ADSORPTION OF METHYL ORANGE FROM AQUEOUS SOLUTION USING BIOCHAR

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CERTIFICATE

This is to certify that the project entitled “**ADSORPTION OF METHYL ORANGE FROM AQUEOUS SOLUTION USING BIOCHAR**” is a bonafide work carried out by Miss **JIYA GEORGE** (Reg.NO: **190011010506**) under guidance of Dr. ANEESH MATHEW, PG Department of Chemistry, Pavanatma College, Murickassery, for partial fulfillment of there quirement for the award of Degree of Master of Science in Chemistry of Mahatma Gandhi University during the year 2019-2021.

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DECLARATION

I, JIYA GEORGE, do hereby declare that this dissertation entitled "**ADSORPTION OF METHYL ORANGE FROM AQUEOUS SOLUTION USING BIOCHAR**" is a bonafide work carried out by me during **2019-2021** at Pavanatma College, Murickassery under the supervision and guidance of **Prof. Dr. Surendran Parambadath** and **Dr. Aneesh Mathew,** and no part therefore has been submitted for the award of any degree, diploma or recognition of university.

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CHAPTER 1: INTRODUCTION

Biochar is the char co product from the thermo chemical processing of biomass utilized as a soil amendment and/or carbon sequestration agent. Processes that produce biochar include pyrolysis (heating without oxygen) and gasification; other co products include heat, electricity, bio-oil, and syngas. Interest in biochar soil applications originally stemmed from the long-term fertility of terra prêt anthropogenic soils in the Brazilian Amazon. More recently, the recalcitrance of biochar carbon has attracted international attention as an inexpensive and effective way to sequester atmospheric carbon for centuries to millennia while simultaneously producing carbon-negative energy and improving soil quality. Current research focuses on relationships between feed stocks, reaction conditions, biochar properties, soil and crop responses to biochar applications, and biochar economics.

Biochar has drawn remarkable consideration for soil improvements due to their enhanced soil fertility, nutrient immobilization and slow-release, carbon storage, which are some of the handful of benefits for soil amendments made with biochar. These enhanced properties are a result of the cumulative effects arising from the changes in the microbial activities in soils along with the agrochemical application. The community structure of the soil biota alters, nutrients transformation rates changes, and so is the release of nutrients from the applied agrochemicals. This chapter reviews the linkages between the biochar applications in soils and the available nutrients for plant growth arising from the agrochemical applications to soils. Furthermore, the alteration in mechanisms of nutrient uptake for food crops growth has also been reviewed upon biochar amendments in soils. Biochar significantly affects the soil conditions and plant growth, which needs further understanding. The chapter gives insights to future directions with regard to the implications, drawbacks of using biochar as soil amendments for an effective biochar–plant nutrient interaction.

Biochar is defined as a carbon-rich material produced during pyrolysis process that is a thermo chemical decomposition of biomass with a temperature about ≤ 700°C in the absence or limited supply of oxygen .Biochar is usually produced as a cost-effective and environmentally friendly sorbent. The ability of biochar in stabilizing organic and mineral compounds is due to its physicochemical properties such as porous structure, expanded specific surface area, high organic carbon content, active functional groups, and also high cation-exchange capacity (CEC). Pyrolysis is usually the method of choice to produce biochar, though biomass gasification produces a smaller char yield compared with pyrolysis. The production of biochar using pyrolysis process is influenced by the source of biomass, the properties (particle size and moisture content) and composition (contents of cellulose, lignin, and ash) of biomass, and also the process parameters (temperature, heating rate, pressure, and residence time). In order to produce a high char yield, a low-temperature and low-heating-rate process is more preferred. The characteristics of biochar are mainly determined by the type of biomass used and the parameters of pyrolysis process. By knowing the effect of each parameter on the biochar properties, the production of biochar with a desired performance can be tailored. As reported by Angin, temperature is the only pyrolysis parameter that can control the elemental compositions of biochar and their atomic ratios. The type of biomass chosen to undergo pyrolysis process plays an important role in determining the status of biochar. Biomass chemical compositions and its size, shape, and structure can significantly affect the sorption capacity of biochar. Agricultural wastes that are locally available can be considered as a low-cost and renewable pyrolysis feedstock . By converting this biomass into the biochar, the residues are able to be utilized in a sustainable way.

