

DEDORIZATION OF KEROSENE USING ACTIVATED CARBON PRODUCED FROM SAWDUST

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ABSTRACT

This project is solely deodorization of kerosene using activated carbon produced from sawdust. The present study of the deodorization was carried out using the adsorption method in which the activated carbon (sawdust) is used as an adsorbent. The sawdust sample was collected from Wood Market (Sawmill) Uti along PTI road, Effurun, Delta State. The sawdust went through series of unit operations to prepare it for deodorization. The sawdust sample was carbonized in a furnace at 450°C for 1 hour. Activation of adsorbent was done using Phosphoric acid and Zinc Chloride separately and then it was oven dried. Analyses were carried out on the adsorbent: moisture content 8.4(H₃PO₄) 6.3(ZnCl₂), ash content 4.0 (H₃PO₄) 3.9(ZnCl₂) and pH value of 3(H₃PO₄) 8(ZnCl₂). Also, analyses were carried out on the deodorized sample which was flash point of 93°C, smoke point of 20mm and a sulphur content of 0.15. The use of activated carbon on Kerosene is for the purpose of removing sulphur content present in the Kerosene. The use of activated carbon produced using Phosphoric acid as activating chemical gave a better yield. It is recommended that desulphurization of Kerosene with the use of activated carbon should be ensured by Government agencies.

INTRODUCTION

Kerosene, one of the byproducts of petroleum was discovered in 1853 by Abraham Gesner. A British physician, Gesner developed a process to extract the inflammable liquid from asphalt a waxy petroleum mixture. Kerosene is a combustible hydrocarbon liquid, widely used to power jet engines of aircraft (jet fuel) and some rocket engines. It is also commonly used as a cooking and lighting fuel for fire toys. Kerosene a thin, clear liquid formed from hydrocarbon, with a density of 0.78 – 0.81g/cm³ is obtained from the fractional distillation of petroleum between 150°C – 275°C, resulting in a mixture carbon chains that typically contain between six and 16 carbon atoms per molecule. Once the oil has been distilled into its fractions, further processing in a series of chemical reactors is necessary to create kerosene. Catalytic reforming, alkylation, catalytic cracking, and hydro processing are four of the major processing techniques used in the conversion of kerosene. Major constituents of kerosene include n-Dodecane, alkyl benzenes, and naphthalene and its derivatives. The flash point of kerosene is between 37 and 65°C (100 and 150°F) and its auto ignition temperature is 220°C (428°F). Heat of combustion of kerosene is similar to that of diesel its higher heating value is 46.2 MJ/Kg and 43.1MJ/Kg as its lower heating value. Kerosene is immiscible in water (cold or heat), but miscible in petroleum solvents. Once the kerosene has been reacted additional extraction is required to remove secondary contaminants that can affect the oils burning properties. Aromatic compounds, which are carbon ring structures such as benzene, sulphur are class of contaminants that must be removed. The contaminants produce an offensive odour in the kerosene which the strong odour if not removed, can cause some problems. Deodorization of kerosene simply means the elimination of the offensive odour in the kerosene. Deodorization using activated carbon produced from wood sawdust, is one of the cheap, renewable and abundantly available means

METHODOLOGY:

SAMPLE COLLECTION

The sample (sawdust) was collected from wood market (sawmill) UTI along PTI road, Effurun, Delta State.

PREPARATION OF SAMPLE

After collection of sample it was burnt with flame under a closed pot to prevent the smoke when using the furnace.

PREPARATION OF ACTIVATED CARBON

The activated carbon was prepared in two stage;

- i. Carbonization
- ii. Activation (chemical activation)

CARBONIZATION OF SAMPLES

The sample (sawdust) was carbonized inside a muffle furnace. The sample was heated to a high temperature of 450°C for 5 minutes in the furnace by limiting the supply of air into the furnace in order to obtain the best quality of sawdust char, with the objective of breaking down the hydrocarbons of high bonding point into more volatile substances. Thus, the bulk of the volatile matter was eliminated. The carbonized sample (sawdust) was allowed to cool at room temperature after which it was grounded to a powdered form using a mortar and a pestle.

