

Full Length Paper

Production And Characterization Of Activated Carbon From Palm Kernel Shell

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Abstract

This think about could be a show of the generation capacity and characterization of actuation carbon using palm part squander. The inquire about may be a squander to riches investigate. The palm bit shell was carbonized in an electric heater at raised temperature (700Oc) for two (2) hours and a short time later the carbonized palm bit shell was enacted by impregnating it with concentrated H₂SO₄ at 9000C for one hour. The characterization of the enacted carbon was done utilizing the ASTM standard strategy which appeared that the actuated carbon has generally moo dampness substance of 10%, fiery debris substance of 1% and a direct iodine number of 552.15 and a+ Ph esteem of 4.6.

Keywords: *Waste, Palm kernel shell, activated carbon*

2. . INTRODUCTION

Carbon is termed to be a simply abundant non-metallic element which structures the base of most living organisms. It is the fourth most copious element in the world after hydrogen, helium and oxygen, and it plays a very crucial role in the health and steadiness of the sphere through the carbon cycle. This cycle is exceedingly intricate and it illustrates the inter connection between organism on earth. Scientist, industries and consumer alike use different forms of carbons and carbon containing compounds in many ways such as activated carbon and carbon in its active form which can be used to purify water among other uses and applications. Activated carbon (AC) is a generic term for a family of many carbonaceous materials none of which can be characterized by a structural formula (Bansal et al, 1998). It is perhaps one of the most important types of industrial carbon materials and is prepared by carbonization and activation of a large number of raw materials of organic origin such as wood, coal liquids e.t.c. (Zhounghuo et al, 2001). posited that the Characteristics of AC depend on the physical

and chemical properties of the raw materials as well as method of activation (Luo and Guo, 2001) opined that the procedure for preparing activated carbon (AC) requires carbonization and activation of the carbonized product by physical or chemical activation (Ogboaya 1992, Jagtoyen et al, 1998). The carbonization process enhances the carbon content and to create an initial porosity in the clur while activation further develops the porosity and creates some ordering of the structure hereby generating a highly porous solid as the final product (Xia et al, 1998, Jolins et al, 1999). One crucial disadvantage of naturally occurring organic substances as precursors for activated carbon is that the resulting pore size distribution cannot be managed (Lain et al, 1989; Adebayo and Aloko 2007). The led to the use of synthetic resins and polymers such as polyvinyl chlorides and zoolytes (Carrott et al, 2001). The last few decades have witnessed increasing technological advancement that requires the use of activated carbons in a wide range of applications involving adsorption (Njoku and Ubani 2009). As a result of increasing

demand for adsorbent, locally available carbonaceous materials have proven worth for producing \

Activated carbon (Odozie and Akaranta 1986; Sharat 2008). The goal of this study is to produce activated carbon from palm kernel shell by chemical activation with conc. H_2SO_4 and to characterize the produced activated carbon. The scope of this work is limited to the production of activated carbon from palm kernel shell and characterization of the ash content, moisture content, iodine number and Ph. The palm kernel shell was carbonized, thereafter it was activated and characterized to determine the ash content, moisture content, iodine number and Ph.

2. REVIEW OF LITERATURE

2.1. Activated Carbon

Activated carbon, too called activated charcoal, could be a set up of carbon confused to have slight, low-volume pores that increment the surface region accessible for adsorption or chemical response. Activated is sometimes substituted with dynamic. Enacted carbon may be a shape of carbon species that's handled and arranged to have tall porosity and exceptionally huge surface range accessible for adsorption (Ahmedna et al, 2000). Ordered carbon shapes a colossal and crucial lesson of porous solids, which have found a wide run of mechanical applications. Basically incited carbon may be a strong, permeable, dark carbonaceous fabric and boring. Another definition for activated carbon characterized by Ain (2007) may be a permeable carbon fabric, ordinarily chars, which have been subjected to response with gasses amid or after carbonization in arrange to extend porosity. Activated carbon is recognized from natural carbon by the expulsion of all non-carbon pollutants and the oxidation of the carbon surface. They are so-called undefined as they have crystalline characteristics, indeed in spite of the fact that they may not appear certain highlights, such as gem points and faces, as a rule related with crystalline state that have appeared from the X-ray thinks about. In spite of the fact that elucidation of the X-ray diffraction designs isn't free from ambiguities, there's common assention that nebulous carbon comprises of plates in which the carbon iotas are orchestrated in a hexagonal cross section, each particle, but those at the edge, being held by covalent linkages to three other carbon particles. The crystallites are shaped by two or more of these plates being stacked one over the other. In spite of the fact that these crystallites have a few basic likeness to a bigger graphite precious stone, contrasts other than measure exist. The adsorptive property stems from the broad inner pore structure that creates amid the activation prepare. Enacted carbon is

carbon delivered from carbonaceous source materials such as nutshells, coconut husk, peat, wood, coir, lignite, coal, and petroleum pitch. Enacted carbon is created by one of the taking after handle; physical reactivation and chemical actuation.

