SAMPLE MECHANICAL PROJECT REPORT

DESIGN AND FABRICATION OF CYCLOCLEAN

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IN
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Submitted by

Batch No: 04

G RAJESH	**18HR1A0309**
S LAVANAKUMAR NAIDU	**18HR1A0325**
K NIKHILA PRIYA	**18HR1A0315**
S BHARGAV	**18HR1A0321**
M AJAY	**17HR1A0334**

Under the esteemed guidance of

Mr. RAM MOHAN B M. Tech.,
Assistant Professor
Mechanical Engineering

Department Of Mechanical Engineering

MOTHER THERESA INSTITUTE OF ENGINEERING &TECHNOLOGY

AFFILIATED TO J.N.T.U.A, ANANTHAPURAMU, APPROVED BY AICTE, NEW DELHI

Melumoi (P), Palamaner, Chittoor (Dist), -517 408

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DEPARTMENT OF MECHANICAL ENGINEERING
MOTHER THERESA INSTITUTE OF
ENGINEERING & TECHNOLOGY
Melumoi(P), Palamaner, Chittoor(Dist.)-517408

Certificate

This is to certify that the Project work entitled

DESIGN AND FABRICATION OF CYCLOCLEAN

is the bonafide work done and

Submitted by

BATCH NO:04

G RAJESH	18HR1A0309
S LAVANAKUMAR NAIDU	18HR1A0325
K NIKHILA PRIYA	18HR1A0315
S BHARGAV	18HR1A0321
M AJAY	17HR1A0334

In the Department of Mechanical Engineering, Mother Theresa Institute of Engineering & Technology, Palamaner, affiliated to J.N.T.U.A, Ananthapuramu in the partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Mechanical Engineering during 2018-2022.

Submitted on: 2/7/2022

Internal Examiner **HOD** **External Examiner**

HEAD OF THE DEPT.
Mechanical Engineering
Mother Theresa Inst. of Engg. & Tech.,
PALAMANER - 517 408.

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G RAJESH	**18HR1A0309**
S LAVANAKUMAR NAIDU	**18HR1A0325**
K NIKHILA PRIYA	**18HR1A0315**
S BHARGAV	**18HR1A0321**
M AJAY	**17HR1A0334**

ABSTRACT

cycloclean is a simple method of purifying water using bicycle. It can be built by using surrounding components. Water is termed as one of the basic needs of human life. Cycloclean machine is designed with a pump, spur gear, filter, sprocket, chain and overhead tank. The system is capable of to clean the impure water. Due to various reasons like poverty, people cant afford a purifier. Lots of power cuts in rural areas made difficulty in using water purifiers. To overcome all these problem we proposed cycloclean. It saves lots of power and its affordability makes it to use heavily. The existing technologies were very much costlier than the cost of our project. We have used light weighted motors so that the system is not heavy and also it is precise.

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CHAPTER 1
INTRODUCTION

Developing countries around the world face challenges accessing safe and clean drinking water. Alarming statistics 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 struggles. Our goal is to design a bicycle attachment to purify and transport water from contaminated sources that is active while the rider is pedaling. This attachment, though not a permanent solution, would be a contribution to the improvement of their quality of life. Our motivation from the idea of quickly aiding those less fortunate areas, as well as providing a backup should those regions run into contamination problems within their local wells.

Pedal Powered Water Purification is simplest form of water purification and it is an eco-friendly system. It works on the basis of mechanical energy without electricity. It is a portable thing and can be transferred to the various irrigation places. Pedal powered water purification consists of reciprocating pump operated by pedal power. The reciprocating pump is mounted on the stand in such a way that the connecting rod of the piston (reciprocating pump). By pedal ling the crank, the crank rotates, thereby rotating the reciprocating pump which in turns discharges water from the container and transmitted to pre filters which purify the water simultaneously. It can be also used as automatically with help of vehicle machines.

Various statistics show that there are many villages in India that do not have the facility of clean and safe drinking water. And that is because they lack proper sources for the purpose of filtered water and one major source is electricity. Water can contain many impurities, chemicals and various bacteria’s. Such contaminants can cause serious health issues and thus is totally unsafe for drinking.

People have to walk miles just to reach to a source of water and that too is not necessarily potable. Thus, the pedal powered water purifier is a decent step towards helping people to get purified water without much sources The pedal powered water filter works mainly on mechanical energy thus cutting down the need of electricity for the process of water filtration which make it more useful for the areas where electricity is still a major issue. Pedaling is free from pollution, thus it is an eco-friendly system and along with that it also provide healthy exercise. The main objective of this water purifier is to provide clean water by the means of converting the pedal energy into useful energy which can be utilized to purify water. It can be used not only to purify water but also for irrigation purposes & always possess a positive impact on health. The Reverse osmosis filter is used which purifies the water to a greater extent & further more filters which help purify it more. Further filters include sediment filter & activated carbon filter. The experimental investigation can be carried out at different rpm which can be helpful in determining the adequate flow rate required & therefore, the amount of power required. Thus, manual power can be harnessed to purify water & make it suitable for drinking purpose.

Alarming statistics led us to the idea 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 active while the rider is pedaling. This attachment, though not a permanent solution, would be a contribution to the improvement of their quality of life. Our motivation was stemmed from the idea of quickly aiding those less fortunate areas, as well as providing a backup should those regions run into contamination problems within their local well.

Water purification is the process of removing undesirable chemicals, biological contaminants, suspended solids and gases from contaminated water. The goal of this process is to produce water fit for a specific purpose. Most water is disinfected for human consumption (drinking water) but water purification may also be designed for a variety of other purposes, including meeting the requirements of medical, pharmacological, chemical and industrial applications.

In general, the methods used include physical processes such as filtration, sedimentation, and distillation, biological processes such as slow sand filters or biologically active carbon, chemical processes such as flocculation and chlorination and the use of electromagnetic radiation such as ultraviolet light.

The purification process of water may reduce the concentration of particulate matter including suspended particles, parasites, bacteria, algae, viruses, fungi; and a range of dissolved and particulate material derived from the surfaces that water may have made contact with after falling as rain.

The standards for drinking water quality are typically set by governments or by international standards. These standards will typically set minimum and maximum concentrations of contaminants for the use that is to be made of the water. It is not possible to tell whether water is of an appropriate quality by visual examination. Simple procedures such as boiling or the use of a household activated carbon filter are not sufficient for treating all the possible contaminants that may be present in water from an unknown source. Even natural spring water considered safe for all practical purposes in the 19th century must now be tested before determining what kind of treatment, if any, is needed. Chemical and microbiological analysis, while expensive, are the only way to obtain the information necessary for deciding on the appropriate method of purification.

According to a 2007 World Health Organization report, 1.1 billion people lack access to an improved drinking water supply, 88percent of the 4 billion annual cases of diarrheal disease are attributed to unsafe water and inadequate sanitation and hygiene, and 1.8 million people die from diarrheal diseases each year.

The WHO estimates that 94percent of these diarrheal cases are preventable through modifications to the environment, including access to safe water. Simple techniques for treating water at home, such as chlorination, filters, and solar disinfection, and storing it in safe containers could save a huge number of lives each year. Reducing deaths from waterborne diseases is a major public health goal in developing countries.

We have water problems in rural and urban areas. Water is the most basic necessity for human life. Nearly one billion people in the world lack of it. As we mechanical engineers, are willing to Fabricate a Bicycle Pedal Water purifier which is provided with a filter for purification for drinking purpose.

The people who are living near sea or river can use this bi-pedal water purifier. For instance, A water filter can be made from a sequence of layer of natural resource Rock, Gravel and Sand. Now-adays, there are modern filtration systems able to reduce the amount of unsafe material that can flow through any water system.

1.1 FILTRATION

Water Filters remove unwanted impurities from water such as sediment, taste and odour, hardness and bacteria to result in better quality water. From producing better-tasting drinking water to more specialist applications such as brewing coffee and making crystal clear ice, we offer a huge range of filters and cartridges to solve any number of water-related issues.

1.1.1 TYPES OF FILTRATIONS

There are 5 types of water filters: Household Jug Water Filter.

- Mechanical Filters
- Absorption Filters
- Sequestration Filters
- Ion Exchange Filters
- Reverse Osmosis Filters

Each one of these addresses a different water problem and many filters actually use a combination of these methods to perform multiple levels of filtration.

