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Treatment of Water using Graphene Oxide Membrane

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Abstract:
Globally, the problem of fresh water scarcity has continued to escalate. Water is one of the Earth's most abundant resources, covering about three-quarter of the planet's surface. One of the most powerful techniques to increase the availability of fresh water is desalination. Searching for more efficient, low-energy-consumption and more economic ways of desalination processes should be the highest priority on the research agenda. The best results are being obtained by using graphene oxide (GO)-assisted membranes in desalination applications. GO's abundant functional groups, including epoxide, carboxyl and hydroxyl, provide functional reactive sites and hydrophilic properties. The membrane, with a thickness of a few Nanometers, has been applied recently in pressurized filtration, which is an ideal method for the application of desalination membranes. The multi-layer GO membrane have a unique architecture and superior performance that enable the development of noble desalination membrane technology. With good mechanical properties, they are easily fabricated and have the ability to be industrially scaled up in the future. Our project utterly deals with the design and development of wastewater treatment technology. Initially grasping various samples from various water sources like sea, ground and industrial effluents discharge points, has led us to the awareness of the value of pH, TDS, amount of hardness and alkalinity of the water. A simple and common process of membrane separation can be opted for desalination process. The equipment can be constructed by using Non-hazardous waste and the membrane is prepared by using chemical methods.

I. Introduction

1.1 WATER

Water is simple for all time. Numerous international locations around the world, mainly creating nations and worldwide locations inside the Middle East location, revel in the sick outcomes of a deficiency of crisp water. The United Nations (UN) Environment Program expressed that 33% of the full populace lives in global places with poor freshwater to help the population [1]. The all out worldwide water holds are 1.Four billion km3, of which round 90 seven.Five% is inside the seas and the staying 2.Five% is new water gift within the surroundings, ice mountains and floor water. Of the aggregate, without a doubt zero.014% is straightforwardly available for humans and high-quality lifestyles forms [2]. Along those traces, massive endeavors are presently required to make handy new water belongings in order to reduce the water deficiency in countries which have deficiencies [3]. Desalination is a way wherein saline water is remotedinto sections, one which has a low centralization of disintegrated salts, this is known as new water, and the opposite which has an hundreds higher grouping of broke up salts than the first feed water, it really is commonly alluded to as brackish water listen [6]. The desalination of seawater has gotten one of the maximum high-quality commercial enterprise strategies to give new water to severa networks and mechanical elements which expect a pivotal manner in financial improvement. There is sizeable R&D movement, especially within the subject of sustainable power supply innovations, to find out new and viable techniques to deliver ingesting water [7, 8]. As of now, there are in more of 7500 desalination plant life in interest regular growing some billion gallons of water for every day.

1.1.1 Salt Water

Salt water will be water that includes typically 3.Five% salt. It is located on the planet's seas and oceans, honestly as in littler sums in saline water.

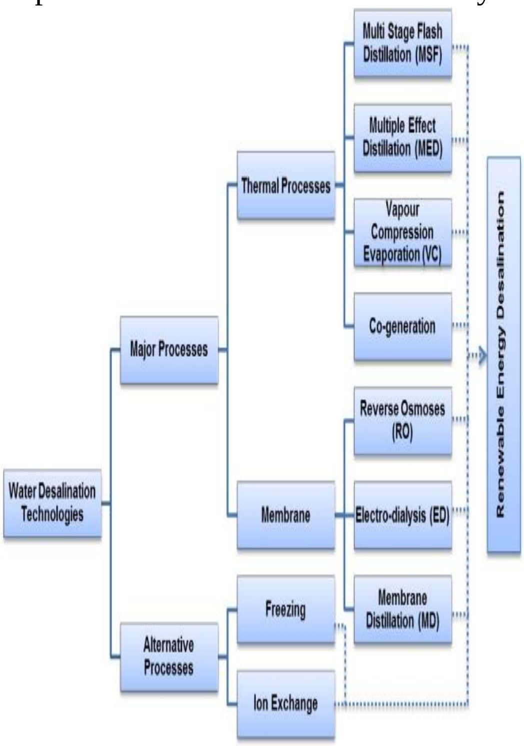
The sodium in salt water is normal to have drained from the ocean depths whilst it turn out to be being framed, even as chloride begins from the aqueous vents and volcanoes.