2.1.1. Physical Reactivation

The method when the antecedent is created into actuated carbon utilizing hot gasses (Encinar, Beltran and Ramiro-1988). Discuss is at that point presented to burn out the gasses, making a reviewed, screened and de-dusted form of actuated carbon. Typically by and large done by suing one or a combination of the following processes: Carbonization: Fabric with carbon substance is pyrolyzed at temperatures within the run 600-900°C, as a rule in inactive climate with gasses like argon or nitrogen. Activation/oxidation: Crude fabric or carbonized material is uncovered to oxidizing environments (oxygen or steam) at temperature over 250°C, ordinarily within the temperature run of 600-1200°C.

2.1.2. Chemical Activation:

Prior to carbonization, the raw material is impregnated with certain chemicals. The chemical is typically an acid, strong base, or a salt (phosphoric acid, potassium hydroxide, sodium hydroxide, calcium chloride, and zinc chloride (25%). Then, the raw material is carbonized at lower temperatures (450-900°C). It is believed that the carbonization/activation step proceeds simultaneously with the chemical activation. Chemical activation is preferred over physical activation owing to the lower temperatures and shorter time needed for activating material.

2.2. FACTORS AFFECTING ACTIVATED CARBON PRODUCTION

2.2.1 Raw material

Most natural materials wealthy in carbon that don't meld upon carbonization can be utilized as crude fabric for the make of enacted carbon. The choice of crude fabric for planning of permeable carbon, a few components are taken into thought. The variables are: Tall carbon substance; moo in inorganic substance (i.e low ash); tall thickness and adequate unstable substance; potential degree of actuation; reasonable fabric, moo corruption upon capacity; the stability of supply within the area. Lignocellulosic materials constitute the more commonly used precursor and

account for around 45% of the total raw materials used for the manufacture of activated carbon; low content in organic materials is important to produce activated carbon with low ash content, but relatively high volatile content is also needed for the control of the manufacturing process; raw materials such as coconut shell and fruit stones are very popular for many types of activated carbon, because their relatively high density,

hardness and volatile content are ideal for production of hard granular activated carbon. Coconut shells, together with peach and olive stones are used commercially for the production of microporous activated carbon useful for a very wide range of applications. Further details about characteristic of raw materials used for making activated carbon are listed in Table 1.

Table 1: Characteristics of various conventional raw materials used for making AC.

Raw materials	Carbon (%)	Volatile (%)	Density (kg/m ³)	Ash (%)	Texture of AC
Softwood	40-45	55-60	0.4-0.5	0.3-1.1	Soft, large pore volume
Hardwood	40-42	55-60	0.55-0.8	0.3-1.2	Soft, large pore volume
Lignin	35-40	58-60	0.3-0.4	-	Soft, large pore volume
Nut shells	40-45	55-60	1.4	0.5-0.6	Hard, large multi pore volume
Lignite	55-70	25-40	1.0-1.35	5-6	Hard small pore volume
Soft coal	65-80	25-30	1.25-1.5	2.12	Medium hard medium micropore volume
Petroleum coke	70-85	15-20	1.35	0.5-0.7	Medium hard medium micropore volume
Semi hard coal	70-75	1-1.5	1.45	5-15	Hard large pore volume
Hard coal	85-95	5-10	1.5-2.0	2.15	Hard large volume

2.2.2. Temperature

Temperature, particularly the final activation temperature, affects the characteristics of the activated carbon produced. Generally, activated carbon produced on a commercial scale is usually conducted at temperatures above 800°C in a mixture of steam and CO₂. Recently researchers have been working out on optimizing the final activation temperature to economize the cost of production and time.

2.2.3. Activation Time

Close to enactment temperature, the enactment time moreover influences the carbonization handle and properties of enacted carbon. From past think about, the actuation times ordinarily utilized were from 1 hour to 3 hours for palm shell and coconut shell. As the time expanded, the rate of surrender diminished steadily and the Wagered surface range moreover expanded. This result is conceivably due to the volatilization of natural materials from crude fabric, which comes about in arrangement of enacted carbon. The degree of diminish

in item abdicate is watched to be lessening when intemperate enactment happens.

2.3. CLASSIFICATION

Activated carbons are complex products which are difficult to classify on the basis of their behaviour, surface characteristics and other fundamental criteria. However, some broad classification is made for general purpose based on their size, preparation method, and industrial application.

2.3.1. Powdered Activated Carbon (PAC)

Regularly, actuated carbons are made in particulate shape as powders or fine granules less than 1.0mm in estimate with an normal breadth between 0.15 and 0.25mm. in this way they show a expansive surface to volume proportion with a little dissemination remove. Actuated carbon is characterized as the enacted carbon

particles held on a 50-mesh sifter (0.297). Powdered activated carbon fabric is better fabric. Powdered activated carbon is made up of pulverized or ground carbon particles, 95-100% of which is able to pass through an assigned work strainer. The ASTM classifies particles passing through an 80-mesh strainer (0.177mm) and smaller as powdered activated carbon. It isn't common to utilize powdered activated carbon in a devoted vessel, due to the tall head misfortune that would happen. Instead, powdered activated carbon is for the most part included straightforwardly to other handle units, such as crude water immaterial, fast blend bowls, clarifiers, and gravity channels.