Biochar is a super charcoal made by heating any biomass – for example, corncob, husk or stalk, potato or soy hay, rice or wheat straw – without oxygen. All of the cellulose, lignin and other, non-carbon materials gasify and are burned away. What remains is pure carbon – 40% of the carbon originally contained in the biomass. Biochar production is a simple process that anyone can do. Warm Heart has designed cheap and easy methods for converting biomass waste into biochar. The simplest and cheapest method is to dig a hole in the ground. You can also build a cheap biochar oven using an old oil drum, or build a trough. Whichever method is used, the process is the same, biomass is burned with a lack of oxygen, turning the biomass in biochar, smoke free.

Benefits of making Biochar

They also produce large quantities of smog precursors such as ammonia and the Sox (sulphur oxides) that react with sunlight to form smog. Finally, that smoke that blocks the sun is PM 2.5 – particulate matter so small that it passes through the walls of the lungs into the bloodstream to wreak havoc throughout the body. Crop waste eliminated through the process of making biochar produces no smoke. Every year, farmers in the developing world burn more than 10 billion tonnes of crop wastes in their fields. This releases 16.6 billion tonnes of CO_2, 11.2 billion tonnes of CO_2e, 1.1 billion tonnes of smog precursors and 65.7 million tonnes of PM2.5 into the atmosphere. The combined annual CO_2 and CO_2e emissions from crop waste burning are equivalent to the annual emissions of 714 coal fired power plants. The alternative – converting the waste into biochar instead of burning it removes three tons Carbon dioxide from the atmosphere for every ton produced; when added to fields as a soil amendment, that carbon is permanently sequestered. The long term benefits of making biochar is a huge reduction of greenhouse gases that contribute to global warming.

The many uses of Biochar

While it may be invaluable for farmers, it has many other practical uses too. The absorption qualities of biochar make it a perfect solution for odor control, useful for eliminating unwanted odors: in cars, homes, compost piles, pet odors, closets, bathrooms, even in stinky old sneakers. The powerful moisture adsorption quality makes it extremely helpful in cutting down mildew in damp areas. Look for ways to enrich your life with biochar, and help build a market to encourage widespread manufacturing of this simple, yet amazing natural product. It could help save the world!

Cation exchange

Biochar can exchange its own cations (e.g., H^+, K^+, Na^+, and Ca^{2+}) with heavy metals and therefore form a chemical bond to retain the heavy metals on its surface. The exchangeable cations of biochar come from two fractions: H^+ from its acidic functional groups such as carboxyl and phenolic groups; and alkaline minerals (e.g., K_2CO_3/K_2O) in biochar, which is formed during production.

The heavy metals adsorbed on biochar through cation exchange are regarded as a readily bioavailable fraction, which can be easily up taken by plants (Filgueiraset al., 2002). They may also desorbs from biochar and pose environmental risks when pH significantly changes. Therefore, the adsorption of heavy metals on biochar through cation exchange may not be suitable for immobilizing heavy metals in contaminated soils in the long term. However, as the exchangeable heavy metals on biochar are relatively easily desorbed by changing pH or compulsive exchange (Gillman and Sumpter, 1986), this adsorption mechanism has the potential to be applied in water treatment due to reusability, as with physical adsorption.

1.1 BIOCHAR FROM WOOD

Charcoal is a lightweight black carbon residue produced by strongly heating wood (or other animal and plant materials) in minimal oxygen to remove all water and volatile constituents. In the traditional version of this pyrolysis process, called charcoal burning, the heat is supplied by burning part of the starting material itself, with a limited supply of oxygen. The material can also be heated in a closed retort.