1.1.1.1 Mechanical Filters

The basic idea of mechanical filtration is to physically remove sediment, dirt or any particles in the water using a barrier. Mechanical filters can be anything from a basic mesh that filters out large debris to a ceramic filter which has an extremely complex pore structure for ultra-fine filtration of pathogenic organisms.

A filter that utilises mechanical filtration will usually be given a micron rating which indicates how effective the filters are in terms of the size of the particles it is capable of removing. Common ratings you might see include:

1. 5 micron - Will remove most particles visible to the naked eye.
2. 1 micron – Will remove particles which are too small to see without a microscope.
3. 0.5 micron - Will remove cysts (giardia and cryptosporidium).

Fig 1.1: Wound sediment filter with a 100 micron rating for mechanical filtration

1.1.1.2 Absorption Filters

Absorption in water filters is most commonly carried out by carbon, which is highly effective at capturing water-borne contaminants. The reason carbon absorbs contaminants so readily is that it has a huge internal surface which is jam packed with nooks and crannies that can trap chemical impurities such as chlorine.

Most common domestic filters contain granular activated carbon (GAC) which reduces unwanted tastes and odours by absorption. More expensive filters use carbon block elements which are generally more effective and usually carry a micron rating for particle removal.

A variety of different substances can be used to make carbon for filters including wood and coconut shell, with coconut shell filters being more effective but also more expensive.

Fig 1.2: Granular activated carbon and a carbon block for absorption filtration

1.1.1.3 Sequestration Filters

Sequestration is the action of chemically isolating a substance. Food grade polyphosphate is commonly used in scale inhibiting filters to sequester the calcium and magnesium minerals which cause limescale and corrosion. However, polyphosphate is generally only introduced in very small amounts and it only inhibits scale rather than eradicating it. This means that polyphosphate does not soften the water but instead works to keep the minerals within the solution, preventing them forming as scale on any surfaces they come into contact with.

Due to the hard minerals still being present in the water, scale inhibition isn’t suitable for all applications. Instead, water softening using a process such as ion exchange is usually recommended in water areas with alkalinity levels of 180ppm or more (very hard water) and applications where water is kept at a constant temperature of 95°C or more.

1.1.1.4 Ion Exchange filters

Ion exchange is a process used to soften hard water by exchanging the magnesium and calcium ions found in hard water with other ions such as sodium or hydrogen ions. Unlike scale inhibition, ion exchange physically removes the hard minerals, reducing limescale and making water suitable for applications where it is kept at a constant high temperature e.g. in commercial coffee machines.

Ion exchange is most commonly carried out using an ion exchange resin which normally comes in the form of small beads. A similar type of resin is used in some Water Softeners and in the case of a water softener the resin utilises sodium ions which need to be periodically recharged to prevent the resin becoming ineffective.

As water filters are usually sealed units you would simply replace the filter with a new one though it should be noted that Calcium Treatment Units (CTUs) can be returned to the supplier and regenerated. Resins that utilise sodium ions aren’t usually used in drinking water filters as the amount of salt (sodium) that can be present in drinking water is legally limited to 200 milligrams/litre. As sodium ion exchange increases salt levels, a hydrogen based ion exchange resin is the preferred option for filters.

1.1.1.5 Reverse Osmosis Filters

Reverse osmosis (RO) is the process of removing dissolved inorganic solids (such as magnesium and calcium ions) from water by forcing it through a semipermeable membrane under pressure so that the water passes through but most of the contaminants are left behind.

Reverse osmosis is a highly effective way of purifying water and is usually combined with a number of other filters such as a mechanical (sediment) filter and an absorption (activated carbon) filter in order to return water with few contaminants remaining. Reverse osmosis systems use water pressure to force water through the membrane so it uses no electricity, though a certain amount of waste water is produced that has to be sent to the drain. The extra filters involved in multi-stage water filtration can make a reverse osmosis unit more expensive than other filtration methods but in applications where 99.9% pure water is required, RO offers the finest level of filtration available as is increasingly being used to treat water made for Coffee.

Fig 1.3: 4 Stage Domestic Drinking Water Reverse Osmosis System

CHAPTER 2
LITERTURE REVIEW

We have reviewed following research papers majorly being related with the technology which we have used in our project work "Design and Fabrication of Cycloclean" apart from books and websites.

[1] Yuichi katsuara et. Al (2011):- President of the 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 needs man power to turn a bike chain driving motor to pump water through a series of filter (without the use of electricity). Clean water can be utilized for domestic purpose.

[2] Ademola Samuel Akinwonmi et. al (2012):- Has prepared pedal powered 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 uses the Bernoulli's principle for the flow calculation with the help of peristaltic pump.

[3] Betzabe Gonzalez et. al (2014) :- Has studied in 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. The sidecar is added to the bicycle for the two tanks set up one of dirty water & other of clean water tank for utilization around the home. Filtered water we get through this design.

[4] Peramanan et. Al (2014):- Has studied the fabrication of Human Power Reverse Osmosis Water Purification Process. The device use pedal to harm 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 a 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.

[5] Jayant Gidwani et al (2016):**-** 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 the 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.

[6] Anusha Pikle, Yash Siriah et al (2017):- 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), 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.

[7] 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. Efficiency of the pump was 46.53 percent against a head of 1.65 m. The pedal pump can be constructed using local materials and skill. It would be suitable to irrigate small and fragmented land holdings, especially to pump water from a shallow depth (up to 2 m) to irrigate small plots like vegetables and seed beds with less physical effort.

[8] Jayant et-al:- Have presented their paper about fabrication of PPWP. And experimentally investigates the working of Pedal Powered Water Pump (PPWP) along with its purification which has been used for pure drinking water supply and garden irrigation.

Pedal Powered Water Pump (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. By pedaling the bicycle, the bicycle wheel rotates, thereby rotating the centrifugal pump which in turns discharges water from the sump.

Pedal Powered Water Pump (PPWP) provides drinking water and irrigation in remote areas where electricity is not available. PPWP is not only free from pollution but also provide healthy exercise. PPWP reduces the rising energy costs.

Pedal Powered Water Pump (PPWP) will design as a portable one which can be used for irrigation in various places. The experimental investigation was executed and performance of the PPWP had carried out at different rpm. The PPWP requires only manual power thereby reducing the utility bill considerably.

[9] Garud and Kulkarni:- Discussed and presented 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.

The present short review shows applicability of RO system for treating effluents from beverage industry, distillery spent wash, ground water treatment, recovery of phenol compounds, and reclamation of wastewater and sea water reverse osmosis (SWRO) treatment indicating efficiency and applicability of RO technology.

CHAPTER 3
EXISTING METHODS

Water purification means the process of removing undesirable chemicals, biological contaminants, suspended solids, and gases from water. The goal is to produce water that is fit for specific purposes. Most water is purified and disinfected for human consumption (drinking water), but water purification may also be carried out for a variety of other purposes, including medical, pharmacological, chemical, and industrial applications. The history of water purification includes a wide variety of methods. The methods used include physical processes such as filtration, sedimentation, and distillation; biological processes such as slow sand filters or biologically active carbon; chemical processes such as flocculation and chlorination; and the use of electromagnetic radiation such as ultraviolet light.

Water purification may reduce the concentration of particulate matter including suspended particles, parasites, bacteria, algae, viruses, and fungi as well as reduce the concentration of a range of dissolved and particulate matter.

The standards for drinking water quality are typically set by governments or by international standards. These standards usually include minimum and maximum concentrations of contaminants, depending on the intended use of the water.

Visual inspection which cannot determine if water meets their quality standards. Simple procedures such as boiling or the use of a household activated carbon filter are not sufficient for treating all possible contaminants that may be present in water from an unknown source. Even natural spring water – considered safe for all practical purposes in the 19th century – must now be tested before determining what kind of treatment, if any, is needed. Chemical and microbiological analysis, while expensive, are the only way to obtain the information necessary for deciding on the appropriate method of purification.