2.3.2. Granular Activated Carbon (GAC)

Granular activated carbon contains a generally bigger molecule estimate compared to powdered activated carbon and subsequently, presents a littler outside surface. Dissemination of the adsorbate is hence an imperative calculate. These carbons are appropriate for retention of gasses and vapors, since they diffuse quickly. Granulated carbons are utilized for water treatment, deodorization, and separation of components of stream framework, and is additionally utilized in fast blend bowls. Granular activated carbon can be either in granular or expelled frame. Granular activated carbon is assigned by sizes such as 8x20, 20x40, or 8x30 for fluid stage applications and 4x6, 4x8, or 4x10 for vapor stage applications. A 20x40 carbon is made of particles that will pass through a U.S. Standard Work Estimate No. 20 sifter (0.84mm) (by and large indicated as 95% held). AWWA (1992) B604 employs the 50-mesh sifter (0.297mm) as the least GAC measure. The foremost well known fluid stage carbons are the 12x40 and 8x30 sizes since they have great balance

2.3.3. Extruded Activated Carbon (EAC)

Extruded activated carbon combines powdered activated carbon with a binder, which are fused together and extruded into a cylindrical shaped activated carbon block with diameters from 0.8 to 130mm. These are mainly used for gas phase applications because of their low pressure drop high mechanical strength and low dust content. Also sold as CTO (Chlorine, Taste, Odour) filter.

2.3.4. Bead Activated Carbon (BAC)

Globule activated carbon is made from petroleum pitch and provided in distances across from roughly 0.35 to 0.80mm. Comparative to EAC, it is

additionally famous for its low weight drop, tall mechanical quality and low sticky substance, but with a littler grain measure. Its circular shape makes it favored for fluidized bed applications such as water filtration.

2.3.5. Impregnated Carbon

Permeable carbons containing a few sorts of inorganic impregnate such as iodine, silver, cations such as Al, Mn, Zn, Fe, Li, Ca have too been arranged for particular application in discuss contamination control particularly in historical centers and exhibitions. Due to its antimicrobial and sterile properties silver impregnated activated carbon is utilized as an adsorbent for refinement of household water. Drinking water can be gotten from normal water by treating the normal water with a blend of activated carbon and $Al(OH)_3$, a flocculating specialist. Impregnated carbons are too utilized for the adsorption of Hydrogen Sulfide (H_2S) and thiols. Retention rate for H_2S as tall as 50% by weight have been detailed.

2.3.6. Polymer Coated Carbon

Usually a handle by which a permeable carbon can be coated with a biocompatible polymer to donate a smooth and porous coat without blocking the pores. The resulting carbon is valuable for hemoperfusion. Hemoperfusion could be a treatment procedure in which huge volumes of the patient's blood are passed over an retentive substance in arrange to evacuate harmful substances from the blood.

2.4. PROPERTIES OF ACTIVATED CARBON

A gram of activated carbon can have a surface range in overabundance of $500m^2$, with $1500m^2$ being promptly achievable. Carbon aerogels, whereas more costly, have indeed higher surface ranges and are utilized in extraordinary applications. Beneath an electron magnifying instrument, the tall surface-area structures of activated carbon are uncovered. Person particles are heightening convoluted and show different sorts of porosity, there may be numerous ranges where level surfaces of graphite-like fabric run parallel to each other, isolated by as it were a number of nanometers or so. These micropores give wonderful conditions for adsorption to happen, since adsorbing fabric can be associated with numerous surfaces at the same time. Tests of adsorption behavior are as a rule done with nitrogen gas at 77K beneath tall vacuum, but in regular terms activated carbon is flawlessly competent of creating the proportionate, by adsorption from its

environment, fluid water from steam at 100 °C (212°F) and a pressure of 1/10,000 of an atmosphere. James Dewar, the scientist after whom the Dewar (vacuum flask) is named, spent much time studying activated carbon and published a paper regarding its adsorption capacity with regard to gases. In this paper, he discovered that cooling the carbon to liquid nitrogen temperatures be allowed it to adsorb significant quantities of numerous air gases, among others, that could then be recollected by simply allowing the carbon to warm again and that coconut-based carbon was superior for the effect. He employed oxygen as an illustration, wherein the enacted carbon would ordinarily adsorb the climatic concentration (21%) beneath standard conditions, but discharge over 80% oxygen in case the carbon was to begin with cooled to room temperatures. Physically, enacted carbon ties materials by van der Waals constrain or London scattering constrain. Actuated carbon does not tie well to certain chemicals, counting alcohols, diols, solid acids and bases, metals and most inorganics, such as lithium, sodium, press, lead, arsenic, fluorine, and boric corrosive. Carbon monoxide isn't well adsorbed by actuated carbon. This ought to be of specific concern to those utilizing the fabric in channels for respirators, rage hoods or other gas control frameworks as the gas is imperceptible to the human faculties, harmful to digestion system and neurotoxic. enacted carbon can be utilized as a substrate for the application of different chemicals to make strides the adsorptive capacity for a few inorganic (and tricky natural) compounds such as hydrogen sulfide (H₂S), ammonia (NH₃), formaldehyde (HCOH), mercury (Hg) and radioactive iodine-131 (¹³¹I). This property is known as chemisorption.

