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Comparative Analysis of Locally Refined Petroleum Product (Diesel) In Niger Delta Region, Nigeria

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ABSTRACT: *This paper focuses on the comparative analysis of locally refined petroleum product (Diesel) in Niger Delta Region of Nigeria..Three analyses were carried on the sample: physiochemical techniques, atomic absorption spectroscope, and gas chromatography. The physiochemical parameter determined include refractive index, flash point, viscosity, cloud point, density, smoke point, diesel index, and total acid number; atomic absorption spectroscope determined weresodium, magnesium, aluminum, sulphur; and gas chromatography determined was total petroleum hydrocarbon. ASTM procedural method was used to determine the metallic, elemental and physiochemical properties, while gas chromatography with flame ionization detector (GC/FID) was used to determine the total hydrocarbon content. The results obtained for locally refined diesel from two outlets and mega filling station samples were; aluminum contents; 1.52%, 3.71% and 0.61%, sodium: 0.94% , 1.63% and 0.47%, flash point: 63.80^{o}C, 83.60^{o}C and 62.10^{o}C, smoke point: 41.70mm, 43.80mm and 24.30mm. The statistical test of equality of variance using an error of five percent (5%) run on the metallic and physio-chemical properties indicates that aluminum, suphur, and total acid number of the locally refined fractions are significantly different from the product of mega filling station. The GC results shows that carbon molecules of kerosene are found in locally diesel sample, and the total petroleum hydrocarbon of mega filling station product is higher than both the locally diesel samples.*
Keywords: *Petroleum product, Diesel, Analysis, Physicochemical*

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I. INTRODUCTION

According to [1], oil is the "life wire" of the economy of Nigeria, and the Nigerian petroleum is mainly produced in southern part (Niger Delta region) of the country. The light and heavy crude oil is from delta basin are paraffinic and low in sulphur, with about 36 gravity and 20-25 gravity [2]. Nearly all the primary reserves of Nigeria are found in and around delta of Niger River, but offshore rigs are eminent in the well endowed coastal region.Nigeria crude oil is classified basically as light and sweet because is largely free from sulphur, and Nigeria is the apex producer of sweet oil in OPEC. Nigeria has four refineries; Warri refinery and petrochemical plant, new Port Harcourt refinery, old Port Harcourt refinery, and default Kaduna refinery operated at 30% production capacity. Estimate shows that the demand and consumption of petroleum in Nigeria grows at rate 12.8% annually. However, the petroleum products are unavailable to most Nigerians, only a limited quantity is supplied to Nigerians, and the few available ones are quite costly due to low production rate of about 75,000 barrel per day. The petroleum recovered by the multinational oil companies is refined overseas and not made available to Nigerians. Due to exploration and extraction in the Niger Delta have destroyed the people means of livelihood (agriculture) brought about conflicts between the Niger Delta people, the oil companies and federal government of Nigeria, as a result different agitation groups was formed for the amelioration of the region environment [3], [4]; and [5]. Inadequate attention for the region by concerned authorities degenerated into armed conflicts characterized by kidnapping, oil bunkering, bombing of oil installations and other negative vices by militant groups in the region [6]; [7]; [8]; and [9], and that the insurgence affected oil exploration, production and distribution, and reduced revenue accruing to government. This lead to the Amnesty Program introduced by late President of Nigeria, AlhajiUmaru Musa Yar'Adua on June 25, 2009 [10]. The amnesty program was designed to bring peace and reconciliation to facilitate uninterrupted exploration and production, but despite the amnesty program oil bunkering is still on high side [11].Due to the thoughts of "harvesting what is ours" to curb hunger and elevate the standard of living of the Niger Delta people, there is a total deviation in the traditional ways of obtaining these fractions through the activities of some locally refiners (artisanal refinery) called bunkers in the south-southern part of Nigeria "Niger Delta". The refining method is totally different from the modern refinery methods and even worsted than the early refinery methods of 1880s that leave a lot of naphtha in kerosene produced [12]. The locally refined products contain a lot of impurities and unsaturated hydrocarbons, which cause cracking sound in vehicle engines; knocking of vehicles, motorcycles, and generators engines; corrosion and fouling of fuel tanks; burning of residential houses, properties, and end users; and pollution of the environment.The fact that major routes of refining are ignored; the refining is carried out without reflux, there is no heater and heat exchanger equipment, and there is no pump and cooler installations. The cook products are sold at very cheap price, and coupled with extreme poverty around the region, a lot of Niger Delta populace prefers its use to convectional refinery products.According to [13], illegal refineries in Niger Delta boil crude oil in metal containers (drums) to distil petroleum products. Open fire is used as the source of heating the petroleum in the drums. The fractions obtained from the locally refineries include gasoline, kerosene, diesel, and residue. The residue is discarded to the immediate surroundings while the gasoline, kerosene, and diesel is sold at cheap price.

