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Treatment Of Spent Lubricating Oil Using Cornstalk Bagasse

Mfon.I.Otite Douglas[1], Onororakpene Victory Akpesiri[2]

Science Laboratory Technology Department,
Petroleum Training Institute
P.M.B 20, Effurun, Delta State, Nigeria
Corresponding Author: Onororakpene Victory Akpesiri
Corresponding Email: onororakpenevictory@gmail.com

***Abstract**: This research investigates the effectiveness of modified corn stalk bagasse in treating used lubricating oil, aiming to enhance its properties and promote sustainable recycling practices. The study involved treating used oil with corn stalk bagasse modified by 0.01M sulfuric acid and dilute sodium hydroxide, leading to significant improvements in key parameters: density decreased from 0.8985 g/cm³ to 0.8721 g/cm³, flash point increased from 200 °C to 230 °C, viscosity changed from 120.54 Cst to 106.27 Cst, and moisture content reduced from 13.30% to 2.3%. These results indicate that the treatment enhances the oil's stability and performance, making it suitable for reuse. Overall, this method offers an eco-friendly solution for recycling used lubricating oils, demonstrating the potential of agricultural by-products in industrial applications and promoting sustainable practices in waste management.*

Keywords: used lubricating oil,cornstalk bagasse

1. Introduction

Lubricating oils are termed viscous liquid product of petroleum produced by vacuum distillation of crude oil. It is composed of long chain saturated hydrocarbons and additives that are used in the moving parts of engines and machines (Ahmed and Nassar, 2011). Lubricating oil reduces frictions between contacting metal surfaces in engines where they are applied by creating separating surfaces between metal surfaces and moving parts. This prevents or reduce wear. During the course of usage, lubricating oil properties diminishes due contaminated with impurities such as benzene, lead, cadmium, polychlorinated biphenyls (PCBs) amongst others which not only toxic and harmful but hazardous and detrimental to the surrounding environment (Cen, Morina and Neville, 2018). Used lubricating oils are sometimes dumped at vacant plots, farmlands, drains and sewer which to sip into open waters causing pollutions.

The use of lubricating oil can not be avoided in a dispensation where there is increased demand for cars, heavy duty automobiles, generators and machineries. There is therefore need to find ways of managing waste lubricating oil. The collecting, refining and reuse of waste lubricating oil will impact positively on energy management and environment protection. Some of the common waste lubricating oil regeneration methods widely used are Solvent extraction, vacuum distillation, acid-clay treatment, hydro-finishing and sometimes these are used in combination (Mabrouk et al, 2023; Tan et al., 2022). The treatments mentioned above are expensive due to the high over pressures, deep vacuums and high temperatures systems applied. One of the oil recovery and regeneration method, adsorption method occupies an important position, so the choice of adsorbent has always been the focus of the purification of waste lubricating oil.

With people's increasing environment awareness, the concept of "disposal of waste with waste" is recognized by people (Perekh et al., 2022) and there is need for urgent formulation and implementation of green adsorbent. Due to this, increasing reports now exist on the use of biomass material from plants as adsorbent to treat aqueous liquid. Agricultural and forestry residues, as natural and low-cost adsorbents, have been studied lately, such as cotton (Zheng et al., 2019), sugarcane bagasse (Fadairo et al., 2021), rice husk activated carbon (Riyanto, and Juliantydjawi, 2018), corncob (Ramos et al., 2012, Buasri et al., 2012). With the increase in corn production, the amount of cornstalk waste is also increasing, which makes cornstalk one of the rich agricultural wastes in the world (Kaur, 2022). Most of them are burned or discarded, which caused severe environmental pollution and a great waste of resources (Gan et al., 2021). Using cornstalk as an adsorbent is not only a reasonable application of agricultural waste, but also enhances the value of biomass. The chemical composition of cornstalk is mainly composed of 34% cellulose, 30% hemicellulose, 19% lignin and 4.2% ash (Zhang et al., 2017). Lignin fills between cellulose and hemicellulose, forming a closed protection for lignin-carbohydrates. Kaur (2018) analyzed the properties of the cornstalk in work and found that the porosity of cornstalk is as high as 83.9%, indicating that the cornstalk is an ideal adsorbent material.

