Cellulose Acetate Blend *Syzygium Cumini* Leaves Green Membrane Synthesis and its Application

SHRUTHI.S

(16PCH018)

Thesis Submitted to

Avinashilingam Institute for Home Science and Higher Education for Women,

Coimbatore-641 043

In Partial Fulfilment of the Requirements for the Degree of

Master of Science in Chemistry

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LIST OF ABBREVIATIONS

TDS	Total Dissolved Solids
MF	Micro Filtration
NF	Nano Filtration
UF	Ultra Filtration
RO	Reverse Osmosis
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
WHO	World Health Organization
DO	Dissolved Oxygen
FT-IR	Fourier Transform- Infra Red
TGA	Thermo Gravimetric Analysis
SEM	Scanning Electron Microscope
SPANDS	Sulfo Phenyl Azo Dihydroxy Naphthalene disulphonic acid
EC	Electrical Conductivity
CA	Cellulose Acetate
EDTA	Ethylene Diamine Tetra Acetic acid

INTRODUCTION

1. INTRODUCTION

Water is nature's most wonderful, abundant and useful compound of the many essential elements for the existence of human beings, animals and plants (viz. Air, water, food, shelter, etc.). Water is rated to be of the greatest importance. Without food, human can survive for a number of days, but water is such an essential that without it one cannot survive.

Water is not only essential for the lives of animals and plants, but also occupies a unique position in industries. Probably, it is most important use as an engineering material is in the steam generation. Water is also used a coolant in power and chemical plants. In addition to it, water is widely used in other fields such as production of steel, rayon, paper, atomic energy, textiles, chemicals, ice and for air-conditioning, drinking, bathing, sanitary, washing, irrigation, fire-fighting, etc,.

On the basis of origin or source, water is classified as,

- Atmospheric, precipitation or rain waters
- Underground water (springs, wells, or boreholes)
- Surface water (river, stream, artificial basins, lakes, ponds)

On the basis of amount of total dissolved solids (TDS), water is classified as,

- Fresh
- Brackish
- Saline
- Brine

On the basis of quality or character of impurities present, water classified as,

- Clear or turbid
- Colorless or Colored
- Soft or hard
- Alkaline or non-alkaline

On the basis of their utility, water is classified as,

- Potable water
- Domestic or utility water
- Industrial water
- Recreational water
- Irrigation water

1.1 Sources of water

Water is not only essential for human beings, plants and animals for sustaining life but is also equally important for agricultural, industrial and other purposes. In fact, it is an essential engineering material. The principal sources of water as follows:

Surface Water

Surface water can further be subdivided into following categories.

(i) Flowing water

Streams and rivers are the primary sources of flowing waters. The main source of river waters is melting of snow, springs, and rains. The river water flows on the earth surface and dissolves soil mineral and several other soluble substances. Thus, river water contains a considerable amount of solvent and suspended impurities. It includes minerals of the soil such as chlorides, sulfates, bicarbonates of sodium, calcium, iron, magnesium, etc., organic matter derived from the decomposition of plants and animals and fine particles of sand.

(ii) Still waters

The primary sources of still water are lakes, ponds, and reservoirs. Lake water is comparatively less contaminated as compared to river waters. It contains much lesser amounts of dissolved minerals. However, the quantity of organic matter in it may be more significant.

(iii) Sea water

Seawater is the impure form of natural water. All rivers, after flowing on the ground, fall into the sea through all sorts of impurities they carry into the sea. This medium contaminates the seawater to a great deal. On the average, seawater contains about 3.5% of dissolved salts, including 2.6% of sodium chloride alone. The other spices usually present in seawater are sulfates and bicarbonates of potassium, magnesium, and calcium; bromides of potassium and magnesium; sulfates of sodium, potassium, etc. sea water is neither suitable for drinking purposes nor industrial applications. Besides the presence of dissolved minerals, suspended impurities, and organic matter, surface water may also contain disease-producing microorganisms and may cause several types of diseases. Therefore, as such, they are not safe for drinking purposes.

Rain Water

Rain is perhaps the purest form of natural water as the natural distillation of surface water obtains it. But while coming down, it comes in contact with several gases such as CO_2, SO_2, NO_2, etc. and dissolves them. It may also absorb particulates present in the atmosphere. Therefore, rainwater reaching earth surface is no more acutely. Moreover, rain is not regular in supply and it may be expensive to collect it.

Underground Waters

The primary source of underground waters, *i.e.*, water present in underground springs and wells is rainwater. The earth absorbs a significant part of the rain. The absorbed water percolates into the ground and goes deep down. While going down, it dissolves several minerals present in the soil. However, due to the presence of metals, it is hard. Depending on the taste it may be used for drinking purposes, but it is not much suitable for industrial applications.

Underground water (water from deep borings and wells) contains no turbidity but contains more mineral salts, free CO_2, calcium and magnesium salts, iron and manganese salts, etc. The temperature of the underground water is lower than that of surface water and remains almost constant. In underground waters, iron usually occurs as ferrous bicarbonate, $Fe(HCO_3)_2$, which is stable only in the presence of significant amount of CO_2. The removal of CO_2 from the water causes the decomposition of $Fe(HCO_3)_2$, followed by ferrous hydroxide, $Fe(OH)_2$. This reaction is utilized in de-ferrization of groundwater. This underground water contains dissolved salts, suspended and colloidal impurities and pathogenic micro-organisms.

1. Dissolved Salts

Natural water may contain inorganic salts, gases and soluble matter as dissolved impurities.

(a) Inorganic salts

The inorganic salts which dissolve in natural waters are usually bicarbonates, chlorides, sulfates and nitrates of sodium, potassium, magnesium, calcium, aluminum and iron. Zinc and copper salts are also sometimes present in traces.

(b) Gases

Several gases such as CO_2, oxides of nitrogen and sulfur, hydrogen sulfide and ammonia may dissolve in natural waters. These gases are present as pollutants in the atmosphere and dissolve in water during rainfall.

(c) Organic matter

Vast quantities of domestic sewage and industrial wastes are thrown into canals and rivers every day. These wastes contain organic compounds which contaminate the natural resources of water.

2. Suspended and Colloidal impurities

The surface water contains suspended particles of sand and minerals eroded from the land. The more robust particles settle down on standing, but smaller particles remain dispersed in the colloidal form.

3. Pathogenic micro-organisms

Various pathogenic micro-organisms such as bacteria, viruses, etc. also enter into water bodies through sewage and other wastes. These micro-organisms were causing various diseases.

1.2 USES OF WATER

Water is mainly used for industrial and municipal purposes.

India, being a vast country, with an area of about 806 million acres, the rainfall constitutes one of the most vital and significant sources of water. The rainwater in the hilly districts and that from the snows that melt in the mountain regions flows in the form of rivers. The original river water is very pure, but it takes up suspended impurities as it flows through the plains. In this process, it is also dissolved CO_2 from the atmosphere, which enables water to dissolve carbonates as it passes over the beds. Some of the rainwater percolates underneath the surface of the earth, till it reaches impervious strata which prevent its further penetration. This would exude in the form of springs. Water from some springs contains dissolved sulfur compounds. Such water is helpful in the cure of some skin diseases. If the water from the springs includes some salts such as $MgCl_2$ and $MgSO_4$, it is also known as saline water.

Molecules and metals present in natural water

The group of the molecular-dispersed substance includes salts and gases that are dissolved in water cations. Such as Na^+, Ca^{2+}, Mg^{2+} and anions such as Cl-, SO_4^{2+}, and HCO^{3-} etc. are usually encountered in natural waters, because salts are dissociated in no small extent in aqueous solution. In other words, it may be assumed that natural waters contain compounds such as Ca $(HCO_3)_2$, Mg $(HCO_3)_2$, $CaCl_2$, $MgCl_2$, $CaSO_4$, $MgSO_4$, $NaSO_4$, and NaCl. Tests often reveal that in addition to Na^+, Ca^+, Cl^-, SO_4^{2-}, HCO^{3-} (which are most widespread) natural waters also contain nitrite acid ions, NO_2^- (nitrites), nitrous acid ions, NO_3^- (nitrates) and ammonium cations (NH_4^+) in small quantities. The presence of these nitrogen compounds in water indicates that water is contaminated by industrial waste waters or by decomposition products of organic substance. Natural waters also contain ferrous compounds. The water holding iron is sprayed (aerated) or air is blown through it to remove CO_2.

1.3 Membrane in water treatment

Through membrane, water can pass to be filtered and purified are the modern water treatment processing. “Chemistry significantly contributes to innovative water treatment solutions, such as turning of salt water into fresh water suitable for human consumption” says Yannick Fovet, head of global development for water at chemical company BASF.

Purification of water by filtration process

In these days a pure, clean and safe drinking water is easily not available. Growing population, environmental degradation and industrial development to cause all for this effects. To this situation, it becomes more important for us to be aware of some purification techniques. Naturally a lot of minerals are found in water and important for our human body. A good water purifier can removes the excess salts, suspended particles and microbes, and retains its essential vitamins and minerals.

Water filters and water purifier, both is works on the same mechanical principle. They first suck up the contaminated water then filter out impurities range from sediments to microorganisms and to give dispense clean water. However, one difference between the two, a purifier can remove viruses and bacteria that filters cannot remove these. But some purifiers chemical and an electro-static charge to kill or capture the viruses. (Sumathi sivam, 2013).

1.4 Techniques available in water treatment

In order to get pure water we want to need some filtration methods. They are described below:

Water purifiers range from simple water filters to advanced purifiers using membrane technology for water filtration followed by disinfection with UV lamp filters.

Membrane technology purification

Micro filtration

The principle of micro filtration is physical separation. It can separate big proteins, yeast cells and micro-organism. It can separate 0.1 to 1µm size particles. Particles are separated depends on the membrane pore size. Conventional pressure between 0.1 and 3 bar.

Ultra filtration

Organic substances, oil emulsions, protein molecules such as gelatin, bacteria, etc., were separated by ultra filtration. It can separate 0.01 to 0.1µm size particles. Conventional pressure between 3 and 5 bar

Nano filtration

In nano filtration bacteria, viruses, sugars, pigments and sulphur are separated. It can separate 0.001 to 0.01µm size particles.**Reverse osmosis**

Salt solutions, metal ions and nitrates, etc. are separated using reverse osmosis method 0.0001 to 0.001μm size of the particles can be separated. High conventional pressure between 10 and 60 bar. So, it can be used high technological and pressure resistant membrane.

Consequently the COD/BOD values of the waste water treated by ultra filtration and micro filtration techniques others are too high to be reused in the production process.

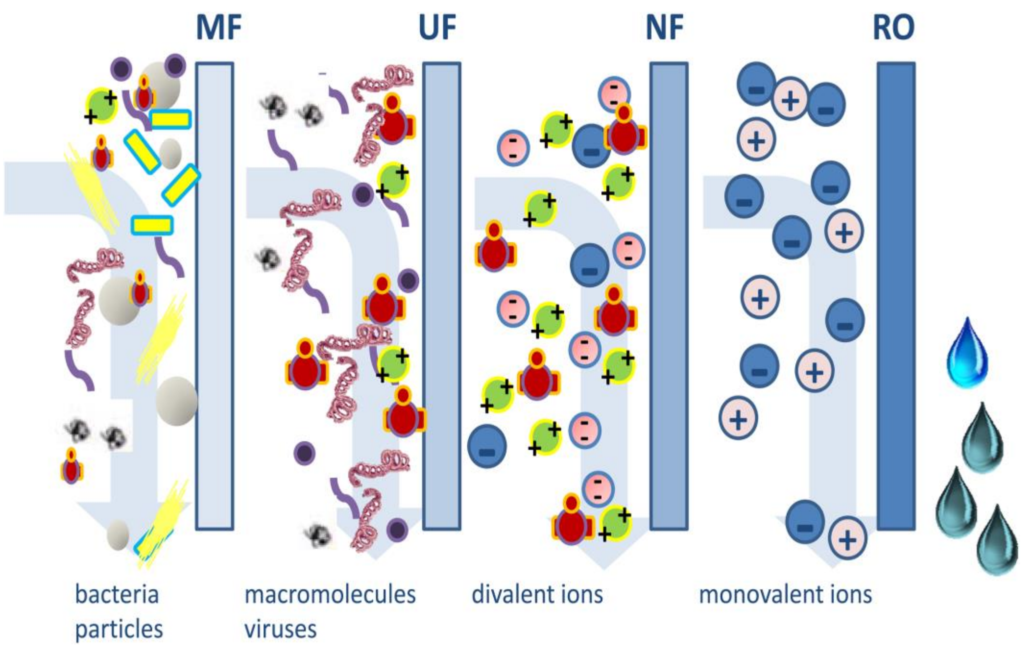


Figure 1.1 Membrane Technology Purification

Advantages using membrane techniques

- ✓ Material reliability
- ✓ Less chemicals required
- ✓ Simple follow-up, once the installation is correctly set
- ✓ Efficient use of energy
- ✓ No changes in state of aggregation necessary

Disadvantages in membrane techniques

- High price of the membrane
- Very concentrated filtrate has to be further treated

TABLE 1.1

Trace minerals in drinking water guidelines. (WHO report 1996)

Minerals	**Drinking water guideline (mg/L)**
Calcium(mg/L)	n.g.
Iron(mg/L)	0.3**
Zinc(mg/L)	3.0**
Copper(mg/L)	1.0**; 2.0*(P)
Selenium(mg/L)	10*
Fluoride(mg/L)	1.5(P)
Magnesium(mg/L)	n.g.
Sodium(mg/L)	200**
Sulphate(mg/L)	250**
Chloride(mg/L)	250**
Manganese(mg/L)	100**; 500*(P)
molybdenum(mg/L)	70*

Health-based guideline value, (P): provisional; **parameters in drinking water that may give rise to complaints from consumers (2) FNB2001, ng-nanograms.

1.5 JAMUN LEAVES

Syzygium cumini is commonly known as **jambul**, **java plum** or **black plum**, sometimes mistranslated as **blackberry**. It is an evergreen tropical tree in the flowering plant Myrtles family Myrtaceae. It belongs to India and indigenous part of Indian folk remedies. **Syzygium cumini** has been spread overseas from India by Indian emigrants.

Figure 1.2 Jamun leaves

Figure 1.3 Jamun leaves powder

The tree was introduced to Florida in 1911, and is also now commonly grown in Suriname, Guyana and Trinidad and Tobago. In Brazil, where it was introduced from India during Portuguese colonization, it has dispersed spontaneously in the wild in some places, as its fruits are eagerly sought by various native birds such as thrushes, tanagers and the great kiskadee.