CHEMICAL ACTIVATION OF SAMPLE (SAWDUST)

After the carbonization of the sample, it was activated chemically by 1M of phosphoric acid (1M H_3PO_4) this was done by mixing 20g of the carbonated sawdust with 100ml of H_3PO_4 . The solution was mixed together by properly stirring it with a stirring rod until the carbonized sawdust was fully dissolved in the phosphoric acid, this was done for 1 hour.

The mixture was left for 24hours and the resulting paste was dried in an oven for 3 hours. After cooling to room temperature the sample was washed with distilled water so as to remove any form of undissolved or undiluted phosphoric acid. The activated carbon was left to dry in the oven. Then, it was sieved and stored in a plastic for further use.

DEODORIZATION OF ADULTERATED KEROSENE

Adsorption method was used where the adsorbent being the activated carbon is used to remove the adsorbates which are the odorants or impurities in the kerosene.

The methods used is a Batch adsorption, consists of contacting activated carbon with adulterated kerosene for a given period of time in a beaker.

After the process completion (typical contact time: 10 – 60 minutes) the spent carbon is separated from the kerosene (e.g by filtration) and regenerated or disposed of.

70g of activated carbon is weighed in a beam balance to determine the weight and poured into a beaker. 20ml of adulterated kerosene is poured into the beaker containing the weighed activated carbon and allowed for a given time to enable adsorption to take place. The adsorbent, been the activated carbon, adsorbed the adsorbate (impurities) in the adulterated kerosene which leaves it partly or wholly deodorized. A filter paper with funnel was used to separate the purified kerosene from activated carbon.

RESULT AND DISCUSSION

Moisture/Ash Content

The result gotten from produce activated carbon as pressed in table 4.1 showed a low amount of moisture content in $ZnCl_2$ activated carbon that H_3PO_4 , the ash content was below average of both activated carbon indicating that the particle density is a bit small, this result showed that the activated carbon is a good raw material for absorption, ash content also affect activated carbon that is it reduces the overall activities of activated carbon, it also reduce the efficiency of

reactivation, the lower the ash value the better the activated carbon for use of adsorbent. The moisture content of the activated carbon produce was 6.3% (ZnCl₂) and 8.4% (H₃PO₄) which were within the range. It can adsorb as much as 23-30% moisture and still appear dry for many purposes. It does not dilute the activated carbon produced.

pH Value

The pH of the produced activated carbon was found to be 3.0 (H₃PO₄) and 8(ZnCl₂) ,thus making H₃PO₄ activated carbon to be very acidic and ZnCl₂ activated carbon basic. The acidic nature or content of the activated carbon, could be attributed to the effect of the activating chemical used (Phosphoric acid) and basic due to the effect of the activating chemical (ZnCl₂).However, it is very important to note that most activated carbon can function at any Ph value depending on the nature of activating chemical used.

Table 4.2:Result of Physio Chemical Analysis on Unadulterated Kerosene Adulterated Kerosene and Deodorized Kerosene.

Parameter	Unadulterated kerosene	Adulterated kerosene	Activated carbon using ZnCl₂	Activated carbon using H₃PO₄
Initial boiling point (IBP)	150 ^o C	167 ^o C	168 ^o C	168 ^o C
End boiling point (EBP)	250 ^o C	327 ^o C	328 ^o C	325 ^o C
Flash point	45 ^o C	95 ^o	55 ^o	54 ^o
Smoke point	22mm	12mm	19mm	20mm
Density @15^o	0.8205	0.8351	0.8350	0.8350
Colour	20(min)	10	15	17
Total sulphur	0.15(min)	0.6	0.4	0.4

4.2.1 Discussion of Result

Table 4.3 Results of Boiling Point on the Unadulterated kerosene, Adulterated kerosene and Activated carbon using ZnCl₂ and H₃PO₄

Parameter	Unadulterated kerosene	Adulterated kerosene	Activated carbon using ZnCl₂	Activated carbon using H₃PO₄
Boiling point	250 ^o C	327 ^o C	328 ^o C	325 ^o C

