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Green Chemistry: Water treatment by different filter types.

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Abstract

Banana peels have been studied as a potential biosorbent for the decontamination of water pollutants. They are considered promising due to their wide availability, efficiency, and low cost compared to commercial adsorbents like activated carbon. The peel exhibits efficient removal of pollutants at various temperatures, with adsorption capacities mostly within 1–100 mg/g. Comparatively, both banana peel and activated carbon have been effective in water filtration. However, the effectiveness can depend on various factors such as the type of pollutant, pH, pollutant concentration, and banana peel dosage.

Key Words: Green Chemistry, water filtration, Charcoal, banana peel.

1. Introduction:

Green chemistry is the plan of chemical items and forms that diminish or kill the utilize or era of unsafe substances. Green chemistry applies over the life cycle of a chemical item, counting its plan, fabricate, utilize, and extreme transfer. The criteria of anticipation of contamination meet the 12 standards of green chemistry [fig 1][Hosam M. Saleh, 2018].

Surface water supplies, and some of the time groundwater supplies, are to be accessible for human utilize. Since the tremendous larger part of cities utilize one water dispersion framework for family units, businesses, and fire control, expansive amounts of water regularly must be made accessible to fulfill the most noteworthy utilize, which is ordinarily drinking water.

Water treatment—Conventional water treatment includes four forms: coagulation, clarification, filtration, and cleansing. Past this, progressed decontamination methods like actuated carbon, turn around osmosis, and progressed oxidation forms ought to be connected.

Coagulation: To destabilize the water's particles, coagulants such as ammonium sulfate and ferric chloride are blended with the crude water and blended.

Flocculation: The destabilized particles amid coagulation clump or flocculate and frame expansive particles.

Clarification: This includes sedimentation; coagulated and flocculated are permitted to settle at the foot, as a rule carried out in tanks, and the clarified shallow water is encouraged filtered.

Filtration: Filtration includes a wide combination of channel media like sand, anthracite, garnet, and granular enacted carbon [Linh-Thy Le, 2024, 100700].

Water filtration is the method of expelling or diminishing the concentration of particulate matter, counting suspended particles, parasites, microbes, green growth, infections, and parasites, as well as other undesirable chemical and natural contaminants from sullied water to create secure and clean water for a particular reason, such as drinking, therapeutic, and pharmaceutical applications.

A ponder on actuated banana peel carbon appeared that it can viably evacuate Rhodamine B, a perilous colour, from water. The adsorption prepare was found to be exothermic, and the energy were best clarified by the pseudo-second-order demonstrate. In terms of fetched and environmental impact, banana peels might be a more economical alternative as they are a shape of biowaste that can be reused and changed into a low-cost, biodegradable adsorbent [Akpomie, K.G,2020,1085]. On the other hand, activated carbon, while effective, is more expensive and its production can have a higher environmental impact. For a more specific comparison between banana peel powder and activated carbon for your particular application, you may want to consider factors such as the specific contaminants you need to remove, the cost and availability of the materials, and the environmental impact of their production and disposal.

In this research we study the effect of different filters according to green chemistry point of view to attain pure sample of water for man handling.

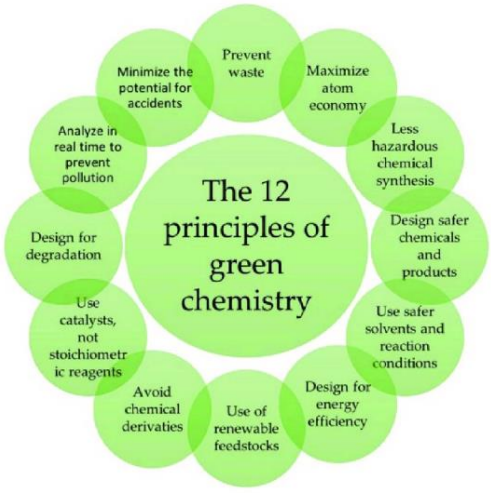

Figure 1: showed the 12 principles of green chemistry.