This study therefore seeks to ascertain the viability of cornstalk bagasse in the regeneration of used lubricating oil.

Aims and Objectives of the paper

The aim of this study is to treat spent lubricating oil using cornstalk bagasse. The objective is to:

I. To develop cornstalk bagasse from cornstalk.

ii. To determine the ash content,specific gravity and viscosity of used and unused lubricating oil.

iii. To use the cornstalk bagasse developed for the treatment of spent lubricating oil.

iv. To compare the viscosity index,density,flashpoint, water contents of the treated lubrication oil with new lubrication oil sample.

2. LITERATURE REVIEW

Spent, used or waste lube oil are commonly used to describe lubricant oil which remains after its useful life has elapse according to the American Standard for Testing Materials (ASTM, 2004). Researchers such as Wilson and Lyon, in Shreir's Corrosion, 2010 explained that when the lubricating oil is in use, it degrades due to oxidation and contamination with metals, water, varnish, ash, gums, carbon residue and other contaminating materials.

Plant biomass plays a vital role in the process of biosorption, which is the removal of pollutants, such as heavy metals, from aqueous solutions using biological materials. The unique properties of plant biomass make it an effective and sustainable option for biosorption applications.

With the increase in corn production, the amount of cornstalk waste is also increasing, which makes cornstalk one of the rich agricultural wastes in the world (Choi, 2018). Except for a very small part, the corncob was used as animal feeds and raw materials for paper pulp. Most of them are burned or discarded, which caused severe environmental pollution and a great waste of resources (Chang-wen et al., 2015). Using cornstalk as an adsorbent is not only a reasonable application of agricultural waste, but also enhances the value of biomass. The chemical composition of cornstalk are mainly composed of 34% cellulose, 30% hemicellulose, 19% lignin and 4.2% ash (Zhang et al., 2017). Lignin fills between cellulose and hemicellulose, forming a closed protection for lignin-carbohydrates. The active groups of biomass such as hydroxyl (Hou et al., 2019), carboxyl, and amino (Chen et al., 2011) have certain adsorption properties to contaminants. There exists close connection between lignin and cellulose microfibers, the presence of lignin will form a natural protective barrier and steric hindrance for biomass.
Generally, the physicochemical pretreatment can reduce the lignin and/or the hemicellulose contents in biomass, simultaneously disrupting the structure of plant cell wall thus increasing surface area, porosity (Auxenfans et al., 2017) and expose more active groups for contaminants adsorption. Choi et al. Choi (2018) analyzed the properties of the cornstalk in work and found that the porosity of cornstalk is as high as 83.9%, indicating that the cornstalk is an ideal adsorbent material. Leyva-Ramos et al., (2005) modified natural cornstalk with citric acid (CA) and nitric acid (NA), which increased the adsorption capacity of cornstalk to Cd (II) from waste water by 10.8 times and 3.8 times, respectively. Nwadiogbu et al. (2016) used cornstalk as raw materials and treated cornstalk with acetic anhydride to improve its hydrophobicity and enhance the adsorption efficiency am to crude oil from wastewater. However, there are a small number of reports on the use of biomass for the adsorption of contaminants in non-aqueous solutions.

3.0 METHODOLOGY

3.1 Materials

Analytical weighing balance (Sartorius balance ED1245)

Autoclave

Cleveland opencup

Hot plate

Crucible

Retort stand

Furnace (Thermo scientific Lindbergh blue M)

Constant temperature bath (Cannon instrument CT-100)

Viscosity meter

Hydrometer

Kitchen knife

3.1.1 Regeants

Sulfuric acid (H2SO4)
Sodium Hydroxide (NaOH)

3.1.2 Plant Material

Cornstalk

3.2.1 Sampling location

PTI road Effurun, is located in the Uvwie Local Government Area of Delta State, Nigeria. Effurun is located between longitude 5°42′0"E to 5°50′0"E and latitude 5°40′0"N to 5°30′0"N.

