International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 03 Mar. 2024, pp: 496-505 www.ijaem.net ISSN: 2395-5252

Layout and Fabrication of Water Cleaner

Gurugubelli Divya Teja, Gurugubelli Vishnu Pramod Teja
[1]Subject Contract Faculty, Dr B R Ambedkar University,Srikakulam,Andhra Pradesh
[2]Aditya Institute of Technology and Management,Tekkali,Srikakulam,Andhra Pradesh

Date of Submission: 15-03-2024 Date of Acceptance: 28-03-2024

ABSTRACT: In this water purifier we combine the RO (Reverse Osmosis) UV (ultraviolet) and UF (Ultra filtration) with TDS controller and AAA (alkaline antioxidant antibacterial). The water purifier is design on the basis of the efficiency increasing, cost of purifier, and maximum places it can be used for different type of water. The water purifier provided mineral cartridge in which the mineral is added and quality of water is increase. The TDS controller is provided to control the TDS of water and to decide the purification outline. It is economical and very efficient for purification of water with minimum wastage of water. Water purification is the collective name for a group of processes that make water more suitable for drinking, medical use, industrial use, and so on. A water purification process is designed to remove or reduce existing water contaminants to the point where the water is fit for use. In the last few years, innovative methods such as nanotechnology have been studied to develop water purification technologies. Graphene is a two-dimensional mesh of carbon atoms arranged in the form of a honeycomb lattice. It has earned the title, "miracle material," thanks to a startlingly large collection of beneficial properties. It is thought that graphene could revolutionize the whole industry, as researchers work on many different kinds of graphene-based materials, each one with unique qualities and designation. The present chapter surveys and reviews the recent research and published literature on the graphene-based materials for water purification. The main methods discussed are adsorption, photocatalysis, membrane filtration, and electrochemical water purification.

KEYWORDS: Reverse Osmosis, Ultraviolent, Alkaline Antioxidant Antibacterial, TDS Controller, Graphene Mesh.

I. INTRODUCTION

Water is essential for life. The amount of fresh water on earth is limited, and with the rapid industrialization, its quality is under constant pressure. Preserving the quality of raw water is important not only for the drinking-water supply, but also for food production and other water uses. Water quality can be compromised by the presence of infectious agents, toxic chemicals, and radiological hazards. Water quality deterioration in distribution systems is mainly caused by inappropriate planning, design and construction or inadequate operation and maintenance and water quality control.

This has been linked to a significant proportion of the burden of waterborne and water-related illness. Stresses on these systems caused by rapid urbanization, population growth and aging infrastructure further exacerbates the problems. The integrity of well managed distribution systems is one of the most important barriers that protect drinking-water from contamination. However, management of distribution systems often receives little attention. Distribution systems can incorrectly be viewed as passive systems with the only requirement being to transport drinking water from the outlets of treatment plants to consumers. Hence it is the prime responsibility of Civil Engineering Department to arrange adequate and safe supply of water of acceptable quality.

The fresh water scarcity is a growing problem all over the world because only 1% of earth's water is fresh water available for human to drink. The US geological survey found that 96.5% of earth's water is located in seas and oceans and 1.7% of earth's water is located in the ice caps. The remaining percentage is made up of brackish water, slightly salty water found as surface water in estuaries and as groundwater in salty aquifers.

The need for fresh water is at the top of the international agenda of critical problems, at least as firmly as climate change. India as a country has 16% of the world's population and 4% of its fresh water resources. Due to rapid industrialization and development, there is an increased opportunity for grey water reuse in developing countries such as India.

Although India occupies only 3.29 million km2 geographical area, which forms 2.4% of the world's land area, it supports over 15% of world's population. The population of India as of March

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 03 Mar. 2024, pp: 496-505 www.ijaem.net ISSN: 2395-5252

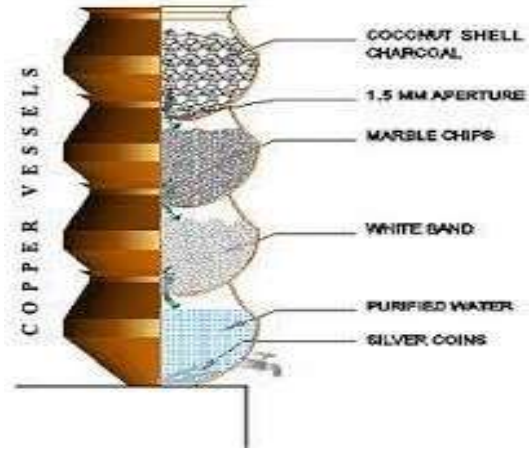
31, 2011 was 1,210,193,422 persons (Census, 2011).