According to a 2007 World Health Organization (WHO) report, 1.1 billion people lack access to an improved drinking water supply; 88% of the 4 billion annual cases of diarrheal disease are attributed to unsafe water and inadequate sanitation and hygiene, while 1.8 million people die from diarrheal disease each year. The WHO estimates that 94% of these diarrheal disease cases are preventable through modifications to the environment, including access to safe water.[1] Simple techniques for treating water at home, such as chlorination, filters, and solar disinfection, and for storing it in safe containers could save a huge number of lives each year.[2] Reducing deaths from waterborne diseases is a major public health goal in developing countries.

3.1 SOURCES OF WATER

Groundwater: The water emerging from some deep ground water may have fallen as rain many tens, hundreds, or thousands of years ago. Soil and rock layers naturally filter the ground water to a high degree of clarity and often, it does not require additional treatment besides adding chlorine or chloramines as secondary disinfectants. Such water may emerge as springs, artesian springs, or may be extracted from boreholes or wells. Deep ground water is generally of very high bacteriological quality (i.e., pathogenic bacteria or the pathogenic protozoa are typically absent), but the water may be rich in dissolved solids, especially carbonates and sulphates of calcium and magnesium. Develop on the strata through which the water has flowed, other ions may also be present including chloride, and bicarbonate. There may be a requirement to reduce the iron or manganese content of this water to make it acceptable for drinking, cooking, and laundry use. Primary disinfection may also be required. Where groundwater recharge is practiced (a process in which river water is injected into an aquifer to store the water in times of plenty so that it is available in times of drought), the groundwater may require additional treatment depending on applicable state and federal regulations.

- Upland lakes and reservoirs: Typically located in the headwaters of river systems, upland reservoirs are usually sited above any human habitation and may be surrounded by a protective zone to restrict the opportunities for contamination. Bacteria and pathogen levels are usually low, but some bacteria, protozoa or algae will be present. Where uplands are forested or peaty, humic acids can colour the water. Many upland sources have low pH which require adjustment.

- Rivers, canals and low land reservoirs: Low land surface waters will have a significant bacterial load and may also contain algae, suspended solids and a variety of dissolved constituents.

- Atmospheric water generation is a new technology that can provide high quality drinking water by extracting water from the air by cooling the air and thus condensing water vapour.
- Rainwater harvesting or fog collection which collect water from the atmosphere can be used especially in areas with significant dry seasons and in areas which experience fog even when there is little rain.
- Desalination of seawater by distillation or reverse osmosis.
- Surface water: Freshwater bodies that are open to the atmosphere and are not designated as groundwater are termed surface waters.

3.2 TREATMENT

3.2.1 Goals

The goals of the treatment are to remove unwanted constituents in the water and to make it safe to drink or fit for a specific purpose in industry or medical applications. Widely varied techniques are available to remove contaminants like fine solids, micro-organisms and some dissolved inorganic and organic materials, or environmental persistent pharmaceutical pollutants. The choice of method will depend on the quality of the water being treated, the cost of the treatment process and the quality standards expected of the processed water.

The processes below are the ones commonly used in water purification plants. Some or most may not be used depending on the scale of the plant and quality of the raw (source) water.

3.2.2 Pre-treatment

- Pumping and containment – The majority of water must be pumped from its source or directed into pipes or holding tanks. To avoid adding contaminants to the water, this physical infrastructure must be made from appropriate materials and constructed so that accidental contamination does not occur.
- Screening – The first step in purifying surface water is to remove large debris such as sticks, leaves, rubbish and other large particles which may interfere with

subsequent purification steps. Most deep groundwater does not need screening before other purification steps.

- Storage – Water from rivers may also be stored in bankside reservoirs for periods between a few days and many months to allow natural biological purification to take place. This is especially important if treatment is by slow sand filters. Storage reservoirs also provide a buffer against short periods of drought or to allow water supply to be maintained during transitory pollution incidents in the source river.
- Pre-chlorination – In many plants the incoming water was chlorinated to minimize the growth of fouling organisms on the pipe-work and tanks. Because of the potential adverse quality effects (see chlorine below), this has largely been discontinued.

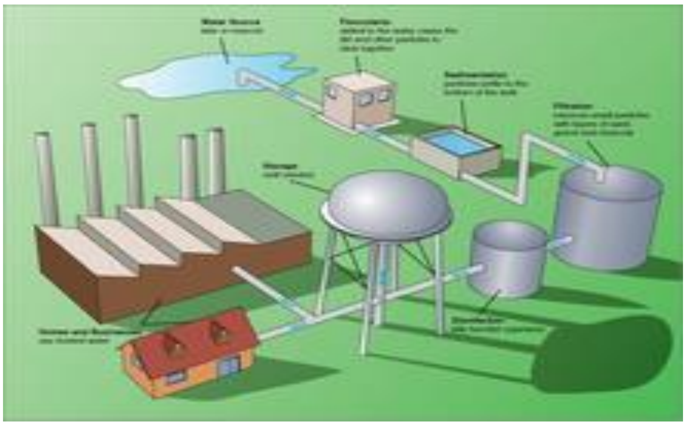

Fig 3.1: Treatment

3.2.3 Ph Adjument

Pure water has a pH close to 7 (neither alkaline nor acidic). Sea water can have pH values that range from 7.5 to 8.4 (moderately alkaline). Fresh water can have widely ranging pH values depending on the geology of the drainage basin or aquifer and the influence of contaminant inputs (acid rain). If the water is acidic (lower than 7), lime, soda ash, or sodium hydroxide can be added to raise the pH during water purification processes. Lime addition increases the calcium ion concentration, thus raising the water hardness. For highly acidic waters, forced draft degasifies can be an effective way to raise the pH, by stripping dissolved carbon dioxide from the water. Making the water alkaline helps coagulation and flocculation processes work effectively and also helps to minimize the risk of lead being dissolved from lead pipes and from lead solder in pipe fittings. Sufficient alkalinity also reduces the corrosiveness of water to iron pipes. Acid (carbonic acid, hydrochloric acid or sulfuric acid) may be added to alkaline waters in some circumstances to lower the pH. Alkaline water (above pH 7.0) does not necessarily mean that lead or copper from the plumbing system will not be dissolved into the water. The ability of water to precipitate calcium carbonate to protect metal surfaces and reduce the likelihood of toxic metals being dissolved in water is a function of pH, mineral content, temperature, alkalinity and calcium concentration.

3.2.4 Coagulation and flocculation

One of the first steps in most conventional water purification processes is the addition of chemicals to assist in the removal of particles suspended in water. Particles can be inorganic such as clay and silt or organic such as algae, bacteria, viruses, protozoa and natural organic matter. Inorganic and organic particles contribute to the turbidity and colour of water.

The addition of inorganic coagulants such as aluminium sulphate (or alum) or iron (III) salts such as iron(III) chloride cause several simultaneous chemical and physical interactions on and among the particles. Within seconds, negative charges on the particles are neutralized by inorganic coagulants. Also within seconds, metal hydroxide precipitates of the iron and aluminium ions begin to form. These precipitates combine into larger particles under natural processes such as Brownian motion and through induced mixing which is sometimes referred to as flocculation. Amorphous metal hydroxides are known as "floc". Large, amorphous aluminium and iron (III) hydroxides adsorb and enmesh particles in suspension and facilitate the removal of particles by subsequent processes of sedimentation and filtration. Aluminium hydroxides are formed within a fairly narrow pH range, typically: 5.5 to about 7.7. Iron (III) hydroxides can form over a larger pH range including pH levels lower than are effective for alum, typically: 5.0 to 8.5.

Fig 3.2: Coagulation and Flocculation

3.2.5 Sedimentation

Waters exiting the flocculation basin may enter the sedimentation basin, also called a clarifier or settling basin. It is a large tank with low water velocities, allowing floc to settle to the bottom. The sedimentation basin is best located close to the flocculation basin so the transit between the two processes does not permit settlement or floc break up. Sedimentation basins may be rectangular, where water flows from end to end, or circular where flow is from the centre outward. Sedimentation basin outflow is typically over a weir so only a thin top layer of water that furthest from the sludge exits.

In general, sedimentation basin efficiency is not a function of detention time or depth of the basin. Although, basin depth must be sufficient so that water currents do not disturb the sludge and settled particle interactions are promoted. As particle concentrations in the settled water increase near the sludge surface on the bottom of the tank, settling velocities can increase due to collisions and agglomeration of particles. Typical detention times for sedimentation vary from 1.5 to 4 hours and basin depths vary from 10 to 15 feet (3 to 4.5 meters).