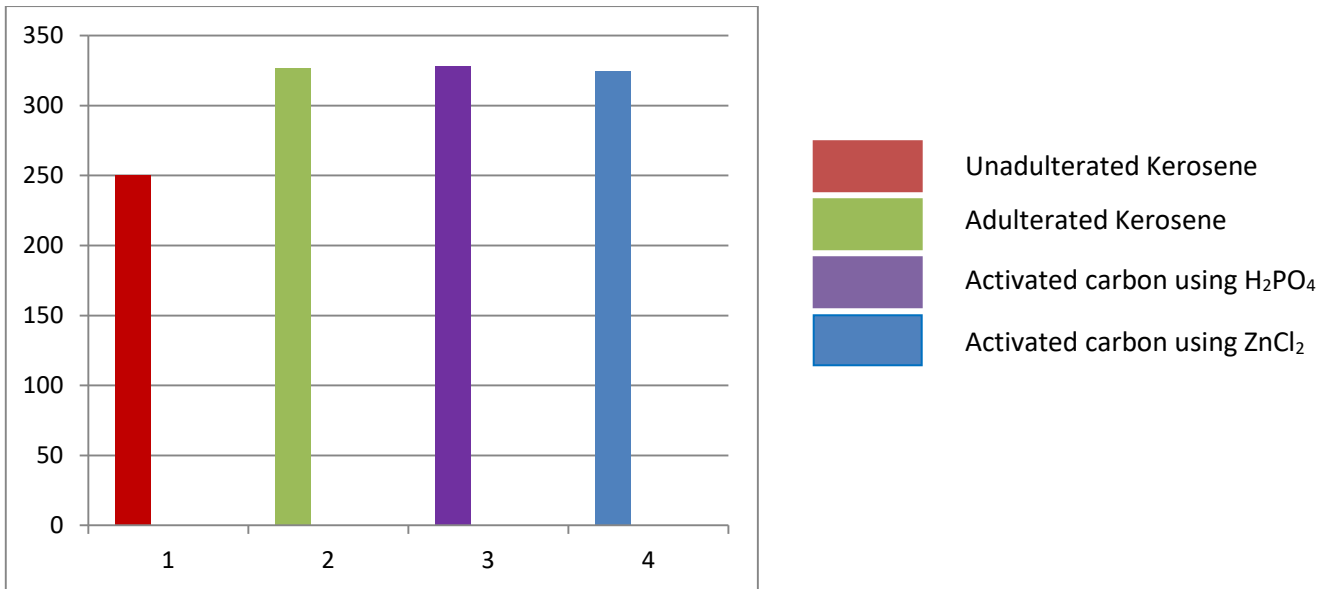


FIGURE 4.1: Bar Chart of Boiling Point on Unadulterated kerosene, Adulterated kerosene and Activated Carbon using ZnCl₂ and H₃PO₄

BOILING POINT

The initial and end boiling point of unadulterated Kerosene was 1500C and 2500C respectively, but that of adulterated and deodorized kerosene was within the range of 165—3300C .Deodorization process using activated carbon on kerosene had no profound effect on the boiling point

Table 4.4 Results of Flash Point on the Unadulterated kerosene, Adulterated kerosene and Activated carbon using ZnCl₂ and H₃PO₄

Parameter	Unadulterated kerosene	Adulterated kerosene	Activated carbon using ZnCl ₂	Activated carbon using H ₃ PO ₄
Flash point	45 ^o C	95 ^o C	55 ^o C	54 ^o C