2.4.1. IODINE NUMBER

Numerous carbons specially adsorb little particles. Iodine number is the foremost essential parameter utilized to characterize activated carbon performance. It could be a degree of movement level (higher number demonstrates higher degree of activation-needs citation), often detailed in mg/g (ordinary run 500-1200 mg/g). It could be a degree of the micropore substance of the enacted carbon (0 to 20 Å, or up to 2 nm) by adsorption of iodine from arrangement. It is identical to surface range of carbon between 900m²/g and 1100m²/g. It is the standard degree for fluid stage applications. Actuated carbon adsorbs iodine exceptionally well. The iodine capacity, mg/g. (ASTM D28 Standard Strategy test) may be utilized as a sign of add up to surface area. Iodine number is characterized as the milligrams of iodine adsorbed by one gram of carbon when the iodine concentration within the remaining filtrate is 0.02 ordinary. Essentially, iodine

number could be a degree of the iodine adsorbed within the pores and, as such, is a sign of the pore volume accessible within the actuated carbon of intrigued. Ordinarily, water treatment carbons have iodine numbers extending from 600 to 1100. Habitually, this parameter is utilized to decide the degree of weariness of a carbon in utilize. Be that as it may, this one ought to be seen with caution as chemical intelligent with the adsorbate may influence the iodine take-up giving wrong comes about. Hence, the utilize of iodine number as a degree of the degree of depletion of a carbon bed can as it were be prescribed on the off chance that it has been appeared to be free of chemical intelligent with adsorbates and on the off chance that an exploratory correlation between iodine number and the degree of fatigue has been decided for the specific application,.

2.4.2. Methylene blue

A few carbons have a mesopore (20 Å to 50 Å, or 2 to 5 nm) structure which adsorbs medium measure particles, such as the color methylene blue. Methylene blue adsorption is detailed in g/100g (extend 11-28 g/100g) (Elliot et al, 1989). Methylene blue is known to have a solid adsorption onto solids and its value is recognized in characterizing adsorptive fabric (Elliot et al, 1989).

2.4.3. Dichlorination

A few carbons are assessed based on the dichlorination half-life length, which measures the chlorine-removal productivity of enacted carbon. The dichlorination half-value length is the profundity of carbon required to diminish the chlorine level of a streaming stream from 5 ppm to 3.5 ppm. A lower half-value length demonstrates predominant execution.

2.4.4. Apparent Density

The strong or skeletal thickness of actuated carbons will ordinarily run between 2.0 and 2.1 g/cm³ (125-130 lbs./cubic foot). In any case, a huge portion of an actuated carbon test will comprise of discuss space between particles, and the real or clear thickness will hence be lower, ordinarily 0.4 to 0.5 g/cm³ (25-31 lbs./cubic foot). Higher thickness gives more prominent volume action and ordinarily shows better-quality enacted carbon.

2.4.5. Hardness/Abrasion Number

It could be a degree of the 'activated carbon's resistance to steady loss. It is an imperative pointer of actuated carbon to preserve its physical judgment and withstand frictional strengths forced by backwashing, etc. There are expansive contrasts within the hardness of enacted carbons, depending on the crude fabric and movement level.

2.4.6. Ash Content

Ash remains decreases the by and large action of actuated carbon and decreases the productivity of reactivation. The metal oxides (Fe_2O_3) can filter out of actuated carbon coming about in discoloration. Acid/water-soluble fiery remains substance is more noteworthy than add up to fiery debris substance. Solvent fiery debris substance can be exceptionally imperative for aquarists, as ferric oxide can advance algal developments. A carbon with a moo dissolvable fiery debris substance ought to be utilized for marine, freshwater angle and reef tanks to dodge overwhelming metal harming and overabundance plant/algal development.

2.4.7. Particle Size Distribution

The better the molecule estimate of an actuated carbon, the way better the get to to the surface region and quicker the rate of adsorption kineties. In vapor stage frameworks this ought to be considered against weight drop, which can influence vitality fetched. Cautious thought of molecule estimate dissemination can give noteworthy working benefits.

2.4.8. Surface Area

By and large, the bigger the particular surface region of the adsorbent, the superior its adsorption execution will be (Guo and Lua, 2003). The foremost broadly utilized commercial dynamic carbons have a particular surface region of the arrange of 600- 1200 m^2/g (Ng et.al, 2002). The pore volume limits the measure of the atoms that can be adsorbed while the surface range limits the sum of fabric which can be adsorbed, accepting a reasonable atomic estimate. The adsorptive capacity of adsorbent is related to its inner surface zone and pore volume. The particular surface region (m^2/g) of permeable carbon is most more often than not decided from gas adsorption estimation utilizing the Brunauer-Emmett-Teller (Wagered) hypothesis. The foremost commonly utilized strategy to characterize

these basic angles of the porosity is based on the translation of adsorption isotherm e.g. Nitrogen at its bubbling point of 77K is the prescribed adsorptive, in spite of the fact that argon at 77K moreover utilized.