3.2.6 Sludge storage and Removal

As particles settle to the bottom of a sedimentation basin, a layer of sludge is formed on the floor of the tank which must be removed and treated. The amount of sludge generated is significant, often 3 to 5 percent of the total volume of water to be treated. The cost of treating and disposing of the sludge can impact the operating cost of a water treatment plant. The sedimentation basin may be equipped with mechanical cleaning devices that continually clean its bottom, or the basin can be periodically taken out of service and cleaned manually.

3.2.7 Floc Blanket Clarifiers

A subcategory of sedimentation is the removal of particulates by entrapment in a layer of suspended floc as the water is forced upward. The major advantage of floc blanket clarifiers is that they occupy a smaller footprint than conventional sedimentation. Disadvantages are that particle removal efficiency can be highly variable depending on changes in influent water quality and influent water flow rate.

3.2.8 Dissolved air flotation

When particles to be removed do not settle out of solution easily, dissolved air flotation (DAF) is often used. After coagulation and flocculation processes, water flows to DAF tanks where air diffusers on the tank bottom create fine bubbles that attach to floc resulting in a floating mass of concentrated floc. The floating floc blanket is removed from the surface and clarified water is withdrawn from the bottom of the DAF tank. Water supplies that are particularly vulnerable to unicellular algae blooms and supplies with low turbidity and high colour often employ DAF.

3.2.9 Filtration

After separating most floc, the water is filtered as the final step to remove remaining suspended particles and unsettled floc.

3.2.10 Bank filtration

In bank filtration, natural sediments in a riverbank are used to provide a first stage of contaminant filtration. While typically not clean enough to be used directly for drinking water, the water gained from the associated extraction wells is much less problematic than river water taken directly from the river.

3.2.11 Membrane filtration

Membrane filters are widely used for filtering both drinking water and sewage. For drinking water, membrane filters can remove virtually all particles larger than 0.2 μm including giardia and cryptosporidium. Membrane filters are an effective form of tertiary treatment when it is desired to reuse the water for industry, for limited domestic purposes, or before discharging the water into a river that is used by towns further downstream.

They are widely used in industry, particularly for beverage preparation (including bottled water). However no filtration can remove substances that are actually dissolved in the water such as phosphates, nitrates and heavy metal ions.

3.3 ADDITIONAL TREATMENT OPTIONS

- Water fluoridation: in many areas fluoride is added to water with the goal of preventing tooth decay.[17] Fluoride is usually added after the disinfection process. In the U.S., fluoridation is usually accomplished by the addition of hexafluoro silicic acid, which decomposes in water, yielding fluoride ions.
- Water conditioning: This is a method of reducing the effects of hard water. In water systems subject to heating hardness salts can be deposited as the decomposition of bicarbonate ions creates carbonate ions that precipitate out of solution. Water with high concentrations of hardness salts can be treated with soda ash (sodium carbonate) which precipitates out the excess salts, through the common-ion effect, producing calcium carbonate of very high purity. The precipitated calcium carbonate is traditionally sold to the manufacturers of toothpaste. Several other methods of industrial and residential water treatment are claimed (without general scientific acceptance) to include the use of magnetic and/or electrical fields reducing the effects of hard water.
- Plumbosolvency reduction: In areas with naturally acidic waters of low conductivity (i.e. surface rainfall in upland mountains of igneous rocks), the water may be capable of dissolving lead from any lead pipes that it is carried in. The addition of small quantities of phosphate ion and increasing the pH slightly both assist in greatly reducing plumbo-solvency by creating insoluble lead salts on the inner surfaces of the pipes.
- Radium Removal: Some groundwater sources contain radium, a radioactive chemical element. Typical sources include many groundwater sources north of the Illinois River in Illinois, United States of America. Radium can be removed by ion exchange, or by water conditioning. The back flush or sludge that is produced is, however, a low-level radioactive waste.
- Fluoride Removal: Although fluoride is added to water in many areas, some areas of the world have excessive levels of natural fluoride in the source water. Excessive levels can be toxic or cause undesirable cosmetic effects such as

staining of teeth. Methods of reducing fluoride levels is through treatment with activated alumina and bone char filter media.

3.4 SAFETY AND CONTROVERISES

In April, 2007, the water supply of Spencer, Massachusetts in the United States of America, became contaminated with excess sodium hydroxide (lye) when its treatment equipment malfunctioned.

Many municipalities have moved from free chlorine to chloramine as a disinfection agent. However, chloramine appears to be a corrosive agent in some water systems. Chloramine can dissolve the "protective" film inside older service lines, leading to the leaching of lead into residential spigots. This can result in harmful exposure, including elevated blood lead levels. Lead is a known neurotoxin.

Fig 3.3: Rainbow trout are often used in water purification plants to detect acute water pollution.

CHAPTER 4
PROPOSED SYSTEM

4.1 CATIA DESIGN

Catia Elements/Pro is a software application within the CAD/CAM/CAE category, along with other similar products currently on the market. Creo Elements/Pro is a parametric, feature-based modelling architecture incorporated into a single database philosophy with advanced rule-based design capabilities. It provides in-depth control of complex geometry, as exemplified by the trapper parameter. The capabilities of the product can be split into the three main headings of Engineering Design, Analysis and Manufacturing.

We created 3D model of this project by using CATIA software. The models are shown below.

Fig 4.1: Catia Design

4.2 BLOCK DIAGRAM

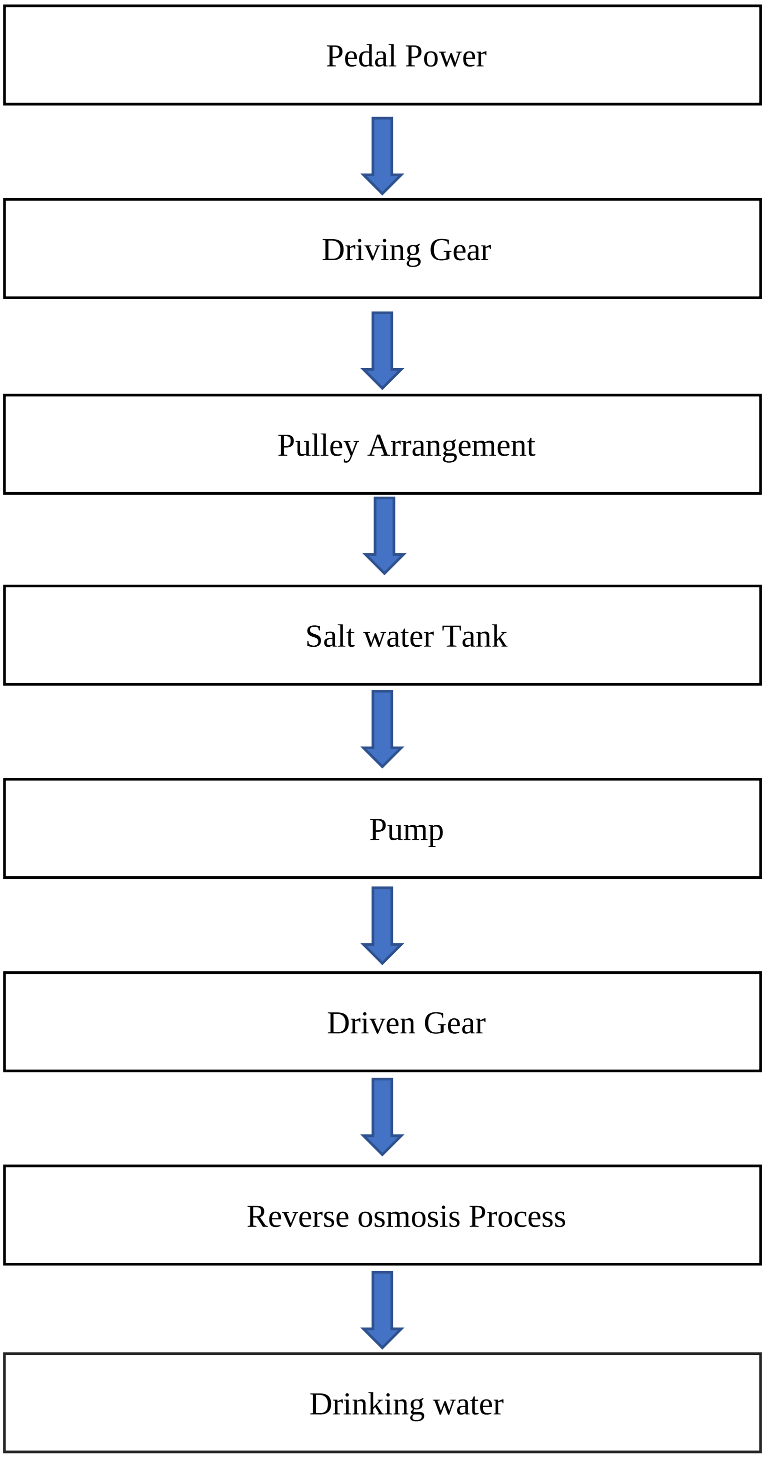

Fig 4.2: Block Diagram

4.3 COMPONENTS AND DESCRIPTION

The major parts that are effectively employed in the design and the fabrication of the pedal powered water purification system lifted on a cycle are described below:

- Sprocket
- Pump
- Gear
- Carbon filter
- Chain
- Overhead tank

4.3.1 Sprocket

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.