Banana peel removes metals from water such as lead, copper, and other metals while also being more effective, less expensive, and healthier than present methods for our living environment. Banana peels, dried and powdered, can remove heavy metals from contaminated water.Lead in water:Lead (Pb) is one of the most commonly utilized metals by humans to this day; we can say that there are still many ancient lead pipes that, while driving drinking water, dissolve and concentrate a portion of the metal in it, and then we go home and drink that water. Lead accumulates in the brain and neurological system, inhibiting iron, cadmium, and molybdenum absorption. This may cause anemia, sclerosis, fatigue, and kidney problems

The waters that received mercury from the industry were investigated, and high concentrations of mercury were discovered which, following a biochemical process known as methylation in the mud at the bottom of the lakes, appeared to be incorporated into these people's food chain, imperceptibly entering the human organism. [Tanweer Ahmed, 2018:330] When our bodies contain mercury, we are more likely to suffer from autism, insomnia, depression, and respiratory problems. Mercury accumulates in a variety of locations, including the kidneys, brain, and neurological system. It also prevents zinc, selenium, iron, and other minerals from being absorbed. Mercury destroys vitamin B12, which usually causes persistent fatigue. It is widely used in large fish, agricultural and livestock chemicals, and dental amalgams. Cadmium and chrome in water: Cadmium (Cd) in water is known to cause prostate problems, bronchitis, infertility, and vascular diseases such as hypertension. Chromium (Cr) isn't far behind, harming the kidneys and liver and increasing the risk of lung cancer.Copper in water: Copper is a trace metal that is important for human health because it acts as a cofactor for many enzymes and proteins. However, an excess of copper can be hazardous to the body, causing liver damage, kidney damage, gastrointestinal irritations, and anemia. Aside from being an inexpensive and conveniently available waste, banana peel includes pectin hydroxyl and carboxyl, which are compounds that can adsorb both organic molecules and heavy metals.Dried

and milled into a thin powder, banana peel can be used to treat heavy metal-contamination inexpensively and successfully.

2. The Theoretical Framework

From the past, the utility of activated carbon in adsorption technique is specially relies upon at the surface chemistry and pore shape of porous carbons. The technique of activation and the character of precursor used significantly affects surface functional group and pore shape of the activated carbon. The specific adsorptive properties of charcoal were first discovered by Scheele in 1773 for the treatment of gases followed by decolorizing of solutions in 1786 and he provided the first systematic account of the adsorptive power of charcoal in the liquid phase. [Amit Bhatnagar, 2013, 2]

In the following years, Lowitz established the use of charcoal for the removal of bad taste and Odors from water during 1789 to 1790. The credit to develop commercial activated carbon goes to a Swedish chemist von Ostreijko who obtained two patents, in 1900 and 1901, on covering the basic concepts of chemical and thermal (or physical) activation of carbon, with metal chlorides and with carbon dioxide and steam, respectively

Activated carbon (AC) has been demonstrated to be a powerful adsorbent for the elimination of a huge form of natural and inorganic pollution from aqueous or gaseous media [J. Rivera-Utrilla, 2011, 2]
Before modifying activated carbons (Acs), it is crucial to comprehend the factors affecting their adsorption so that their physical and chemical characteristics can be customized to improve their attraction to metals and various species in water. These factors include surface area, pore size distribution, volume, and the types of surface functional groups [J. Rivera-Utrilla, 2011, 2]

Currently, scientists are exploring green technology, which involves the use of technology and scientific advancements to protect the environment. Green technology, also known as environmental technology or clean technology, includes practices like green chemistry and environmental monitoring [Sami Ullah, 2024, 2]

3. Methods of Research and the tools used

The tools used in research was a UV-Visible/diffuse reflectance instrumentation. Also, the diffuse reflectance (DR) spectra of the nanomaterials were recorded using JASCO V-530 spectrometer (Japan) equipped with an integrating sphere accessory for diffuse reflectance spectra, $BaSO_4$ was used as a reference. Magnetic stirrer with hot plate JENWAY 1000 magnetic stirrer (100-1000 rpm) with hot plate is used for photocatalysts preparation. PH Meter JANWAY 3505 ion analyser is used for adjusting the pH value of solutions. A plastic bottle and a plastic filter body as the body of filter. Also, a Centrifuge is used for separation.

Experimental:

We studied three different types of filters with contaminated water sample to compare the reactivity of the invinted filter type.

Char Coal-Filter (the 1st type)

We used a 20 ml water sample as a standard volume. The components of filter as seen in the picture [Fig. 2], were arranged as follows coal layer (coal is spread in a piece of fabric), cotton and an amount of washed and grinded seashells. The contaminated water sample was poured into the filter and leaved for complete filtration.