In Ayurveda, its fruits, seeds, barks and leaves are used as medicine for treating bleeding disorders and other diseases. Nowadays, jamun leaves are cured for nausea, vomiting, bleeding disorders, and metrorrhagia and also jamun leaves are useful in mouth ulcers, bleeding piles, diarrhea and typhoid fever. The eating of jamun leaves is good in treating of digestive related disorders. Chewing and eating of jamun leaves are good in treating of diarrhea and ulcers. Jamun leaves have great significance in ayurvedic medicine. **(Jagdev Singh, 2016)**

Research reports on jamun leaves reveal its astringent, anti-diarrheal, anti-microbial, anti-inflammatory, anti-diabetes, antiemetic, antihemorrhagic and anti hyperglycemic properties.

Phyto chemical studies on jamun showed major chemical constituents including,

- Flavonoids
- Glycosides
- Steroids
- Alkaloids
- Saponins
- Phenols
- Ellagic Acids
- Oleanolic Acid
- Essential oils and tannins.

TABLE1.2 Botanical Classification (Plant Taxonomy)

Kingdom	Plantae
Sub-Kingdom	Viridiplantae
Infra Kingdom	Streptophyta (land plants)
Super Division	Embryophyta
Division	Tracheophyta (tracheophytes – vascular plants)
Class	Spermatophytina (spermatophytes – seed plants)
Super Order	Rosanae
Order	Myrtales
Family	Myrtaceae (myrtles)
Genus	Syzygium
Species	Syzygium Cumini (S. Cumini) – Java Plum

TABLE 1.3 Synonyms and Vernacular Names

Botanical name	Syzygium cumini
Botanical synonym	Eugenia cumini & Eugenia jambolana
English name	Java plum(sometimes Malabar plum), Indian blackberry
Hindi name	Jamun, Jambul
Other names	Naval, Jamblang, Jambolan, Duhat, Jambolan Plum, Kavika, Jamelonguier, Mesegerak, Jambas, Rajaman, Kala Jamun, Nered, Nerale, Jamali
Ayurvedic names	Jambu, Mahaphala

Morphology

Syzygium cumini has a slow growing tree. The height up to 30m and can live more than 100 years. On the base of the tree, the bark is rough and dark greycolor. The wood of the tree is water resistant. The leaves are an aroma similar to turpentine, are pinkish when they young, changing to a leathery, glossy dark green with a yellow midrib as they mature. The leaves are used as food for livestock and also have good nutritional value. The tree starts flowing from March or June. The fruit has a combination of sweet, mildly sour and astringent flavor and it tends to color the tongue purple. It varies from 1.5 centimeters to 3.5 centimeters. The primary nutrition contained in 100 grams of jamun fruit. The chemical present in jamun leaves are β-sitosterol, betulinic acid, mycaminose, crategolic (maslinic) acid, nhepatcosane, n-nonacosane, n-hentriacontane, noctacosanol, n-triacontanol, n-dotricontanol, quercetin, myricetin, myricitrin and the flavonol glycosides myricetin 3-O-(4''-acetyl)-α Lrhamnopyranosides.

Pharmacological activity

1. Antimicrobial activity

A disease caused by microbes and bacteria has increased. One interesting research observed the effect of jamun leaves against drug resistant gram positive and gram negative bacteria. The phytochemicals present in jamun leaves to confer anti microbial activity.

Flavonoids present in jamun have high natural ability to modify the body’s reaction against viruses and allergies and thus possess anti- microbial and anti-allergic properties. Steroids and tannins also developed the anti-microbial activity. Research report also give tannins have the ability to inhibit the HIV replication selectively.

Jamun leaves exhibited antibacterial activity against the following:

- Bacillus Subtilis (causes food poisoning)
- Salmon typhi (causes typhoid)
- Pseudomonas Aeruginosa (causes infection in lungs, kidney and urinary tract)
- Escherichia coli (causes food poisoning)
- Proteus Vulgaris (causes urinary tract infections and wound infections)

2. Controlling diabetes

The jamun fruit and jamun leaves are good for diabetes patient. The extract of the bark, seeds and leaves are good in decreased of sugar in urine (Glycouria). It is notorious that this Indian berry has a magnificent ability in helping patient who is suffering diabetes, especially type II which related closely to unhealthy lifestyle, lack of exercise and over-consuming of sugary foods. Glycemic index is an indicator of how food will influence our blood sugar.

Being low in glycemic index making jamun fruit a healthy snack for people who have diabetes type II. Oleanolic acid scientifically known to have anti-diabetic properties.

It improves insulin response, biosynthesis, signaling and secretion, the chemicals responsible for lowering our blood sugar by converting glucose in our blood to energy. It also prevents diabetes complication by slowing down the process of both sugar and lipid accumulation in the blood.

3. Anti-hypertensive treatment

Treatment with jamun leaf extract reduces vasoconstrictor agents that constrict the blood vessel and in turn raise the blood pressure level. Furthermore, the presence of flavonoids and triterpene significantly vasodilatory effect the blood levels and ensures smooth blood flow throughout our body. In addition to this, antioxidants present in Jamun reduce the oxidative stress in kidneys and blood vessels and thus help in lowering high blood pressure. Besides this, Jamun is a good source of potassium that further helps in the treatment of hypertension. Thus, Jamun can be successfully made a part of DASH diet (DIETARY APPROACHES AGAINST HYPERTENSION).

4. Treatment for mouth ulcers

The decoction is prepared by using 10 grams jamun leaf powder and 800 ml of water, which is simmered to reduce to 200 ml liquid. The decoction is used for gargling to treat mouth ulcers. Alternatively, a paste is made using water, jamun leaf powder and katha (catechu). This can quickly relief the mouth ulcers. Jamun leaves powder, which is obtained after drying and burning it, used as teeth powder and helpful in checking gum infection and bleeding.

5. Treatment for opium toxicity

Nausea, vomiting and loss of appetite are main concerns in opium toxicity. The jamun leaves juice or decoction helps to reduce the opium toxicity.

6. Helping with bleeding hemorrhoids

Drinking jamun juice has been proven effective to treat bleeding hemorrhoids. It can also treat a hardening veins that is prone to burst, thus it made a good home remedy to treat piles.

7. Improves immunity

Other than treating sore throat and maintaining good skin vitamin C has also been proven to boost our immunity system thus improving our body protection against infection from viruses and bacteria, while generally also gives us more energy throughout the day.

8. Jamun leaves treat ulcers

The eating of jamun leaves is good in treating of digestive related disorders. Chewing and eating of jamun leaves are good in treating of diarrhea and ulcers. Jamun leaves have great significance in ayurvedic medicine. Jamun is good in prevention of liver diseases such as necrosis and fibrosis. Due to presence of bio-chemical and phytochemical substance like polyphenol, the black plum acts like as anti-cancer substance. Jamun solves acidity when it is taken along with roasted cumin powder and black salt.

Jamun juice benefits

Jamun juice has many health and medicinal benefits. Being it a seasonal fruits, one should try to have more and more amount of Jamun juice during the month of June, July and August. Some of the amazing and surprising health benefits of jamun juice are given below.

1. Drinking of Jamun juice is used to treat digestive disorders such as diarrhea, dysentery and dyspepsia.
2. In case of diarrhea, jamun juice is beneficial after mixing little amount of saturated in it.

3. Jamun juice along with curd is good against digestive problems.
4. Teeth related problems can be solved by applying jamun juice or by drinking it.
5. Jamun juice is beneficial in treating of piles and hemorrhoids.
6. Drinking of the fresh fruit juice helps in cough and asthma.
7. Jamun juice enhances your immune system.
8. It protects you from cold and acts as anti-aging agent.
9. The juice of the fruits is given in spleen enlargement and urine retention.
10. Jamun juice should be taken to overcome the problem of female sterility.

OBJECTIVES

- To prepare a green membrane and study its uses in salt water rejection.
- Effective membrane filtration and ease of filtration.
- To study the physio-chemical parameters of water before and after the filtration with the membrane.
- To characterize the membrane with FT-IR, SEM and TGA.
- To determine the water compaction, thickness and porosity of the prepared membrane.
- To study the electrical conductivity and pH.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

- Development of nitrocellulose membrane was impregnated by synthesis of silver nano particles (AgNPs). This AgNPs is obtained from Asper-gillus niger (AgNPs-Asp), Cryptococcus laurentii (AgNPs-Cry) and Rhodotorula glutinis(AgNPs-Rho). This is used as impregnated nitro cellolose membrane filters. From these the anti microbial effect was observed for AgNPs-Rho. It is not only for small for small particles but also to poly saccharides groups that surrounding the particles. From this study the complete inhibition bacterial growth was observed in nitro cellulose membrane filters impregnated with $1mgL^{-1}$ of bio synthesized AgNPs. This concentration to reduce the bacteria and water can be filtered. **(Jorge G. Fernández *et al*., 2015)**

- In recent years cellulose nano materials (CNs) to be explored in application of water treatment process. This CNs is the combination of cellulose nano crystals (CNCs) and cellulose nano fibrils (CNFs). It provides detailed of pristine, surface functionalized CNCs and CN- incorporated nano composites for the application of water treatment. Water treatment such as sorption, membrane filtration and flocculation. This cellulose nano materials has been used to remove the contaminates in water. CNs possesses desirable properties such as activated carbon and petroleum based polymer used in water treatment process. **(Nishil Mohammed *et al*., 2018)**

- Synthetic dyes are high solubility; it is difficult to remove them from waste water with the help of conventional techniques. In this work, by using the leaf of jamun (syzygium cumini) plant to remove methyl red dye from aqueous solution. This was performed keeping temperature constant. The optimum adsorbent dosage was 4-5 grams in 100ml dye sample for time 60mins. Jamun leaves can achieved up to 97% removal of methyl red as per the experimentation at 50ppm dye concentration. The equilibrium absorption can be carried out using Freundlich᾽s theorem. **(Vastal Shah., 2017)**

- The purification of water treatment is great interest not only the developed countries but also the developing countries. Nano metals (Ag and Au) and nano membrane help to develop the water treatment and it is used to solve the water related problems like waterborne pathogens, biofouling and removal of toxic metals (Pb, As and Cr).the application of nano technology in water treatment is in the form of nano sensors, nano membranes, nano metallic particles and photo catalysis for water purification. All of these nano sensors to detect the contaminants in water. **(Toqeer Ahmed *et al*., 2013)**

- ❖ The polymeric NF membrane was manufactured by different methods. Composites of NF membrane formed by interfacial polymerization. The structure, monomeric and polymeric reactants obtained to endow specific characteristics. Additives used to influence the reaction. Other methods are manufacture of NF membranes by phase inversion and coatings, grafting of post-treatments. It allow for success in more challenging feeds like pH extremes, high temperature, chlorine and solvents. **(Mou Paul *et al*.,2016)**

- ❖ The reverse osmosis, nano filtration and ultra filtration membrane technologies can be used in solution to make different problems related to treatment of strongly polluted waters in different orgin and reuse the effluents. The new approach was decreased fouling of membranes which construct a membrane channel and selection of membrane characteristics. The design of open-channel spiral-wound modules to exploit membrane without danger of scaling and to design new effective water treatment. By using long-term studies and pilot tests made it to develop the optimization of membrane units with minimum expenditures like electric power, maintenance and effluent discharge. **(A.G.Pervov *et al*., 2015)**

- ❖ In several areas natural water sources contains radio nuclides in maximum concentrations allowed levels for drinking water. A small concentration of radium is present insignificantly exceeding the drink water standards. This radium is always accompanied by radium decay product of gas radon. This radium membrane multistage water treatment to remove the undesirable components including radio nuclides feed to direct water heating systems can also be developed. The multi stage technologies are aeration, degassing, mechanical purification and desalination can isolated the relevant type of impurities. Aeration and degassing process involves the oxidation of iron and removal of radon. Mechanical filtration implemented on an ultra filtration that removes suspended solids, colloidal particles, micro organisms and iron hydroxide flakes and also heavy metals are removed by ultra filtration. Desalination is performed by using reverse osmosis to remove the residual radium. In pilot testing no buildup of radiation on the membrane elements and its decay products are withdrawn with the concentrate. **(S.Yu.Larinov *et al*., 2015)**

- A new water treatment constructed using integrated membrane technology (IMT). The concentration of salt water is tens of thousands of times lower than the natural water. IMT are best solution for water treatment plants (WTPs) in modern power facilities. Using this membrane to obtain deeply demineralized water and reduces the consumption of reagents. **(S.L.Gromov *et al*., 2011)**

- Membrane technology has grown only treat waste water, recycle the polluted water and provide fresh water. But electro spun nano fibrous membranes (ENMs) to exhibit distinctive features such as high porosity uo to 90% and large specific surface area. Compare with other nano fiber fabrication techniques, electro spinning capable of develop nano fibrous scaffolds and it is facile. This membrane challenges the future improvement in water treatment applications. It can be used for academic studies and industrial applications. One area which received a countless benefits is will continue to profit in future is the fabrication of novel electro spun membrane for water treatment. **(Yuan Liao *et al*., 2017)**

- A novel tree like cellulose nano fiber membrane was fabricated via electro spinning method by added a certain amount of tetra butyl ammonium chloride (TBAC) into cellulose acetate followed by deacetylation process. The morphological structure, material structure and air filtration process to characterize both cellulose and cellulose acetate tree like nano fiber membrane. In this membrane, water contact angles, mechanical properties and air filtration process also characterized. Air filtration tree like nano fiber membrane can achieved 99.58%. This membrane exhibited small pore size, good hydrophilicity, excellent solvent resistance and good mechanical property. Optimal parameters for preparing CA/TBAC (0.1 mol/L) tree-like nano fiber membranes were voltage of 35 kV, tip to collector distance of 15 cm, spinning rate of 1.0 mL/h. Advantages of the tree-like structure and natural materials were combined through this method. **(Kai Zhang *et al*., 2018)**

- To provide drinking water in space missions such as the International Space Station (ISS) was costly requirement for human habitation. The cost limit of water transport, the waste water is collected and purified used a variety of physical and chemical means. Sand-based biofilters had designed to function against gravity and bio films have form in microgravity conditions. To development a universal silver-recycling biological filter system was able to function in both microgravity and full gravity conditions would reduce the costs to removing organic contaminants from wastewater by limiting the energy and chemical inputs required. This process aims to propose the use of a sand-substrate bio filters to replace chemical means of water purification on manned spaceflights. **(Starla G. Thronhill *et al*., 2018)**