The effects of the local refining ranges from the formation of soot as observed around major cities and villages around the creeks in the Niger Delta region; lease of potential poisonous chemicals like methane accompanied by carbon dioxide, nitrogen dioxide, sulphur, organic compounds such as benzene, toluene, xylene, and hydrogen sulfide; destruction of soil nutrients and properties, and death of aquatic lives; and kidney failure and skin cancer in human (see plate 1 and 2).

Plate 1: Black smoke released to atmosphere during local refining.
Plate 2: Bunkering activities hindering growth of vegetation around the area.

Conventionally, petroleum is refined in the refinery via fractional distillation to fractionate the mixture into fractions such as fuels, lubricants, and intermediate feedstock for petrochemical industries[14]. The pretreatment which includes desalting and dehydration, and refining which distillation is the major operation which processing of petroleum takes place.The distillation unit of refinery involves pumps, blower, heat exchangers, boilers, and reflux drum [15]. Refinery processes is divided into three major types which include separation (division of crude oil into various streams or fractions), conversion (chemical type alteration of the petroleum components to produce salable materials), and finishing (purification of various product streams).This paper therefore seeks to compare locally refined and convectional petroleum product (diesel) in the Niger Delta, Nigeria.

II. MATERIALS AND METHODS

Materials/Analysis the sample

Atomic Absorption Spectroscope: The samples to be analyzed using the AAS apparatus was first digested and diluted using reagents such as sulphuric acid, nitric acid, hydrogen chloride, ammonia, sodium carbonate, distilled water, artho phosphoric acid, and di-phenol lamine. The detection of themetals presence in the sample is based on wavelength.

Gas Chromatography (Agilent 6890): Poured the sample into a one litreseparatory funnel, and add 50ml of methylene chloride to the sample seal; shake for about 30 seconds to rinse the inner surface. Transfer the solvent to the separatory funnel and extracted the sample by shaking the funnel for about two minutes with regular venting to release excess pressure. The organic layer was allowed to separate from water for a minimum of ten minutes; the methylene chloride extract was collected in a 250ml flask. Add second volume of methylene chloride to the sample bottle, both the separatory funnel and the column was rinsed with 20ml of the solvent into the extract. The extraction procedure were repeated a second time, and extracts combined in the Erlenmeyer flask. The extraction were performed the third time in the same manner as the preceding's. Pour the combined extract through a drying column containing packed cotton wool anhydrous sodium sulphate and silica; connect the extract into the vial and concentrate with 1.0ml of the solvent and inject 1.0µL into the flame ionization detector gas chromatography for its PAH (polyaromatic hydrocarbon), TPH (total petroleum hydrocarbon), and BTEX (benzene, toluene, ethylbenzene, and xylene) analysis. The GC/FID is connected to a computer which interprets the result and plot the graph (chart) of the concentration of carbon per time.