Activated-Carbon filter (the 2nd type)
This filter is composed of three layers as shown in Fig 3, activated carbon, seashell, and dried cellulose membranes. First the carbon sample was heated at temperature higher than 200 ºC. The three layers are arranged in the manner desiccant cellulose membranes, washed and cracked shells and activated carbon. Pour the water sample and let's see the results.

Banana Peel Filter type (the 3rd type)
Banana peels were collected and were washed with distilled water. After washing, we left them to dry in the sun for one week [Fig 4]. After drying the peels in the sun, they also dried in the oven at a 200 ºC. Then they were transferred to a modified filter, made mostly of banana peels and

polypropylene bottles. Weigt 5 grams of banana peel as a sample then swirl the sample in 40 ml of water and was put in centrifuge to separate the powder from the water. The powder was filtered off and air dried to be used. The test experiment is made of 0.01 g of banana peel powder with a 20 ml of contaminated water. Place the mixture of the sample and water in the autoclave oven for 24 hours. After that the mixture was put in centrifuge to separate the powder from the water. The powder was filtered off and air dried to be used. The test experiment is made of 0.01 g of banana peel powder with a 20 ml of contaminated water using a plastic filter body as shown in Fig 5. The pure form of water produced from filtration step is represented in Fig 6.

4. Results of Research

Testing the efficiency of banana peel filter type

We performed some available experiments to make sure the effectiveness of the used filter types.

Absorbance using methylene blue in banana peel powder.

By adding an amount of blue dye on an amount of water in a tube containing the dried sample, we found that the sample has absorbed some of the dye. After few hours, the colour is completely absorbed due to the sample high absorption capacity [Fig 7].

Conductivity experiment:

At first, we will prepare some solutions like (NaCl and $CoSO_4$) and measure conductivity for these solutions then we will put the Banana peel powder and measure the conductivity again fig 8.

Preparation of NaCl solution:

Wt= M × V/1000 × M. Wt=0.12g

Preparation of $Fe[NO_3]_3$ solution:

Wt= M × V/1000 × M.Wt=0.48gm

Preparation of $Cr[NO_3]_3$solution:

Wt= M × V/1000 × M.Wt=0.47gm

Preparation of $CoSO_4$ solution:

Wt= M × V/1000 × M.Wt=0.3gm

Permissible limits for electrical conductivity in water: the electrical conductivity value of drinking water is (50-1500) µmhos/cm. It is one of the important properties of natural and industrial water. It represents the weight of dissolved salts in a certain weight of solution as shown in table 1.

The adsorption capacity of green synthetized charcoal was evaluated for dye (methylene blue) and heavy metal (Cobalt ions) removal. The dye removal was followed by measuring the decrease in the absorption spectrum of dye in the presence of green synthetized charcoal as adsorbing agent. Fig 10 shows that the methylene blue absorption maximum was decreased by time. The following equation was used to calculate the decolorization efficiency of cobalt using studied adsorbing agent (green synthetized charcoal)

Decolorization efficiency = 100* Ao – Af/Ao

where Ao and Ao are the initial and final absorbance values of the dye solution.

((100×0.245)-0.18))/ 0.245 =99.2%

After 20 min of reaction, almost the solution was decolorized (99.2%). The decolorization rate kinetics of methylene blue is found to obey first order rate kinetics confirmed by the linear fit equation

ln At/ A0 = - kt

In0.5/0.7=-k×20

-0.3=-k×20

K=0.016

where k is the rate constant (min1), t is the irradiation time, At and A0 are the initial and final absorption values of the dye solution, respectively. A plot of lnAt/A0 versus t yields a straight line. The photocatalytic initial decolorization rates of methylene blue using green synthetized charcoal is 0.016 min^{-1}.

Also, the capacity of charcoal to adsorbed cobalt sulfate from water was followed by measuring the absorption spectrum of cobalt sulphate in visible region and also by measuring the conductance value after reaction time equal 20 min. Fig. 11 shows that the adsorption efficiency of green synthetized charcoal to cobalt are very low (26.5%).