India also has a livestock population of 500 million, which is about 20% of world's total livestock. However total annual utilizable water resources of the country are 1086km3 which is only 4% of world's water resources. Total annual utilizable resources of surface water and groundwater are 690 km3 and 396 km3, respectively.

Consequent to rapid growth in population and increasing water demand, stress on water resources in India is increasing and per capita water availability is reducing day by day. In India, per capita surface water availability in the years 1991 and 2001 were 2300m3 (6.3m3/day) and 1980m3 (5.7m3/day), respectively, and these are projected to reduce to 1401 and 1191m3 by the years 2025 and 2050, respectively. Total water requirement of the country in 2050 is estimated to be 1450 km3 which is higherthan the current availability of 1086 km3. Pure, clean water is an absolute must for our survival.

Water resources used by humans for various domestic purposes such as drinking, cooking food, washing clothes, baths, recreations, flushing toilets, and car washing. Water is also used for various industrial purposes, agricultural purposes, power generation, fishing, and so forth. The quantity of available fresh water is inadequate to meet the growing demands of human beings.

The conventional water sources, like rivers, lakes, ponds, and so forth, in the form of surface water are not fully dependable because most of these are rain fed. Presently, rainfall is below normal in most of the years. This results in failure of many surface water source schemes. Similarly, due to the reasons stated already the subsurface sources also fail in certain extent.



Olden water purification process

The importance of water purification

Water is the source of life. Three days without it can cause dehydration. But with the many dangers that can lurk in it, and which are invisible to the naked eye, proper precautions cannot be neglected. The five different methods we examined all have their own strengths and weaknesses. The best approach would be to use multiplemethods, which would ensure that you and your family have the cleanest water possible.

II. ANCIENT METHODS TO PURIFY WATER:-

BOILING:-Purification by boiling simply involves killing the bacteria or viruses by heating them to death. The procedure, method for purifying water by boiling it is very simple and easy cheap. Just heat the water in a clean container until it boils and let it boil for 5minutes.

Moringa Seeds:- The Moringa oleifera tree grows in abundance in many tropical and subtropical regions of the world. It reaches maturity in only six months and is already used in many regions as a food source. The pods, seeds, leaves, roots and flowers are all edible and nutritious.

On top of all this, there is something in these seeds that has the ability to kill bacteria and clarify the water. Women in ancient Egypt are said to have rubbed Moringaseeds on their clay water pots, and the dried powder from the crushed seeds has been used for hand washing for many years.

Distillation of water:-

Distillation is one of the oldest methods of water treatment and is still used today, but rarely as a home treatment method. It can effectively remove many contaminants from drinking water, including bacteria, inorganic substances and many organic compounds.

Please note that the treatment of distilled water at home is only considered a temporary solution. The perfect options for contaminated consuming water problems are to stop the practices that triggered the contamination or to alter the supply of the water. Distillation is a process that relies on water evaporation to eliminate impurities from the water. The contaminated water is heated to form steam. Inorganic compoundsand large non-volatile organic molecules do not evaporate with the water and are left behind, which is good for our stomach. The steam cools and then condenses to form purified water.

Distillation is the most effective method for removing inorganic compounds such as metals (iron and lead) and nitrates, hardness (calcium and magnesium) and particulate matter from a contaminated water source. The boiling process

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 03 Mar. 2024, pp: 496-505 www.ijaem.net ISSN: 2395-5252

also kills microorganisms such as bacteria and some viruses that are causing waterborne diseases. The effectiveness of distillation in eradicating natural compounds varies depending on the chemical traits of the natural compound, comparable to solubility and boiling level.

Ceramic filtration:- Locally manufactured ceramic filters are traditionally used worldwide to treat household water. Currently, the most widely used ceramic filter is the **Potters for Peace exterior** design. The filter is shaped like a flowerpot, holds about 8-10 litres of water and fits into a plastic or ceramic container. To use the ceramic filters, families fill the top container or the ceramic filter itself with water, which flows through the ceramic filter(s) into a storage container. The treated water is then accessible through a tap integrated into the water storage container.