III. RESULTS AND DISCUSSION

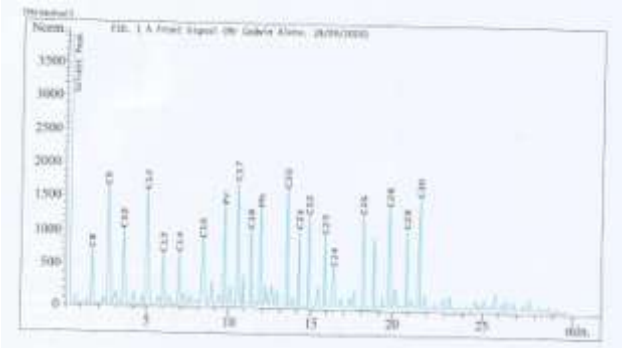
The results obtained after characterization of diesel samples are presented in the following Tables and Figures.

Table 1: Metallic/Elemental properties of diesel samples

Metallic/Elemental Test	Nembe	Yenagoa	Average	Mega Filling Station	Remark
Sodium (%)	0.94	1.63	1.285	0.471	Not acceptable
Magnesium (%)	0.85	1.18	1.015	0.35	Not acceptable
Aluminum (%)	1.52	3.71	2.615	0.611	Not acceptable
Sulphur (%)	0.131	0.184	0.1575	0.059	Not acceptable

Table 2 Physiochemical properties of diesel samples

Physiochemical properties test	Nembe	Yenagoa	Average	Mega Filling Station	Remark
TAN (Mg KOH/g)	0.21	0.18	1.195	0.008	Not acceptable
Diesel index	70.35	45.5	57.925	83. 59	Not acceptable
Refractive index	1.46757	1.46952	1.4685	1.4745	Acceptable
Flash point (^oC)	63.8	83.6	73.7	62.1	Not acceptable
Viscosity (cst)	0.705	1.89	1.2975	1.889	Not acceptable
Cloud point (^oC)	-5	-6	-5.5	-6.7	Acceptable
Density (g/cc)	0.85	0.855	0.8525	0.852	Acceptable
Smoke point (mm)	41.7	43.8	42.75	24.3	Not acceptable



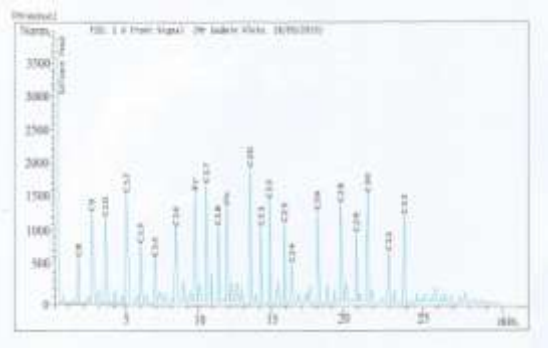


Figure 1 Chromatogram chart of the Diesel sample from Nembe LGA.
Figure 2: Chromatogram chart of the Diesel sample from Yenagoa LGA.

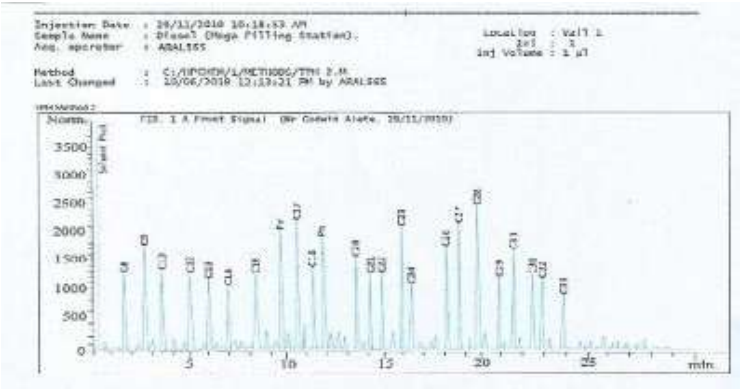
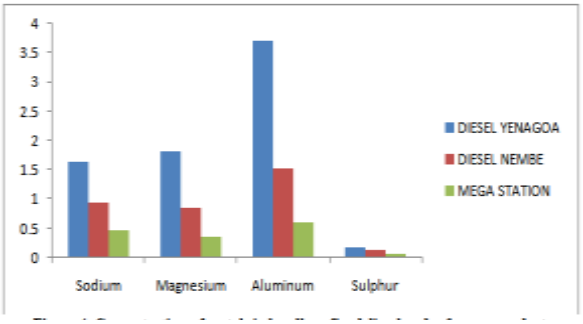


Figure: 3: Chromatogram chart of the diesel from mega filling station.