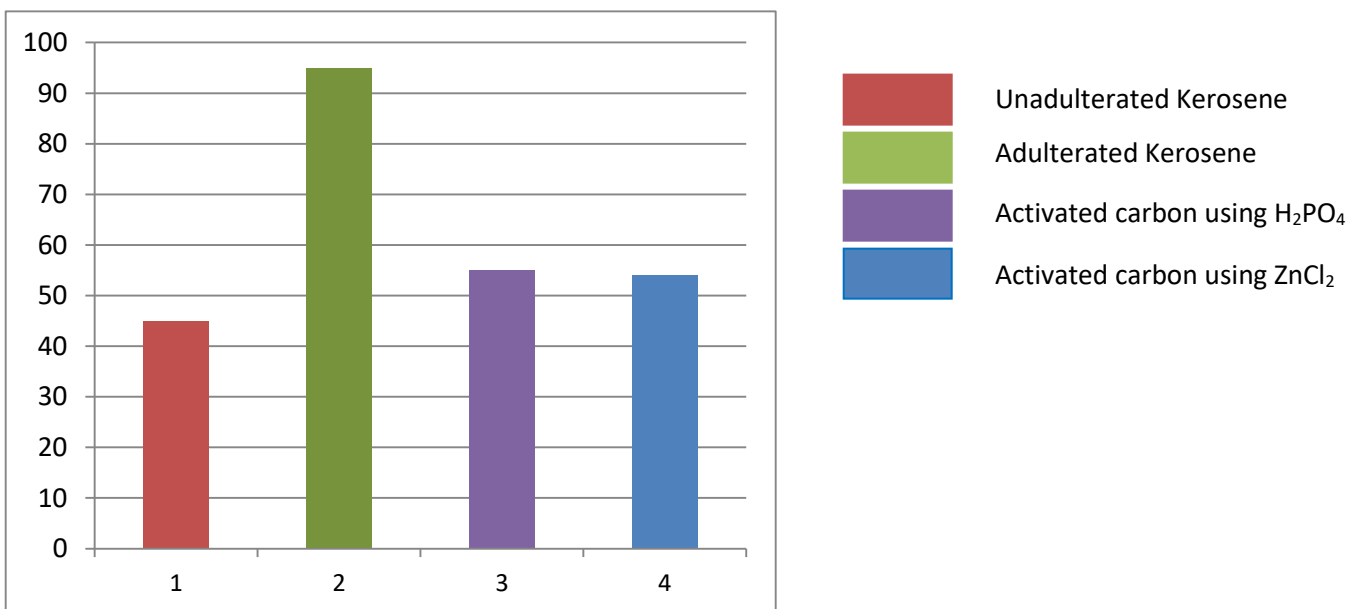


FIGURE 4.2: Bar Chart of Flash Point on Unadulterated kerosene, Adulterated kerosene and Activated Carbon using ZnCl₂ and H₃PO₄

FLASH POINT

The flash point of unadulterated kerosene was 450C, but that of adulterated was 950C. After the process of deodorization, the flash was reduced to a range within 500C—550C

Table 4.5 Results of Smoke Point on the Unadulterated kerosene, Adulterated kerosene and Activated carbon using ZnCl₂ and H₃PO₄

Parameter	Unadulterated kerosene	Adulterated kerosene	Activated carbon using ZnCl ₂	Activated carbon using H ₃ PO ₄
Smoke point	22mm	12mm	19mm	20mm