Charcoal, a water filter as old as time:- Activated carbon is known to be a material regularly used in water filters, and it is reputed to be particularly effective against heavy metals, bacteria, viruses and many pollutants (hormonal chemicals, pharmaceuticals, oil, etc.). Charcoal is found in filter jugs, tap water filters, and water filters in American refrigerators. What is less well known is that man has long used the filtration properties of coal.

III. METHODOLOGY:-

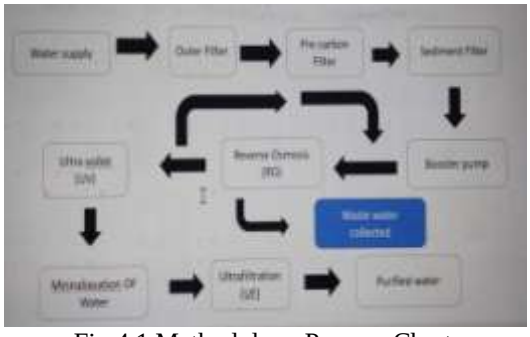


Fig.4.1 Methodology Process Chart

a. Pre-Filtration: Many water purifiers incorporate a pre-filtration stage to remove larger particles, sediment, and debris from the water. This step helps prevent clogging and extends the lifespan of the subsequent purification components. Common pre-filters include sediment filters or activated carbon filters.

b) Reverse Osmosis (RO): The RO technology will be employed as the primary filtration stage. It will utilize a semi-permeable membrane to remove dissolved salts, heavy metals, pesticides, and other chemical contaminants, thus improving the overall water quality.

c) Ultraviolet (UV) Purification: Following the RO stage, the water will pass through a UV chamber, where it will be exposed to ultraviolet light. The UV radiation will effectively neutralize and kill bacteria, viruses, and other microorganisms present in the water, ensuring its safety.

d) Ultra filtration (UF): After UV purification, the water will undergo ultra filtration using a membrane with tiny pores. This stage will remove any remaining suspended particles, colloids, and some larger viruses, further enhancing the water quality.

Storage and Dispensing: The purified water will be collected in a storage tank equipped with a dispenser. The tank will have a sufficient capacity to meet the daily water consumption needs of the users. The dispenser will provide convenient access to the purified water for drinking and other purposes.

Monitoring and Maintenance: The water purifier will incorporate sensors and indicators to monitor the purification process and filter life. Additionally, regular maintenance procedures, such as filter replacement and cleaning, will be clearly outlined in the user manual to ensureoptimal performance.

DESIGN AND CONSTRUCTION

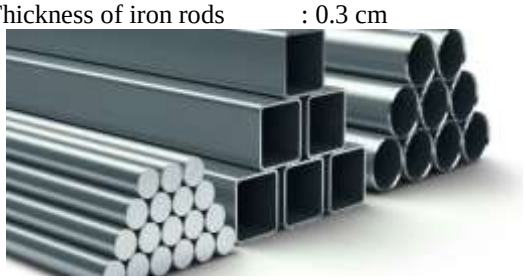
IRON RODS

Small size iron rods 8 nos

Height of iron rods : 50 cm
Width of iron rod : 1.5 cm
Thickness of iron rods : 0.3 cm

Big size iron rods 4 nos

Height of iron rods : 150 cm
Width of iron rod : 4 cm
Thickness of iron rods : 0.3 cm



Galvanized Iron Sheet:

Transparent to legs front side

Height of GI sheet : 76.5 cm
Width of GI sheet: 76 cm
Thickness of GI sheet : 0.6 cm

Transparent to legs back side

Height of GI sheet : 115 cm
Width of GI sheet: 76 cm
Thickness of GI sheet : 0.6 cm

Side of frame GI sheet used

Height of GI sheet : 119 cm

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 03 Mar. 2024, pp: 496-505 www.ijaem.net ISSN: 2395-5252

Width of GI sheet: 50 cm
Thickness of GI sheet : 0.6 cm

TRANSPARENT SHEET
Height : 38.5 cm
Width : 76 cm
Thickness : 0.2 cm

ROLLING WHEELS
Wheel Diameter : 5 cm
Height from the ground : 6.5 cm
No of wheels :4

TOTAL DISSOLVED SOLIDS: In simple terms, a TDS Controller or MTDS is a device that controls the TDS (Total Dissolved Solids) of water. Unlike the filters, cartridges, and membrane(s), TDS Controller does not filter or purify the water in any way.