3. CHARACTERIZATION OF ACTIVATED CARBON

It is exceptionally imperative to characterize the actuated carbon in arrange to classify it for specifics employments. For the most part, physical properties and chemical properties are the characteristic of actuated carbon. The characteristics of enacted carbon depend on the physical and chemical properties of the crude materials as well as enactment strategy utilized as said by Guo and Luo (2001). Physical properties of actuated carbon, such as cinder substance and dampness substance can influence the utilize of a granular actuated carbon and render them either appropriate or unacceptable for particular applications. Whereas the required surface region of enacted carbon and surface chemistry is classified as chemical properties, besides, the permeable structure of enacted carbon too can be characterized by different strategies such as adsorption of gasses (N_2 , Ar, CO_2) or Vapors (benzene, water).

3.1. Ash content

The cinder substance of a carbon is the buildup that remains when the carbonaceous materials is burned off. As enacted carbon contain inorganic constituents determined from the source materials and from enacting operators included amid fabricate, the overall sum of inorganic constituents will change from one review of carbon to another, 'The inorganic constituents in a carbon are ordinarily detailed as being within the shape in which they appear when the carbon is ashed. Fiery remains substance can lead to extend hydrophilicity and can have catalytic impacts, causing rebuilding handle amid recovery of utilized activated carbon. The inorganic fabric contained in actuated carbon is measured as cinder substance, by and large within the run between 2 and 10%. To decide the substance of fiery debris, a weighed amount (2 grams of powdered carbon, or 10 to 20 grams granular carbon) is put in a porcelain pot and warmed in discuss in a suppress heater until the carbon has been totally burned. The temperature ought to be

3.2. Moisture content

Actuated carbon is for the most part estimated on a dampness free premise, in spite of the fact that every so often a few dampness substance is stipulated, e.g., 3, 8, 10%. Unless bundled in hermetically sealed

holders, a few actuated carbons when put away beneath muggy conditions will adsorb significant dampness over a period of month. They may adsorb as much as 25% to 30% dampness and still show up dry. For numerous purposes, this dampness substance does not influence the adsorptive control, but clearly weakens the carbon. Hence, an extra weight of damp carbon is required to supply required dry weight.

3.3. Surface functional group of activated carbon

The selectivity of enacted carbons for adsorption is depended upon their surface chemistry, as well as their pore size dispersion. Regularly, the adsorptive surface of actuated carbon is roughly impartial such as that polar and ionic species are less promptly adsorbed than natural molecules. For numerous applications it would be beneficial to be able to tailor the surface chemistry of enacted carbon in arrange to progress their viability. The chemical composition of the crude fabric impacts the surface chemistry and offer a possibly lower taken a toll strategy for altering the properties of enacted carbons. For illustration, enacted carbon fiber created from nitrogen- wealthy isotropic pitches have been found to be exceptionally dynamic for the catalytic transformation of SO₂ to sulfuric corrosive. Different surface utilitarian bunches containing oxygen, nitrogen and other heteroatoms have been distinguished on actuated carbon. It's since actuated carbons have a expansive porosity and various cluttered space

3.4. IODINE NUMBER

Numerous carbons specially adsorb little particles, iodine number is the foremost crucial parameter utilized to characterize activated carbon performance. It could be a degree of movement level (higher number shows higher degree of activation-needs citation), often detailed in mg/g (ordinary extend 500-1200 mg/g). It could be a degree of the micropore substance of the actuated carbon (0 to 20 A, or up to 2mm) by adsorption of iodine from arrangement. It is proportionate to surface region of carbon between 900mg and 1100m²/g. It is the standard degree for fluid stage applications. Actuated carbon adsorbs iodine exceptionally well. The iodine capacity, mg/g, (ASTM D28 Standard Strategy test) may be utilized as an sign of add up to surface area. Iodine number is characterized as the milligrams of iodine adsorbed by one gram of carbon when the iodine concentration within the leftover filtrate is 0.02 ordinary, essentially, iodine number could be a degree of the iodine adsorbed within the pores and, as such, is an sign of the pore volume

3.5. USES OF ACTIVATED CARBON

Enacted carbon is utilized in gas decontamination, decaffeination, gold decontamination, metal extraction, pharmaceutical, sewage treatment, discuss channels in gas covers and respirators, channels in compressed discuss among numerous other applications.

4. INDUSTRIAL APPLICATION

One major mechanical application includes utilize of enacted carbon within the metal wrapping up field. Its is exceptionally broadly utilized for decontamination of electroplating arrangements.