This process happens naturally when combustion is incomplete, and is sometimes used in radiocarbon dating. It also happens inadvertently while burning wood, as in a fireplace or wood stove. The visible flame in these is due to combustion of the volatile gases exuded as the wood turns into charcoal. The soot and smoke commonly given off by wood fires result from incomplete combustion of those volatiles. Charcoal burns at a higher temperature than wood, with hardly a visible flame, and releases almost nothing except heat.

Production methods

Charcoal has been made by various methods. The traditional method in Britain used a clamp. This is essentially a pile of wooden logs (e.g. seasoned oak) leaning in a circle against a chimney. The chimney consists of 4 wooden stakes held up by some rope. The logs are completely covered with soil and straw allowing no air to enter. It must be lit by introducing some burning fuel into the chimney; the logs burn very slowly and transform into charcoal in a period of 5 days' burning. If the soil covering gets torn or cracked by the fire, additional soil is placed on the cracks. Once the burn is complete, the chimney is plugged to prevent air from entering. The true art of this production method is in managing the sufficient generation of heat, by combusting part of the wood material, and its transfer to wood parts in the process of being carbonized. A strong disadvantage of this production method is the huge amount of emissions that are harmful to human health and the environment (emissions of un burnt methane). As a result of the partial combustion of wood material, the efficiency of the traditional method is low. Modern methods employ retorting technology, in which process heat is recovered from, and solely provided by, the combustion of gas released during carbonisation. Yields of retorting are considerably higher than those of kilning, and may reach 35%-40%. The properties of the charcoal produced depend on the material charred. The charring temperature is also important. Charcoal contains varying amounts of hydrogen and oxygen as well as ash and other impurities that, together with the structure, determine the properties. The approximate composition of charcoal for gunpowders is sometimes empirically described as C_7H_4O.

Charcoal has been used since earliest times for a large range of purposes including art and medicine, but by far its most important use has been as a metallurgical fuel. Charcoal is the traditional fuel of a blacksmith's forge and other applications where an intense heat is required. Charcoal was also used historically as a source of black pigment by grinding it up. In this form charcoal was important to early chemists and was a constituent of formulas for mixtures such as black powder. Due to its high surface area charcoal can be used as a filter, and as a catalyst or as an adsorbent.

Wood charcoal

The process of making charcoal is ancient, with archaeological evidence of charcoal production going back about 30,000 years. Wood charcoal has been used since earliest times for a large range of purposes including cooking, medicine, art, metallurgy, industry etc. The raw material for wood charcoal could be wood chips, branches, saw dust, agricultural wastes etc. Wood charcoal is mostly pure carbon, called char (the first syllable of charcoal), made by heating wood above 400° C in a low oxygen environment. The process, called pyrolysis, can take days and burns off volatile compounds such as water, methane, hydrogen, and tar. There are some methods that burn the volatile gasses to prevent them from escaping as pollution and producing surplus heat, other methods collect them for later use as biofuels.

Figure 1 Wood Charcoal

Procedure in making wood charcoal

The manufacturing of charcoal is a multi-step process that requires control of the various factors that could affect the process: the wood used, heating temperature, air availability, and time of processing. In commercial processing, the burning takes place in large concrete or steel kiln, which is almost three meters in diameter and a little over a meter in height. Once the dry wood is split into smaller pieces and stacked loosely almost to the top of the charcoal chamber, the kiln is closed and covered with an insulation layer. A small fire is started in the combustion chamber and soon the chimney begins to produce very wet, low temperature steam. The purpose of maintaining this fire is twofold, to create heat for driving out water and impurities, and to use up the oxygen coming into the kiln. Depending on the size of the wood inside, after a while the smoke changes to bluish and almost clear, what means that the water is gone and the wood should be mostly converted to charcoal. The process leaves black lumps and powder, about 25% of the original weight. It takes about 14-16 hours and produces ready-to-use lump charcoal. It should be noted that if the kiln is opened while the charcoal is still hot, it will burst into flame and all of the charcoal will turn to ash

1.2 DYE

A dye is a colored substance that chemically bonds to the substrate to which it is being applied. This distinguishes dyes from pigments which do not chemically bind to the material they color. The dye is generally applied in an aqueous solution, and may require a mordant to improve the fastness of the dye on the fiber.