- A sensitive and rapid method was developed to detect Cryptosporidium parvum oocysts in drinking water. This molecular assay combined immune magnetic separation with polymerase chain reaction amplification to detect very low levels of Cryptosporidium parvum oocysts. Magnetic beads coated with anti cryptosporidium were used to capture oocysts directly from drinking water membrane filter concentrates. At the same time removing polymerase chain reaction inhibitory substances. The DNA was then extracted by the freeze-boil Chelex-100 treatment, followed by polymerase chain reaction. The immune magnetic separation polymerase chain reaction product was identified by non-radioactive hybridization using an internal oligo nucleotide probe labeled with digoxigenin. This immune magnetic separation-polymerase chain reaction assay can detect the presence of a single seeded oocyst in 5^100-l samples of drinking water, thereby assuring the absence of Cryptosporidium parvum contamination in the sample under analysis. **(Sylvie Hallier-Soulier *et al*., 1999)**

- Membrane technology was widely explored process for separation and filtration of many chemicals, both domestically and commercially. Historically in India, domestic filtration techniques were based on conventional methods using cloth membranes. Different cloth materials were used for filtration of drinking water and separation of various kinds of colloidal solutions. In this a variety CNT of membranes finds different applications in nano filtration. In these CNT membranes due to their mass transport and electrochemical actuation-driven transport represent substitute materials for traditional membranes in the field of membrane technology. These filters may be tailored to specific needs by controlling the nano tube density in the walls and the surface character by chemical functionalization. There are many use of these CNT membranes was nano scale fluidic interconnect-based micro fluidic platforms.CNT based membranes represent a new frontier in membrane science. **(Anchal Srivastava *et al*., 2013)**

- Hygienic safety of reusable water filters to changing filters for 4 weeks in high risk areas together routine, weekly alcohol based surface disinfection and additionally in the visible contamination. The three filters type did not found total bacterial counts. Manual reprocessing was proved insufficient. Using this reprocessing in disinfector with alkaline solution, acid treatment and thermal disinfection. The filters were effectively reprocessable and to provide tap water meeting the German drinking water regulations as well as the WHO guidelines, including the absence of pathogens. **(Georg Daeschlein *et al*., 2007)**

- Membrane bioreactor (MBR) for the pretreatment of reverse osmosis to reuse and reclamation of industrial waste water treatment plant was investigated in this study. MBR can perform through water quality in term of parameters such as chemical oxygen demand (COD), total suspended solids(TSS), total nitrogen(TN) and total coli form(TC) were measured. Slit density index (SDI) used as a indicator for RO feed water. In this study the result can be demonstrated to produce high quality permeates water. Approximately 75%, 98%, 74% and 99% removed the COD, TSS, TN and TC were recorded respectively. SDI of the permeate effluent fro, the membrane was below 3 for most of the times. It mentioned that pilot yield a high quality effluent from membrane was used as a RO feed water. In can be concluded MBR can produce high permeate quality and is capable to be very efficient method for RO pretreatment. Product of permeate from MBR with average SDI less than 3 indicate that the rate of RO pretreatment. It can be an anticipated that the rate of RO membrane fouling to reduce and the life of RO membrane was extended. While reduce and the life of RO membrane modules will extend. Through FESEM examinations, a gel layer was observed to be formed on the membrane surface in the MBR during the operation. Analysis of XRF results shows that organic matters and calcium oxides are the main components of membrane fouling. Also effluent water from the MBR has a high quality according to SS, COD, TN and TC removal during operation. These results are promising and all indications show that this method is feasible for RO pretreatment and water reuse of industrial application. **(Majid Hosseinzadeh *et al*., 2013)**

- ❖ Multifunctional, crumpled graphene oxide (CGO) porous nano composites are reactive, advanced water treatment membrane. Crumpled 3D graphene oxide fundamentally differs from 2D flat graphene oxide analogous that are highly aggregation and compression resistant of other multifunctional particles inside the 3D composite structures. While superior antimicrobial properties, evaluated with GOAg, were observed for both biofilm and suspended growth scenarios. This was the first demonstration of 3D, crumpled graphene oxide based nano structure applied specifically as active membrane assemblies and high materials potential platform for truly tailored approach for next generation water treatment and separation technologies. **(Yi Jiang *et al*., 2015)**

- ❖ A membrane was produced in a room temperature for three step manufacturing process. The principle of the solution is filtering solutions contain pigmentary water color or food processing. Comparing filtrations shows that insoluble water color pigments were too large to pass the pores of the membrane and were successfully rejected by the membrane. While food coloring was completely soluble in water and can easily pass through the membrane. The laboratory experiment was performed in a 2h activity and serves for the production of safe drinking water and template removal acid/base theory.

This experiment was performed with 52 advanced high school students. **(Adrian Kaiser *et al*., 2017)**

- The recent efforts in modernization of water treatment facilities, the problem of to access healthy drinking water for hundreds of millions of people have still not been solved. By using papermaking method a water filter based on Cu-coated nano fibrillated cellulose with controlled porosity was prepared. MS2 bacteriophages were used in model human pathogenic virions. This membrane filters were characterized by scanning electron microscope, X-ray diffraction, and specific surface area measurement, dynamic light scattering and inductively coupled plasma mass spectroscopy. From these analysis to proves the fixation of degree of virus retention and enhances the efficiency of filtration. By using these functionalized water filters, we were able to achieve a virus retention of at least 5 magnitudes at three different pH values like 5.0, 7.5, and 9. It can also applicable for very high initial virus stock concentrations. **(Gergo P.Szekeres *et al*., 2018)**

- More than 88 billion barrels of wastewater are produced yearly in the world from gas and oil production. Given the rising demand for drinkable water, there is a need for advanced purification processes. Here we review membrane filtration processes used in the gas and oil production for wastewater treatment, with focus on microfiltration, nanofiltration, ultra filtration, reverse osmosis, forward osmosis, membrane distillation and electro dialysis. The application was to coal seam gas extraction water treatment. Furthermore, some other membrane separation processes including membrane reactor, membrane bioreactor and could successfully contribute to reducing environmental issues, to make the most of the probable water reuse in an enhanced water oilfield or in various industrial processes. Researches for fabricating advanced membranes for industrial applications especially in membrane distillation are in progress. The main challenge to membrane separation processes is the membrane fouling. The fouling-resistant membranes were being fabricated to solve this problem in common membranes; this know-how can be used for the treatment of the produced water. **(Mashallah Rezakazemi *et al*., 2017)**

- Water demands was a grand challenge of the twenty-first century due to pollution and climate change that are decreasing the amount of drinking water. There was need for improved techniques to purify contaminated waters. Nanotechnology provides materials of unprecedented properties, which can be used to clean water. This studies the recent developments in nano technology for wastewater treatment using novel polymeric membrane materials. The use of polymeric membrane materials and polymer brush membrane were prepared. Brush membranes have been successfully implemented in several water purification applications. Polymer brushes were designed to increase the antifouling and anti-scaling properties of membranes. Brush membranes were used to increase rejection of dyes and small molecules from wastewater effluent streams. The recovery of dyes from textile plants is an environmental as well as economic benefit for the textile industry. The separation of mono valent ions, such as fluoride from chloride ions, shows the specificity which charged polymer brushes can afford to water softening membranes. Furthermore, polymeric nano filtration membranes can be transformed into reverse osmosis membranes through the grafting of polymer brushes. These brush membranes exhibit similar fluxes and salt rejections as commercial polyamide reverse osmosis membranes, but with lower mineral scaling propensities. However, there are still several drawbacks that have to be negotiated. Materials functionalized with nano particles incorporated or deposited on their surface have a potential risk, since nano particles might release and emit to the environment where they can accumulate for long periods of time. **(Lavanya Madura *et al.*, 2017)**

- The technology for removal of $_{90}$Sr from the waters of the Techa reservoir cascade. It also includes the stages of preliminary decontamination, ion exchange softening with desorption and carbonate precipitation for hardening salts and $_{90}$Sr from the desorbates, sorption cleanup on natural Zeolites and the concentration of the strontium containing carbonate precipitates. After that the precipitates were removed, the solutions were reused in the stage of desorption. The quality of the decontaminated waters to meet all requirements for discharge in terms of all indicators. The $_{90}$Sr was concentrated by 900 as solid radioactive wastes in the form of sediment with moisture content of 50% and 170 as air dried solids. **(V.V.Shatalov *et al.*, 2008)**

- ❖ Porous SiC based materials have high mechanical, chemical and thermal robustness and thus have been largely applied to water-filtration technologies. In this study, circular disc shaped SiC microfiltration membranes were prepared by dry pressing of commercially available SiC powder with yttria and alumina as additives followed by a low-cost oxide bonding technique. The membranes fabricated were characterized using Scanning Electron Microscopy (SEM), Powder X-ray Diffraction (PXRD), porosity and pore size distribution analysis and compared with the membrane prepared by liquid phase sintering route from the same powder composition. Finally, water permeation studies were carried out in a standard membrane module and clean water flux was determined. These membranes were found well suited for treatment of oily waste water and grey water. The membrane prepared by oxide bonding method effectively removed ~ 89–93% of COD, ~ 77–86% of oil/grease and 88.4–92% of TSS from kitchen waste water and the removal efficiency were better compared to the membrane prepared by liquid phase sintering method. The effects of corrosions on the membranes were investigated in strong acid and alkali solution at 90 °C. The membranes prepared by oxide bonding method showed better corrosion resistance with retention of mechanical strength.**(Dulal Das *et al*., 2017)**

- ❖ Viral filtration was a critical step in the purification of biologics and microbiological water quality. Viral filters were protection elements against airborne viral particles. The present review focused on cellulose based filter currently used for size-exclusion and adsorptive filtration of viruses from biopharmaceutical and environmental water samples. Data from spiking studies quantify the viral filtration performance of cellulose filters were detailed, i.e., first, the virus reduction capacity of regenerated cellulose hollow fiber filters in the manufacturing process of blood products and the efficiency of virus recovery concentration from water samples by the viradel (virus adsorption–elution) method using charge modified, electropositive cellulosic filters or conventional electronegative cellulose ester micro filters. Viral analysis of field water samples by the viradel technique was surveyed. It also describes cellulose-based filter media used in individual protection equipment against airborne viral pathogens, presenting innovative filtration media with virucidal properties. Some cons of cellulosic viral filters and perspectives for cellulose-based materials in viral filtration were done in this study. **(Guy-Alain Junter *et al*., 2017)**

- The conventional treatment processes were unable to treat the excessive dissolved organic compounds by microfiltration technologies have gained momentum as effective solutions to treat the surface water. The efficacy of low-pressure membrane filtration technologies such as microfiltration and ultra filtration has been under scrutiny ever and numerous research studies aimed at enhancing their capabilities to reject the suspended solids and organic matters. This study to develop the trajectory of membrane technology, ranging from microfiltration membrane bioreactors, for treating dissolved organic matters in surface water and their future potential. This is a critical review of the physicochemical and biological options such as, but not limited to, pretreatment of water using coagulation, ozonation, adsorption and a combination of these. It is concluded that the membrane bioreactor system, which combines biological process and physical rejection, high potential in treating polluted surface water, which needs to be further investigated extensively to promote its application in water treatment plants.**(Chettiappan Visvanathan *et al*., 2017)**

- The aim of the study was to evaluate the use of membrane reactor for wastewater treatment Mazandaran pulp and paper industry. This industry waste water was determined experiments such as: COD, BOD, Colour, densitometry, viscometry and TG/DTA analyzer. In this study, flux and retention of various nano filtration and low-pressure reverse osmosis membranes were investigated at two temperatures. By using a low shear (DSS Labstak M20) and a high shear (CR250/2) filter. The overall aim was to study the suitability of nano filtration in purification of the discharge water from external activated sludge process in the pulp and paper industry for reuse in the paper manufacturing process and to compare the results of nano filtration paper machine process waters. To successfully remove mono valent anions and inorganic carbon from the discharge water a low-pressure reverse osmosis membrane such as the TFCULP membrane is needed. With that membrane the permeate flux is lower than for nano filtration membranes but the permeate quality is significantly better when considering inorganic ions such as sodium, chloride, nitrate and inorganic carbon (bicarbonate). The permeate flux was two times higher in the high shear filter than in the low shear filter but the retentions were significantly lower. The result of this study was decrease pollutants parameter in Tajan Rivers that is effluent because attention to surface water quality has limited in Iran. A direct nano filtration of discharge water from external activated sludge processes from pulp and paper mills gave a higher flux at a higher recovery than nano filtration of clear filtrates (process waters) from a paper machine. With the high shear CR250/2-nanofilter the fluxes of the NF270 and the TFC ULP membranes were from 100 to 150L/(m2 h) and from 45 to 65 L/(m2 h) respectively. when discharge waters were filtered at a pressure of 8 bar, a temperature of 40◦C and at a VRF of 10. These values were twice as high as those obtained with the low shear filter. However, the retentions were significantly lower (e.g. conductivity 15% units) with the high shear filter than with the low shear filter. An existing biological treatment in the mills effectively removed the low molar mass organic compounds resulting in a really high retention of organic compounds in NF. The measured parameters such as organic carbon, UV absorption and color were almost completely retained by the used membranes but inorganic carbon and mono valent ions (particularly chloride and nitrate ions) permeated easily through the NF270 membrane and were retained from 50 to 90% with the TFC ULP membrane. Chloride ions were always less permeated than nitrate ions but both ions existed at a higher concentration in the permeate of NF membranes than in the original discharge water. Especially, when the concentration factor was relatively high. The retention of inorganic carbon decreased also with concentration as well as at a high temperature. Generally, the retention of inorganic compounds was more affected by the temperature than the retention of organic compounds. NanO filtration was an attractive method to purify discharge waters for reuse in the paper manufacturing process as far as the discharge waters does not contain too high amounts of monovalent ions. This might when a paper mill was integrated with a pulp mill that uses chloride-based chemicals to bleach the pulp. Then the discharge water probably contains so much chloride ions that NF is not a sufficient method for circulating the discharge water back to the process. To remove mono valent anions and DIC from the discharge water low-pressure reverse osmosis membranes are needed such as the TFC ULP membrane. With that membrane the flux was lower but the permeate quality is significantly better as to inorganic compounds such as sodium, chloride, nitrate and inorganic carbon (bicarbonate). **(Mahdi Khosravi *et al*., 2011)**