3.2.2 Sample Collection(Used and Unused Lubricating oil

A 5 litre sampling container was thoroughly washed and sterilized in an auto clave. A motor workshop along PTI Road, Effurun was visited and waste lubricating oil (engine oil) was

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collected in the container already presterilized. High grade unused lubricating oil was also purchase at a retail outlet and was used as control for this work. Both lubricating oils were kept in the lab prior to analysis

3.2.3 Collection and Preparation of Cornstalk Bagasse from cornstalk

Cornstalk

samples were obtained from a recently harvested farmland in Oghara community, Delta state. The cornstalk were stripped off its leaves, washed to remove debris, chopped into smaller sizes and crushed. The crushed bagasse was treated with 0.01M of sulfuric acid and dilute sodium hydroxide, and washed with distilled water until it became colour free. The colour free bagasse were dried in the oven at 800°C, after which it was kept for batch adsorption process

3.2.4 Determination of Ash content, Carbon Residue, Viscosity and Specific gravity of both Used lubricating Oil and Unused Lubricating Oil

2g of lubricant oil sample was weighed in a suitable crucible and carefully heated and ignited by flame until leaving a carbonaceous material only. Then, the carbon residue was calculated (ASTM D 482., 2003). After that, it was heated in a furnace at 775±25 ˚C until the carbonaceous material disappeared. The crucible was removed from the furnace and left to cool at room temperature, and the ash amount was calculated (Hameed et al., 2017). ASTM D7110 was used in determining the viscosity of the lubricating oils and the specific gravity measured using ASTM D287 method.

3.2.5 Treatment of Used lubricating Oil

The waste oil was allowed to settle down and all the free water and sediment were separated. The mixture was mixed with a fixed amount of 15%(wt) of the adsorbent and stirred properly for different contact time in a batch adsorption process at ambient temperature. The sample was then filtered, and then analyzed for different physical properties such as; kinematic viscosity, pourpoint, viscosity index, flashpoint, and density

4.0 RESULTS AND DISCUSSION

4.1 Results

Used lubricating oil was obtained from a mechanic workshop and treated with corn stalk bagasse modified with 0.01M sulfuric acid and dilute sodium hydroxide. The table below therefore, highlights important information about how the properties of lubricating oil changed after treatment with modified sugarcane bagasse. The unused sample serves as a reference for the oil's original characteristics, while the used sample shows the effects of its application and how it degrades over time.

Table 4.1 Characterization parameters of new, spent and treated lubricating oil

Parameter	**Unit**	**ASTM Method**	**Unu Sam (Sta**
Density @15 ºC	g/cm^3	D1298	0.87
Flash Point	ºC	D92	220
Viscosity @ 40 ºC	Cst	D445	196.
Moisture Content	%	D4442	1.62
Ash Content	%	D482	<1
Pour Point	ºC	D97	-32

Key: Degree Centigrade (ºC), Grams Per Centimeter (g/cm3), America Society for Testing and Materials (ASTM), Centistokes (Cst), Percentage (%).

4.2 Discussion of Results

The treatment of used lubricating oil with corn stalk bagasse modified using 0.01M sulfuric acid and dilute sodium hydroxide resulted in significant changes across various parameters characterized. Initially, the density of the unused oil was measured at 0.8785 g/cm³, while the used oil showed an increase to 0.8985 g/cm³, reflecting the accumulation of contaminants during usage. After treatment, the densities of the treated samples decreased slightly, with values of 0.8675 g/cm³ for the 5g sample, 0.8706 g/cm³ for the 10g sample, and 0.8721 g/cm³ for the 15g sample. This decline indicates a reduction in heavier impurities, suggesting that the treatment process effectively cleansed the oil. The flash point, an important safety property, was initially 220 °C for the unused oil but dropped to 200 °C in the used oil, indicating increased volatility. Following treatment, the flash points improved significantly, with the 15g treatment reaching 230 °C, showing enhanced stability and reduced risk of ignition.