Moreover, the conductance values at t= 0 and after 20 min of the reaction time are 9.49 and 7.14, respectively. The conductance depletion value (2.35) is also confirming the obtained results by absorption method that the adsorption capacity of green synthetized charcoal for minerals are relatively low compared with organic dye. This is attribute to that the source of charcoal is banana peel. It is well known that banana peel have several types of minerals such as phosphorus, iron, calcium, magnesium, sodium, copper and potassium [23] [Opeyemi,2016, 369-376]. Presence of these minerals on the produced charcoal can be able to reduce the adsorption capacity of charcoal for minerals.

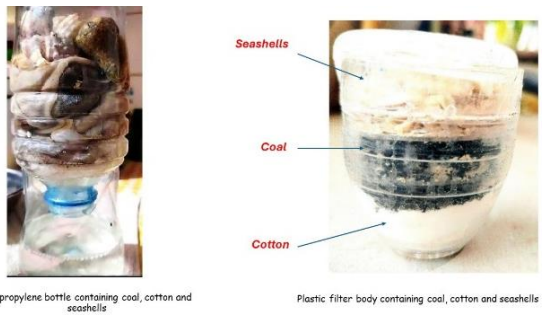

Fig 2: Showed the 1st type filter components.

Fig 3: Showed the 2nd type filter components.

Fig 4: Showed the stages of converting the banana peel into charcoal.

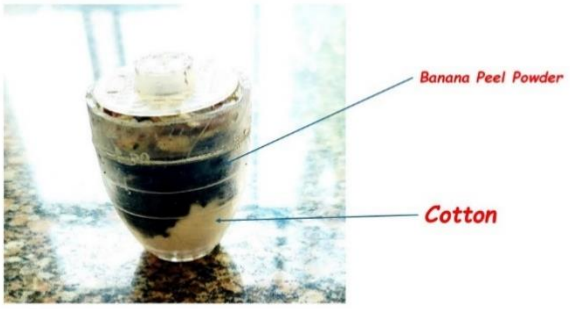

Fig 5: Showed 3rd type filter components.

Fig 6: Showed the purity of water produced from the application of 3rd type filter.

Fig 7: Decolouration of methylene blue by the banana peel powder

Fig 8: Conductance measurements of polluted and purified water samples

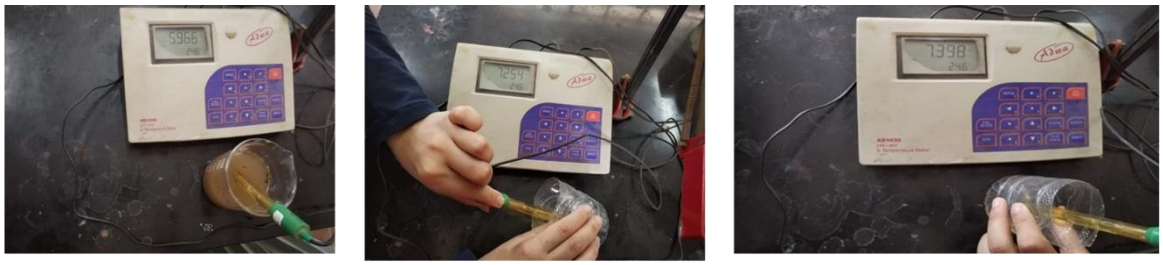

Fig 9: Ph measurement for polluted water and purified water samples

Table 1: Permissible limits for electrical conductivity in water: the electrical conductivity value of drinking water is (50-1500) µmhos/cm

Material in 0.1M	**Before adding banana peel powder**	**After adding 0.01 g banana peel powder**
NaCl	1430000	96000
$CoSO_4$ (Conc.)	94900	71400
$CoSO_4$ (dil.)	25700	19000
water	12900	10500

5. Interpretation of Results

By the experiment we found that in the 1st type filter the water became no longer turbid, but it is not suitable for drinking water because the coal used is not activated enough to remove all impurities. The water is suitable for growing trees such as ornamental trees [singh, 2020, 10], [awwal, 2020].