Water Input 1: Purified water output from the RO membrane

Water Input 2: Purified Water from UF Membrane in case of RO+UF+UV+TDS Controller or RO+UF+TDS Controller Water Purifiers

Water Output: Mix of two water inputs in the required ratio.

TDS Control Screw: TDS Control screw controls the TDS value in output water by manually adjusting the flow of water from the two water inputs.

1) If TDS needs to be reduced then the flow of input water from the RO membrane is increased and the flow of input water from the Activated Carbon Filter or UF membraneis reduced.

2) If TDS needs to be increased then the flow of input water from the RO membrane is reduced and the flow of input water from the Activated Carbon Filter or UF membrane is increased.

Dual Media Filter:-This removes the total suspended solids, dirt, iron and reduce silt. The raw water from the source is taken to Dual Media Filter (DMF) where all the suspended solids are removed with the help of filter bed. The filter require backwash when differential pressure goes above 0.5Kg/cm2 or when it stops giving desired output or after pre- decided time interval.

Dual Media Filter

Pre Carbon Filter: Filtered water from dual media

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 03 Mar. 2024, pp: 496-505 www.ijaem.net ISSN: 2395-5252

filter is fed to activated carbon filter in order to remove free chlorine, organic compounds, colour and smells. The filter require backwash when differential pressure goes above 0.5Kg/cm2 or when it stops giving desired output or after pre-decided time interval.

Pre Carbon Filter

Sediment filter : A sediment filter acts as a barrier against different types of sediments or suspended solids. It sieves or holds back physical impurities like dust, dirt, sand, silt, clay, and other solid particles. Mostly the particles that are visible to the naked eye aretreated by sediment filters during the process of water purification.

A Sediment filter usually acts as the first stage of water purification. Being thefirst line of defense, its core function is to remove the physical impurities or particulate matter from water. It prohibits all the solid particulate from entering your filtered water and enhances the filtration efficiency of RO membrane and UV filters.

It is not responsible for changing the taste or smell of water. It is one of the preventive filtration methods and does not remove chemicals, heavy metals, bacteria, viruses, or dissolved solids in water. These impurities are removed by further stages of RO and UV purification. Pure it uses gradient sediment filters which are efficient to entrap impurities as small as 5 microns.

Sediment Filter

Reverse Osmosis Membrane: Reverse Osmosis is the tightest possible membrane process in liquid/ liquid separation. In principle, water should be the only material passing through the membrane and essentially all dissolved and suspended material is rejected. The Reverse Osmosis Membrane is the heart of the system. The most commonly used is a spiral wound of which there are two options: the CTA (cellulose tri-acetate), which is chlorine tolerant but of lower service life, and the TFC (thin film composite/material), which is not chlorine tolerant but higher service life.

Advanced reverse osmosis technology uses "cross flow" that allows a partially permeable membrane to clean itself continuously. As some of the fluid passes through the membrane, the rest continues downstream, sweeping the rejected species away from it. The process requires a pump to push the fluid through the membrane. The higher the pressure, the larger the driving forces.

As concentration of the fluid being rejected increases, so does the driving force. Reverse osmosis is used to reject bacteria, salts, sugars, proteins, particles, dyes, and other constituents. Separation of ions with reverse osmosis is aided by charged particles. This means that dissolved ions that carry a charge, such as salts, are more likely to be rejected by the membrane .The larger the charge and the particle; the more likely it will be rejected.

Reverse Osmosis

Booster Pump: A Booster Pump helps to increase the water pressure by utilizing diaphragms to boost the pressure of the water. Water from your tap floods the outer chamber of the pump. Inlet diaphragms sucks water into a center chamber while an outlet diaphragm pushes water out the outlet of the pump.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 03 Mar. 2024, pp: 496-505 www.ijaem.net ISSN: 2395-5252

Booster Pump\

Specification :
Input volt: 24v dc
Working pressure: 100PS
Pressure by pass: - 125 PS
Flow at 100 PSI: - 1.6LPM
Current at 120PSI: 0.65V

RO SMPS Adapter: RO adapter helps your filtration unit function properly. It is secure from overloading and rise in temperature and protects from short circuit. Suitable for all kinds of filtration units Water Purifier Adaptors are designed to provide all the power requirements for water purifier's application. Our adapter is perfectly designed by our accomplished professionals using cutting-edge machinery and well-tested material in agreement with set worldwide norms.