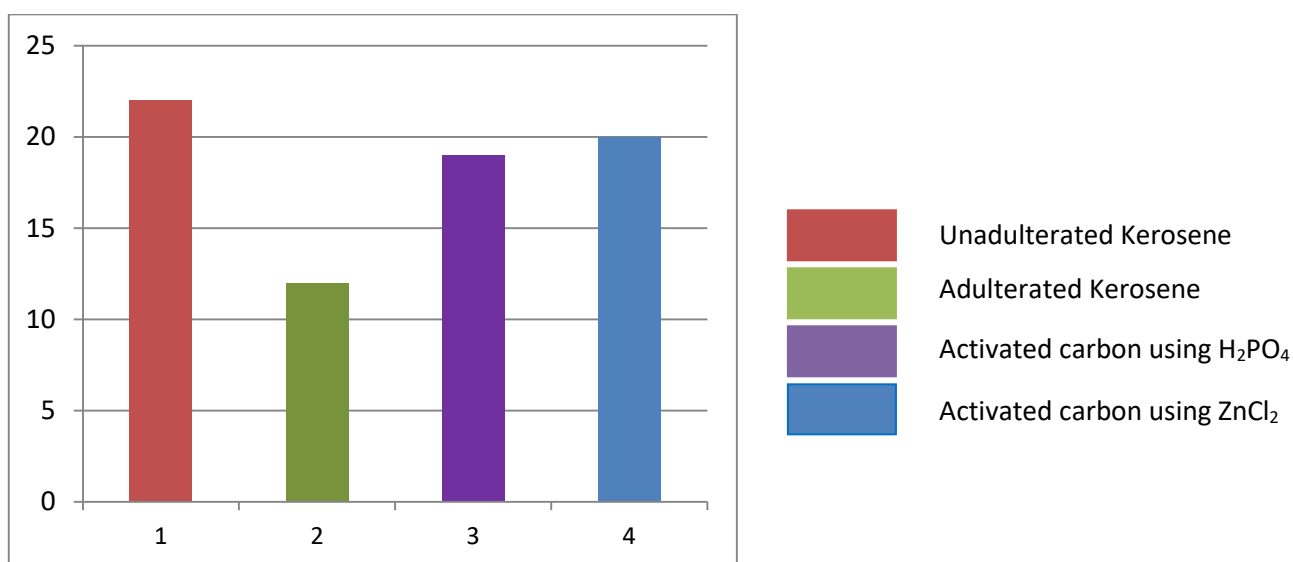


FIGURE 4.3: Bar Chart of Smoke Point on Unadulterated kerosene, Adulterated kerosene and Activated Carbon using ZnCl₂ and H₃PO₄

SMOKE POINT

The smoke point of unadulterated kerosene was 22mm and that of adulterated kerosene was 12mm. After deodorization, the smoke point of the adulterated kerosene increased to a range of 18mm—20mm

Table 4.6 Results of Density on the Unadulterated kerosene, Adulterated kerosene and Activated carbon using ZnCl₂ and H₃PO₄

parameter	Unadulterated kerosene	Adulterated kerosene	Activated carbon using ZnCl ₂	Activated carbon using H ₃ PO ₄
density@15°	0.8205	0.8351	0.8350	0.8350

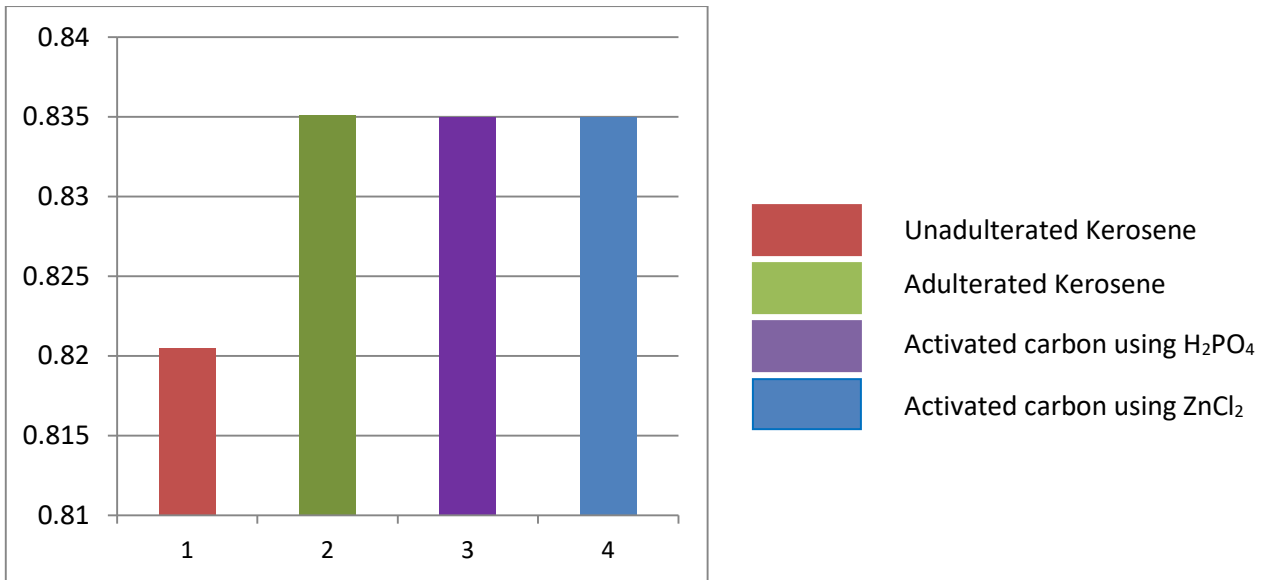


FIGURE 4.4: Bar Chart of Density on Unadulterated kerosene, Adulterated kerosene and Activated Carbon using ZnCl₂ and H₃PO₄