4.1. FUEL STORAGE

Inquire about is being done testing different enacted carbons' capacity to store normal gas and hydrogen gas. The permeable fabric acts like a wipe for distinctive sorts of gasses. The gas is pulled in to the carbon fabric through Van der Waals powers. A few carbons have been able to realize holding energies of 5-10 kJ per mol. The gas may at that point be desorbed when subjected to higher temperatures and either combusted to do work or within the case of hydrogen gas extricated for utilize in a hydrogen fuel cell. Gas capacity in actuated carbons is an engaging gas capacity strategy since the gas can be put away in a moo weight, moo mass, moo volume environment that would be much more doable than bulky on-board compression tanks in vehicles. The Joined together States Office of Energy has indicated certain objectives to be accomplished within the region of inquire about and improvement of nano-porous carbon materials. All of the objectives are however to be fulfilled but various teach, counting the ALL-CRAFT program, are proceeding to

4.2. GAS PURIFICATION

Channels with enacted carbon are as a rule utilized in compressed discuss and gas filtration to evacuate oil vapors, smell and other hydrocarbons from the discuss. The foremost common plans utilize a 1-stage or 2 organize filtration guideline in which enacted carbon is inserted interior the filter media. Activated carbon is additionally utilized in spacesuit Essential Life Bolster Frameworks. Activated carbon channels are utilized to hold radioactive gasses inside the discuss vacuumed from a atomic bubbling water reactor turbine condenser.

The expansive charcoal beds assimilate these gasses and hold them whereas they quickly rot to non-radioactive strong species. The solids are caught within the charcoal particles, whereas the sifted discuss passes through.

4.3. CHEMICAL PURIFICATION

Enacted carbon is commonly utilized on the research facility scale to decontaminate arrangements of natural atoms containing undesirable colored natural pollutions.

4.4. MERCURY SCRUBBING

Actuated carbon, regularly implanted with sulfur or iodine, is broadly utilized to trap mercury outflows from coal-fired control stations, restorative incinerators, and from normal gas at the wellhead. This carbon could be a extraordinary item costing more than US\$4.00 per kg. Be that as it may, it is frequently not reused.

4.5. MEDICAL USES

Enacted carbon is utilized to treat poisonings and overdoses taking after verbal ingestion. It isn't viable for a number of poisonings counting solid acids or soluble base, cyanide, press, lithium arsenic, methanol, ethanol or ethylene glycol. Tablets or capsules of enacted carbon are utilized in numerous nations as an over-the-counter medicate to treat loose bowels, heartburn, and tooting. Erroneous application (e.g, into the lungs) comes about in aspiratory desire which can now and then be deadly its immediate medical treatment isn't started. The utilize of actuated carbon is contraindicated when the ingested substance is an corrosive, an soluble base, or a petroleum item.

4.6. ANALYTICAL CHEMISTRY APPLICATIONS

Enacted carbon, in 50% w/w combination with celite, is utilized as stationary stage in low-pressure chromatographic partition of carbohydrates (mono-, di-trisaccharides) utilizing ethanol arrangements (5-50%) as versatile stage in explanatory or preparative conventions.

4.7. ENVIRONMENTAL APPLICATIONS

Carbon adsorption has various applications in expelling toxins from discuss or water streams both within the field and in mechanical forms such as: Spill

clean-up; groundwater remediation; drinking water filtration; discuss filtration; unstable natural compounds capture from portray, dry cleaning, gasoline apportioning operations, and other processes; actuated carbon is additionally utilized for the estimation of radon concentration in discuss.

4.8. AGRICULTURE USES

Actuated carbon (charcoal) is an permitted substance utilized by natural ranchers in both animals generation and wine making. In animals generation it is utilized as a pesticide, creature nourish added substance, preparing help, non-agricultural fixing and disinfectant. In natural winemaking enacted carbon is permitted for utilize as a handling specialist to retain brown color colors from white grape concentrates.

5. MATERIALS AND METHODS

The set of materials that were utilized for this investigate work are as takes after: Suppress heater (carbonite heater made in Britain serial No 2083015 Sort RWF 12120), cauldron, channel paper, measuring utensils, spatula, thermometer, measuring barrel, mortar and pestle, electronic Weighing adjust, wash bottle, electric stove (carbonite hot discuss broiler made in Britain Serial no 20803020, Sort PF120), peH meter, palm bit shell REAGENTS: Sulphuric corrosive; refined water; ethanol.



Figure 1: Carbonization/Activation Setup

5.1. SAMPLE COLLECTION AND PREPARATION

The sample (Palm Kernel Shell) was collected from Jefia, Effurun, Delta State. After the collection of the

sample, it was for sundried for about two days. The activated carbon was prepared in two stages – Carbonization and chemical activation

5.2. CARBONIZATION OF SAMPLES

The test (palm part shell) was carbonized interior a suppress heater. The carbonization was done at a temperature of 700°C for two (2) hours within the heater. The carbonized palm part shell was permitted to cool at room temperature after which it was grounded to a powdered frame employing a mortar and pestle.

5.3. CHEMICAL ACTIVATION OF SAMPLE (PALM KERNEL SHELL)

After the carbonization of the test, it was enacted chemically by impregnating it with 98.07% H₂SO₄ corrosive on an impregnation proportion of 1:1 this was done by blending 77.9g of the carbonized palm bit shell with 77.9ml of H₂SO₄. The arrangement was blended together by legitimately blending it with a blending pole. The coming about glue was at that point put in a heater at a temperature of 900oC for 45mins (actuuated temperature) this was done to extend its porosity. The coming about enacted carbon was at that point permitted to cool to room temperature and washed altogether in a measuring utencil with refined water and permitted to settle underneath the water and total expulsion of the leftover sulphuric corrosive was accomplished by repeated washing and decantation. The ultimate slurry was sifted employing a pipe and channel paper and exchanged into an broiler at a temperature of 120C modify drying, the dried actuuated carbon was at that point exchanged into an discuss tight holder to anticipate adsorption dampness.