Specification:
Input Power Supply: 150 AC – 275 AC 50 Hz 0.5A
Out Put: 24 DC – 2.5 A Max

RO SMPS Adapter

Ultra Violet (UV): Ultraviolet (UV) Purifiers utilize the proven principle of ultraviolet light radiation to eliminate or reduce unacceptable levels of microorganisms in water and other liquids. Ultraviolet light energy destroys bacteria, viruses, fungi, spores, algae and other such contaminants, which are pathogenic to humans, other animals and plants. Ultraviolet purification is a completely natural, non-chemical, environmentally safe technique, which adds nothing to, and removes nothing from (such as trace minerals) the water.

Untreated water enters the lower portion of the purification chamber and flows through the unit in an upward circular path. The spiraling movement assures the maximum irradiation of the fluid and prevents larger particles from blocking the treatment of microorganisms. The purification chamber contains the ultraviolet light- producing lamp. In operation, the lamp emits a bluish glow, which is visible in the view port window on the side of some units.

Ultra Violet Membrane

Ultra Filtration (UF) Membrane: Ultra Filtration (UF) is a membrane filtration process similar to Reverse Osmosis, using hydrostatic pressure to force water through a semi-permeable membrane. The pore size of the ultrafiltration membrane is usually 103 - 106 Daltons. Ultrafiltration (UF) is a pressure-driven barrier to suspended solids, bacteria, viruses, endotoxins and other pathogens to produce water with very high purity and low silt density.

Ultra Filtration Membrane

Ultra filtration (UF) is a variety of membrane filtration in which hydrostatic pressure forces a liquid against a semi permeable membrane. Suspended solids and solutes of high molecular weight are retained, while water and low molecular weight solutes pass through the membrane. Ultra filtration is not fundamentally different from reverse osmosis, microfiltration or nanofiltration, except in terms of the Size of the Molecules It Retains.

Mineral Cartridge: Once, the water is purified, the essential minerals are added back into the purified water through the Mineral Cartridge. This ensures, the water that you consume not only is free of all harmful chemicals, heavy metals and pesticides but is also rich in the essential minerals.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 03 Mar. 2024, pp: 496-505 www.ijaem.net ISSN: 2395-5252

Mineral Cartridge

Float Indicator: Float devices use the buoyancy of a float to indicate the liquid level in the tank. One common approach is to attach the float to a chain. The chain is attached to a counterweight which indicates the level as the float moves up and down.

Float indicator

FABRICATION PROCESS

CUTTING: Cutting processes work by causing fracture of the material that is processed. Usually, the portion that is fractured away is in small sized pieces, called chips. Common cutting processes include sawing. The metal sheets which are required to cover the equipment were done by cutting process.

Hand Cutting

ARC WELDING: Arc welding is a fusion welding process used to join metals. An electric arc from an AC or DC power supply creates an intense heat of around 6500°F which melts the metal at the join between two work pieces. The arc can be either manually or mechanically guided along the line of the join, while the electrode either simply carriesthe current or conducts the current and melts into the weld pool at the same time to supply filler metal to the join.

Arc Welding

SPOT WELDING: Spot welding is a resistance welding process. This welding process is used primarily for welding two or more metal sheets together by applying pressure and heat from an electric current to the weld area. It works by contacting copper alloy electrodes to the sheet surfaces, whereby pressure and electric current are applied and heat is generated by the passage of current through resistive materials such as low carbon steels. Work pieces are held together under pressure exerted by electrodes. Typically, the sheets are in the 0.5 to 3 mm (0.020 to 0.118 in) thickness range. Forcing a large current through the spot will melt the metal and form the weld.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 03 Mar. 2024, pp: 496-505 www.ijaem.net ISSN: 2395-5252

Spot Welding

SHEET METAL WORKING:- In sheet metal forming, the final shape of a part is made from a flat metal sheet. The desired shape is achieved through plastic deformation, without undergoing any machining like milling. Sheet metal forming is used in almost every sector of industrial production, like the automotive industry, the aircraft industry, the home appliance industry, the food industry etc. We used this process to bend the sheets.