- Bisphenol A (BPA) was one of the recalcitrant contaminants that were present in drinking water Sources. This study was conducted to explore the performance of ultra filtration (UF) membrane system for the BPA removal in which BPA was spiked in water sample collected from a treatment of plant. The effects of process conditions that may influence the removal and flux performance of the membrane including operating pressure, feed pH and BPA concentration and backwash cleaning were investigated. The results showed that an applied pressure of 1 bar was the optimum pressure for achieving good balance of BPA removal (95 %) and water flux (109 L m^{-2} h^{-1}) compared to operating pressure of 0.5 and 1.5 bar. The variation of feed pH showed significant impact on BPA elimination with the highest rejection (90 %) achieved at pH 7 while the lowest removal (20 %) at pH 10. BPA concentration had no significant impact on BPA removal as high removal rate (>95 %) was observed regardless of feed concentration. The membrane cleaning via backwash was able to recover 90 % BPA removal even after three consecutive cycles of filtration. This indicated the promising performance of UF membrane system for industrial water treatment. **(Mimi Suliza Muhamad *et al*., 2016)**

- In this study mainly focused on the multiple facets of water use, reuse and runoff in nursery and green house production including current and future regulations. Water filtration and water treatment to removal of sediment, pathogens and agro chemicals were discussed. Container-growth crop producers can adopt research-based practices proactively to minimize the economic and environmental risk of high quality water, by required to change external factors such as regulations and fines over time as a result of changing climate conditions. **(John C. Majsztrik *et al*., 2017)**

- In this study, to demonstrated the accumulated micropollutants in the spent carbon filter used in the water purifier. First, the method to desorbs micropollutant from the activated carbon was developed and optimized. Then, using this optimized desorption conditions micropollutants exist in spent carbon filters collected from houses in different regions in Korea where water purifiers were used. A total of 11 micropollutants (caffeine (CFF), acetaminophen (ACT), sulfamethazine (SMA), sulfamethoxazole (SMZ), metoprolol (MTP), carbamazepine (CBM), naproxen (NPX), bisphenol-A (BPA), ibuprofen (IBU), diclofenac (DCF) and triclocarban (TCB)) were analyzed using LC/MS-MS from the spent carbon filters. MTP were only detected in the carbon filters, but not in the tap waters indicating that these micropollutants, which exist less than the detection limit in tap water, were accumulated in the carbon filters. The regional micropollutant detection patterns in the carbon filters showed higher levels of micropollutants. The results suggest that desorption of micropollutant from the carbon filter used can be a tool to identify micropollutants present in tap water with trace amounts or below the detection limit. **(Da-Sol Kwon *et al*., 2017)**

- Enteric viruses were cause of waterborne disease in worldwide. Because of the drinking water the numbers are often quite low, large volumes (100-1,000L) of waters were processed. The VIRADEL was most commonly used method in microporous filters. Negatively charged filters require the addition of multivalent salts and acidification of the water sample to effect virus adsorption, which can make large-volume sampling difficult. Positively charged filters require no preconditioning of sample that were able to concentrate viruses from water over a greater pH range than electronegative filters. The most widely used electropositive filter was the Virosorb 1MDS Ultra filters concentrate viruses based on size exclusion rather than electro kinetics, but are impractical for field sampling or processing of turbid water. Elution (recovery) of viruses from filters following concentration is performed with organic (e.g., beef extract) or inorganic solutions (e.g., sodium polyphosphates). Eluates were reconcentrated to decrease the sample volume to enhance detection methods (e.g., cell culture infectivity assays and molecular detection techniques). While the majority of available filters were high virus retention efficiencies. These methods to elute and reconcentrate viruses have met with varying degrees of success due to the biological variability of viruses present in water. (**Luisa A.Ikner *et al*., 2012)**

- The membrane separation industry date back to the eighteenth century. However, commercial products appeared less than 50 years ago. The evolution of the industry to its current state was reviewed here. The important role of the saline water in the development of the industry was highlighted along with early patent literature that describes the manufacture, design, and operation of membrane systems. These patents still provide the technological base for the industry. The state-of-the-art in material selection, membrane formation, and module design and characterization was explained. Finally, emerging future directions were identified in select areas including gas separation, biotechnology, water and wastewater treatment, nanofiltration and alternative energy applications. **(G. Glenn Lipscomb., 2009)**

- Water is importance for life on earth. The synthesis and structure of cell constituents and transport of nutrients into the cells as well as body metabolism depend on water. The contaminations present in water were disturbing the spontaneity of the mechanism and result in long/short-term diseases. Continued research efforts result in some technologies to remove the contaminations from water. The review includes concepts and potentialities of the technologies in a comprehensible form. It also includes some meaningful hybrid technologies and promising awaited technologies in coming years. **(S.Sharma *et al*., 2017)**

- The contaminants in drinking water have been created a demand for household water treatment systems, which provide higher quality water to spread. The aim of this study was to evaluate the performance of household water treatment systems used in Kerman for the removal of cations and anions. Various brands of home water treatment devices commonly used in Kerman were selected, with one device chosen from each brand for study. In cases in which the devices were used extensively, samples were selected with filters that had been changed in proper time, based on the device's operational instructions. The samples were selected from homes in the center and four geographical directions of Kerman. Then, sampling was conducted in three stages of input and output water of each device. For each of the samples, parameters were measured. Such as chloride, sulfate, bicarbonate, calcium, magnesium, hardness, sodium, nitrate and nitrite (mg/L), temperature (^{o}C) and pH. The average removal efficiency of different parameters by 14 brands in Kerman, which include chloride ions, sulfate, bicarbonate, calcium, magnesium, sodium, nitrites, nitrates, and total hardness, was obtained at 68.48, 85, 67, 61.21, 78.97, 80.24, 32.59, 66.83 and 69.38%, respectively. The amount of sulfate, bicarbonate, chloride, calcium, magnesium, hardness, sodium and nitrate in the output water of household water treatment systems. Nitrite concentration in the output of some devices was more than the input water and showed a significant difference (P less than 0.05). **(Mohammad Malakootian *et al*., 2017)**

- ❖ An effective method for separating sodium alginate through polysulfone (PSf) membranes modified with tetrahydrofuran (THF) and water pressure. The PSf were dipped into THF and then exposed to water pressure. Upon the application of water pressure, the PSf showed interconnected "sponge-like" pores structures and had a higher porosity of 24.6%. In addition, the modified PSf support at 8 bar for 30 s showed the highest water flux of 259 L/m2h in the sodium alginate filtration test.The modified PSf support at 8 bar for 1 min showed a notable sodium alginate rejection of 98.8%. These results were attributable to the weakened interactions of the polysulfone chain when the PSf supports were exposed to THF and water pressure of 8 bar. The higher porosity of the modified supports was confirmed by scanning electron microscopy (SEM) and porosimeter data.**(Jeonghyun Hwang *et al*., 2017)**

- ❖ The use of membrane technology for produced oily water treatment has become an active area of research for both academia and industry. The membranes have enhanced efficiency and prolonged life time during oily water treatment has been a rallying point for many scientists. This review was on the advancement of polymeric and ceramic membrane technologies, membrane modification strategies used to mitigate membrane fouling and optimization of permeate flux, particularly for oily water systems. In addition, recent methodologies used for modeling the permeate flux decline were highlighted. **(Mohamed Zoubeik *et al*., 2017)**

- In this study development and application of photo catalytic membrane reactors for water treatment from organic pollutants has been analyzed. The main types of these reactors and the construction techniques the properties of catalytically active membranes were discussed. The combination of photo catalysis and the membrane methods was facilitate the effective removal of different organic substances from water. The factors affecting the water purification efficiency and the prospects of using the hybrid photocatalytic membrane reactors in water treatment proces were also mentioned. **(V. M. Kochkodan *et al.*, 2009)**

- The state of the art in scientific developments and technological solutions to develop nanofiltration in drinking water treatment. This shown the possibilities of nanofiltration and analyzed reasons restricting its wide scale use in drinking water supply. It was covered new approaches to the solution of problems related to membrane fouling. **(V. V. Goncharuk *et al.*, 2011)**

- Syzygium cumini and Cd(II) samples were mixed together and characterized by FT-IR and scanning electron microscope(SEM) techniques. The biosorption of cadmium ion in aqueous solution was study as a function of pH, contact time, adsorbate, adsorbent, cation and anoin concentrations. Biosorption capacities and rate of transfer of cadmium ions onto syzygium cumini were evaluated. **(Rao *et al.*, 2010)**

- By using a batch adsorber the adsorption of cadmium on to syzygium cumini has been studied. While contact time, solution pH, initial concentration and adsorbent particle size have been determined to affect the Cd (II) sorption. Equilibrium isotherms were studies the sorption capacity of syzygium cumini leaves. Using Langmuir model equation, the mono layer of sorption capacity of syzygium capacity were studied. **(Kalpana.p *et al.*, 2011)**

- The removal of Fe(II) can removed by treating syzygium cumini leaves powder(SCL) with nitric acid. Because of low cost, easily available and renewable. The experiments were carried out for adsorption kinetics and isotherm. Adsorption capacity to enhanced by increasing the temperature up to 45^{o}C. Thermo dynamic study has showed that Fe(II) adsorption phenomenon onto SCLP was favoured and spontaneous. **(Halnor *et al.*, 2012)**

- "Jamun" is an important medicinal plant used in various traditional medicine. It is effective in the treatment of diabetes mellitus, inflammation, ulcers and diarrhea and preclinical studies have possess chemo preventive, radio protective and antineoplastic properties. The plant is rich in compounds containing anthocyanins, glucoside, ellagic acid, isoquercetin, kaemferol and myrecetin. Jamun is traditionally used for the treatment of various diseases especially diabetes and related complications. Jamun is selective in the action in breast cancer cells. The effect of Jamun and its phytochemicals was also be investigated for its chemo preventive effects in other models of carcinogens, that includes chemical, radiation and viral carcinogenesis models. Jamun raw and value added products should be advertised to urban population for its health benefits and especially for promotion of Jamun growers in India.(**Vikas Ramteke *et al.*, 2015)**

- Water and energy always crucial for the world's social and economic growth. Their supply and uses must be sustainable. This study to develop membrane technologies in water and energy sustainability. By analyzing their potential applications by membrane providing emerging technologies and scrutinizing research and development challenges in the field of membrane materials. **(Ngoc Lieu Le *et al.*, 2016)**

- By using novel methodology the metal nano particles were modified by to prepare sensors based on carbon nanostructures electrodes was proposed. In this study a novel bismuth nanoparticle/carbon nanofiber (Bi-NPs/CNF) electrode and a carbon nanotube (CNT)/gold nanoparticle (Au-NPs) have been developed. Bi-NPs/CNF films were prepared by some of the methods. To demonstrate the utility and versatility of these methods, single walled carbon nanotubes (SWCNTs) and gold nanoparticles (Au-NPs) were selected to prepared a completely different electrode. Thus, the new Au-NPs/SWCNT/PTFE electrode was tested with a multi response technique. UV/Vis absorption spectroscopy experiments were carried out for studying dopamine, demonstrating the good result of the Au-NPs/SWCNT electrode developed. **(Erica Paramo *et al.*, 2018)**

- The study was evaluated to various medicinal plants used for anti diabetic activity. Diabetes mellitus was one of the most common non-communicable diseases globally. This possesses threat to be a 21st century. However ancient time plants have been exemplary source of medicine. In Ayurveda mentioned the used of plants in treatment of various ailments. In estimated 2, 50,000. Systematic study was to be determined this medicinal plant. **(G Arumugam *et al.*, 2013)**

AIM AND SCOPE

3. AIM AND SCOPE

- ✓ Water is very precious to human life. Pure water is very essential in our health point of view.
- ✓ Membrane technology plays a vital role in the purification of water by water treatment processes.
- ✓ Thus the main scope of this work is to prepare a green membrane and to study its characteristics.
- ✓ The membrane is applicable in the removal of salt from salt water and also the role of this eco-friendly membrane in human life.

MATERIALS AND METHODS

4. MATERIALS AND METHODS

4.1 Chemicals required

Cellulose Acetate, Jamun Leaf Powder, BDH Indicator, Ammonium Chloride and 1.25g of Magnesium Salt of EDTA, Erichrome Black –T Indicator, Calcium Carbonate, Murexide Indicator, Sodium hydroxide, Phosphate buffer, Magnesium Sulphate, Calcium Chloride, Ferric Chloride, Potassium Dichromate, Standard Ferrous Ammonium Sulphate (FAS) 0.25N, Ferrion Indicator, Concentrated Sulphuric Acid, Silver Sulphate Crystals, Mercuric Sulphate Crystals, Potassium Chromate Indicator, Silver Nitrate Solution (0.014N), Sodium Fluoride, Zirconyl Chloride Octahydrate, Zirconyl Acid-SPADNS Reagent, Phenolphthalein Indicator, Methyl Orange Indicator, Standard Sulphuric Acid, 0.1N Potassium Chloride.

4.2 Preparation of membrane

Membrane Preparation (a)

About 2g of jamun leaf powder, 1g of charcoal and 0.5g of cellulose acetate was mixed with about 7ml of water and it is stirred well by using mortal piston to form a paste. Then paste is applied uniformly on the 6.12cm length and 3.14mm of stainless steel was taken the stainless steel rod and it is rotated in the tile to make it uniform surface on the stainless steel. It was dried at 24 hours at room temperature. Then the thickness of the membrane was found to be 15.45mm.

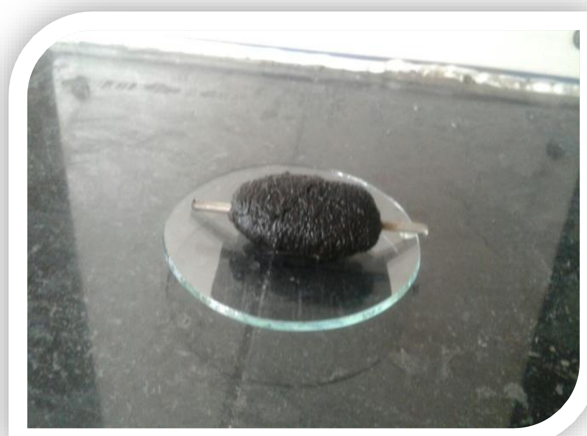


Figure 4.1 Membrane (a)

Membrane preparation (b) About 2g of jamun leaf powder, 0.5g of charcoal and 0.5g of cellulose acetate was mixed with about 8ml of water and it is stirred well by using mortal piston to form a paste. Then paste is applied uniformly on the 6.12cm length and 3.14mm of stainless steel was taken the stainless steel rod and it is rotated in the tile to make it uniform surface on the stainless steel. It was dried at 24 hours at room temperature. Then the thickness of the membrane was found to be 15.50mm	 **Figure 4.2 Membrane (b)**

4.3 Characterization of membrane

The prepared membrane was characterized by the following techniques

Compaction

The thickness of the cast membrane was measured by using WIRA Digital thickness tester (WIRA Instrument, UK). The thickness of the membrane used in this study was 0.43±0.2mm. The prepared membrane was initially pressured with distilled water at 250mm Hg for 2min 38 sec. These pre-pressurized membrane were used in subsequent water filtration process.

