardness as $CaCO_3$	:- 152.50 ppm or mg/L	50 – 100 ppm or mg/L Approx.
8.	Total Sulphate as SO_4	:- 14.42 ppm or mg/L	50 – 100 ppm or mg/L Approx.
9.	Total Chloride as Cl	:- 31.95 ppm or mg/L	50 – 100 ppm or mg/L Approx.
10.	Phosphate as P	:- Nil	Nil
11.	Silica as SiO_2	:- 7.29 ppm or mg/L	Below 10 ppm

Fig. 16 Purified water Test analysis

Remarks: - By the above analysis, Water is potable and used as drinking purpose.

[Fig. 12, Fig. 14, Fig. 16 are related to result analysis of water simple from Government certified STIC Lab]

Performance and Reliability of water Filter

- ❖ Should aim to replace them about every three to five months of mineral cartridge.
- ❖ Durability is at least 6 month. That lifespan has much to do with how much crud is in the water, whether it's hard or soft, and so on.

6. CONCLUSIONS

The benefits associated with access to safe drinking water provide a strong argument to increase resource allocations to interventions aimed at further improving the current drinking-water situation, as a key entry point for achieving much wider livelihood benefits. The pedal operated water filtration system is a new system that is useful in developing countries like India to have daily access to safe drinking water all by harnessing the energy of pedal power.

- In the face of this growing water crisis, this system is related to struggle against safe and secure drinking water.
- It is pedal driven pump to drive water from trunk through filter by system and that clean water store in storage tank.
- Due to this we solving problem of transportation of water, get clean water and reduce health issue.
- This project is related to water crisis, unfiltered water and health issue.
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BIOGRAPHIES

Yakin N. Pokiya perusing his Bachelor Degree in Mechanical Engineering from, Shree Swami Atmanand Saraswati Institute of Technology Surat-395006, Gujarat, India.

Hitesh P. Tailor perusing his Bachelor Degree in Mechanical Engineering from, Shree Swami Atmanand Saraswati Institute of Technology Surat-395006, Gujarat, India

Fenil P. Tandel perusing his Bachelor Degree in Mechanical Engineering from, Shree Swami Atmanand Saraswati Institute of Technology Surat-395006, Gujarat, India

Keval D. Tarsariya perusing his Bachelor Degree in Mechanical Engineering from, Shree Swami Atmanand Saraswati Institute of Technology Surat-395006, Gujarat, India

Daxesh S. Vanani perusing his Bachelor Degree in Mechanical Engineering from, Shree Swami Atmanand Saraswati Institute of Technology Surat-395006, Gujarat, India

Prof. Manish D. Savaliya has completed his Master from C.K. Pithawala College of Engineering and Technology in Machine Design, Surat. He is a professor of Fluid Mechanics and Hydraulic Machine in Department of Mechanical Engineering, Shree Swami Atmanand Saraswati Institute of Technology Surat-395006, Gujarat, India