Sheet Metal Cutting

GRINDING:- Grinding is a method of reducing the size of hard materials or sharpening tools, generally accomplished in several stages. To produce desired fineness of end products, grinding is done after crushing. For example, through crushing the mineral ore to belowa certain size and finishing by grinding it into powder, the ultimate fineness depends onthe fineness of dissemination of the desired mineral. Grinding is used for chamfering of the iron tubes and strips for perfect fitting. A grinding machine, often shortened to grinder, is a power tool (or machine tool) used for grinding. As the accuracy in dimensions in grinding is of the order of 0.000025 mm, in most applications it tends to be a finishing operation and removes comparatively little metal, about 0.25 to 0.50 mm depth.

Grinding Process

SCREW DRILLING: Self-drilling screws eliminate the need for separate drilling and tapping work. Self- drilling screws operate on the principles of a drill bit or a cutting tool. The performanceof the self-drilling screws is determined by their cutting speed, feed rate, the material to be working on, and the depth of the cut.

Screw drilling

FINAL FABRICATION SETUP:

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 03 Mar. 2024, pp: 496-505 www.ijaem.net ISSN: 2395-5252

WORKING PRINCIPLE:-

The working principle of a water purifier that incorporates Reverse Osmosis (RO), Ultraviolet (UV), and Ultrafiltration (UF) technologies can be described as follows:

The water from the source enters the purifier and undergoes pre-filtration. This stage involves the removal of large particles, sediment, dirt, and debris through a sediment filter or a pre-filter. Pre-filtration helps protect the RO membrane and other components from damage or clogging. The pre-filtered water then enters the RO stage. This process utilizes a semi-permeable membrane with extremely small pores. The water is subjected to high pressure, forcing it through the membrane while leaving behind dissolved salts, heavy metals, pesticides, chlorine, and other contaminants. The purified water passes through the membrane and flows into a clean water storage tank.

Once the water has undergone the RO process, it moves to the UV purification stage. In this step, the water passes through a UV chamber where it is exposed to ultraviolet light. The UV light kills or deactivates bacteria, viruses, and other harmful microorganisms present in the water, ensuring it is safe for consumption. After UV purification, the water moves to the UF stage. This process utilizes a membrane with even smaller pores than the RO membrane. The UF membrane effectively removes suspended particles, colloids, some larger viruses, and any remaining impurities, further improving the quality of the water

Some water purifiers may include an additional stage of activated carbon filtration. This stage uses activated carbon filters to remove any residual chlorine, unpleasant odors, or taste from the purified water, providing a final touch of freshness and taste enhancement. The purified water is collected in a storage tank within the water purifier. The tank is typically made of food-grade material and is equipped with a dispenser. Users can conveniently access the purified water for drinking or other purposes through the dispenser.

The water purifier may incorporate sensors and indicators to monitor the purification process, water level, and filter status. These indicators notify the user when it is time to replace the filters or perform maintenance. Regular maintenance, such as periodic filter replacement and cleaning, ensures the continued efficiency and effectiveness of the water purifier. By combining the RO, UV, and UF technologies, this type of water purifier offers a comprehensive purification process that addresses a wide range of contaminants and microorganisms, delivering clean, safe, and healthy drinking water to the users.

IV. RESULT:

SLNo	Type Of Water	Quantity Of Water (lt)	Purified Water (lt)	Waste Water (lt)	Normal Water Ppm	Purified Water Ppm	Waste Water Ppm	Time Taken (min)
1	College water	15	12.75	2.25	187	176	205	20
2	College water + salt water	15	9.25	5.75	345	240	310	22
3	Bore water	8	5.4	2.6	270	210	240	13

V. CONCLUSION:-

Water purification can 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.

Finally we conclude rate of purification with good ppm and also decreasing the cost of water purification.

Water, something that makes up about 60 percent of the human body, is the quintessential air in our lives - whose significance is established, but hardly realised by us. However, the subject of contaminated water needs to be addressed, particularly when 80 percent of India's surface water is assessed to be polluted, thereby making water-borne diseases claim thousands of lives every year. Thankfully, the water purification industry is embattling this situation with an innovation-driven approach and has made considerable advance in the yesteryears.