The viscosity results show that, the unused oil had a high viscosity of 196.23 Cst, which decreased to 110.33 Cst in the used oil, highlighting a loss of lubricating properties due to degradation. The treated samples exhibited slight improvements in viscosity, with the 5g sample at 109.43 Cst, the 10g sample at 107.50 Cst, and the 15g sample achieving the lowest viscosity at 106.27 Cst. This suggests that the treatment not only restored some lubricating qualities but also enhanced fluidity, making the oil more effective for use. Notably, the 15g sample proved to be the most efficient in restoring the oil's properties across several parameters, including density, flash point, and viscosity. Moisture content, a critical factor for oil quality, was alarmingly high at 13.30% in the used oil, posing risks for engine corrosion. Post-treatment, moisture levels decreased dramatically, with the 5g sample at 4.1%, the 10g sample at 3.8%, and the 15g sample at just 2.3%. This substantial reduction is vital for ensuring the longevity and performance of lubricating oils. The ash content remained low across all samples, with values around 0.0088% to 0.0089%, indicating that the treatment effectively removed contaminants without introducing new inorganic residues. Lastly, the pour point remained stable at -32 °C across all samples, suggesting that the treatment did not adversely affect the oil's flow properties at low temperatures.

-5.0 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This study found that treating used lubricating oil with modified corn stalk bagasse improved its properties. The treatment enhanced the oil's stability and performance while effectively reducing contaminants and moisture content, which are crucial for preventing engine wear and corrosion. This method, therefore, offers an eco-friendly solution for recycling used oil, showing the potential of agricultural by-products in industrial applications and promoting sustainable practices in waste management**.**

5.2 Recommendation

Based on the findings in this research work, following are recommended:

Optimization of Treatment Conditions:
Further research should explore varying concentrations and treatment times of the modified corn stalk bagasse to maximize the effectiveness of contaminant removal and property enhancement in used lubricating oil.

Conducting Comparative Studies:
Investigate the effectiveness of different agricultural by-products against modified corn stalk bagasse to identify the most efficient materials for treating used lubricating oil.

Examining Mechanisms of Action:
Study the specific chemical and physical mechanisms through which modified corn stalk bagasse interacts with contaminants in used oil, providing insights for improving treatment processes and outcomes.

REFERENCES

Ahmed, N., and Nassar, A. (2011). Lubricating Oil Additives. 10.5772/22923.

Bakhtyar K. A.; Muhammad A. A. and Karim J. J. (2011). Acid Activation and Bleaching Capacity of Some Local Clays for Decolourizing Used Oils. Asian Journal of Chemistry; Vol. 23, No. 6.

Basel Convention (2002). Technical Guidelines on Used Oil Re-Refjning of Other Re-Uses of Previously Used Oil, ISBN: 92-1-158605- 4.

Buasri, A., and Chaiyut, N., Tapang, K., Jaroensin, S., & Panphrom, S. (2012).

Cen, H., Morina, A., and Neville, A. (2018) Effect of lubricant ageing on lubricants' physical and chemical properties and tribological performance; Part I: effect of lubricant chemistry. Industrial Lubrication and Tribology, 70 (2). pp. 385-392. ISSN 0036-8792 https://doi.org/10.1108/ILT-03-2017-0059

Emam, E. A. and Shoaib; A. M. (2020). Re-refining of used lube oil, I- by solvent extraction and vacuum distillation followed by hydrotreating. Journal Petroleum & Coal ,55 (3), 179-187.

Emetere M. E (2017). Investigations on aerosols transport over micro-and macro-scale settings of West Africa. Environmental Engineering Research 22 (1), 75-86.

Fadairo, Ekaette. (2021). Determination of Sugarcane Bagasse Effectiveness in Treatment of Polycyclic Aromatic Hydrocarbons-Contaminated Soil in Effurun Mechanic Workshops. 10.0000/ichst/2021v.

Gan, X., Chen, L., Chen, X., Pan, S., & Pan, H. (2021). Agricultural bio-waste for removal of organic and inorganic contaminants from waste diesel engine oil. Journal of Hazardous Materials, 414, 124906. https://doi.org/10.1016/j.jhazmat.2020.124906

Gan, X., Lu, Chen., Xiaohui, Chen., Shouquan, Pan. and Hongkun, Pan. (2021) Agricultural bio-waste for removal of organic and inorganic contaminants from waste diesel engine oil, Journal of Hazardous Materials, Volume 414, 124906,

Gardea-Torresdey, J. L., Tiemann, K. J., Gamez, G., Dokken, K., & Cano-Aguilera, I. (2012). Lignocellulose by-products for the removal and sequestration of heavy metals from water. Journal of Hazardous Materials, 57(1-3), 29-39.