DENSITY

The deodorization process had no effect on the density of the adulterated kerosene

Table 4.7 Results of Colour on the Unadulterated kerosene, Adulterated kerosene and Activated carbon using ZnCl₂ and H₃PO₄

Parameter	Unadulterated kerosene	Adulterated kerosene	Activated carbon using ZnCl ₂	Activated carbon using H ₃ PO ₄
Colour	20	10	15	17

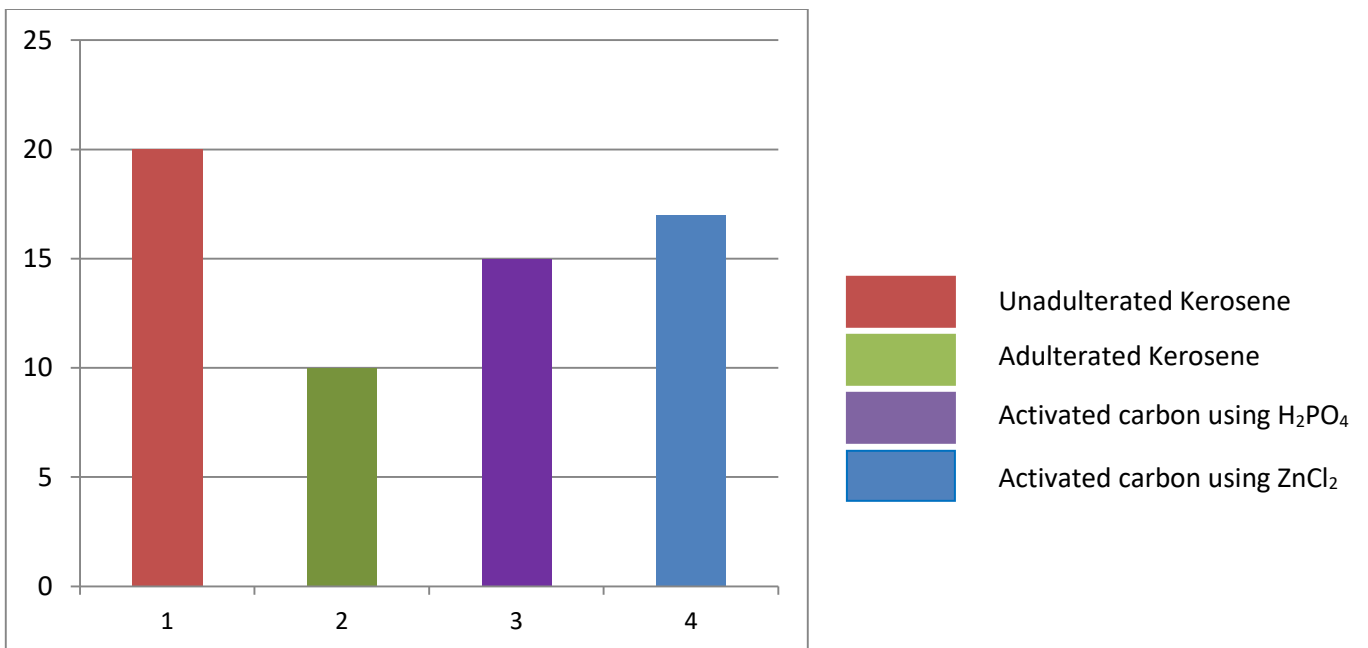


FIGURE 4.5: Bar Chart of Colour on Unadulterated kerosene, Adulterated kerosene and Activated Carbon using ZnCl₂ and H₃PO₄

COLOUR

The deodorization process improved the colour of adulterated kerosene from 10 to orange within 15—17

Table 4.8 Results of Total Sulphur Content on the Unadulterated kerosene, Adulterated kerosene and Activated carbon using ZnCl₂ and H₃PO₄

Parameter	Unadulterated kerosene	Adulterated kerosene	Activated carbon using ZnCl ₂	Activated carbon using H ₃ PO ₄
Total Sulphur Content	0.15	0.6	0.2	0.15