Both dyes and pigments are colored, because they absorb only some wavelengths of visible light. Dyes are usually soluble in water whereas pigments are insoluble. Some dyes can be rendered insoluble with the addition of salt to produce a lake pigment. The color of a dye is dependent upon the ability of the substance to absorb light within the visible region of the electromagnetic spectrum (380-750 nm). An earlier theory known as Witt theory stated that a colored dye had two components, a chromophore which imparts color by absorbing light in the visible region (some examples are nitro, azo, quinoid groups) and an auxochrome which serves to deepen the color. This theory has been superseded by modern electronic structure theory which states that the color in dyes is due to excitation of valence π-electrons by visible light.

Methyl orange

Methyl orange is a pH indicator frequently used in titration because of its clear and distinct color variance at different pH values. Methyl orange shows red color in acidic medium and yellow color in basic medium. Because it changes color at the pK_a of a mid-strength acid, it is usually used in titration for acids. Unlike a universal indicator, methyl orange does not have a full spectrum of color change, but it has a sharp end point. In a solution becoming less acidic, methyl orange changes from red to orange and, finally, to yellow—with the reverse process occurring via solution of increasing acidity

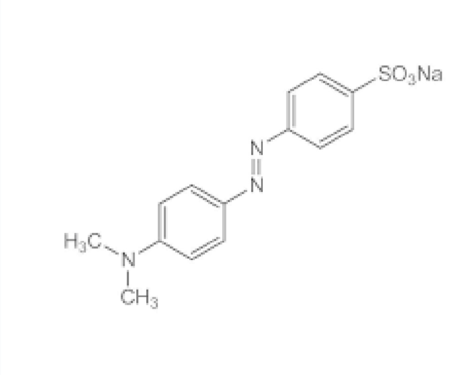

Figure 2. Structure of Methyl orange

General Properties of Methyl Orange

Some general properties of methyl orange are tabulated below.

Chemical formula	$C_{14}H_{14}N_3NaO_3S$
Molar mass	327.33 g·mol^{-1}
Appearance	Orange or yellow solid
Density	1.28 g/cm^3

General Preparation of Methyl Orange

In alkaline solution its colour is yellow, but the colour changes to red on the addition of a mineral acid. This change of colour is not produced by carbonic or other feeble acids. Hence, this indicator may be used for the titration of the more powerful mineral acids in the presence of carbonic acid and the feebler organic acids. The presence of much water causes the red colour of a faintly acid solution of methyl orange to become yellow, probably due to hydrolytic dissociation. The indicator solution generally used is prepared by dissolving 0.1gm in 100cc of distilled water. One drop of this solution is used for each 20cc of solution to be titrated. A somewhat more sensitive solution, but one in which it requires more experience to detect the colour change, is prepared by dissolving 0.02gm in 100cc of hot water, allowing the solution to cool, and filtering out any deposited m-sulfonic acid. This more dilute indicator is to be preferred for very exact titrations with very dilute acids and alkalis

USES

Methyl orange is a pH indicator frequently used in titration because of its clear and distinct color variance at different pH values. Methyl orange shows red color in acidic medium and yellow color in basic medium.

1.3 ADSORPTION

Adsorption is the adhesion of atoms, ions or molecules from a gas, liquid or dissolved solid to a surface. This process creates a film of the adsorbate on the surface of the adsorbent. This process differs from absorption, in which a fluid (the absorbate) is dissolved by or permeates a liquid or solid (the absorbent). Adsorption is a surface phenomenon, while absorption involves the whole volume of the material, although adsorption does often precede absorption. The term sorption encompasses both processes, while desorption is the reverse of it.

Like surface tension, adsorption is a consequence of surface energy. In a bulk material, all the bonding requirements (be they ionic, covalent or metallic) of the constituent atoms of the material are fulfilled by other atoms in the material. However, atoms on the surface of the adsorbent are not wholly surrounded by other adsorbent atoms and therefore can attract adsorbates. The exact nature of the bonding depends on the details of the species involved, but the adsorption process is generally classified as physisorption (characteristic of weak van der Waals forces)or chemisorption (characteristic of covalent bonding). It may also occur due to electrostatic attraction.