Water uptake

Percent water content of the membrane was obtained after soaking the membrane in water for 24hrs and the membrane were weighed followed by mapping it with filter paper. The wet membrane was placed in opened air at 1hr and the dry weights of the membrane were determined. From the wet and dry weights, percentage of water content was determined by

% water content = wet sample weight - Dry sample weight/wet sample weight × 100

FT-IR

The membrane structure of the prepared membrane was characterized by using FT-IR (Model IR Affinity-1).

SEM

The surface morphology of the prepared membrane was viewed through scanning electron microscope studies. The model used was SCANNING ELECTRON MICROSCOPE XL 20 PHILPS.

TGA

Using thermo gravimetric analysis the weight loss of the membrane was found out. This model used for this was EXSTAR SII TG/DTA6300.

Filtration of membrane

The water was filtered using steel rod covered with the prepared membrane. The sample water was added drop wise to it so the water is filtered through the membrane. The filtered water was then collected and then analyzed the physio-chemical parameters.

4.4 Analysis of physical and chemical parameters

The parameters analyzed to assess the water quality are broadly divided into

Physio-chemical parameters

pH, electrical conductivity, Total Hardness, Calcium Hardness, Magnesium Hardness, Dissolved Oxygen (D.O), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Carbonate and Bicarbonate, Chlorides, Fluoride, Sodium, Bacteria and Fungi.

pH

The effect of pH on the chemical and biological properties of liquid makes its determination very important. It is one of the most important parameter in water chemistry and is defined as -log $[H^+]$, and measured as intensity of acidity or alkalinity on a scale ranging from 0.14. If free H^+ are more it is expressed acidic (i.e. pH<7) while more OH^- ions is expressed as alkaline (i.e. pH>7).

In natural water pH is governed by the equilibrium between carbon dioxide/ bicarbonate/ carbonate ions and ranges during day largely due to photosynthetic activity (consumption of carbon-di-oxide) and decreases during night due to respiratory activity. Waste water and polluted natural waters have pH values lower or higher than 7 based on the nature of the pollutant.

Apparatus required

- **pH indicator (BDH) method:** BDH indicator (9Universal Indicator) and test tubes.
- **Electrometric method:** Glass electrode, reference electrode (mercury/ calomel or silver/ silver chloride) and pH meter.
  The colorimetric indicator method can be used only for approximate pH values.

Procedure

- **Colorimetric method:** About 10ml of the simple is taken in a wide mouth test tube, 0.2ml of BDH indicator is added, and shaken gently. The color developed is matched with the chart and the pH is noted.

Electrical conductivity (EC)

Principle

The electrical conductivity is used to determine the cell constant value.

Apparatus required

EC meter and Thermometer

Reagent

0.01N Potassium chloride solution: Dry a small quantity of A.R grade Potassium chloride at 60°C for 2 hours. Weigh 0.7456gm of it and dissolve in freshly distilled water and make to one litre. The solution gives an electrical conductivity of 1411.8×10^{-3} i.e. 141dS/m at 25°C

Procedure

- Calibrate the conductivity cell with the help of standard KCl solution and determine the cell constant.
- Dip the conductivity cell assembly in water sample taken in a 50 or 100ml beaker and record the conductivity. If the value is too low, change the adjustments accordingly. Record the temperature of water during the test.
- Observed values of EC are multiplied by the cell constant (using given on conductivity cell) and a temperature factor to express results at 25°C.
- Remove the cell from sample water, clean with distilled water and dip into a beaker of distilled water. EC is expressed as dS/m.
- Keep the conductivity cell in distilled water when not in use.

Calculation

The cell constant K is given by cell constant (K) = $EC_{w25} = EC_T \times K \times F_t$

Where,

- EC_{w25} is the conductivity of water at 25°C.
- EC_T is apparent conductivity of water as measured.

- K is the constant
- Ft is the temperature correction factor.

Total hardness

Hardness is predominantly caused by divalent cations such as calcium, magnesium, alkaline earth metal such as iron, magnesium, strontium, etc. The total hardness is defined as the sum of calcium and magnesium concentration, both expressed as $CaCO_3$ in mg/l. Carbonated and bicarbonate of calcium and magnesium cause temporary hardness. Sulphates and chlorides cause permanent hardness.

Principle

In alkaline conditions EDTA (Ethylene diamine tetra acetic acid) and its sodium salt react with cations forming a soluble chelated complex when added to a solution. If a small amount of dye such as Erichrome black-T is added to aqueous solution containing calcium and magnesium ions at alkaline pH of 10.0±0.1, it forms wine red colour. When EDTA is added as a titrant, all the calcium and magnesium ions in the solution get complexed resulting in a sharp color change from wine red to blue, marking the end point of titration.

Hardness of water prevents lather formation with soap rendering the water unsuitable for bathing and washing. It forms scale in boilers, making it unsuitable for industrial usage. At higher pH >12.0, Mg^{++} ion precipitates with only ca^{++} in a solution. At this pH, murexide indicator forms a pink color with ca^{++} ion. When EDTA is added ca^{++} gets complexed resulting in a change from to purple indicating end point of the reaction

Apparatus required

Burette, Pipette, Conical flask, Beakers, etc.,

Reagents

- **Buffer Solution:** 16.9 g of ammonium chloride and 1.25g of magnesium salt of EDTA is dissolved in 143ml of concentrated ammonium hydroxide and diluted to 250ml with distilled water.

- **Erichrome black-T indicator:** 0.5g of Erichrome black-T indicator is dissolved in 100g of triethanolamine.
- **Standard EDTA titrant**: 0.01M or Ng AR grade EDTA is dissolved in distilled water and dilutedto100ml and is standardized against standard calcium solution 1ml =1mg $CaCO_3$.
- **Standard Calcium Solution:** 1.0g of AR grade $CaCO_3$ is weighed into a 250ml conical flask, to which 1:1 HCL is added and boiled to expel carbon-di-oxide, and diluted to 100ml. 1ml =1mg $CaCO_3$.

Procedure

Exactly 50ml of the well-mixed sample is pipette into a conical flask, to which 1ml of ammonium buffer and 2-3 drops of Erichrome Black-T indicator is added. The mixture is titrated against standard 0.01M EDTA until the wine red color of the solution turns pale blue at the end point.

Calculation

$$\text{Total Hardness} = \frac{\text{Volume of titrant x 1 x 1000}}{\text{Volume of sample taken}}$$

Calcium hardness

The presence of calcium (fifth most abundant) in water results from passage through or over deposits of limestone, dolomite, gypsum and such other calcium bearing rocks. Calcium contributes to the total hardness of water and is an important micro- nutrient in aquatic environment and is especially needed in large quantities by molluscus and vertebrates. It is measured by EDTA titrimetric method. Small concentration of calcium carbonate prevents corrosion of metal pipes by laying down a protective coating. But increased amount of calcium precipitates on heating to from harmful scales in boilers, pipes and utensils.

Principle

When EDTA (Ethylene-diamine tetra acetic acid) is added to the water containing calcium and magnesium, it combines first with calcium. Calcium can be determined directly with EDTA when pH is made sufficiently high such that the magnesium is largely precipitated as hydroxyl compound (by adding NaOH and iso-propyl alcohol). When murexide indicator is added to the solution containing calcium, all the calcium gets complexed by the EDTA at pH 12-13. The end point is indicated from a colour change from pink to purple.

Apparatus required

Burettes, Pipette, Conical flask, Beaker and Droppers.

Reagents

- Sodium hydroxide (8%): 8g of Sodium hydroxide in 100ml of distilled water.
- Murexide indicator (ammonium purpurate): 0.2g of murexide is ground well with 100g of sodium chloride thoroughly.
- Standard EDTA titrant, 0.01M: 3723 g of EDTA (disodium salt) is dissolved in distilled water made up to 100ml with the same.

Procedure

A known volume (50ml) of the sample is pipette into a clean conical flask, to which 1ml of sodium hydroxide and 1ml of isopropyl alcohol is added. A pinch of murexide indicator is added to this mixture and titrated against EDTA until the pink color purple.

Calculation

$$\text{Calcium as Calcium carbonate} = \frac{\text{Volume of titrant} \times 1 \times 1000}{\text{Volume of Sample taken}}$$

Magnesium hardness

Magnesium is a relatively abundant element in the earth's crust, ranking eighth in abundance among the elements. If is found in all natural waters and its lies in rocks, generally present in lower concentration than calcium. It is also an important element contributing to hardness and a necessary constituent of chlorophyll. Its concentration of water greater than 125 mg/L can influence cathartic and diuretic actions.

Principle

Magnesium hardness can be calculated from the determined total hardness and calcium hardness.

Calculation

Magnesium hardness = (Total hardness – Calcium hardness)

High concentration of magnesium proves to be diuretic and laxative, and reduces the utility of water for domestic use while a concentration above 500 mg/L imparts an unpleasant taste to water and renders it unfit for drinking. Chemical softening, reverse osmosis and electro dialysis or ion exchange reduces the magnesium hardness to acceptable levels.

Chlorides

The presence of chlorides in natural waters can mainly be attributed to dissolution of salt deposits in the form of ions (Cl^-). Otherwise, high concentrations may indicate pollution by sewage, industrial wastes, intrusion of sea water or other saline water. It is a major form of inorganic anions in water for aquatic life. High chloride content has a deleterious effect on metallic pipes and structures, as well as agricultural plants. They are calculated by Argentometric method.

Principle

In alkaline or neutral solution, potassium chromate indicated the end point of the silver nitrate titration of chlorides. Silver chloride is quantitatively precipitated before the red silver chromate is formed.

Apparatus required

Burette, Pipette, Conical flask, Beaker etc

Reagents

- **Potassium chromate indicator solution:** 50g of potassium chromate is dissolved in minimum amount of distilled water and silver nitrate is added drop wise till a red precipitate is formed. The mixture is allowed to stand for about 12 hours and diluted to 1000ml with distilled water.
- **Silver nitrate solution (0.014N):** 2.395g of silver nitrate is dissolved in distilled water and made up to 1000ml.

Procedure

A known volume of filtered sample (50ml is taken in a conical flask, to which about 0.51 if potassium chromate indicator is added and titrated against standard silver titrate dichromate ($AgCrO_4$) starts precipitating.

Calculation

$$\text{Total Sodium chloride} = \frac{\text{Volume of silver nitrate x normality}}{\text{Volume of sample taken}}$$

Fluoride

Fluoride has dual significance in water supplies. High concentration caused dental fluorosis and lower concentration (<0.8 mg/L) caused dental caries. A fluoride concentration of approximately 1mg/L in drinking water is recommended. They are frequently found in certain industrial processes resulting in fluoride rich waste waters. Significant sources of fluoride are found in coke, glass and ceramic, electronics, pesticide and fertilizer manufacturing, steel and aluminum processing and electroplating industries. It is calculated by SPADNS method.

Principle

The colorimetric method of estimating fluoride is based on the reaction of fluorides (HF) with zirconium SPADNS solution and the 'lake' (colour of SPADNS reagent), which is greatly influenced by the acidity of the reaction mixture. Fluoride reacts with the dye 'lake', dissociating (bleaching) dye into a colourless complex anion ($ZrF6^{2-}$). As the amount of fluoride increases, the colour produced becomes progressively higher or of different hue.

Apparatus required

Spectrometer and Lab glassware.

Reagents

Standard fluoride solution

- **Stock:** 221.0mg of AR grade sodium fluoride was dissolved in distilled water and made up too 100ml to give =100μg of F^-
- **Working standard:** 100ml of the stock fluoride was diluted to 100ml to give 1ml= 10μg of fluoride.
- SPADNS solution: 958 mg of SPADNS is dissolved in 500ml of distilled water.
- **Zirconyl-acid reagent;** 133mg Zirconyl chloride octahydrate ($ZrOCL_2.8H_2O$) was dissolved in about 25ml of distilled water. 350ml of Conc.HCL was added and diluted to 500ml with distilled water.
- **Zirconyl acid-SPADNS reagent:** Equal volume SPADNS and zirconyl acid reagent was mixed.

Procedure

A standard graph is prepared by using fluoride concentrations ranging from 0.005 mg/L to 0.150 mg/L at 70nm. A reference solution is prepared by adding 4ml of acid zirconyl-SPADNS reagent to 21 ml of distilled water. A known volume of filtered sample (21 ml) is taken in a test tube, 4ml of acid zirconyl –SPADNS reagent is added to the sample along with a reference solution. The mixture is left for about 30 min for complete colour development and the optical density is read at 570 nm

Calculation

$$\text{Fluoride} = \frac{(\text{O.D sample})\ (\text{conc.of the standard})\ (1000)}{(\text{O.D standard})}$$

Carbonate and bicarbonate

Carbonate and bicarbonate in a solution can be determined by titrating the solution against acid using phenolphthalein and methyl orange respectively as indicators when the color of the phenolphthalein is discharged it indicates of the neutralization of carbonate. At this stage methyl red indicator is added and the titration is continued when the color changed from yellow to rose it is the end point for the complete neutralization of bicarbonate. The following equation illustrates the changes.

$$2Na_2CO_3 + H_2SO_4 = 2NaHCO_3 + Na_2SO_4$$

Pink Colorless

$$2NaHCO_3 + H_2SO_4 = Na_2SO4 + 2H_2O + 2CO$$

Reagent

- Standard sulphuric acid (0.05n)
- Methyl orange indicator (0.5%)
- Phenolphthalein indicator (0.25%)

Procedure

- ✓ Pipette 10ml of water in conical flask and add 2-5 drops of phenolphthalein. Appearance of pink color indicates the presence of carbonate.
- ✓ If carbonate is present add 0.1N sulphuric acid from a burette till the solution become colorless.

- ✓ Record these readings add a few drops of methyl orange indicator and titrate till the color changes from yellow to rose red.
- ✓ Record this reading and also repeat this process number of times to get the concordant readings.

Calculation

- Volume of the water sample taken =25g
- Volume of 0.1N H_2SO_4 used for half Neutralization of CO_3 = A ml
- Volume of 0.1N H_2SO_4 used for complete Neutralization of CO =2 X A ml

RESULTS AND DISCUSSION

5. RESULTS AND DISCUSSION

5.1 FT-IR spectrum

5.1.1 FT-IR spectrum of membrane (a)

The FT-IR spectrums of membrane (a) are shown in figure 5.1 and the values are tabulated in table 5.1.