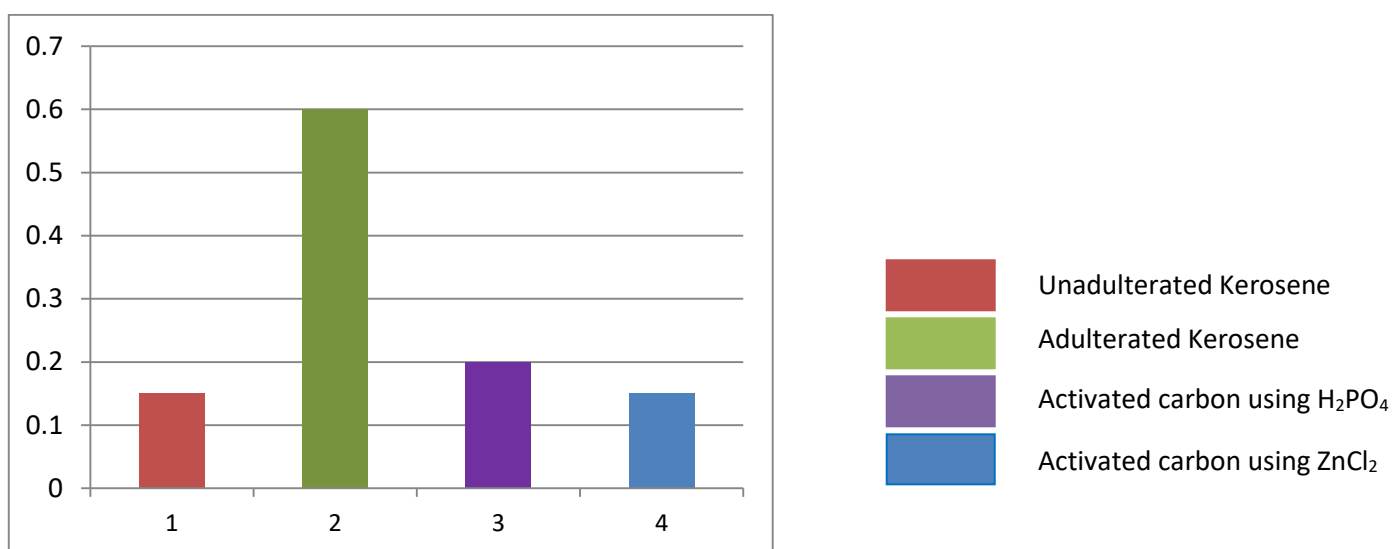


FIGURE 4.6: Bar Chart of Total Sulphur Content on Unadulterated kerosene, Adulterated kerosene and Activated Carbon using ZnCl₂ and H₃PO₄

Total sulphur content

Deodourization of kerosene using activated carbon produced from sawdust by desulphurization using absorption method simply means removal of sulphur compounds like sulphide mecaptan etc. this absorption of sulphur in kerosene took place in a baker containing some amount of activated carbon, after a given time the mixture was separated into Plainfield kerosene and ash activated carbon using filter paper with funnel.

The results for sulphur content in deodorized kerosene showed some similarity within the range of the control (unadulterated kerosene)

CONCLUSION AND RECOMMENDATION

Conclusion

Deodorization of kerosene using activated carbon produce from sawdust did not only remove or reduce the odor but also converted some other contaminants into harmless substance during the process which made it suitable for domestic use.

The use of activated carbon produce using Phosphoric acid as activating chemical gave a better yield.

Recommendation

This project work “deodorization of kerosene using activate carbon produced from sawdust” has shown considerable potential in the removal of odor from kerosene. It is necessary that people

using adulterated or contaminated kerosene should use activated carbon to deodorize tin order to reduce the effect of the odorized kerosene which is harmful to health. Government agencies should ensure that the adulterated and contaminated kerosene undergo deodorization before use in order to lessen air pollution.

REFERENCES

Opara C.C, Oyom Alex Igiri, Okonkwo Moses(2012) Deodorization of kerosene using activated carbon as Absorbent.

Greener Journal of physical Science. ISSN: 2276-7851 p. 70 – 71

DENG H et al(2009) Preparation and characterization of activated carbon from cotton stalk by micro wave assisted chemical activation- Application methylene blue adsorption from aqueous solution. ***Journal of Hazardous materials***, Amsterdam, V. 166, n 2, P. 1514- 1521.