1.1.2 Ground Water

Groundwater is the water present beneath Earth's floor in soil pore regions and within the breaks of rock developments. A unit of rock or an unconsolidated keep is called a spring while it can yield a usable amount. The investigation of the dispersion and improvement of groundwater is hydrogeology, moreover referred to as groundwater hydrology Groundwater is guessed to offer grease which can effect the improvement of faults.It is regularly plenty less steeply-priced, greater fine and less powerless closer to infection than floor water. In this manner, it's miles often carried out for open water resources. For example, groundwater gives the most crucial wellspring of usable water stockpiling .

2. Layout of Desalination paperwork

Different desalination paperwork have been grown, a number of which might be right now beneath innovative paintings. The maximum usually implemented and industrially examined



technologies can be partitioned into two sorts: stage change warm procedures and layer forms, and, as appeared in figure, both include various procedures. Likewise, there are the elective innovations of freezing and particle trade which are not generally utilized. All are worked by either a regular vitality or sustainable power source to deliver new water.

2.Materials:

1. Graphene oxide Powder,Thin Glass Film ,Polyethersulphone
2. 7.2 Equipments used: burette, Pipette, measuring cylinder, Conical flask, Magnetic stirrer, pH Meter, TDS Meter, glass Rod, Oven.
3. Chemicals Used: Graphene Oxide, water, Polyethersulphone, EB-T, HCl or H_2SO_4,basses,Phenopthelin Indicator.

3. Methodology:

1- Prepation of Membrane

The membrane is being prepared by the most common method used in Membrane preparation ie Phase inversion method. In this method the membrane is easily prepared and the membrane can be used for all cases of filtration purposes.

Definition Of Phase Inversion Membrane

Stage reversal is a technique of managed polymer change from a fluid degree to strong level. There are four critical methods used to make stage reversal layers: precipitation from fume stage, precipitation by using using managed vanishing, thermally instigated degree detachment, and inundation precipitation. Out of the 4, drenching precipitation is the maximum typically applied approach for making plans polymeric layers.

Precipitation from the Vapor Phase

When a dissolvable polymer combination is cast at the movie, it is mounted a fume surroundings that consists of a nonsolvent immersed with a similar dissolvable. Because of the high centralization of dissolvable inside the fume climate, the dissolvable from the solid film remains instead of dissipates into the environment. Layer frames with the resource of dispersion of nonsolvent into the forged movie. This approach brings about a permeable layer.Precipitation via Controlled Evaporation The polymer right now disintegrated in a dissolvable and nonsolvent aggregate. The dissipation of the dissolvable due to excessive unpredictability occurs, making the enterprise have a better nonsolvent and polymer content material. The polymer ultimately encourages and frames a wiped clean layer. Thermally Induced Phase Separation combined or unmarried dissolvable polymer association is chilled off to accomplish stage department. Dissolvable

January-February 2020
ISSN: 0193-4120 Page No. 15341 - 15347

dissipation actuates movie arrangement. This method is frequently applied in getting prepared microfiltration layers.

Submersion Precipitation

Stage reversal via using inundation precipitation is the most extensively applied movie making plans method. A polymer in addition to dissolvable (polymer association) is thrown on a legitimate helping layer and in a while submerged in a coagulation bathe containing nonsolvent. Because of the dissolvable and nonsolvent change, precipitation happens. The polymer need to be dissolvable in dissolvable blend. The mix of stage partition and mass exchange affects the movie form.

4.Procedure:

1. Membrane preparation

- Decide what ratio of materials to use.
- Calculate how much of each material you will use using the molar mass and density for each substance.
- Measure out the correct amounts for each material.
- Add the measured materials to the vial with lid.
- Add a stir bar to the solution and cap the vial.
- Place the vial on the stir plate and stir until fully dissolved. Make sure the stir bar can move fully but is not splashing the solution.
- Set the doctor blade to the desired membrane thickness.
- Uncap the vial and quickly pour the solution onto the glass plate. The solution can vary dramatically in viscosity depending on what material proportions are used.
- SLOWLY drag the doctor blade over the solution making sure no pooling occurs at the edge of the blade. Do not drag the blade back over the membrane because it could lead to a nonuniform membrane.
- Dunk the area of the glass plate with the membrane on it in the water. The membrane should distinctly change phase. For my PSF membrane it immediately changes white.
- Repeat steps 2-4 until the rest of the solution is used up.
- Try to remove the membrane with a GLOVED hand. If it easily slides off place it on a paper towel.
- If the membrane does not slide off easily use a sharp object like a razor blade to separate the membrane from the glass plate.
- Treatment of Water
- The created membrane is placed in the bottle and a little amount of water is taken and poured on the membrane and the permeate is collected at the bottom.
- The permeate water is tested for parameter according to WHO limits.