In contrast, the second type of filter, activated carbon filtration, may efficiently remove some organic contaminants and chlorine in drinking water. It can also lower the amount of lead, dissolving radon, and innocuous taste and odor-causing substances. One disadvantage is that because the chlorine is removed from the upper layer of the medium, the AC creates a wet atmosphere conducive to the growth and multiplication of bacteria. Bacteria can pose issues in medical applications or when employing carbon as a pretreatment for reverse osmosis [Bruce I, 2013].
Activated carbon (AC) has been demonstrated to be an powerful adsorbent for the elimination of a huge form of natural and Inorganic pollution from aqueous or gaseous media [J. Rivera-Utrilla, 2011]

Before modifying activated carbons (Acs), it is crucial to comprehend the factors affecting their adsorption so that their physical and chemical characteristics can be customized to improve their attraction to metals and various species in water. These factors include surface area, pore size distribution, volume, and the types of surface functional groups [J. Rivera-Utrilla, 2011, 2]

Currently, scientists are exploring green technology, which involves the use of technology and scientific advancements to protect the environment. Green technology, also known as environmental technology or clean technology, includes practices like green chemistry and environmental monitoring. Green Chemistry focuses on using products and techniques that reduce the production of harmful substances. One of the key principles of green chemistry is the synthesis of materials using renewable feedstock, with biomass being a major renewable resource. Biomass includes materials like wood, crops, agricultural residues, and food waste. A variety of biomass materials are commonly used for environmental and energy purposes, such as cereal crops, agricultural residues, and forestry materials. Lignocellulose, found in various plants, is considered the Earth`s most abundant and renewable biomass resource [Sami Ullah, 2024, 2].

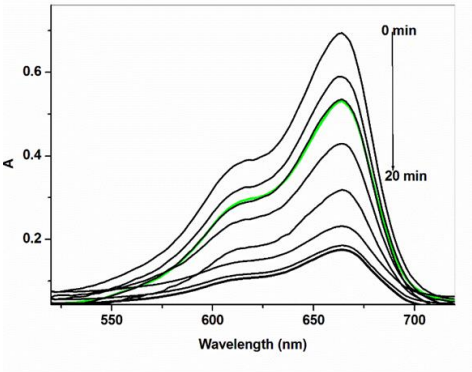

Fig 10: Methylene blue curve

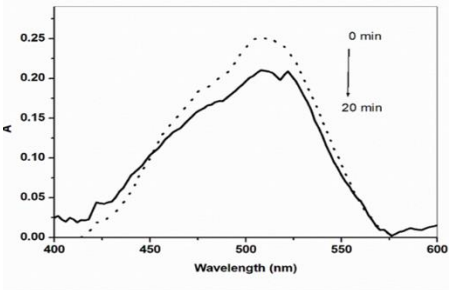

Fig 11: CoSO4 curve

Utilizing activated carbon (AC) is a very efficient method for purifying water to meet the necessary safety standards for consumption and agricultural use. Compared to alternatives like zeolite, clays, and polymers, AC stands out for production and activation
its excellent stability and removal performance. Numerous studies have shown that AC is highly effective in removing various contaminants from wastewater, making it the preferred choice for water purification due to its exceptional adsorption capabilities and overall effectiveness. Furthermore, producing AC from biomass offers two significant benefits: carbon sequestration and the potential for AC to filter into the soil [Sami Ullah, 2024, 3].

The pores found In activated carbon are important and can be categorized into three types:

microspores, mesopores, and macro-pores. Among these, microspores and mesopores are crucial for increasing the surface area of activated carbon compared to macropores. These pores, along with functional groups, are key for gas adsorption by activated carbon, enhancing its adsorption [Sami Ullah, 2024, 4].

Typically, businesses create activated carbon (AC) from limited resources such as coal, lignite, peat, and petroleum derivatives, leading to high expenses and complex regeneration procedures. The demand for activated carbon had risen to 2.1 million metric tons by 2018. To address this growing demand and need, numerous researchers are actively exploring cost-effective and sustainable ways to produce Ac [Sami Ullah, 2024, 4].

Bio char is viewed as the primary source of activated carbon and can be produced through thermochemical conversion methods like pyrolysis or gasification of biomass. Slow pyrolysis has the potential to produce larger quantities of bio char from various feedstocks, particularly biomass, utilizing different techniques and conditions. Gasification or pyrolysis of biomass can result in the creation of bio-oil, bio char, and biogas, all of which exhibit unique properties different from the original biomass [Sami Ullah, 2024, 5].

Activated carbon (AC) can be produced from biochar and biomass using a variety of processes, including physical activation, chemical activation, physiochemical activation, and microwave-assisted activation. Physical activation uses heat and gases such as steam, CO_2, N_2, or their combinations. Chemical activation involves the employment of acids, bases, metal oxides, and alkali metals. Physiochemical activation combines heat and chemical agents, whereas microwave-assisted activation uses microwave radiation [Sami Ullah, 2024, 6].