The sprocket looks like a gear but differs in three important ways:

- Sprockets have many engaging teeth; gears usually have only one or two.
- The teeth of a gear touch and slip against each other; there is basically no slippage in a sprocket.
- The shape of the teeth is different in gears and sprockets.

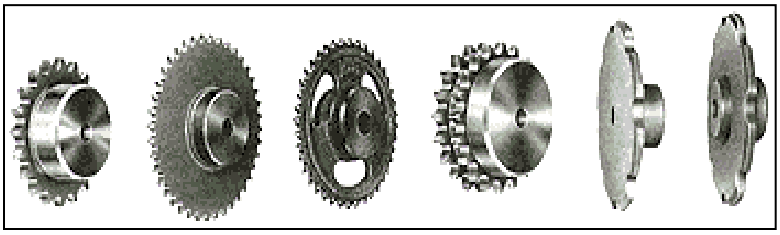

Fig 4.3: Types of sprockets

4.3.1.1 Engagement with Sprockets

Although chains are sometimes pushed and pulled at either end by cylinders, chains are usually driven by wrapping them on sprockets. In the following section, we explain the relation between sprockets and chains when power is transmitted by sprockets.

4.3.1.2 Back tension

First, let us explain the relationship between flat belts and pulleys. Figure 2.5 shows a rendition of a flat belt drive. The circle at the top is a pulley, and the belt hangs down from each side. When the pulley is fixed and the left side of the belt is loaded with tension (T0), the force needed to pull the belt down to the right side will be:

T1 = T0 3 eµu

For example, T0 = 100 N: the coefficient of friction between the belt and pulley, µ = 0.3; the wrap angle u = ¼ (180).

T1 = T0 3 2.566 = 256.6 N

In brief, when you use a flat belt in this situation, you can get 256.6 N of drive power only when there is 100 N of back tension.

For elements without teeth such as flat belts or ropes, the way to get more drive power is to increase the coefficient of friction or wrapping angle. If a substance, like grease or oil, which decreases the coefficient of friction, gets onto the contact surface, the belt cannot deliver the required tension.

In the chain's case, sprocket teeth hold the chain roller. If the sprocket tooth configuration is square, as in Figure 2.6, the direction of the tooth's reactive force is opposite the chain's tension, and only one tooth will receive all the chain's tension. Therefore, the chain will work without back tension.

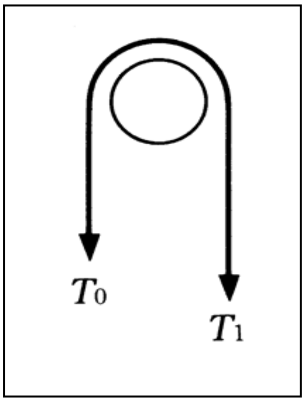

Fig 4.4: Flat Belt Drive

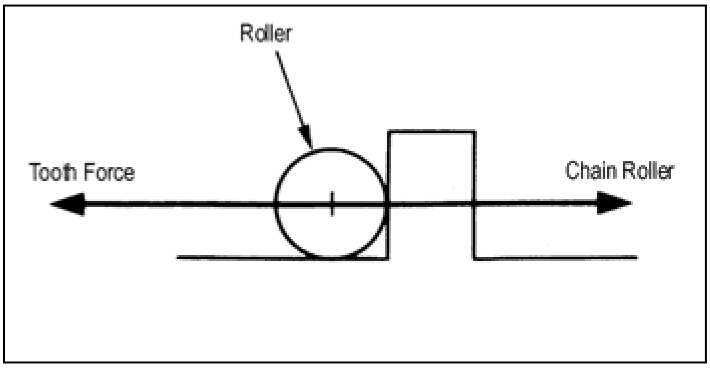

Fig 4.5: Simplified Roller

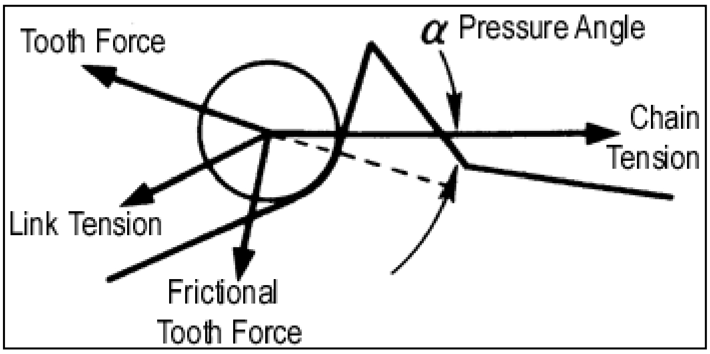

Fig 4.6: Balance of Forces Around the Roller

But actually, sprocket teeth need some inclination so that the teeth can engage and slip off of the roller. The balances of forces that exist around the roller are shown in Figure 4.6, and it is easy to calculate the required back tension.

4.3.1.3 Chain wear and jumping sprocket teeth

The key factor causing chain to jump sprocket teeth is chain wear elongation (see Basics Section 2.2.4). Because of wear elongation, the chain creeps up on the sprocket teeth until it starts jumping sprocket teeth and can no longer engage with the sprocket.

Figure 4.7 shows sprocket tooth shape and positions of engagement.

Figure 4.8 shows the engagement of a sprocket with an elongated chain.

Figure 4.7 there are three sections on the sprocket tooth face a: Bottom curve of tooth, where the roller falls into place;

b: Working curve, where the roller and the sprocket are working together;

c: Where the tooth can guide the roller but can't transmit tension. If the roller, which should transmit tension, only engages with C, it causes jumped sprocket teeth.

The chain's wear elongation limit varies according to the number of sprocket teeth and their shape, as shown in Figure 2.11. Upon calculation, we see that sprockets with large numbers of teeth are very limited in stretch percentage. Smaller sprockets are limited by other harmful effects, such as high vibration and decreasing strength; therefore, in the case of less than 60 teeth, the stretch limit ratio is limited to 1.5 percent (in transmission chain).