Adsorption is present in many natural, physical, biological and chemical systems and is widely used in industrial applications such as heterogeneous catalysts, activated charcoal, capturing and using waste heat to provide cold water for air conditioning and other process requirements (adsorption chillers), synthetic resins, increasing storage capacity of carbide-derived carbons and water purification. Adsorption, ion exchange and chromatography are sorption processes in which certain adsorbates are selectively transferred from the fluid phase to the surface of insoluble, rigid particles suspended in a vessel or packed in a column. Pharmaceutical industry applications, which use adsorption as a means to prolong neurological exposure to specific drugs or parts thereof, are lesser known.

Physisorption

Physical adsorption results from interactions between subcritical fluid species and nearly any solid surface. The measurements are made by a variety of well-developed techniques and interpreted by using ever more sophisticated models. Physical adsorption experiments probe thermodynamic phase equilibria between bulk fluid phases and adsorbed phases, which progress from single, isolated molecules to a single layer of molecules on the surface (a monolayer) to multi layers to condensation (or sublimation). Analyses of equilibrium data characterizing the adsorption of physisorbing gases are commonly employed to estimate the morphology of the sample, including the total surface area, the distribution of the dimensions of any pores (ranging in diameter from about 0.1 to 50 nm), and the total pore volume/void fraction. These analyses are employed to guide understanding of the influence of morphology on sorption, separations, and catalysis.

Considerable progress has been made in the last several decades in investigations of physical adsorption on high-surface-area solids, both experimentally and theoretically (*1–8*), such that we now understand the phenomena associated with sorption far better than we ever have. Furthermore, materials synthesis has developed to such an extent that we can now produce materials possessing very high surface areas (> 1000 $m^2 g^{-1}$ of solid) or with uniform pores in the range 1–20 nm, or even solids with multiscale porosity comprising a network of pores of one size embedded within a network of pores of another dimension and/or connectivity. Physical adsorption (physisorption) is then employed to characterize, design, and optimize the morphology of the material for specific applications.

Chemisorption

Chemisorption is a kind of adsorption which involves a chemical reaction between the surface and the adsorbate. New chemical bonds are generated at the adsorbant surface. Examples include macroscopic phenomena that can be very obvious, like corrosion, and subtler effects associated with heterogeneous catalysis, where the catalyst and reactants are in different phases. The strong interaction between the adsorbate and the substrate surface creates new types of electronic bonds.

In contrast with chemisorption is physisorption, which leaves the chemical species of the adsorbate and surface intact. It is conventionally accepted that the energetic threshold separating the binding energy of "physisorption" from that of "chemisorption" is about 0.5 eV per adsorbed species. Due to specificity, the nature of chemisorption can greatly differ, depending on the chemical identity and the surface structural properties. The bond between the adsorbate and adsorbent in chemisorption is either ionic or covalent.

1.4 Factors Affecting Adsorption

Adsorption occurs on the surface of almost all solids. However, the extent of adsorption of a gas on the surface of a solid depends upon the following factors :

(i) Nature and surface area of the adsorbent

(ii) Nature of the adsorbed gas

(iii) Temperature

(iv) Pressure of the gas

Let us now discuss these factors briefly.

(i) Nature and Surface Area of the Adsorbent

Different solids would adsorb different amounts of the same gas even under similar conditions. Substances like charcoal and silica gel are excellent adsorbents. The substances that are porous in nature and have rough surfaces are better adsorbents.