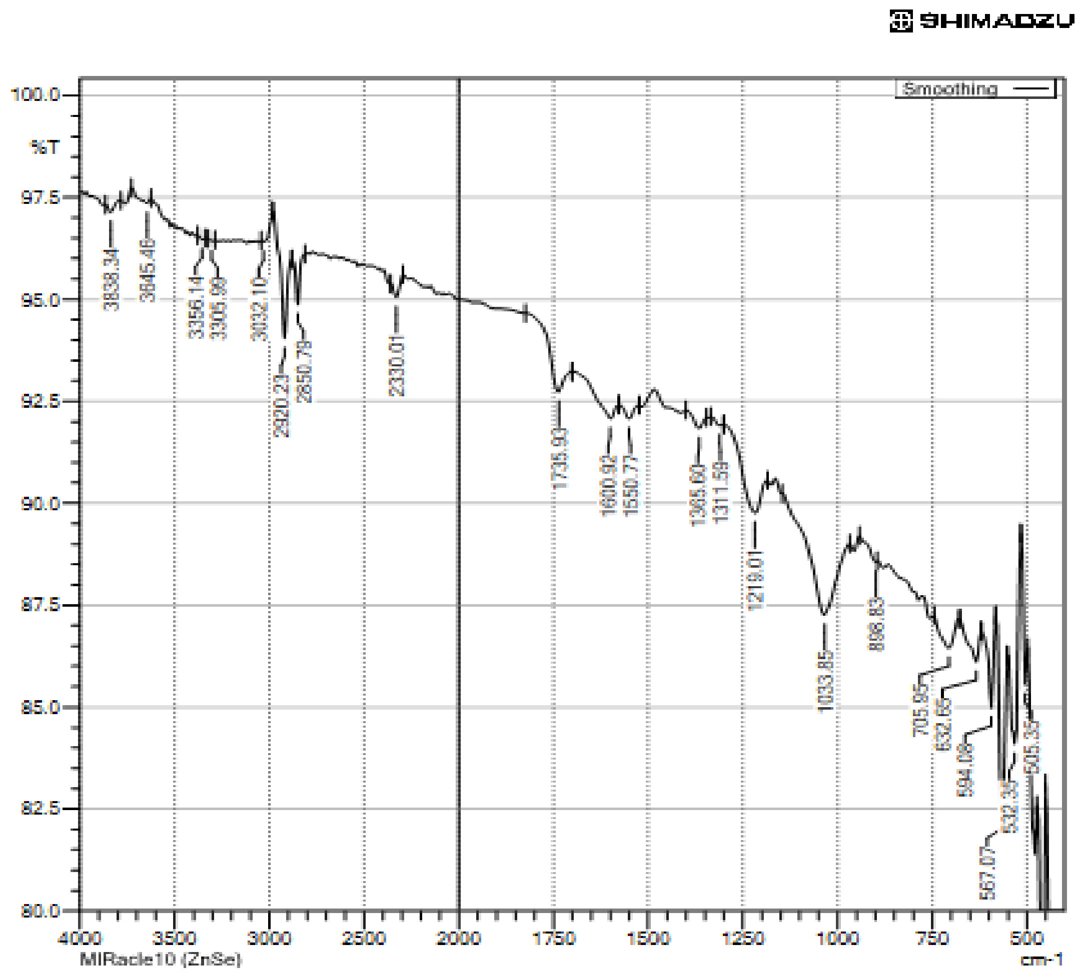


Figure 5.1

FT-IR spectrum of membrane (a)

Table 5.1

FT-IR Peaks of membrane (a)

Frequency (cm^{-1})	**Assignment**	**Possibilities**
3645.46	O-H stretch	Alcohols
3356.14	O-H stretch (H-bonded), N-H stretch	Alcohols, amines, amides
3305.09	O-H stretch (H-bonded), N-H stretch	Alcohols, amines, amides
3032.10	==C-H stretch, O-H stretch	Alkenes, carboxylic acids
2920.23	C-H stretch, O-H stretch	Alkanes, carboxylic acids
2850.79	C-H stretch, =C-H stretch, O-H stretch	Alkanes, aldehydes, carboxylic acids
1735.33	C=O stretch	Carbonyl groups, ester
1600.92	N-H bend, N-H bend	Amines, amides
1550.77	N-O stretch, N-H bend	Nitro groups, amides
1365.60	-C-H bend, N-O stretch	Alkanes, nitro groups
1311.59	C-N stretch, C-O stretch	Amines, carboxylic acids
1219.01	C-N stretch, C-O stretch	Amines, ester
898.83	=C-H bend	Alkenes
705.95	=C-H bend	Alkenes

From the table it was found that the peaks corresponding alcohols, alkanes, alkenes, amides, carboxylic acids, carbonyl groups, ester, amines and nitro groups were identified.

5.1.2 FT-IR spectrum of membrane (b)

The FT-IR spectrum of membrane (b) are shown in figure 5.2 and the values are tabulated in table 5.2

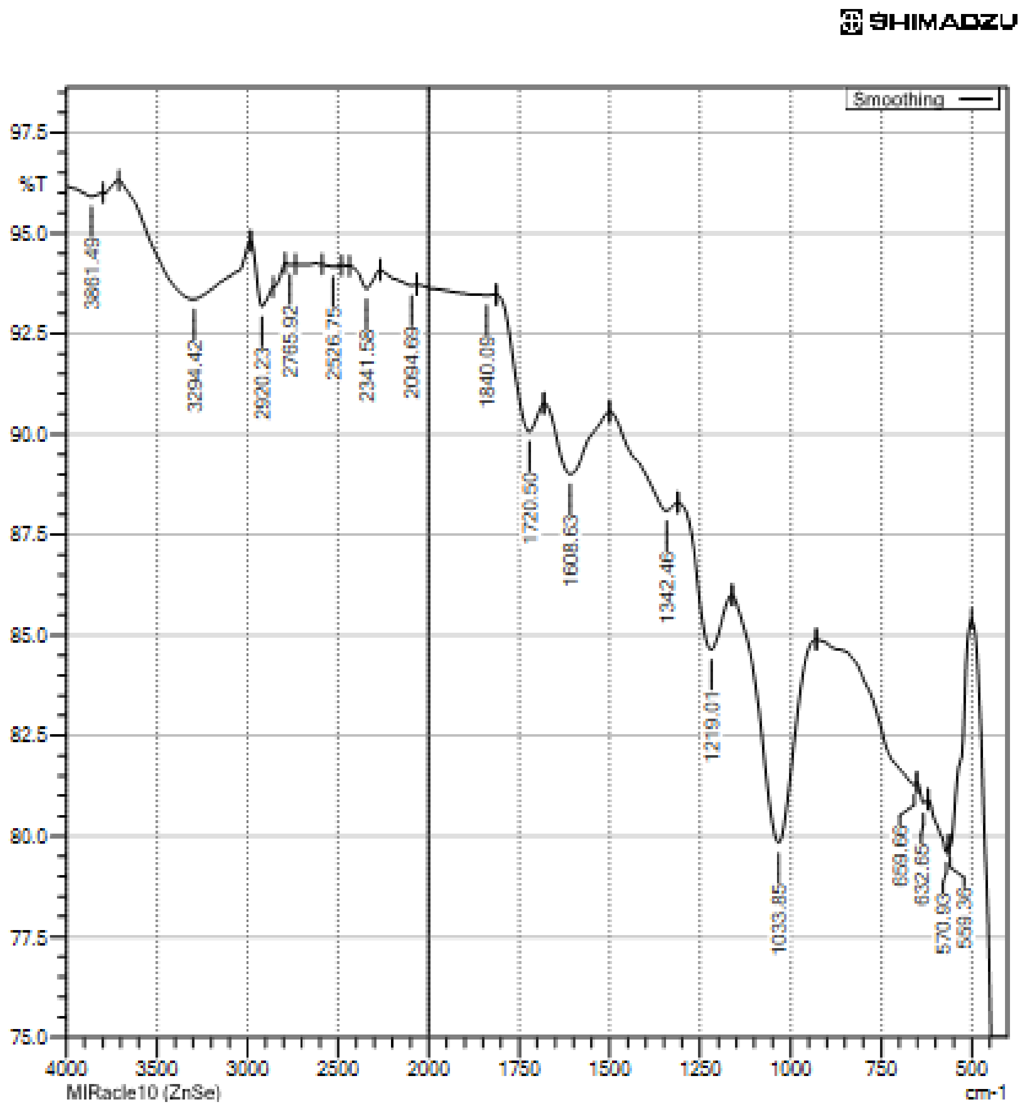


Figure 5.2

FT-IR spectrum of membrane (b)

Table 5.2

FT-IR Peaks of membrane (b)

Frequency (cm^{-1})	**Assignment**	**Possibilities**
3294.42	O-H stretch (H- bonded), N-H stretch	Alcohols, amides
2920.23	C-H stretch	Alkanes
2765.92	O-H stretch	Carboxylic acids
2526.75	O-H stretch	Carboxylic acids
1720.50	C=O stretch	Carbonyl groups, carboxylic acids
1608.63	C=C stretch, N-H bend	Alkenes, amides
1342.46	C-N stretch, N-O stretch	Amines, nitro groups
1219.01	C-N stretch, C-O stretch	Amines, carboxylic acids, ether
	C-N stretch, C-O stretch	Alcohols, ester

From the table it was found that the peaks corresponding alcohols, alkanes, amides, carboxylic acids, carbonyl groups, ester, amines and nitro groups were identified.

5.1.3 FT-IR spectrum of cellulose acetate

The FT-IR spectrums of cellulose acetate are shown in figure 5.3 and the values are tabulated in table 5.3.

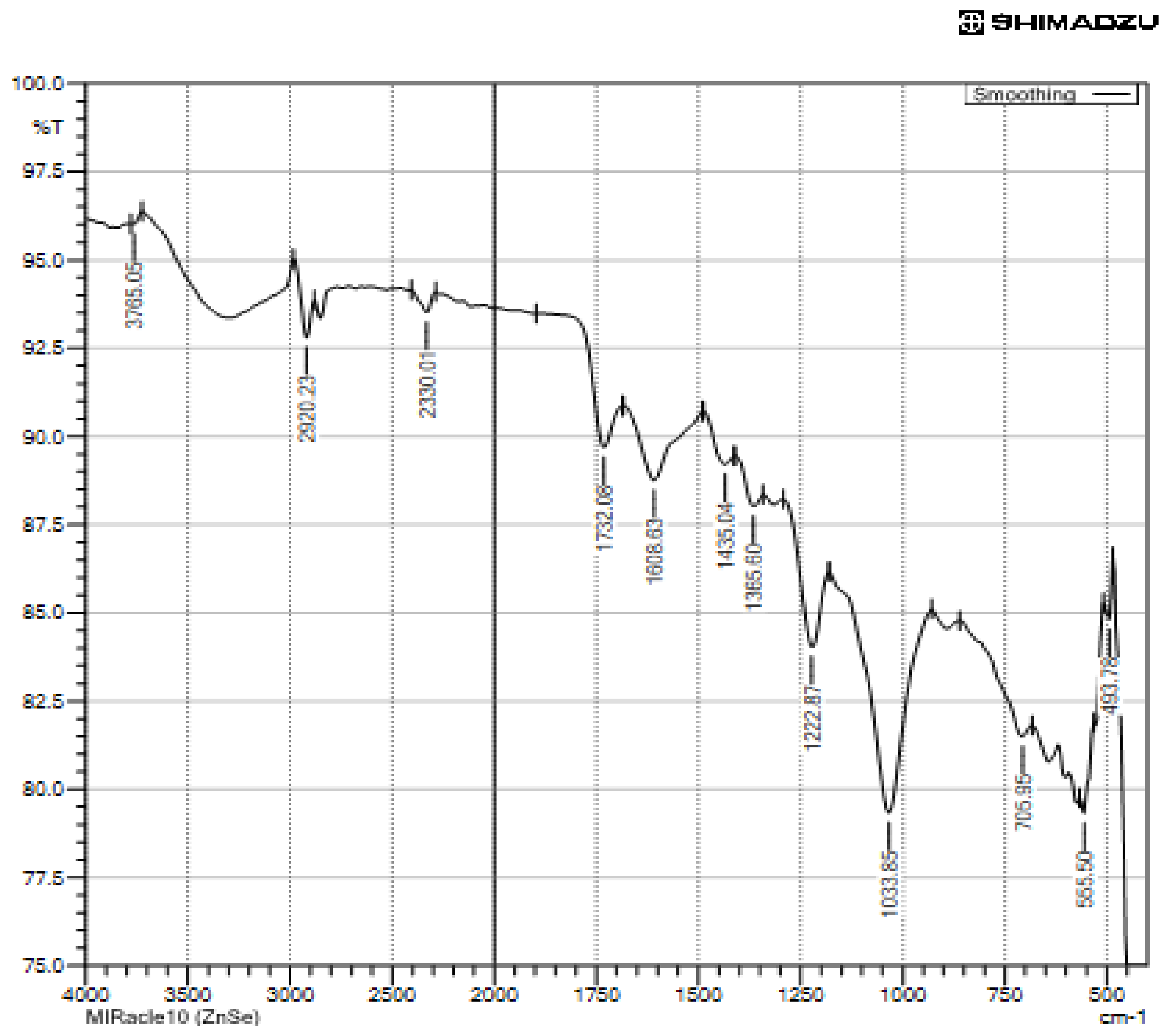


Figure 5.3

FT-IR spectrum of cellulose acetate

Table 5.3

FT-IR Peaks of cellulose acetate

Frequency (cm^{-1})	**Assignment**	**Possibilities**
3765.05	O-H stretch	Alcohol
2920.23	C-H stretch	Alkanes
1732.08	C=O stretch	Carbonyl groups
1435.04	-C-H bend	Alkanes
1365.60	-C-H bend, C-O stretch	Alkanes, ester
1222.87	C-O-H bend, C-O stretch	Alcohols, carboxylic acid
1033.85	C-O stretch	Ester

From the table it was found that the peaks corresponding alcohols, alkanes, carbonyl groups, ester and carboxylic acids were identified.

From the values of FT-IR spectrum in membrane (a), (b) and cellulose acetate we can understand that syzygium cumini leaves and charcoal powder blended with cellulose acetate.

5.2 water uptake

Membrane (a):

% Water content = Wet sample weight – Dry sample weight/ wet sample weight x 100

= [10.550- 5.060/10.550 x 100]

=0.0052.