A recent breakthrough in advanced water technology is filtering the salt water from the sea, into drinkable water. Scientists at the University of

Manchester recently discovered how to precisely control the size of pores in a graphene oxide sieve. This breakthrough allowed the scientists to filter out the salts in water to make the water safe to drink. Another recent discovery by scientists and UK engineers is the use of ultrasound waves to purify and desalinate ocean water. The system works by utilising ultrasound waves to 'explode' the unclean ocean water into particles smaller than ten microns. These microns evaporate and condense, which then results in clean and pure water.

REFERENCES

[1]. C. Cox and J. Graham, "Steps towards automatic clarification control," in IEEE Colloquium on Advances in Control in the Process Industries: An Exercise in Technology Transfer, pp. 6/1–6/4, March 1994.

[2]. D. Bevan, C. Cox, and A. Adgar, "Implementation issues when installing control and condition monitoring at water treatment works," in IEEE Colloquium on Industrial Automation and Control: Distributed Control for Automation, pp. 5/1–5/4, March 1998.

[3]. T.-H. Han, E.-S. Nahm, K.-B. Woo, C. Kim, and J.-W. Ryu, "Optimization of coagulant dosing process in water purification system," in Proceedings of the 36th SICE Annual Conference, pp. 1105–1109, July 1997.

[4]. M. Onat and M. Dogruel, "Effluent turbidity control in direct filtration," in Proceedings of IEEE Conference on Control Applications, vol. 2, pp. 1284–1289, June 2003.

[5]. Y. Miyajima, T. Katou, R. Inaba, S. Kobayashi, and H. Ezure, "A knowledge-based water purification control system," in Proceedings of IEEE International Workshop on Artificial Intelligence for Industrial Applications, pp. 455–460, May 1988.

[6]. T. Kingham and T. Hoggart, "Chlorination control in a large water treatment works," in IEEE Colloquium on Application of Advanced PLC (Programmable Logic Controller) Systems with Specific Experiences from Water Treatment, pp. 2/1–2/16,June 1995. 4

[7]. O. Boubaker, R. M'Hiri, M. M. Ksouri, and J. Babary, "SISO and MIMO variable structure control of fixed bed bioreactors," in UKACC International Conference on Control, vol. 1, pp. 229–234, September 1998.

[8]. O. Boubaker and J. Babary, "On SISO and MIMO sliding control of a distributed parameter biological process," in IEEE International Conference on Systems, Man, and Cybernetics, vol. 1, pp. 50–55, October 1999.

[9]. M. Zierolf, M. Polycarpou, and J. Uber, "A control-oriented approach to water quality modeling of drinking water distribution systems," in Proceedings of the 1996 IEEE International Conference on Control Applications, pp. 596–601, September 1996. [10]. M. Zierolf, M. Polycarpou, and J. Uber, "Development and autocalibration of an input-output model of chlorine transport in drinking water distribution systems," IEEE Transactions on Control Systems Technology, vol. 6, pp. 543–553, July 1998.

[10]. Z. Wang, M. Polycarpou, J. Uber, and F. Shang, "Adaptive periodic control for chlorine residual maintenance in drinking water distribution networks," in Proceedings of the 40th IEEE Conference on Decision and Control, vol. 5, pp. 4069–4074, December 2001.

[11]. M. Polycarpou, J. Uber, Z. Wang, F. Shang, and M. Brdys, "Feedback control of water quality," IEEE Control Systems Magazine, vol. 2, pp. 68– 87, June 2002.

[12]. Bhausaheb L. Pangarkar et-al "Reverse Osmosis and Membrane Distillation for Desalination of Groundwater: A Review" 2007

[13]. Benny Freeman et-al "Fundamentals of Membranes for Water Treatment", 2000

[14]. Joseph G. Jacangelo "Role of membrane technology in drinking water treatment in the United States" publishes in year 1997.

[15]. Alexei G. Pervov "RO and NF membrane systems for drinking water production and theirmaintenance techniques" publish in year 2000.

[16]. Ben CorryDesigning "Carbon Nanotube Membranes for Efficient Water Desalination" School of Biomedical, Biomolecular and Chemical Sciences, The UniVersity of Western Australia, Crawley, Western Australia, 6009 Australia. Publish in 2007.