Table 3: Summarized results of the chromatogram charts of the diesel samples

Carbon type present	Concentration of carbon type on each sample (ppm) Diesel Nembe LGA	Diesel Yenagoa LGA	Diesel Mega filling Station
C_8	785.52	649.53	1345.25
C_9	1635.74	1231.76	1723.96
C_{10}	981.71	1176.76	1351.05
C_{11}	_	_	_
C_{12}	1523.39	1453.53	1203.76
C_{13}	543.15	753.94	1013.52
C_{14}	570.63	582.01	957.1
C_{15}	_	_	2029.03
C_{16}	794.72	918.94	1181.24
Pr	1313.16	1427.59	1950.12
C_{17}	1516.7	1538.52	2117.57
C_{18}	928.71	915.08	1210.72
Ph	1293.2	1281.71	1762.52
C_{19}	718.51	_	_
C_{20}	1418.62	1617.76	1338.85
C_{21}	794.43	826.42	986.72
C_{22}	1194.57	1393.3	1143.11

C_{23}	971.34	957.16	1951.01
C_{24}	435.6	418.48	978. 36
C_{25}	_	_	_
C_{26}	1180.38	1083.72	1537.05
C_{27}	731.11	_	1901.16
C_{28}	1203.82	1296.25	2225.05
C_{29}	786.51	734.18	1138.73
C_{30}	1403.86	1355.53	1586.12
C_{31}	_	_	1023.75
C_{32}	_	586.94	958.63
C_{33}	_	923.1	712.43
C_{34}	_	_	_
C_{35}	_	_	_
TOTAL	22725.4	23122.2	35383.9



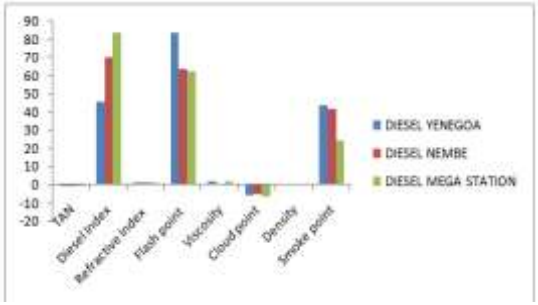


Figure 4: Concentration of metals in locally refined diesel and reference product
Figure 5: Physiochemical properties of locally refined diesel and reference product

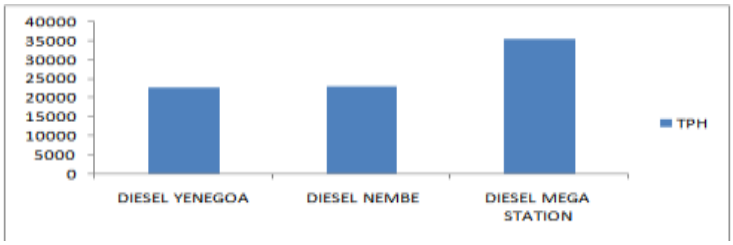


Figure 6: Total petroleum hydrocarbon of locally refined diesel and reference product

Test of equality of variance run on the locally refined diesel products and diesel product from a mega filling station in Niger Delta.