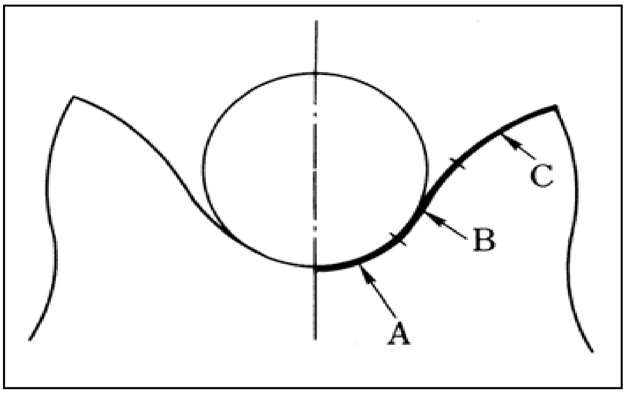

Fig 4.7: Sprocket Tooth Shape and Positions of Engagement

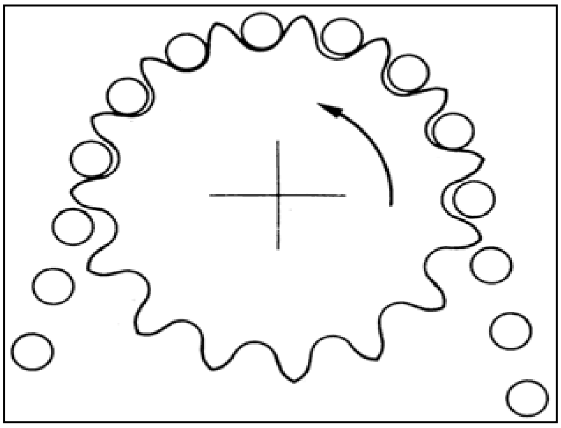

Fig 4.8: The Engagement Between a Sprocket and an Elongated Chain

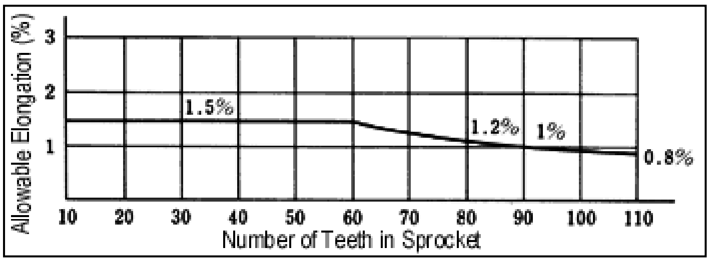

Fig 4.9: Elongation Versus the Number of Sprocket Teeth

In conveyor chains, in which the number of working teeth in sprockets is less than transmission chains, the stretch ratio is limited to 2 percent. Large pitch conveyor chains use a straight line in place of curve B in the sprocket tooth face.

A chain is a reliable machine component, which transmits power by means of tensile forces, and is used primarily for power transmission and conveyance systems. The function and uses of chain are similar to a belt. There are many kinds of chain. It is convenient to sort types of chain by either material of composition or method of construction.

We can sort chains into five types:

- Cast iron chain.
- Cast steel chain.
- Forged chain.
- Steel chain.
- Plastic chain.

Demand for the first three chain types is now decreasing; they are only used in some special situations. For example, cast iron chain is part of water-treatment equipment; forged chain is used in overhead conveyors for automobile factories.

In this book, we are going to focus on the latter two: "steel chain," especially the type called "roller chain," which makes up the largest share of chains being produced, and "plastic chain." For the most part, we will refer to "roller chain" simply as "chain."

NOTE: Roller chain is a chain that has an inner plate, outer plate, pin, bushing, and roller.

In the following section of this book, we will sort chains according to their uses, which can be broadly divided into six types:

1. Power transmission chain.
2. Small pitch conveyor chain.
3. Precision conveyor chain.
4. Top chain.
5. Free flow chain.
6. Large pitch conveyor chain.

The first one is used for power transmission; the other five are used for conveyance. In the Applications section of this book, we will describe the uses and features of each chain type by following the above classification.

In the following section, we will explain the composition of power transmission chain, small pitch chain, and large pitch conveyor chain. Because there are special features in the composition of precision conveyor chain, top chain, and free flow chain, checks the appropriate pages in the Applications section about these features.

4.3.1.4 Basic Structure of Power Transmission Chain

A typical configuration for RS60-type chain is shown in Figure 4.10

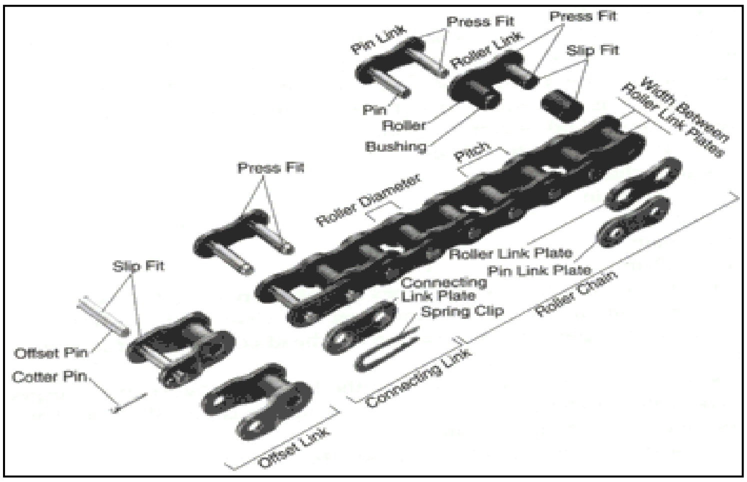

Fig 4.10: The Basic Components of Transmission Chain

4.3.1.5 Connecting Link

This is the ordinary type of connecting link. The pin and link plate are slip fit in the connecting link for ease of assembly. This type of connecting link is 20 percent lower in fatigue strength than the chain itself. There are also some special connecting links which have the same strength as the chain itself. (See Figure 4.11)

4.3.1.6 Tap Fit Connecting Link

In this link, the pin and the tap fit connecting link plate are press fit. It has fatigue strength almost equal to that of the chain itself. (See Figure 1.2)

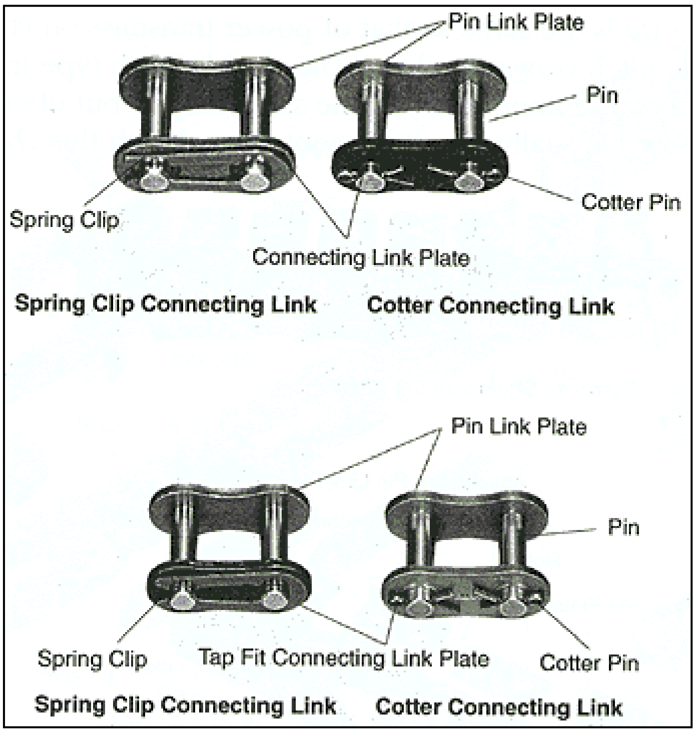

Fig 4.11 : Standard Connecting Link (Top) and Tap Fit Connecting Link (Bottom)

4.3.1.7 Offset Link

An offset link is used when an odd number of chain links is required. It is 35 percent lower in fatigue strength than the chain itself. The pin and two plates are slip fit. There is also a two-pitch offset link available that has fatigue strength as great as the chain itself.

4.3.2 PUMP

A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action. The operating principle of the pump is to convert mechanical energy to pressure. In operation, a rotating impeller accelerates a liquid and as the area of the casing expands the velocity of the fluid is convert to pressure. As a result pressurized fluid exits the pump discharge.

Fig 4.12: Pump

4.3.2.1 Positive Displacement Pump

A positive displacement pump makes a fluid move by trapping a fixed amount and forcing (displacing) that trapped volume into the discharge pipe. Some positive displacement pumps use an expanding cavity on the suction side and a decreasing cavity on the discharge side. Liquid flows into the pump as the cavity on the suction side expands and the liquid flows out of the discharge as the cavity collapses. The volume is constant through each cycle of operation.

A positive displacement pump can be further classified according to the mechanism used to move the fluid:

- Rotary-type positive displacement
- Reciprocating-type positive displacement
- Linear-type positive displacement

4.3.3 Gear

A Gear is a rotating circular machine part having cut teeth or in the case of gearwheel, inserted teeth which mesh with another toothed part to transmit torque.

Spur gear are the simplest type of gear. They consist of a cylinder with teeth projecting radially. Viewing the gear at 90 degree from the shaft length the tooth faces are straight and aligned parallel to the axis of rotation.