Activated carbon is created in two stages: carbonization and activation. To eliminate volatile organic chemicals and gasses, the raw material is first dried and heated. The material is subsequently heated in an oxygen-deficient atmosphere to temperatures ranging from 400 to 600°C. Activation is the process of using activating chemicals such as CO_2 or steam at temperatures similar to or higher than those used in carbonization. This removes byproducts and creates a porous substance with a wide surface area and complicated structure. Typically, one gram of activated carbon has a surface area of 500 to 2000 m^2, which can be further expanded by chemical processes [Hajira Tahir, 2021,113]

Advantage of activated carbon

It has been demonstrated that activated carbon is useful in removing a variety of contaminants from water, including heavy metals, dyes, medications, and organic pollutants [Muthaian Jaya Rajan, 2022, 8].

The removal of dyes from water bodies is a major problem, especially when it comes to the textile sector, which creates a wide variety of dye types that contaminate water sources. These dyes are hazardous to human health and aquatic life, and they degrade slowly. It is being explored how to eliminate harmful dyes like methylene blue using biomass derived from agricultural waste.

Drinking water is also contaminated by heavy metals and anions from places like chemical industries and the paint industry. Human health may be negatively impacted by certain contaminants over time. For heavy metals, activated carbon might not be the best choice, even though it works well for eliminating pollutants. To solve this problem, alternative adsorbents made of biomass waste are being developed. [Muthaian Jaya Rajan, 2022, 9]

Furthermore, water supplies and aquatic life are at risk from the dumping of palm oil effluent, which has high concentrations of BOD and COD. Adsorption is a promising way for eliminating hazardous chemicals from oil effluents because traditional treatment techniques are generally ineffective. Biomass derived from agricultural waste has demonstrated potential in efficiently eliminating these toxic compounds from water.

Activated carbon is a useful tool for eliminating impurities from drinking water to enhance its colour, flavour, and odour. High temperatures are used to enhance the surface area of this carbon,

which improves its ability to absorb organic chemicals that give off an unwanted taste or smell. Moreover, coffee is decaffeinated, sugar, honey, and sweets are refined, and liquors, juices, and vinegars are colored with activated carbon. In the water treatment industry, it is a popular option for getting rid of organic pollutants and heavy metals. Activated carbon is also used in compressed air filtration, air and industrial gas purification, and tertiary wastewater treatment. Even the recovery of valuable metals like silver and gold uses it. All things considered, activated carbon produced from agricultural biowaste is an affordable and efficient substitute for commercial choices for water treatment procedures in a variety of industries [Muthaian Jaya Rajan, 2022, 9].

Disadvantages of activated carbon:

AC filters are not effective in eliminating microbial contaminants, hard water minerals like calcium and magnesium, fluoride, nitrate, and various other compounds [Bruce I. Dvorak, 2013, 1].

Absorbance is an important process in water quality analysis. It is used to measure the amount of light absorbed by compounds in water. This helps determine the presence and concentration of pollutants [Zitzewitz, 1999, 395].

The main benefits of the absorbance experience include:

Contaminant Detection: Absorption can be used to detect potential contaminants in water, such as heavy metals or organic compounds.

Estimating concentrations: By measuring absorption, the concentrations of various pollutants can be estimated. This helps determine how these contaminants affect water quality.

Quality Monitoring: Absorption analysis is used to monitor water quality in treatment plants and industries. The effectiveness of purification and desalination processes can be determined.

Planning environmental measures: Based on the results of absorption analysis,

actions can be taken to maintain water quality and protect the environment.

Banana fibers are:

A natural sorbent Dried and milled into a thin powder, banana peel can be used to inexpensively and successfully treat heavy metal-contaminated water.

And from the result we have

The panana peels have high absobance when we add methylene blue(dye) after few hours the color is disappear

Banana fibers in their natural state produce a highly sorbent material. The key factor is the high porosity and natural capillary action of the fiber, allowing It to absorb oil [RUDI, 2020, 6].