T-Test

Table 4: Group statistics on metals in Nembe L.G.A diesel

	Locations	N	Mean	Std. Deviation	Std. Error Mean
Sodium	Nembe	3	.9400	.47000	.27135
	Mega Filling Station	3	.4737	.23501	.13568
Magnisium	Nembe	3	.8533	.42501	.24538
	Mega Filling Station	3	.3533	.17502	.10105
Aluminium	Nembe	3	1.5200	.76000	.43879
	Mega Filling Station	3	.6137	.30501	.17610
Suphur	Nembe	3	.1337	.06504	.03755
	Mega Filling Station	3	.0597	.03001	.01732

Table 5: Independent samples test on metals in Nembe L.G.A diesel

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Sodium	Equal variances assumed	.795	.423	1.537	4	.199	.46633	.30339	-.37600	1.30867
	Equal variances not assumed			1.537	2.941	.224	.46633	.30339	-.51018	1.44285
Magnisium	Equal variances assumed	1.206	.334	1.884	4	.133	.50000	.26537	-.23679	1.23679
	Equal variances not assumed			1.884	2.659	.168	.50000	.26537	-.40915	1.40915

Aluminium	Equal variances assumed	1.231	.329	1.917	4	.128	.90633	.47280	-.40638	2.21905
	Equal variances not assumed			1.917	2.628	.164	.90633	.47280	-.72633	2.53899
Suphur	Equal variances assumed	1.091	.355	1.789	4	.148	.07400	.04135	-.04082	.18882
	Equal variances not assumed			1.789	2.814	.178	.07400	.04135	-.06266	.21066

T-Test

Table 6: Group statistics on physiochemical properties of Nembe diesel

	Locations	N	Mean	Std. Deviation	Std. Error Mean
TAN (Mg KOH/g)	Nembe	3	.2133	.10504	.06064
	Mega Filling Station	3	.0060	.00529	.00306
Diesel index	Nembe	3	70.3533	35.17500	20.30830
	Mega Filling Station	3	83.5933	41.79500	24.13035
Refractive index	Nembe	3	1.4660	.73500	.42435
	Mega Filling Station	3	1.4750	.73500	.42435
Flash point (oC)	Nembe	3	63.8000	31.90000	18.41747
	Mega Filling Station	3	62.1000	31.05000	17.92673
Viscosity (cst)	Nembe	3	.7050	.35500	.20496
	Mega Filling Station	3	1.8863	.94500	.54560
Cloud point (oC)	Nembe	3	-5.0000	2.50000	1.44338
	Mega Filling Station	3	-6.7000	3.35000	1.93412
Density (g/cc)	Nembe	3	.8533	.42501	.24538
	Mega Filling Station	3	.8540	.42500	.24538
Smoke point (mm)	Nembe	3	41.7000	20.85000	12.03775
	Mega Filling Station	3	24.3000	12.15000	7.01481

Table 7: Independent samples test on physiochemical properties of Nembe diesel

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
TAN (Mg KOH/g)	Equal variances assumed	3.914	.119	3.414	4	.027	.20733	.06072	.03874	.37592
	Equal variances not assumed			3.414	2.010	.076	.20733	.06072	-.05267	.46734
Diesel index	Equal variances assumed	.059	.820	-.420	4	.696	-13.24000	31.53888	-100.80597	74.32597
	Equal variances not assumed			-.420	3.887	.697	-13.24000	31.53888	-101.82210	75.34210
Refractive index	Equal variances assumed	.000	.999	-.015	4	.989	-.00900	.60013	-1.67522	1.65722
	Equal variances not assumed			-.015	4.000	.989	-.00900	.60013	-1.67522	1.65722
Flash point (oC)	Equal variances assumed	.001	.971	.066	4	.950	1.70000	25.70157	-69.65901	73.05901
	Equal variances not assumed			.066	3.997	.950	1.70000	25.70157	-69.67953	73.07953
Viscosity (cst)	Equal variances assumed	1.379	.305	-2.027	4	.113	-1.18133	.58283	-2.79952	.43685
	Equal variances not assumed			-2.027	2.553	.152	-1.18133	.58283	-3.23385	.87119
Cloud point (oC)	Equal variances assumed	.165	.705	.704	4	.520	1.70000	2.41333	-5.00048	8.40048
	Equal variances not assumed			.704	3.700	.523	1.70000	2.41333	-5.22003	8.62003