Spur gears are a cylindrical shaped toothed component used in industrial equipment to transfer mechanical motion as well as control speed, power and torque.

Spur gear are used for a wide range of speed ratios in a variety of mechanical applications such as pumps, watering system and clothes washing.

Fig 4.13: Spur Gear

4.3.4 Carbon Filter

Carbon filtering is a method of filtering that uses a bed of activated carbon to remove contaminants and impurities, using chemical absorption.

Each particle/granule of carbon provides a large surface area/pore structure, allowing contaminants the maximum possible exposure to the active sites within the filter media. One pound (450 g) of activated carbon contains a surface area of approximately 100 acres (40 Hectares).

Activated carbon works via a process called adsorption, whereby pollutant molecules in the fluid to be treated are trapped inside the pore structure of the carbon substrate. Carbon filtering is commonly used for water purification, in air purifiers and industrial gas processing, for example the removal of siloxanes and hydrogen sulfide from biogas. It is also used in a number of other applications, including respirator masks, the purification of sugarcane and in the recovery of precious metals, especially gold. It is also used in cigarette filters.

Active charcoal carbon filters are most effective at removing chlorine, sediment, volatile organic compounds (VOCs), taste and odor from water. They are not effective at removing minerals, salts, and dissolved inorganic compounds. Typical particle sizes that can be removed by carbon filters range from 0.5 to 50 micrometers. The particle size will be used as part of the filter description. The efficacy of a carbon filter is also based upon the flow rate regulation.

When the water is allowed to flow through the filter at a slower rate, the contaminants are exposed to the filter media for a longer amount of time.

Fig 4.14: Filter

4.3.5 Chain

A bicycle chain is a roller chain that transfers power from the pedals to the drive-wheel of a bicycle, thus propelling it. Most bicycle chains are made from plain carbon or alloy steel, but some are nickel-plated to prevent rust, or simply for aesthetics.

Fig 4.15: Chain

4.3.6 Overhead Tank

Water tanks are used to provide storage of water for use in many applications, drinking water, irrigation agriculture, fire suppression, agricultural farming, both for plants and livestock, chemical manufacturing, food preparation as well as many other uses.

Fig 4.16: Tank

4.4 REVERSE OSMOSIS

The reverse Osmosis is the process by which a liquid flow from higher concentration to lower concentration through a semipermeable membrane.

Thus it helps in reducing the concentration of the solution and filtering the impurities with less concentration. The membrane is useful in direction of flow of liquids and hence can be made available for the purification.

Through this Reverse Osmosis the contaminants in the higher concentrated solutions can be made to flow to the lower concentration solutions

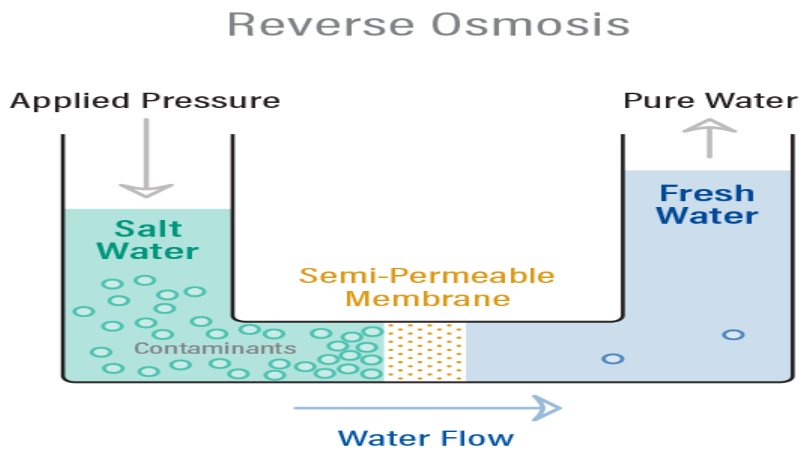

Fig 4.17: Reverse osmosis

4.5 WORKING PROCEDURE

In Pedal powered water purifier, mechanical power is transmitted to the shaft, and the shaft is connected to pump which is mounted on bicycle. Thus the power is transmitted to the centrifugal pump. The attachment of the centrifugal pump helps to create the required amount of pressure, also known as osmotic pressure, by reducing pressure on the opposite side.

This pressure helps water to move forward & go through the semi permeable membrane. The smaller impurities that can’t be separated via sedimentation in the tank itself, will be separated with the help of this membrane. Further, the water goes to sediment filter which increases it purity level more. The remaining impurities can be removed with the help of carbon filter. Carbon filtering is a method of filtering that uses a bed of activated carbon to remove contaminants and impurities, using chemical adsorption.

Sedimentation & normal filtration are important processes required before reverse osmosis purification as they remove comparatively larger particles which can damage the semi permeable membrane. The smaller & lesser the amount of impurity interacting with RO membrane, the longer is the life of the membrane which increase the efficiency, effectiveness & life of the system.

After passing through all the filters, pure water is stored for drinking in another container, which can be used for drinking purpose. Or, if we remove filter assembly, this system can also be used for irrigation purpose.

Water stored in containers can be pressurized with the help of pump attached to the sprocket &directly being able to be watered in field as enough pressure has been generated with the help of pump.

Thus, this model of water purifier can help to solve the drinking problem in the rural areas which are still lacking the proper electricity supply.

Fig 4.18: Overall Design of Project

CHAPTER 5

ADVANTAGES, DISADVANTAGES & APPLICATIONS

ADVANTAGES

- Simple in construction.
- Easy to fabricate.
- The components are easily available in the market.
- Effective method of water purification system.
- No need of electric power or fuel for operating the system.
- Pollution free system can be achieved.
- Maintenance free system.
- The cost of the system is less.
- Cycling also serves as a good exercise.

DISADVANTAGES

- More number of moving parts.
- Need more manual power.
- Repairing and replacing the parts is not an easy task.
- The pump must be handles with care.

APPLICATIONS

These types of pedal powered water purification systems lifted on a cycle have a wide range of applications in the fields like,

- Domestic purposes.
- All industries.
- Water filtration industries.
- Small scale business.

CHAPTER 6
BILL OF MATERIAL

6.1 MATERIAL COST

Table 6.1: Material cost

SI. NO.	Parts	Qty.	Amount (Rs)
1	Cycle	1	1900
2	Pump	1	1550
3	Filter	3	900
4	Chain	1	300
5	Sprocket	2	650
6	Overhead Tank	1	300
7	Sump	1	300
8	Hose	Req. amount	100
9	Tags	12	24

TOTAL = 6,024/-

6.2 LABOUR COST

Lathe, Drilling, Welding, grinding, Gas cutting.

Cost = 1,000/-

6.3 OVERHEAD CHARGES

The overhead charges are achieved by "manufacturing cost"

Manufacturing cost = Material cost + Labour cost

= 6,024 + 1,000

= 7,024/-

Overhead charges = 20% of the manufacturing cost

= 20/100 *7,024

= 1,404.8/-

6.4 TOTAL COST

Total cost = Material cost + Labour cost + Overhead charges

= 6,024 + 1,000 + 1,404.8

= 8,428.8/-

Total cost for this project = 8,428.8/-

CHAPTER 7
RESULTS AND DISCUSSSION

All the objective had been fulfilled successfully and thus we are able to made a cycloclean machine to purify the water. Cycloclean machine is designed with a pump, spur gear, filter, sprocket, chain and overhead tank. The system is capable of to clean the impure water. The photo of our project is shown above, thus the cycloclean machine is helpful to rural areas to purify water. It is safer and takes very less time. The existing technologies were very much costlier than the cost of our project. We have used light weighted motors so that the system is not heavy and also it is precise.