The extent of adsorption also depends upon the surface area of the solid. Greater the surface area, more is the surface available for adsorption and greater is the adsorption. The surface area depends upon the particle size of the substance. A cube of each side equal to 1cm has six faces. Each of them is a square with surface area of 1cm^2. Thus, the total surface area of this cube is 6 cm^2 . If its each side is divided into two equal halves, ½ cm long, and the cube is divided into two equal halves, ½ cm long, and the cube is cut along the lines indicated), the cube would be divided into 8 smaller cubes with each side 0.5 cm long . Surface area of each small cube would be 1.5 cm^2 and the total surface area of all the 8 smaller cubes would be 12 cm^2 which is double the surface area of the original cube. If it is subdivided into smaller cubes, each of side equal to 1 x 10^{-6} cm the surface area will increase to 6 x 10^6 cm^2 or 600 m^2. The increase in surface area would result in greater adsorption.

(ii) The Nature of the Adsorbed Gas

The extent of adsorption also depends upon the nature of the gas. The gases which are more easily liquifiable or are more soluble in water are more readily adsorbed than others. For example, under similar conditions, the amount of SO_2 or NH_3 adsorbed by charcoal is much more than that of H_2 or O_2 gases. It is because the intermolecular forces are stronger in more easily liquifiable gases, therefore, they get adsorbed more strongly.

(iii) Temperature

The extent of adsorption decreases with rise in temperature. For example, under one atmosphere pressure, one gram of charcoal adsorbs about 10 cm^3 of N_2 gas at 272 K, 20 cm^3 at 248 K and 45 cm^3 at 195 K.

Adsorption is an exothermic process. The change in enthalpy when one mole of a substance is adsorbed, is called enthalpy of adsorption. The adsorption process is similar to the condensation process. The reverse process is called desorption and is endothermic in nature. It is similar to the evaporation process. When a gas is kept in contact with a solid adsorbent in a closed container, a dynamic equilibrium is established in due course of time.

Gas adsorbate + solid adsorbent ↔ gas adsorbed on the solid + *heat*

Since the forward process (adsorption) is exothermic in nature, according to the Le Chatelier's principle, it would be favoured at low temperature. Therefore, the extent of adsorption would increase on decreasing the temperature and would decrease on increasing the temperature.

(iv) Pressure of the gas

At a constant temperature the extent of adsorption increases with increase in the pressure of the gas (adsorbate). We shall study the relation between the two in detail a little later a constant temperature the extent of adsorption increases with increase in the pressure of the gas (adsorbate). We shall study the relation between the two in detail a little later. On between the two in detail a little later. At a constant temperature the extent of adsorption increases with increase in the pressure of the gas (adsorbate). We shall study the relation between the two in detail a little later

1.5 Mechanism of Adsorption

Adsorption occurs because the particle on the surface and the particle in the bulk of the adsorbent are not in the same environment. That is, the net force acting on them is not the same.

- The particle on the surface has unbalanced forces acting on it which are also called residual attractive forces
- Due to these forces, the surface particles of the adsorbent attract the adsorbate particles

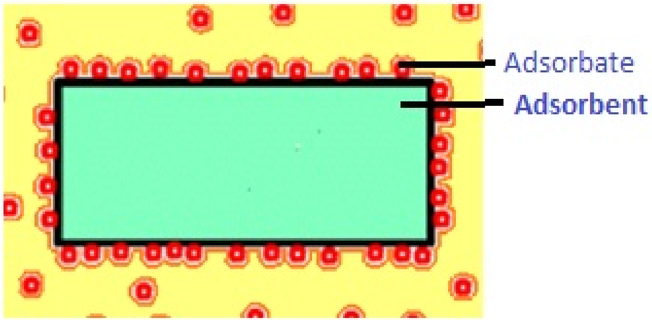

Figure 3 Mechanism of Adsorption

- During adsorption, there is always a decrease in the residual attractive forces of the surface. That is, the energy of the surface decreases and this appears as heat. This is called the heat of adsorption
- The amount of heat evolved when one mole of adsorbate is adsorbed on the adsorbent surface is called enthalpy of adsorption
- Adsorption is always exothermic and the enthalpy change, ΔH is always negative
- When the adsorbate molecules are adsorbed on the surface of the adsorbent, their freedom of movement becomes restricted and hence ΔS the entropy decreases
- We know that Gibbs free energy, **$\Delta G = \Delta H - T\Delta S$**.