Gupta, S. K., Kumar, A., & Sharma, P. (2020). Adsorption of methylene blue from aqueous solution using neem leaf powder: Kinetics and thermodynamics. Journal of Environmental Chemical Engineering, 8(4), 104292. https://doi.org/10.1016/j.jece.2020.104292

Hameed, T., Khudhair, M., Jafar, A., Nifal, W. and Huseen, J. (2019). Study Using Different Adsorbents Materials in Purification of Waste Lubricating Oil. Engineering and Technology Journal. 35. 10.30684/etj.35.1C.15.

Jafari, A. J.r and Hassanpour, M., (2015). Analysis and comparison of used lubricants, regenerative technologies in the world. Retrieved from: Journal of Petroleum and Gas Engineering. 2 (2), 12-19.

Kadir, M. F. A., Zainal, Z. A., & Rahman, N. A. (2021). Heavy metal adsorption using moringa seed biomass: A comparative study. Environmental Science and Pollution Research, 28(15), 18912-18925. https://doi.org/10.1007/s11356-021-13347-5

Kaur, P., & Singh, R. (2020). Adsorption of phenolic compounds from wastewater using wheat straw: Kinetic and equilibrium studies. Water Science and Technology, 81(4), 765-775. https://doi.org/10.2166/wst.2020.191

Kaur, P., Singh, J., Kaur, M., Rasane, P., & Kaur, S., Kaur, J., Nanda, V., Mehta, C., and Sowdhanya, D. (2022). Corn Silk as an Agricultural Waste: A Comprehensive Review on Its Nutritional Composition and Bioactive Potential.

Kaur, S., Kaur, M., & Sharma, S. (2018). Utilization of rice husk for the removal of heavy metals from wastewater: A review. Environmental Science and Pollution Research, 25(26), 25896-25912. https://doi.org/10.1007/s11356-018-2677-4

Lam, S.S, Liewa, K.K., Jusoh A.A, Chong c.T., Ani, F.N., Chase HA. (2016). Progress in waste oil to sustainable energy, with emphasis on pyrolysis techniques. Renewable and Sustainable Energy Reviews 7 (53) 741753

Mabrouk, M., and Eid, Y., Tarek, M., AlSayed, M., Elfakharany, K., Maher,
Methods of Used Lubricating oil, International Journal of Civil Engineering and Technology, 9(12),506—514

Mohammeda, R., Ibrahim, A., Taha,H. and McKay, G. (2013) .Waste lubricating oil treatment by extraction and adsorption . Chemical Engineering Journal ,220,343–351

Moura, L., Assunção F., J. L.; Ramos, A. C. S.(2017). Recovery of used lubricant oils through adsorption of residues on solid surfaces. brazilian journal of petroleum and gas , v. 4 n. 3, 091-102 .

Muthuraman, M., Rajendran, K., & Senthilkumar, A. (2019). Adsorption of fluoride ions from aqueous solution using banana peel biomass: Kinetics and equilibrium studies. Journal of Environmental Management, 240, 127-135. https://doi.org/10.1016-/j.jenvman.2019.03.049

Nabil M, A., Essam A.H, Al Z., and Mehr ab Mehrvar (2014) treatment of waste lubricating oil using an adsorption process with various adsorbents. This research was published in the International Journal of Chemical and Biological Engineering.

Nabil M, Abdel-Jabbar, Essam A.H, Al Zubaidy, Mehrab Mehrvar. Waste Lubricating Oil

Nabil M, Abdel-Jabbar, Essam A.H, Al Zubaidy, Mehrab Mehrvar. Waste Lubricating Oil

Naife, M., Rashid, S., Jabbar, M. (2022). Treatment of Used lubricant Oil by Solvent Extraction. Iraqi Journal of Chemical and Petroleum Engineering. 23. 43-50. 10.31699/IJCPE.2022.1.6.