1. Analysis of Permeate water

- The treated water is checked for given parameters like pH, TDS, alkalinity, hardness.

➢ pH:-

- The pH meter is dipped in the water and the pH value is noted.

➢ TDS:-

- The TDS meter is dipped the water and the TDS value is noted in ppm.

➢ Alkalinity:-

- The treated water is collected and a little amount of water from it is taken in a conical flask.
- Take a beaker and fill it with acids & basses like Hcl or H_2So_4&NaoH.
- Fill the beaker with 50ml of water and insert the pH meter in it and note the pH value.
- Start the magnetic stirrer and open the burette valve and let the acid mix in the water drop by drop.
- With continous mixing note down the pH value and let the acid mix until the pH value reaches initial value to 4.5
- After the pH comes down to 4.5 note down the burette reading and calculate alkalinity.
- Follow the same process with base. But the pH value should go above the intial value.

January-February 2020
ISSN: 0193-4120 Page No. 15341 - 15347

- Hardness:-
- First fill the burette with EDTA solution.Then pipette out 20ml of hardwater in a conical flask.
- Then add 10ml of buffer solution and add 1-2 drops of EB-T indicator.
- You will observe a colour change from colourless to wine red.
- Titrate with burette solution and observe a color change from wine red to steel blue.
- Repeat the experiment until you get consecutive values like 2-3 times.
- Total hardness:-
- Take 50ml of water in a conical flask. Then add 10ml of buffer solution.
- Now add 1-2 of EB-T indicator.observe the color change to wine red color.
- Titrate with burette solution ie EDTA solution and see for color change to steel blue.
- Permanent Hardness:-
- Take a beaker and add 100ml of water sample and boil it until the water level goes down to 50ml.
- Transfer the boiled water in a conical flask and add buffer solution and indicator.
- Observe the color change and titrate against EDTA solution and observe the color change.
- Repeat the experiment until consecutive values.
- After Treatment of WATER :-
- GROUND WATER :-
- TDS level - 575 ppm.
- pH level - 7.2-7.3
- Alkalinity - 146 mg/l.
- Hardness - 112 mg/l.

1. SEA WATER :-

- TDS level - 533 ppm.
- pH level - 7.33-7.50
- Alkalinity - 152 mg/l.
- Hardness - 212 mg/l.

2. INDUSTRIAL WASTE WATER :-

- TDS level - 720 ppm.
- pH level - 9.30
- Alkalinity - 130 mg/l.
- Hardness - 300 mg/l.

PICTURES OF THE RESULTS :