7.1 Comparison of water purifier between Time vs Discharge

Table 7.1: Experimental Results on Time vs Discharge

SI.NO	Time	Cycloclean (ml)	Kent Grand (ml)
1	60	988	333
2	120	1990	667
3	180	3000	1000
4	240	3980	1400
5	300	5000	1690

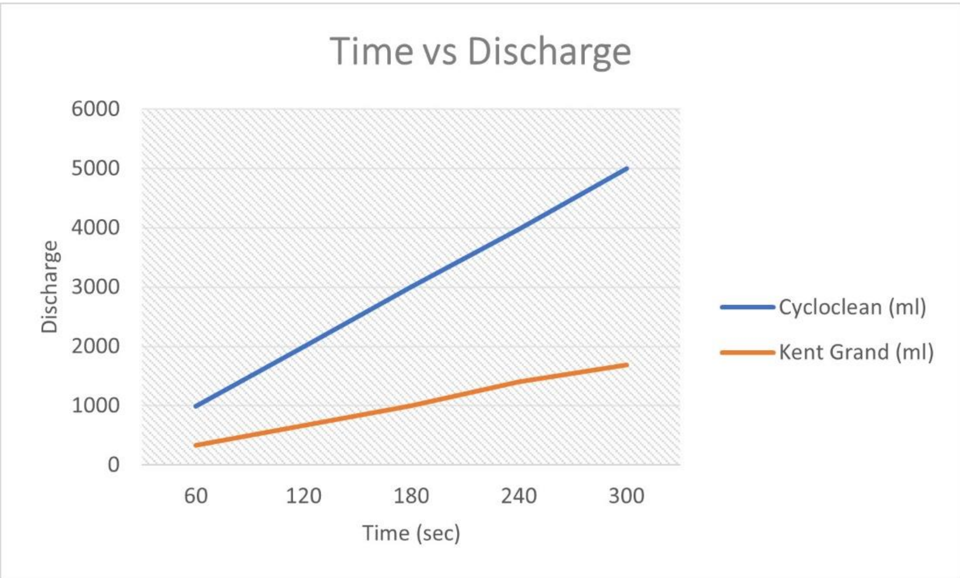

Fig 7.2: Comparison of water purifier between Time vs Discharge

Cycloclean system producing 988 ml of purifier water in 60 sec compare to existing system, kent Grand system producing 333 ml of purifier water in 60 seconds. The existing technologies were very much costlier than the cost of our project.

7.2 Comparison of water purifier between Pure vs Waste water

Table 7.3: Experimental Results on Pure water vs Waste water

SI.NO.	Pure water (ml)	Cycloclean waste water (ml)	Kent Grand Waste water (ml)
1	1000	750	2000
2	2000	1600	4050
3	3000	2300	6150
4	4000	3100	8200
5	5000	3800	10100

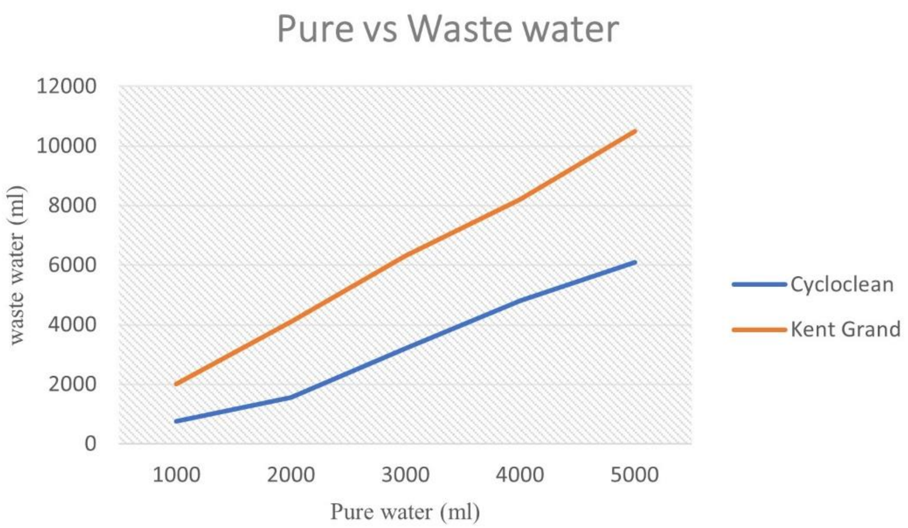

Fig 7.4: Pure vs Waste

Cycloclean system for every 1000 ml of filtered water, an average purifier wastes around 700 ml of water is compared to existing system, Kent grand for every 1000 ml of filtered water, an average purifier wastes around 2000 ml of water.

7.3 Comparison of Power Consumption between cycloclean vs Kent Grand system

Table: Experimental Results on Power Consumption between Cycloclean vs Kent Grand system

SI.NO.	Time (sec)	Cycloclean Power Consumption (w)	Kent Grand Power Consumption (w)
1	60	168	0.0833
2	120	377	0.1666
3	180	586	0.2499
4	240	796	0.3332
5	300	1005	0.4165

Calculation:

Cycloclean Power Consumption

- **For 60 sec**

  P=2*π*N*T/60

  P=2*π*20*80/60

  P=168 w

- **For 120 sec**

  P=2*π*45*80/60

  P=377 w

- **For 180 sec**

  P=2*π*70*80/60

  P=586 w

- **For 240 sec**

  P=2*π*95*80/60

  P=796 w

- **For 300 sec**

  P=2*π*120*80/60

  P=1005 w

Kent Grand Consumption Power

- **For 5 hours**

  5 hours=25 w
- **For 1 hour**

  1 hour=5 w
- **For 60 sec**

  60 sec=0.0833
- **For 120 sec**

  120 sec=0.1666
- **For 180 sec**

  180 sec=0.2499
- **For 240 sec**

  240 sec=0.3332
- **For 300 sec**

  300 sec=0.4165

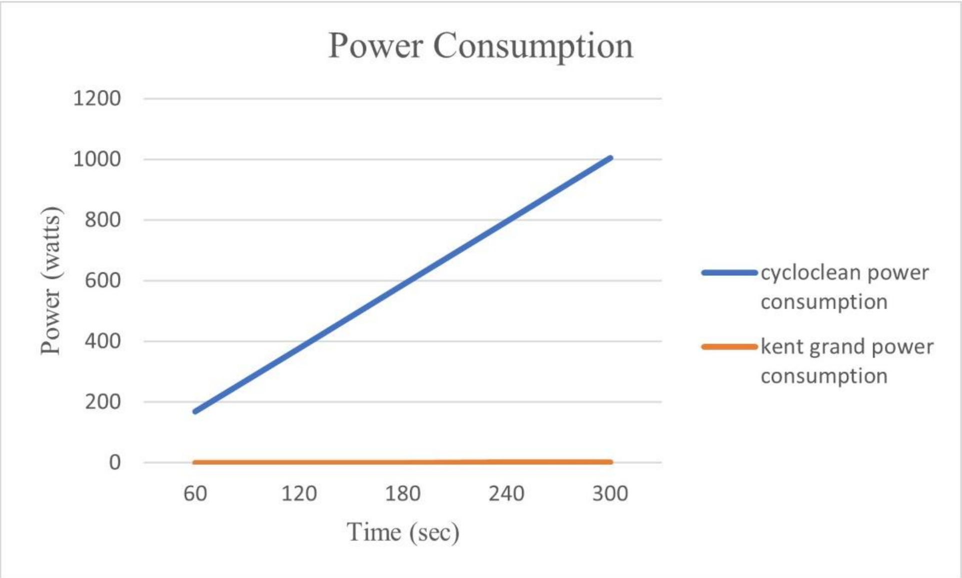

Fig 7.6: Power Consumption

Cycloclean system consumes high power compared to existing system, Kent Grand system consumes less power, but cycloclean system discharge filtered water is high compared to Kent grand system.

7.4 Comparison of Purity Level Between Cycloclean and Kent Grand System.

Cycloclean system ph level of purified water is between 6.5-7, is compared to Kent grand system enhances the ph level of purified water up to 9.5

CHAPTER 8
CONCLUSION

The main motto of our project is to supply purified water to rural area. Now a days purifiers becoming more expensive, so we are introducing this project. We have designed our project by using catia software. The whole project is constructed with locally available components, especially the mechanical components used in this project work are procured from mechanical fabrication, essential to make it as real working system. Finally we have earlier discussed in Results and Discussion, our project is more effective than existing methods.

REFERENCES

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[2] Ademola Samuel Akinwonmi et. al (2012):- Has prepared pedal powered water purification and design was focused on process of conception, invention, visualization, calculation, etc. he also made a force analysis to check performance criteria.

[3] Betzabe Gonzalez et. al (2014) :- Has studied in the design and he used peristaltic pump with silicone tubing.

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[7] M.Serazul Islam, M.Zakaria Hossai and M.Abdul Khadir:- Conducted an experiment on “Design and development of pedal pump for low lift irrigation”.

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