Namasivayam, C., & Kavitha, D. (2019). Removal of dyes from wastewater using jackfruit leaf powder as an adsorbent. Journal of Environmental Management, 250, 109-116. https://doi.org/10.1016/-j.jenvman.2019.109116

Nwachukwu A., Jude A., and Huan F. (2016) Evaluation of the potential of mechanic villages for small-scale used engine oil recycling business. This was published in the African Journal of Environmental Science and Technology in, Volume 6(12), pages 464-475.

Oladimeji, T., Sonibare, J., & Omoleye, J., & Emetere, M., & Elehinafe, F. (2018). A review on treatment methods of used lubricating oil. International Journal of Civil Engineering and Technology. 9. 506-514.

Ong, S. T., Keng, P. S., Chong, A. W., & Lee, W. N. (2017). Utilization of agricultural waste materials for removal of heavy metals from contaminated water: a review. Global NEST Journal, 19(3), 411-426.

Ramos, R., & Landin-Rodriguez, L.E., Leyva, S. & Medellin-Castillo, N. (2012). Modification of corncob with citric acid to enhance its capacity for adsorbing cadmium(II) from water solution. Chemical Engineering Journal. 180. 113– 120. 10.1016/j.cej.2011.11.021.

Rincon, J., Canizares, P., Garcia, M.T. (2015). Regeneration of used lubricating oil by polar solvent extraction. Ind. Eng. Chem. Res. , 44, 43–73.

Riyanto, A., and Juliantydjawi, D. (2018). The effect of treatment with activated carbon on the metal content in reuse of lubricating oil waste. MATEC Web of Conferences. 154. 01018. 10.1051/matecconf/201815401018.

Saeed, A., Akhter, M. W., & Iqbal, M. (2005). Removal and recovery of heavy metals from aqueous solution using papaya wood as a new biosorbent. Separation and Purification Technology, 45(1), 25-31.

Shaikh, R. & Mahanwar, P. 2018. Reclamation of used engine oil using polymeric flocculants. International Journal of Chemical Sciences, 16(2), 1-14.

Sharad, S., Swapnil, R., Sanjeel, N., Sreehari, N., Uddhav, Pai., Senroid, F., Satyam, P., Joshua, S. (2020) Refining of used Engine Oil, International Journal Of Engineering Research & Technology (IJERT) Volume 09.

Shri Kannan C, Mohan Kumar KS, Sakeer Hussain M, Deepa Prjya N and Saravanan K. (2014). Studies on Reuse of Re-Refined Used Automotive Lubricating Oil. Research Journal of Engineering Sciences 3(6), 8-14.
Summer Corn Cultivating Area of China at Present and Under Future Climate

Tan, H., Azmi, N., Veny, H., Ying P. and Passarella, R. (2022). A comparative study on treatment for recycling of waste lubricating oil. Malaysian Journal of science.

Temitayo E., Jacob A., James O., Abiola A., Hilary O., (2018). Data on the treatment of used lubricating oil from two different sources using solvent extraction and adsorption. Data in Brief 19 (2018)2240–2252.

Treatment by Adsorption Process Using Different Adsorbents. International Journal of

Treatment by Adsorption Process Using Different Adsorbents. International Journal of

Udonne J D, Bakare A. (2013). Recycling of Used Lubricating Oil Using Three Samples of Acids and Clay as a Method of Treatment. Int. Arch. App. Sci. Technology; Vol 4 [2] 08- 14.

Udonne, J. D. (2011). A comparative study of recycling of used lubrication Oils using distillation, acid and activated charcoal with clay methods.

Vineet Katiyar, Sattar Husain. Recycling of Used Lubricating Oil Using 1-Butanol Int. J.
Volesky, B. (2007). Biosorption and me. Water research, 41(18), 4017-4029.

W., Mohamed, T., Setait, M., Elazab, A., Abdel-Hamid, S., and Aly, Sohair. (2023). Optimization of waste lubricating oil regeneration using acid-clay process. Environmental Progress & Sustainable Energy. 10.1002/ep.14194.
Waste and Biomass Valorization. 14. 1-20. 10.1007/s12649-022-02016-0.

Zhang, Q., and Yang, Z. (2017). Impact of Extreme Heat on Corn Yield in Main