Membrane (b):

% Water content = Wet sample weight – Dry sample weight/ wet sample weight x 100

= [11.732- 6.260/11.732 x 100]

= 0.0047.

5.3 Membrane thickness

The thickness of the membrane was measured using WIRA Digital thickness tester (WIRA Instrument, UK). The thickness of the prepared membrane (a) was 14.15mm and thickness of the membrane (b) was 15.50mm.

5.4 TGA

Figure 5.4 & 5.5represents the TG curve of membrane (a). The weight loss of membrane (a) is completely decreased at 108^0C. Likewise, figure 5.6 & 5.7 represents the TG curve of membrane (b). The weight loss of the membrane (b) is completely decreased at 111 ^{0}C.

Figure 5.4

Thermo gravimetric analysis of the membrane (a)

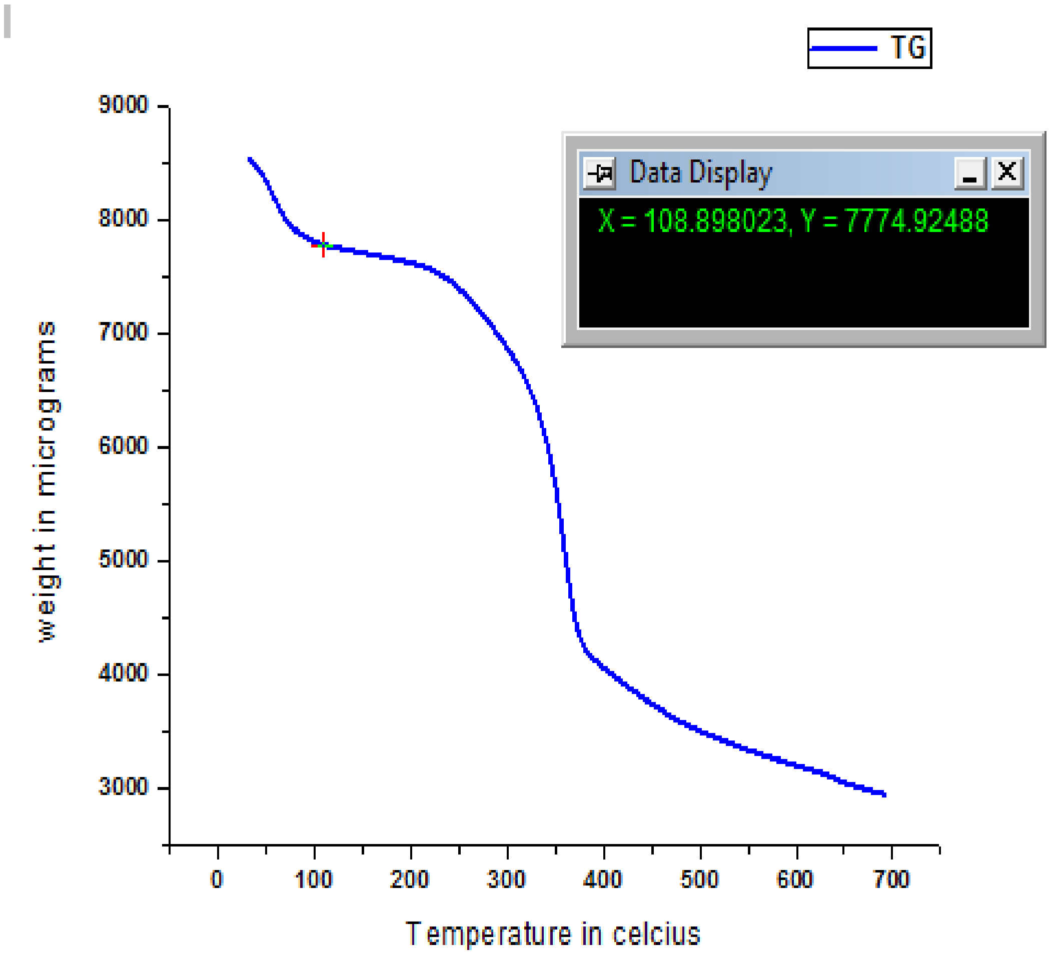
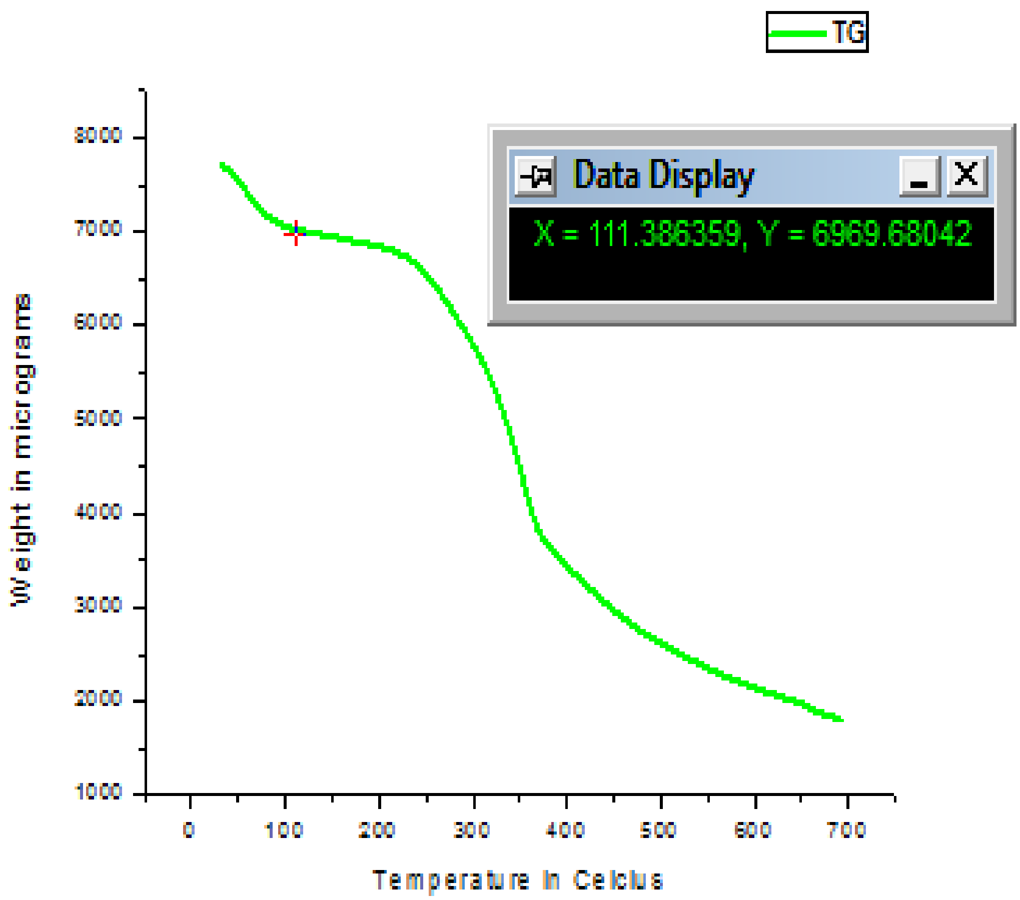


Figure 5.5

Thermo gravimetric analysis of the membrane (b)