TDS of Ground water

pH of Ground water

Fig 9.3.1 Alkalinity test of water sample

January-February 2020
ISSN: 0193-4120 Page No. 15341 - 15347

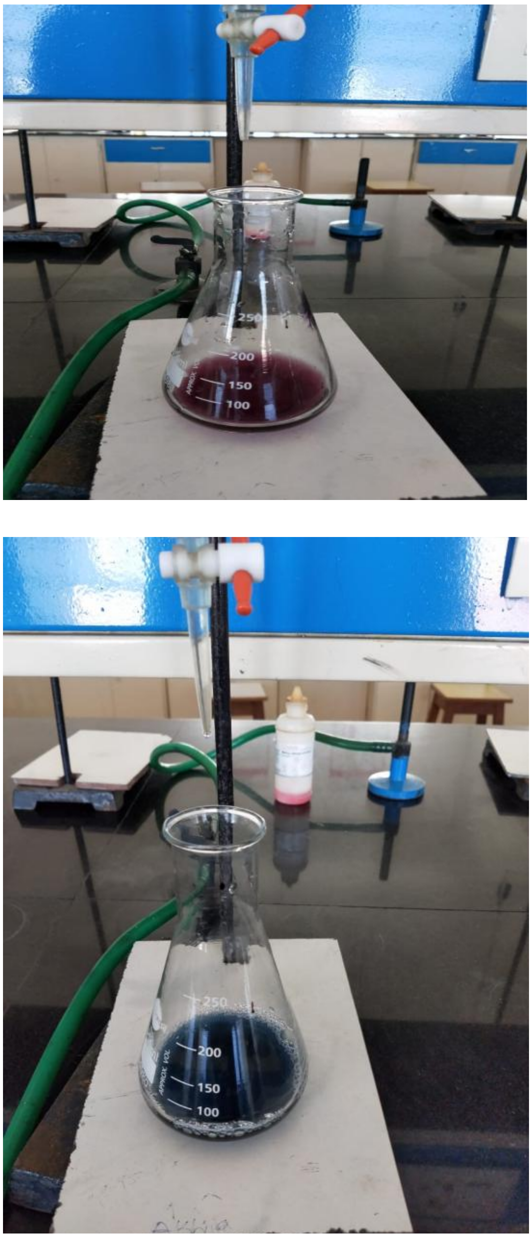


Fig 9.4.1 Hardness test of Watersamples

5.DISCUSSION:

The every year creation of graphene materials is assessed to increment through greater than multiple times to reach at one thousand-ton degree in the following 5 years.Fifty three Early-set up put it up for sale requests will probable originate from area of information programs that present low limitations to appropriation, at the same time as meeting omitted innovation goals. For graphene and graphene oxides, such open doorways will likely contain layers and filtration framework for water decontamination, as maximum as of late the commercialization of TFN movies. Albeit most graphene-empowered water film advancements are however within the exploration and improvement set up, it's miles normal that pilot degree exhibitions pointed towards the industrial corporation marketplace will growth fast. In spite of the truth that improvement and commercialization of enhancements are difficult to anticipate – and nanoporousgraphene films are on the soonest segment of all innovations pointed out – we see them as the maximum encouraging of these advances. In any case, because of further ease and reasonably much less hard framework turning into a member of, GO-primarily based layer techniques are relied upon to have little by little short market capacity. To arrive at expressed ability, economic and huge scope introduction of graphene materials which is probably tailorable for layer programs is crucial. These incorporate nanoporousgraphene, GO, and GO nanocomposites, with fluctuated length and best stipulations Graphene is an wonderful starting cloth for growing period particular layers because of its nuclear thickness and excessive mechanical super, along the ones lines the growing enthusiasm for mass vehicle houses throughout graphene-based totally movies. Graphene films are these days created as single layer and stacked multilayers. Figuresummarizes the principle uses of these creative movies thinking about the partition systems.

6.CONCLUSION:

In this project, after conducting so many test for desalination using our graphene oxide membrane we came to a conclusion that our results which we got is not upto our expectation. After conducting so many test we thought that the desalination of water could be possible with our single layered Graphene oxide membrane but turn out to be that the membrane pore size is very large compared to the size of the salts present in the water. When we tried, that how we can increase our salt removal efficiency we learned of preparing a stack of membranes would be a solution to the problem. With our single layered graphene membrane the efficiency was only about 40-45 percent, but then after when we began to prepare membrane stack double layer then the efficiency increased a bit. But that wasn't enough, if we want to remove the salts completly the membranes has to be coated with a Nano Porous sheet so that the pore size decreases and does not allow the salts to pass through them. After conducting the test on membrane when we passed water through the membrane the water color did not changed but the time of filtration increased with increase in usage of graphene powder. We have demonstrated that selective permeable GO membranes can be synthesized via a simple LbL coating approach. The GO membrane has exhibited a number of fascinating advantages over existing membranes. First, it uses graphite as an inexpensive raw material, significantly lowering the membrane fabrication cost. Second, the synthesis procedure for both GO nanosheets and GO membrane are simple and scalable, providing technical readiness for scaling up the membrane production. In the present stage, the synthesized GO membrane has very high rejection of an organic dye with a molecular weight of around 500 Da. Water flux of the GO membrane is about 4−10 times higher than that of most currently commercially available NF membranes. Further adjusting of GO properties and the membrane synthesis protocol will hopefully improve water flux and salt rejection. Potential improvement strategies include engineering the spacing between GO layers by incorporating different-sized cross-linkers, modifying membrane charges by functionalizing GO with different functional groups, and optimizing membrane thickness by varying the number of GO layers. Indeed, the facile synthesis of economical GO membranes with enhanced performance promisingly qualifies this new type of membrane as a next-generation, cost-effective, and sustainable alternative to the long-existing thin-film composite polyamide membranes for water separation applications.

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January-February 2020
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