5.4. CHARACTERIZATION OF ACTIVATED CARBON

DETERMINATION OF PH AND IODINE

The standard test strategy for assurance of enacted carbon pH ASTM D 3838-80 was utilized. 1.0g of actuuated carbon (PAC) was weighed and exchanged into a measuring utencil. 100ml of refined water was measured, included and mixed. The tests were permitted to stabilize and tapped, at that point the pH of the filtrate was measured employing a pH meter. 1g of the dried carbon was exchanged to a dry glass stoppered 250ml Erlenmeyer jar. 10ml of 5% v/v hydrochloric corrosive was pipetted into the jar. The jar was twirled until the carbon was wetted the substance were permitted to bubble for 30secs.then the carafe and its substance

were permitted to cool to room temperature, at that point 100ml of 0.10N iodine arrangement was included by pipette the carafe was stoppered quickly and shook energetically for 30secs.thereafter it was sifted by gravity through a channel paper instantly after the 30secs of shaking. the introductory 21ml of the filtrate was disposed of and the leftover portion was collected in a clean measuring utencil at that point the filtrate in th

Calculation

$$I = B-S/B \times 300.14$$

I = iodine number

B = Blank in ml

S = Sample Titre in ml

5.5. DETERMINATION OF MOISTURE CONTENT

The standard test method for ash content-ASTM D2867-70 was used. 2g of the sample was put into a pre-dried crucible and weighed the crucible was placed in a preheated oven (at 150°C) and allowed to dry to constant weight for 3hrs.

Calculation

$$\text{Moisture content (\%)} = \frac{\text{loss in weight on drying}}{\text{initial sample weight}} \times 100$$

5.6. DETERMINATION OF ASH CONTENT:

The standard test method for ash content-ASTM D2866-70 was used. A crucible was pre-heated in a muffle furnace at 650°C for 1hr, cooled in a desiccator and weighed. 1.0g of activated carbon sample was transferred into the crucible and reweighed. The crucible containing the sample was then placed in the muffle furnace at 650°C for 4hrs. It was removed and allowed to cool in a desiccator to room temperature (30°C) and reweighed again. The ash content was calculated using:

$$\text{Ash Weight (\%)} = \frac{\text{Ash Weight}}{\text{Dry weight}} \times 100$$

RESULTS AND DISCUSSION

Parameters	Units	Results	ASTM Range
Ph Value		4.6	
Iodine Value	Mg/g	552.15	1-14max
Moisture Content Max	%	10	≤10 max
Ash Content	%	1	≤8 Max

6. RESULT

6.1. CARBONIZATION

For activated carbon to have the desired properties, the temperature of Carbonization must be well controlled. The temperature must be sufficiently high so as to be able to dry all non-carbon substances during carbonization. If the temperature of carbonization is too high it will greatly affect the activity of the carbon produced. The same applies to the temperature at which the carbonized product is activated. The temperature of carbonization and activation influences the molecular architecture of the carbonized material, leading to increase in surface area and internal pores (Ahmedna et al, 2011)

6.2. SURFACE CHARACTERIZATION OF ACTIVATED CARBON

MOISTURE/ASH CONTENT

The characteristics of the delivered actuated carbon as displayed in table 4. 1 appeared a moo sum of dampness and fiery remains substance, showing that the molecule thickness is generally little this result appears that actuated carbon delivered from palm part shell is an great crude fabric for adsorption. Cinder substance can moreover influence actuated carbon i.e. it diminishes the in general action of enacted carbon. It moreover diminishes the productivity of reactivation, the lower the fiery remains esteem in this manner the way better the enacted carbon for utilize adsorbent (Ahmedna et al, 2011). The dampness substance of the enacted carbon delivered was 10% which was inside the extend. It can adsorb as much as 25-30 % dampness and still show up dry for numerous purposes. It does not weaken the carbon produced. This is upheld by (Guo and Lua, 2004) that the overall sum of inorganic constituents will shift from one review of carbon to another.

IODINE NUMBER

Iodine number may be a essential parameter used to characterize enacted carbon execution. It could be a degree of the small scale pore substance of the enacted carbon and is gotten by the adsorption of iodine from arrangement by the actuated carbon test. The microspores are mindful for the expansive surface area of enacted carbon particles and are made amid the actuation handle. It is within the miniaturized scale pore that adsorption generally takes put. The esteem (of iodine number) gotten for the created actuated carbon (S52.15) is more noteworthy than the esteem gotten for fluted enacted carbon (229.90) by Ahmedna et al, 2011. It was taken note that the variety in characteristics (values) of different actuated carbon especially iodine number were due to enactment forms, enacting reagent and temperature enactment time in agreement with comparable past discoveries (Jagtoyen, 1998, Buszek et al., 2000). It has been set up that the iodine number in mg/g gives an assess of the surface region in

PH VALUE

The pH of the created actuated carbon was found to be 4.6, in this way making the enacted carbon to be exceptionally acidic. The acidic nature or substance of the created actuated carbon, might be ascribed to the impact of the enacting operator utilized (sulphuric corrosive). Be that as it may, it is exceptionally imperative to note that most enacted carbon can work at any pH esteem depending on the nature of enacting specialist utilized.