Density (g/cc)	Equal variances assumed	.000	.998	-.002	4	.999	-.00067	.34702	-.96414	.96281
	Equal variances not assumed			-.002	4.000	.999	-.00067	.34702	-.96414	.96281
Smoke point (mm)	Equal variances assumed	.520	.511	1.249	4	.280	17.40000	13.93252	-21.28287	56.08287
	Equal variances not assumed			1.249	3.218	.295	17.40000	13.93252	-25.28855	60.08855

T-Test

Table 8: Group Statistics on metals in Yenagoa diesel

	Locations	N	Mean	Std. Deviation	Std. Error Mean
Sodium	Yenagoa	3	1.6333	.81501	.47054
	Mega Filling Station	3	.4737	.23501	.13568
Magnisium	Yenagoa	3	1.1800	.59000	.34064
	Mega Filling Station	3	.3533	.17502	.10105
Aluminium	Yenagoa	3	3.7133	1.85500	1.07099
	Mega Filling Station	3	.6137	.30501	.17610
Suphur	Yenagoa	3	.1847	.09500	.05485
	Mega Filling Station	3	.0597	.03001	.01732

Table 9: Independent samples test on metals I Yenagoa diesel

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Sodium	Equal variances assumed	1.890	.241	2.368	4	.077	1.15967	.48972	-.20000	2.51933
	Equal variances not assumed			2.368	2.330	.123	1.15967	.48972	-.68555	3.00489
Magnisium	Equal variances assumed	1.810	.250	2.327	4	.081	.82667	.35531	-.15983	1.81316
	Equal variances not assumed			2.327	2.349	.127	.82667	.35531	-.50367	2.15700
Aluminium	Equal variances assumed	2.731	.174	2.856	4	.046	3.09967	1.08537	.08621	6.11313
	Equal variances not assumed			2.856	2.108	.098	3.09967	1.08537	-1.34822	7.54755
Suphur	Equal variances assumed	1.732	.259	2.173	4	.095	.12500	.05752	-.03470	.28470
	Equal variances not assumed			2.173	2.395	.141	.12500	.05752	-.08720	.33720

T-Test

Table 10: Group statistics on physiochemical properties of Yenagoa diesel

	Locations	N	Mean	Std. Deviation	Std. Error Mean
TAN (Mg KOH/g)	Yenagoa	3	.1800	.09000	.05196
	Mega Filling Station	3	.0060	.00529	.00306
Diesel index	Yenagoa	3	45.5000	22.75000	13.13472
	Mega Filling Station	3	83.5933	41.79500	24.13035
Refractive index	Yenagoa	3	1.4667	.73501	.42436
	Mega Filling Station	3	1.4750	.73500	.42435
Flash point (oC)	Yenagoa	3	83.6000	41.80000	24.13324
	Mega Filling Station	3	62.1000	31.05000	17.92673
Viscosity (cst)	Yenagoa	3	1.8933	.94500	.54560
	Mega Filling Station	3	1.8863	.94500	.54560
Cloud point (oC)	Yenagoa	3	-6.0000	3.00000	1.73205
	Mega Filling Station	3	-6.7000	3.35000	1.93412

Density (g/cc)	Yenagoa	3	.8550	.42500	.24537
	Mega Filling Station	3	.8540	.42500	.24538
Smoke point (mm)	Yenagoa	3	43.8000	21.90000	12.64397
	Mega Filling Station	3	24.3000	12.15000	7.01481

Table 11: Independent samples test on physiochemical properties of Yenagoa diesel