5.5 SEM

Figure 5.6

Scanning electron microscope image of the membrane (a) at 10µm

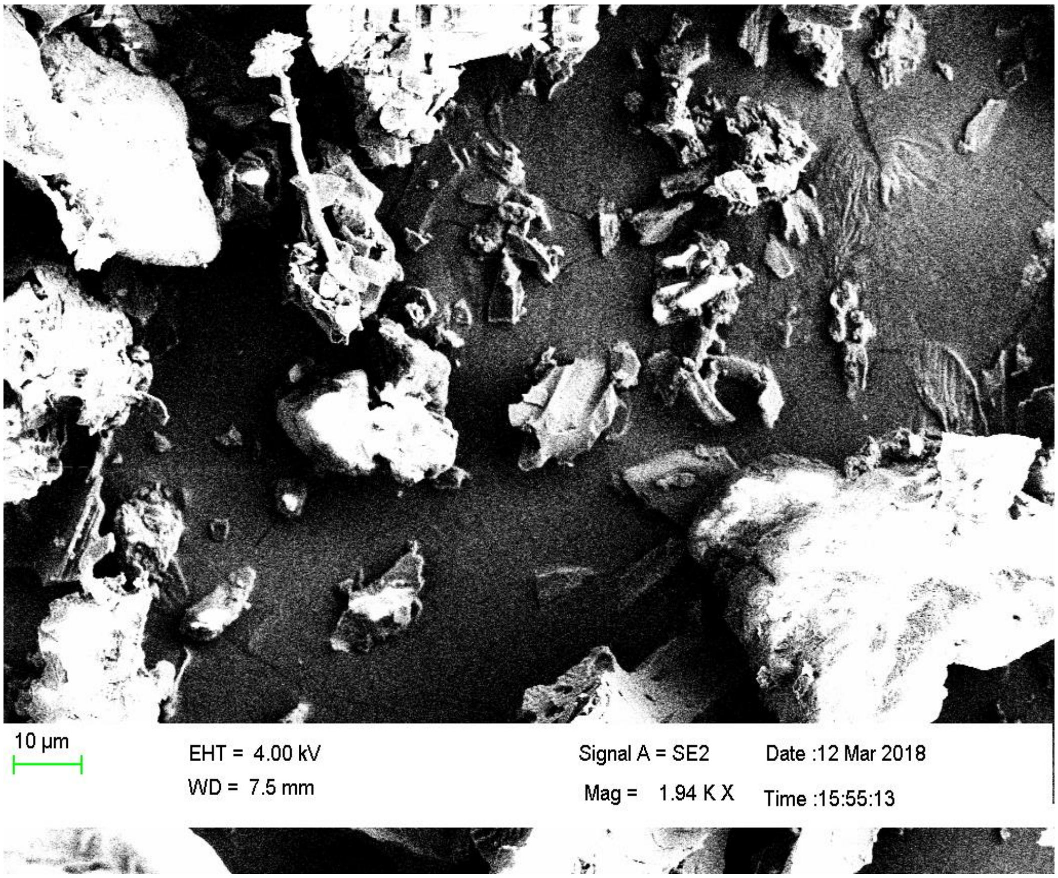


Figure 5.7

Scanning electron microscope image of the membrane (a) at 2µm

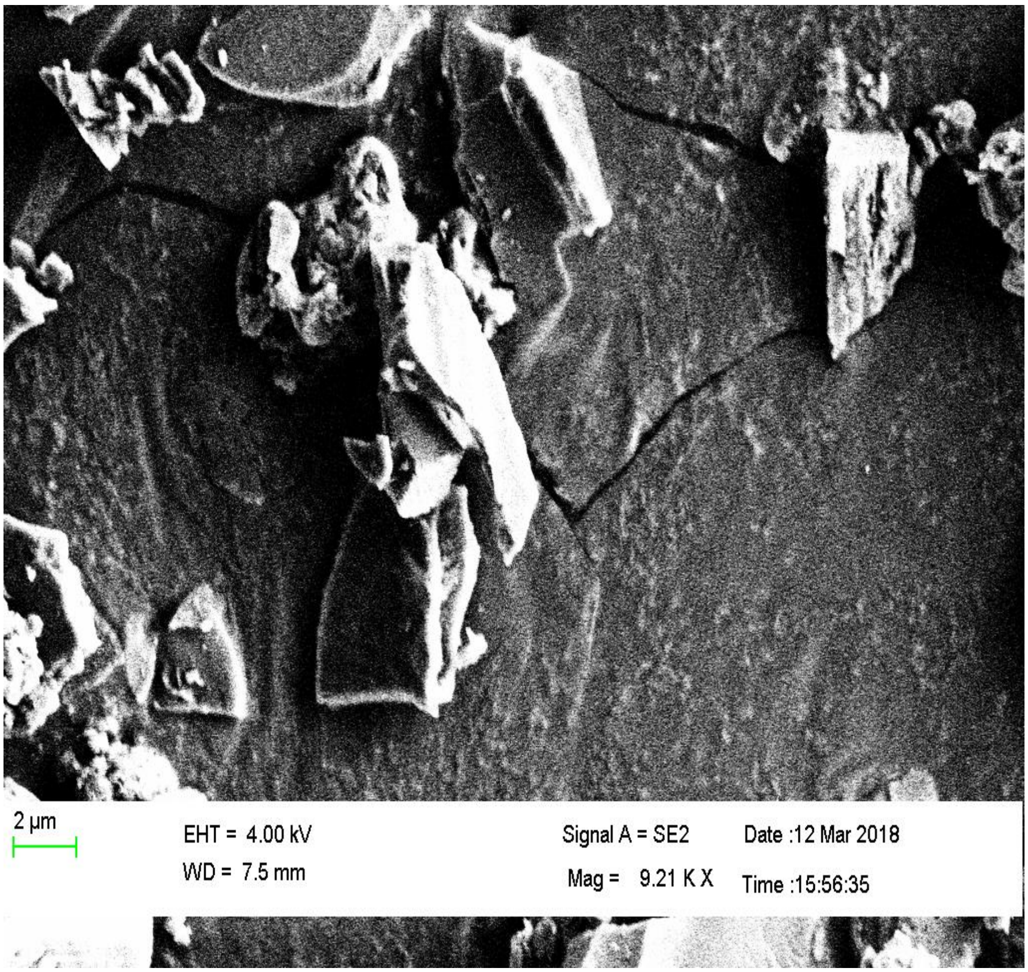


Figure 5.8

Scanning electron microscope image of the membrane (b) at 20µm

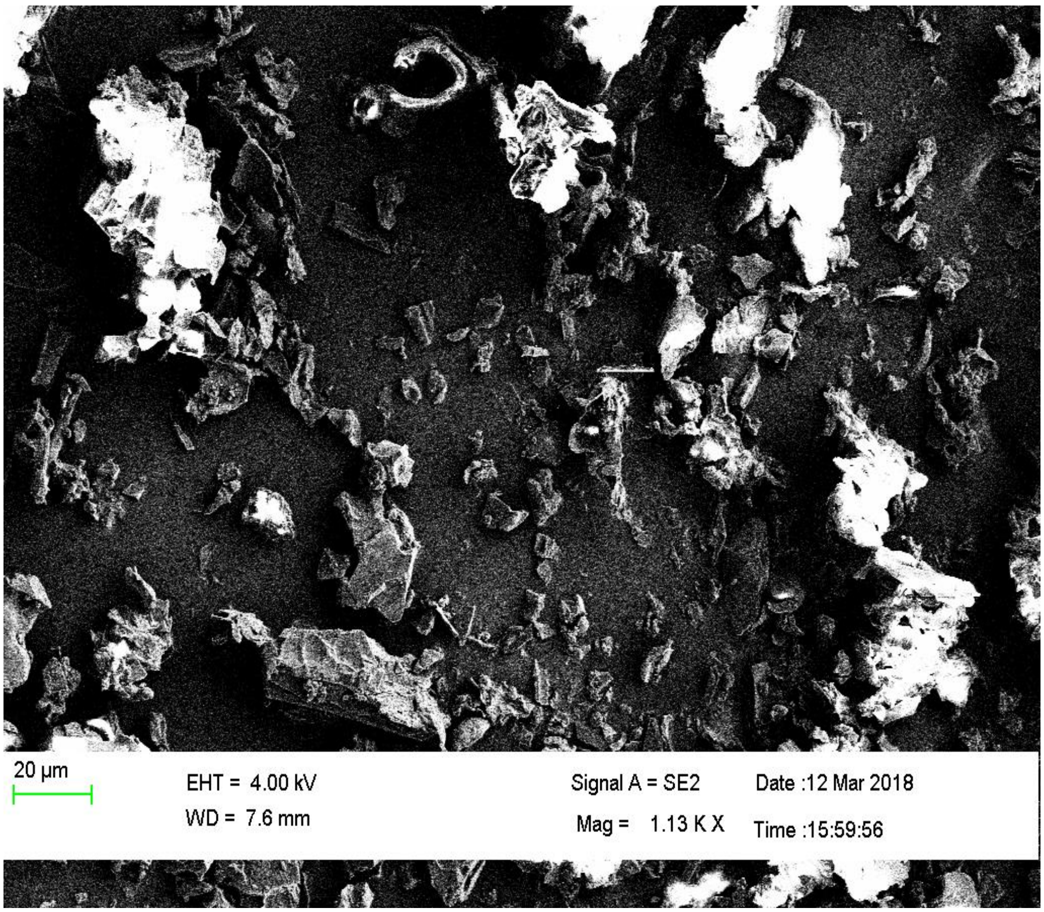


Figure 5.9

Scanning electron microscope image of the membrane (b) at 10µm

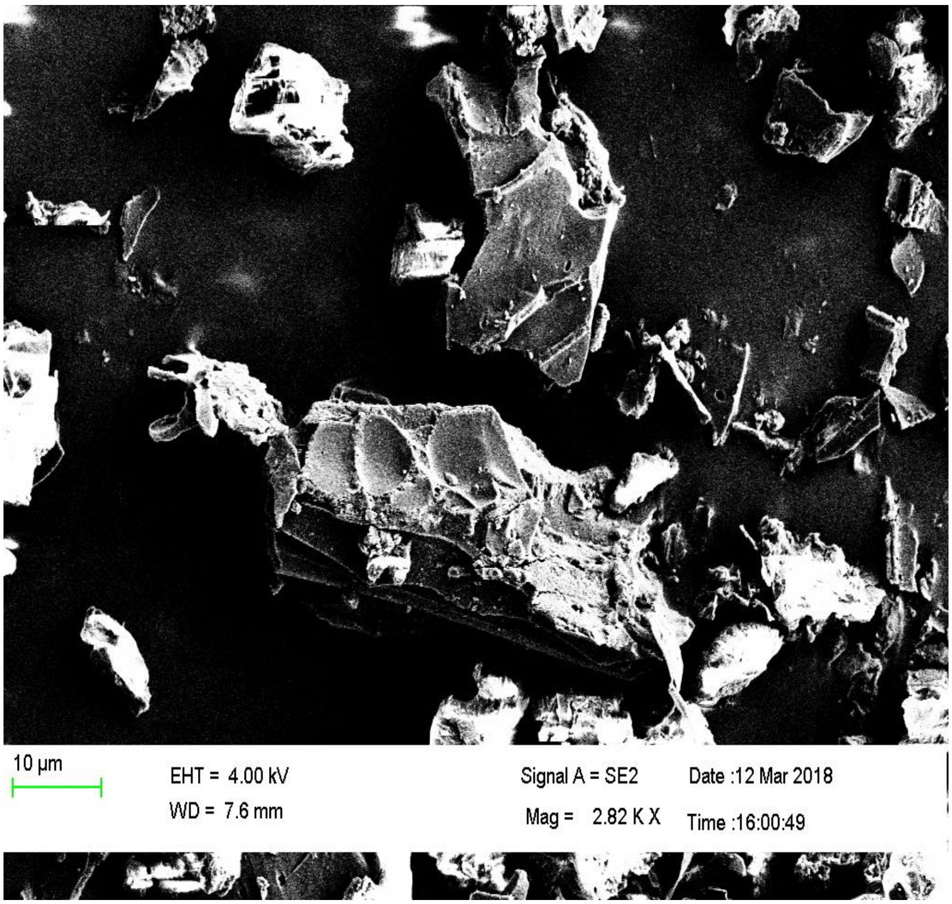


Table 5.4

Physio-Chemical Parameters of Sample Water (I) and

Filtered Water Using Prepared Membrane (a) and (b)

S.NO	PARAMETER	SAMPLE WATER (I)	MEMBRANE	
			a	b
1	pH	8.24	7.78	7.65
2	Electrical conductivity (dS/m)	4.44	2.01	1.48
3	Calcium (mg/L)	4.10	2.10	3.10
4	Magnesium (mg/L)	15.05	9.05	7.15
5	Sodium (mg/L)	25.05	9.35	3.35
6	Potassium (mg/L)	0.20	0.20	0.20
7	Carbonate (mg/L)	2.40	2.40	2.40
8	Bicarbonate (mg/L)	5.60	5.60	5.60
9	Chloride (mg/L)	22.00	15.00	15.00

5.6 Hardness (mg/L)

Table 5.5: Hardness Measured for Sample Water (I) and Filtered Water Using Prepared Membrane (a) and (b)

S.NO	PARAMETER	SAMPLE WATER (I)	MEMBRANE	
			a	b
1	Calcium carbonate	2.40	2.10	2.40
2	Magnesium chloride	11.15	3.15	2.25
3	Magnesium bicarbonate	3.90	5.60	4.90
4	Calcium bicarbonate	1.70	1.70	0.70
5	Sodium chloride	10.85	9.35	3.35
6	Potassium chloride	0.55	0.20	0.20

5.7 pH

pH is an important indicator which indicates acidic and alkaline nature of water. pH should be in the level of 6.6 to 8.4 (World Health Organization). The pH of the sample (I) was 8.24 and filtered using membrane (a) and (b) the pH was found to be 7.78 and 7.65.The obtained values were compared with the standard value of World Health Organization and it was found that the values were in good agreement.

5.8 Electrical conductivity (EC)

Electrical conductivity (EC) is used to determine the cell constant value. The electrical conductivity should be in the level of 6.6 to 8.4 (World Health Organization). The electrical conductivity of the sample (I) was 4.44dS/m and filtered using membrane (a) and (b) the electrical conductivity was found to be 2.01and 1.48 (dS/m).

5.9 Calcium

In drinking water, calcium hardness should be in the level of 75mg/L (World Health Organization). Calcium should be in the level of 6.6 to 8.4 (World Health Organization). The calcium of the sample (I) was 4.10 and filtered using membrane (a) and (b) the calcium was found to be 2.10 and 3.10mg/L. The obtained values were compared with the standard value of World Health Organization and it is found that the values were in good agreement.

5.10 Magnesium

In drinking-water Magnesium hardness should be in the level of 50mg/L (World Health Organization 2003). The magnesium of the sample (I) was 15.05mg/L and filtered using membrane (a) and (b) the magnesium was found to be 9.05 and 7.15 mg/L. The obtained values were compared with the standard value of World Health Organization and it was found that the values were in good agreement.

5.11 Potassium

In drinking-water, Potassium hardness should be in the level of 82mg/L (World Health Organization 2003). The potassium of the sample (I) was 0.20 mg/L and filtered using membrane (a) and (b) the potassium was found to be 0.20 and 0.20mg/L. The obtained values were compared with the standard value of World Health Organization and it was found that the values were in good agreement.

5.12 Sodium

In drinking-water, Sodium hardness should be in the level of 200mg/L (World Health Organization 2003). The sodium of the sample (I) was 25.05mg/L and filtered using membrane (a) and (b) the sodium was found to be 9.35and 3.35mg/L. The obtained values were compared with the standard value of World Health Organization and it was found that the values were in good agreement.

5.13 Carbonate

The carbonate hardness should be in the level of 500 mg/L L (World Health Organization 2003). The carbonate of the sample (I) was 2.40 mg/L and filtered using membrane (a) and (b) the carbonate was found to be 2.40 and 2.40mg/L. The obtained values were compared with the standard value of World Health Organization and it was found that the values were in good agreement.

5.14 Bicarbonate

The bicarbonate hardness should be in the level of 100mh/L L (World Health Organization 2008). The bicarbonate of the sample (I) was 5.60 mg/L and filtered using membrane (a) and (b) the bicarbonate was found to be 5.60 and 5.60mg/L. The obtained values were compared with the standard value of World Health Organization and it was found that the values were in good agreement.

5.15 Chloride

Chloride is an important parameter in accessing the water quality. The values of chlorides in normal drinking water are range 250mg/L (World Health Organization 2003). The chloride of the sample (I) was 22.0 mg/L and filtered using membrane (a) and (b) the chloride was found to be 15.0 and 15.0mg/L. The obtained values were compared with the standard value of World Health Organization and it was found that the values were in good agreement.

Table 5.6

Physio-Chemical Parameters of Sample Water (II) and Filtered Water Using Prepared Membrane (a) and (b)

S.NO	PARAMETER	SAMPLE WATER (II)	MEMBRANE	
			a	b
1	pH	6.98	6.58	6.32
2	Electrical conductivity (dS/m)	6.96	4.25	1.93
3	Calcium (mg/L)	16.56	9.56	3.15
4	Magnesium (mg/L)	19.16	10.06	3.25
5	Sodium (mg/L)	29.40	18.40	8.42
6	Potassium (mg/L)	4.48	4.48	4.48
7	Carbonate (mg/L)	0.80	0.80	0.80
8	Bicarbonate (mg/L)	3.20	3.20	3.20
9	Chloride (mg/L)	58.00	58.00	14.00

5.16 Hardness (mg/L)

Table 5.7

Hardness Measured for Sample Water (II) and Filtered Water Using Prepared Membrane

S.NO	PARAMETER	SAMPLE WATER (II)	MEMBRANE	
			a	b
1	Calcium carbonate	0.80	0.80	0.80
2	Magnesium chloride	19.16	10.06	2.40
3	Calcium bicarbonate	3.20	3.20	2.35
4	Sodium chloride	26.28	18.40	8.42
5	Magnesium carbonate	0.30	0.30	0.30
6	Magnesium bicarbonate	4.90	4.90	0.85
7	Potassium chloride	0.20	4.48.	3.18

5.17 pH

pH is an important indicator which indicates acidic and alkaline nature of water. pH should be in the level of 6.6 to 8.4 (World Health Organization). The pH of the sample (II) was 6.98 and filtered using membrane (a) and (b) the pH was found to be 6.58 and 6.32.The obtained values were compared with the standard value of World Health Organization and it was found that the values were in good agreement.

5.18 Electrical conductivity (EC)

Electrical conductivity (EC) is used to determine the cell constant value. The electrical conductivity should be in the level of 6.6 to 8.4 (World Health Organization). The electrical conductivity of the sample (II) was 6.96dS/m and filtered using membrane (a) and (b) the electrical conductivity was found to be 4.25 and 1.93(dS/m).

5.19 Calcium:

In drinking water, calcium hardness should be in the level of 75mg/L (World Health Organization). Calcium should be in the level of 6.6 to 8.4 (World Health Organization). The calcium of the sample (II) was 16.56 and filtered using membrane (a) and (b) the calcium was found to be 9.56 and 3.15mg/L. The obtained values were compared with the standard value of World Health Organization and it is found that the values were in good agreement.

5.20 Magnesium:

In drinking-water Magnesium hardness should be in the level of 50mg/L (World Health Organization 2003). The magnesium of the sample (II) was 19.16mg/L and filtered using membrane (a) and (b) the magnesium was found to be 10.06 and 3.25mg/L. The obtained values were compared with the standard value of World Health Organization and it was found that the values were in good agreement.

5.21 Potassium:

In drinking-water, Potassium hardness should be in the level of 82mg/L (World Health Organization 2003). The potassium of the sample (II) was 4.48mg/L and filtered using membrane (a) and (b) the potassium was found to be 4.48 and 4.48mg/L. The obtained values were compared with the standard value of World Health Organization and it was found that the values were in good agreement.

5.22 Sodium:

In drinking-water, Sodium hardness should be in the level of 200mg/L (World Health Organization 2003). The sodium of the sample (II) was 29.40 mg/L and filtered using membrane (a) and (b) the sodium was found to be 18.40 and 8.42mg/L. The obtained values were compared with the standard value of World Health Organization and it was found that the values were in good agreement.

5.23 Carbonate:

The carbonate hardness should be in the level of 500 mg/L L (World Health Organization 2003). The carbonate of the sample (II) was 0.80 mg/L and filtered using membrane (a) and (b) the carbonate was found to be 0.80 and 0.80 mg/L. The obtained values were compared with the standard value of World Health Organization and it was found that the values were in good agreement.

5.24 Bicarbonate:

The bicarbonate hardness should be in the level of 100mh/L L (World Health Organization 2008). The bicarbonate of the sample (II) was 3.20 mg/L and filtered using membrane (a) and (b) the bicarbonate was found to be 3.20 and 3.20mg/L. The obtained values were compared with the standard value of World Health Organization and it was found that the values were in good agreement.

5.25 Chloride:

Chloride is an important parameter in accessing the water quality. The values of chlorides in normal drinking water are range 250mg/L (World Health Organization 2003). The chloride of the sample (II) was 58.00 mg/L and filtered using membrane (a) and (b) the chloride was found to be 58.00 and 14.00mg/L. The obtained values were compared with the standard value of World Health Organization and it was found that the values were in good agreement.

SUMMARY & CONCLUSION

6. SUMMARY AND CONCLUSION

- The aim of the study is to prepare Green synthesized membrane using eco-friendly method.
- The prepared membrane has no toxicity.
- The physio-chemical parameter values described by the World Health Organization (WHO) and the values are mostly in good agreement.
- The preparation of the membrane can be simple follow-up, once the installation is correctly set.
- There is no solvent is used to prepare a membrane and also easy to handle.
- The cost of the membrane is very low.
- It is easily available and easily prepared.

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