CONCLUSION

This ponder has appeared that actuated carbon may be recouped from palm bit shell mesocarp a renewable, cheap and copious squander. Result of this think about seem give actuated carbon buyers with taken a toll compelling and naturally neighborly elective sources. The enacted carbon arranged from palm part shell at an enacting time of two (2) hours and a carbonization temperature of 700oC utilizing sulphuric corrosive (H₂SO₄) gave a great abdicate of fiery debris and dampness substance Subsequently carbonization temperature of 700oC and actuating time of 2hours

utilizing palm bit shell is an great strategy of creating actuated carbon with a tall surface area. Based on the developing crave to change over agrarian squander into valuable items and to guarantee the supportability of worldwide nourishment security, it is hence suggested that agrarian squander such as banana peels, orange peels, coconut shell, corn cob, saw dust e.t.c ought to be utilized as crude fabric within the generation of actuated carbon. In arrange to asce

REFERENCES

- Adebayo, G.A & Aloko D. F (2007) production and characterization of Activated from agricultural waste (Rice husk and corn bob). *Journal of Engineering and Applied science*, 2 (2), 440 - 444
- Ahmedna M Marshall W. E & Rao R.M (2001) production of granular activated carbons from selected agricultural by products and evaluation of their, physical chemical and absorption properties *Bio resource Technology*, 71 (2), 113 - 123
- Bansal, R.C Donnet. J, Stock (1988). *Active carbon marcel Dekker MC*. New York.
- Carrott, J.A, Nabais J.M.V & Ribeiro Carrott, M.M.L (2001) preparation of activated carbons fibres from acrylic textile fibre. *Carbon*, 39, 1543-1555.
- Dastgeib S.A & Rockstraw D.A (2001) Pecan sheel activated carbon synthesis characterization, and application for the removal of copper from aqueous solution *Carbon* 39, 1849- 1855.
- D. Iozanocastello, M.A. lillo-Rodnas, D carzarla-Amoros And A Linares Solano (2001) Activated carbon production.
- Fapetu O.P (2000) Production of Carbon from Biomass for Industrial and Metallurgical Processes *Nig. J. Eng. Manage.* 134-37.
- F. Caturla, M. Molina-Sabio, F. Rodriguez-Reinoso. Preparation of activated carbon by chemical activation with ZnC12. *Carbon*, 29, 999-1007 (1991).
- Guo, T. F and Lua, A. C., (2004): Effect of activation temperature on the texture and chemical properties of potassium hydroxide activated carbon prepared from pistachio nutshell. *Journal of colloid and interface science* 274 (2): P 594 601
- Hernandez, J.R Aquino, L.F & Capreda S.C (2007). Activated carbon production from pyrolysis and steam activation of cotton gin trasu ASABE 076084. Minneapolis Convention Centre Minne so ta U.S.A.
- Lafi W. K (2001) production of activated carbon from acorns and Olives seeds *Biomass Bio energy*, 20(1) 57-62.
- Laua, A. C & Guo, d. (2001) Micro porous oil palm shell activated carbon prepared by physical activation for gas phase adsorption, *lagmuir* 17, 7112-7117.
- Manocha, J. M. (2003): HEMP - derived activated carbon fibers' by chemical activation with phosphoric acid, *fuel*, 88(1): P19-26.
- Nioku P.C and Ubani C.O (2009) A comparative analysis on the adsorption of heavy metals from industrial waste water using activated palm kernel shell and activated animal bone *International Journal of chemistry*, 19(3), 101 106
- Otaru, A.J, Ameh C.U A.S., Abdukareem, A.S., Odigure, J.O and Okafor, J.O 2013, development and characterization of adsorbent from rice husk ash to bleach vegetable oils *Journal of applied chemistry volume 4*, pp42-49
- Sharat Book Bureau (2001), *Work activated carbon focast for 2012 and 2017*. Prog org. global press release distribution.
- Srinivasakannan, c. and Zailani, kM., (2004): Production of Activated carbon from rubber, wood, sawdust. *Biomass and Bioenergy*, vol. 27(1) Elsevier
- Yak out S.M, Sharf, 2011, "characterization of activated carbon prepared by phosphoric acid activation of olive stones", *Arabian journal of chemistry*
- Yang, B.Y., (2003): Preparation and characterization of activated carbon from waste biomass, *journal of Hazardous Materials* 165 (1-3). P55-60
- Zhoughuo, H. Srinivasan, M.P and Yaming, N. (2001). Novel activation process for preparing highly mesoporous activated carbons 39. 877-886.
- Zarifah Ndiah Binti Mohamad Salleh A thesis on the production of activated carbon from palm kernel shell, submitted to the faculty of chemical and natural Resources Engineering University of Malaysia Pahang.