For adsorption to be spontaneous, ΔG must be negative. This can happen if ΔH has a significantly high negative value as –TΔS is positive.

- As the adsorption continues, ΔH becomes less and less negative till it becomes equal to TΔS and ΔG becomes zero. At this point, equilibrium is attained.

1.6 Applications of Adsorption

1. For production of high vacuum.
2. Gas masks containing activated charcoal is used for breathing in coalmines. They adsorb poisonous gases.
3. Silica and aluminium gels are used as adsorbents for controlling humidity.
4. Removal of colouring matter from solutions.
5. It is used in heterogeneous catalysis.
6. In separation of inert gas.
7. As adsorption indicators.
8. In chromatographic analysis.
9. Qualitative analysis,

OBJECTIVE OF THE STUDY

- To study the dependence of variable parameters on the adsorption of methyl orange on biochar.
- To confirm the activity of adsorbant

CHAPTER 2: LITERATURE REVIEW

The textile industry is one of the largest in many low and middle-income countries, especially in Asia, second only to agriculture. Textile wastewater is discharged into the environment due to the lack of affordable and sustainable solutions to adsorb or remove the dye from the water. Biochar is generated by pyrolysis of organic material from plant waste in low-oxygen conditions, and is considered carbon-negative. Biochar for dye adsorption in textile wastewater effluent was proven to be highly effective. However, adsorption efficiency varies with experimental parameters, therefore there is a gap in application especially in small dye houses. Efforts should be made to find innovative and affordable solution to make the textile industry more sustainable, by developing methods for collection and reuse, recycle and up cycle of textile waste, by reducing the consumption of water, energy and chemicals and by developing methods for treatment of the textile wastewater. Two activated carbon (AC) samples were produced from sugarcane bagasse using different chemical activation substances (H2SO4 and NaOH). The AC sample activated by H2SO4 presented enhanced surface properties compared to the NaOH activated sample, with higher specific surface area and porosity determined by BET and SEM analysis were also tested for methyl orange (MO) adsorption.

The adsorption efficiency decreased as MO concentration increased. Experimental data including adsorption isotherms and the Gibbs free energy ($\Delta G°$) thermodynamic potential were analysed. Adsorption experimental results agreed well with the Langmuir adsorption isotherm with a high correlation coefficient (R2) and the chemisorption process formed spontaneously adsorbed monolayers. Therefore, sugarcane bagasse waste was considered as a low cost precursor to prepare AC adsorbents with high pollutant removal efficiency through spontaneously adsorbed monolayers.

CHAPTER 3: MATERIALS AND METHOD

MATERIALS REQUIRED

All chemical in this world were of analytical grade without any further treatment**.**

INSTRUMENTS REQUIRED

Colorimeter, Weighing machine, Heavy rotary shaker, Hot air oven.

CHEMICALS REQUIRED

Methyl orange

Figure 4 : Methyl orange

PREPARATION OF THE ADSORBENT

adsorption behavior of Methyl orange

The adsorption experiment was performed using a 0.02mM solution of the dye material. The effects of important parameters, such as amount of adsorbent, volume of dye solution, time were also studied on the adsorption using eriochrome black t dye solution.

Effect of initial adsorbent amount

The experiments were carried out using 20ml of 0.02mM concentrated dye solutions and different amounts of adsorbent (10,20,30mg) , and the amount adsorbed was calculated by analysing the initial and final concentrations of dye solution using a colorimetric analysis. The dyes adsorptions were linearly increased in progressing the amount of adsorbent. The increase in the number of active site causes the rise in adsorption amount.

Effect of time

The experiments were carried out using 30mg of wood charcoal and 20 ml of eriochrome black t solutions in different 5 test tubes. Then we shake these 5 mixtures (6,12,24hrs) and the amount adsorbed was calculated by analysing the initial and final concentrations of the dye solutions using a colorimetric analysis. The dyes adsorptions were linearly increased in progressing the amount of adsorbent. The increasing number of active sites causes the rise in adsorption amount.