A natural water purifier

Banana fibers have already been tested for use as a filtration agent In the treatment of wastewater, which is often contaminated with oils and other organic materials. The natural affinity of banana fiber to oils and organics, and its tendency to repel water, makes it a good natural alternative filtration agent for industrial and municipal waste treatment [kyan, 2021, 3].

The conductivity of water is a measure of the capability of water to pass electrical flow. This ability directly depends on the concentration of conductive ions in the water. These conductive ions originated due to inorganic materials such as chlorides, alkalis, carbonate and sulphide compounds and dissolved salts [Haro, 2021, 197], [haroon2020, 2].

Pure water is said to be a bad conductor of electricity. Normal water is said to have impurities from ions called minerals etc. These ions are known to be responsible for the conduction of electric current in the water. Because the electrical current in water is transported by the ions present in them, the electrical conductivity is said to increase with the increase in the concentration of ions in them.

Drinking water 200 to 800 µS/cm.

The amount of dissolved solids in water determines the electrical conductivity. Electrical conductivity (EC) measures the ionic process of a

solution that enables it to transmit current. [Ibrahim, 2021,1]

Charcoal

The increasing global population, water demand for agriculture, and urbanization have put significant strain on freshwater resources, necessitating the need for freshwater recharge. Greywater, which accounts for 80% of household wastewater, can be reused in areas without transportable water, such as irrigation and lavatory flushing. However, greywater can contain chemicals, microorganisms, and viruses, which can negatively impact soil, groundwater, surfacewater, and contribute to disease transmission.

To address this issue, onsite filtration machines with local and less expensive materials have been used. Different microorganisms and viruses have unique properties that affect their interaction with the filter media. Activated charcoal filters were found to be more effective in reducing certain chemical parameters, while bark filters had a more acidic impact [Sidibe, Modibo, 2014, 2]

Charcoal is an odorless, tasteless, high-quality black powder or black porous solid. It is normally Encountered as path granules or powder. It is insoluble in water and additionally in natural solvents [Abdollahi, M., Hosseini, A., 2014, 779].

Uses: Charcoal has been used for various purposes, including medicine and art, but its most significant use has been as a metallurgical, cooking, industrial, and car gasoline. It was used as a carbon black source in chemical reactions, a component of gunpowder, and as a catalyst, filter, or adsorbent.

Other makes use of of charcoal encompass in: the decolorizing of sugar, Water and air purification Treatment, Solvent recovery [Abdollahi, M., 2014, 779].

Cost of char coal: Charcoal is a convenient, affordable, and disposable cloth, with higher prices for hardwood charcoal. It is heavier and stronger than softwood charcoal, making it more affordable. A 1.5kg bag of hardwood charcoal costs N100, while a 25kg bag costs between N1000 to N1200. [Yahaya Hassan labaran, 2020, 1931].

Preparation of the Charcoal: The charcoal was transformed into hard charcoal through pyrolysis, a process where hardwood is burned under high heat without air, and then boiled to remove impurities and increase carbon atom pores [Yahaya Hassan labaran, 2020, 1931].

Drying and sizing: The charcoal received changed into dried beneathneath the solar via way of means of spreading it on a polypropylene mat for a duration of 5 days. Dried charcoal changed into overwhelmed the usage of mortar and pestle into small bits from powder as much as the dimensions of 10 mm gravel. It changed into then sieved into 3 one-of-a-kind specific sizes (6.three mm, 2 mm, 1.18 mm, and powder).

Activation: The sieved charcoal changed into activated via way of means of soaking it in boiled water for approximately hours to re-open up tiny pores among the carbon atoms [Chyka, P. A., 2005]

Washing: The activated charcoal changed into washed very well with distilled water and changed into then dried beneath Neath the sunlight.

6. Conclusion

The population increased, so we needed to provide the water necessary for living organisms. Therefore, we worked to purify wastewater to make it suitable for drinking and other uses.
We used charcoal as an absorbent for impurities and as a water filter. We conducted some experiments to convert charcoal into activated charcoal. We found that activated charcoal is better than regular charcoal in purifying water. As activated carbon (AC) has been demonstrated to be an powerful adsorbent for the elimination of
a huge form of natural and inorganic pollution from aqueous or gaseous media. We explained the importance of activated charcoal in green technology and that it does not pollute the environment. We used banana peels to remove impurities from water because banana peel

contains pectin hydroxyl and carboxyl, which are substances that have the ability to adsorb both organic molecules and heavy metals.

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