Effect of concentration of dye

The experiments were carried out using 30g of wood charcoal and different concentrations of dye solutions (0.02,0.04,0.06,0.08mM)and the amount adsorbed was calculated by analysing the initial and final concentrations of dye solution using a colorimetric analysis. The dyes adsorptions were linearly increased in progressing the amount of adsorbent. The increase in the number of active site causes the rise in adsorption amount.

CHAPTER 4 : INSTRUMENTATION

The instruments used for making the biochar and batch adsorption include,

HOT AIR OVEN

Figure 5 Hot Air Oven

Hot air ovens are electrical devices which use dry heat to sterilize. They were originally developed by Pasteur. Generally, they use a thermostat to control the temperature. Their double walled insulation keeps the heat in and conserves energy, the inner layer being a poor conductor and outer layer being metallic. There is also an air filled space in between to aid insulation. An air circulating fan helps in uniform distribution of the heat. These are fitted with the adjustable wire mesh plated trays or aluminium trays and may have an on/off rocker switch, as well as indicators and controls for temperature and holding time. The capacities of these ovens vary. Power supply needs vary from country to country, depending on the voltage and frequency (hertz) used. Temperature sensitive tapes or biological indicators using bacterial spores can be used as controls, to test for the efficacy of the device during use.

HEAVY ROTARY SHAKE

Figure 6 Heavy Rotary Shake

These Shakers are ideal for mixing and development of cultures, chemicals, solvents, and assays etc. in Microbiological, Cell Culture & Life Science laboratories.

The Unit has base assembly fabricated from heavy mild steel sections. Brushless Induction drive motor with frequency drive makes the unit suitable for continuous non-stop operation. Step less electronic frequency control ensures gentle start and maintains preset speed. Compact counter balanced drive mechanism ensures high stability and reliability even in continuous operation & uneven load distribution.

WEIGHING MACHINE

Figure 7 Weighing Machine

A scale or balance is a device to measure weight or mass. These are also known as mass scales, weight scales, mass balances, and weight balances. The traditional scale consists of two plates or bowls suspended at equal distances from a fulcrum. One plate holds an object of unknown mass (or weight), while known masses are added to the other plate until static equilibrium is achieved and the plates level off, which happens when the masses on the two plates are equal. The perfect scale rests at neutral. A spring scale will make use of a spring of known stiffness to determine mass (or weight). Suspending a certain mass will extend the spring by a certain amount depending on the spring's stiffness (or spring constant). The heavier the object, the more the spring stretches, as described in Hooke's law. Other types of scales making use of different physical principles also exist.

CHAPTER 5: RESULT AND DISCUSSION

About 0.014g of is weighed Methyl orange and transferred into 250 ML beaker, and it is diluted to 250 ML using distilled water. About 20 ML of made up solution is transferred into 3 different conical flask and then 0.30gm of charcoal is added to each of the conical flask. It is then placed on heavy rotary shaker for 5hrs.It is then taken out and filtered using whatman filter paper and then the absorbance is measured using calorimeter. This method is repeated every 10 minutes respectively.

TIME (Minutes)	TRANSMITTANCE (%)	
	Before adsorption	**After adsorption**
10	46	55
20	46	72
30	46	80
40	46	92
60	46	96
80	46	95

Generally transmittance increases with increasing the time of stirring on a mechanical shaker . Transmittance measure the amount of light that passes through a material.

CHAPTER 6: CONCLUSION

The project dealt with study of determination of adsorption of Methyl orange on biochars .Absorbance were analysed by using colorimetry**.** Initially caliberated the concentration of dye solution and observed the minimum amount as 0.02Mm for getting reliable result. The different adsorption experiment with this concentration of and varying adsorb amount resulted 30mg is a minimum amount for getting a consistant result. Kinetics of this adsorption abridged the fast adsorption capacity of the activated charcoal. A Methyl orange the adsorption parameters discussed above have been supported the efficiency of activated charcoal towards adsorption from aqueous solution

7. REFERENCE

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