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
TAN (Mg KOH/g)	Equal variances assumed	3.479	.136	3.343	4	.029	.17400	.05205	.02948	.31852
	Equal variances not assumed			3.343	2.014	.078	.17400	.05205	-.04849	.39649
Diesel index	Equal variances assumed	.641	.468	-1.387	4	.238	-38.09333	27.47353	-114.37208	38.18541
	Equal variances not assumed			-1.387	3.090	.257	-38.09333	27.47353	-124.11068	47.92401
Refractive index	Equal variances assumed	.000	.998	-.014	4	.990	-.00833	.60013	-1.67455	1.65789
	Equal variances not assumed			-.014	4.000	.990	-.00833	.60013	-1.67455	1.65789
Flash point (oC)	Equal variances assumed	.170	.701	.715	4	.514	21.50000	30.06295	-61.96812	104.96812
	Equal variances not assumed			.715	3.692	.517	21.50000	30.06295	-64.78744	107.78744
Viscosity (cst)	Equal variances assumed	.000	1.000	.009	4	.993	.00700	.77159	-2.13528	2.14928
	Equal variances not assumed			.009	4.000	.993	.00700	.77159	-2.13528	2.14928
Cloud point (oC)	Equal variances assumed	.024	.884	.270	4	.801	.70000	2.59631	-6.50852	7.90852
	Equal variances not assumed			.270	3.952	.801	.70000	2.59631	-6.54298	7.94298
Density (g/cc)	Equal variances assumed	.000	.997	.003	4	.998	.00100	.34701	-.96246	.96446
	Equal variances not assumed			.003	4.000	.998	.00100	.34701	-.96246	.96446
Smoke point (mm)	Equal variances assumed	.606	.480	1.349	4	.249	19.50000	14.45951	-20.64604	59.64604
	Equal variances not assumed			1.349	3.125	.267	19.50000	14.45951	-25.49542	64.49542

Diesel fuel is one of the middle distillate with saturated species as the major components. Within the saturated constituents, the concentration of n-paraffins decreases regularly from C_{11} to C_{20}; but for middle distillate of diesel fraction, the carbon molecule of diesel ranges from C_{17} to C_{20}.Below the carbon molecular range causes instability and incompatibility which led to undesirable changes in the original properties of petroleum product.The result as compared in Table 1 and visualized in Figure 4, shows that the metallic contents; sodium (average 1.29%), magnesium (average 1.02%), aluminum (average 2.62%) and sulphur (average 0.16%) of the locally refined diesel samples are not acceptablewhen compared with the sodium (0.47%), magnesium (0.35%), aluminum (0.61%), and sulphur (0.059%) of the mega filling station diesel which meet standard specifications; this indicates there will be more corrosion problem, more fouling of vehicle and storage tanks, and a lot environmental hazard when the diesel is used in vehicles and equipment. Also from the result as compared in Table 2 and visualized in Figure 5, the physiochemical

properties like total acid number (average 1.195MgKOH/g), diesel index (average 57.925), flash point (average 73.70^{o}C), cloud point (average -5.5^{o}C), and smoke point (average 42.75mm) of the locally refined diesel samples are not acceptable, while the refractive index, viscosity, and density are within acceptable range; this indicates that the diesel has corrosion potential, the ignition quality of the diesel is not optima, the diesel is fire hazardous, there will be knocking of the engine since the diesel contains wax, and the diesel will cause much smoke. The statistical test of equality of variance using an error of five percent (5%) shown in table 4 to 11 indicates that aluminum, suphur, and total acid number of the locally refined fractions are significantly different from the product of mega filling station. Therefore the locally refined dieselposes a lot of danger to equipment and storage tanks, and causes environmental pollution.From chromatogram charts of Figures 1 to 3, the GC/FID provided information with regard to the carbon molecules of the samples together with the concentration, but the Identification of product type (paraffins, naphthenes, and aromatic) is not shown; [12] stated that the identification of product type in GC/FID is not straightforward. The chromatograms charts of Figures1 to 3 show the peak value of carbon concentration per time. The summary results as presented in Table 3 shows that the carbon molecule of the samples ranges from C_8 to C_{35}. Compounds less than C_6 are not detected because they are highly volatile and interference can occur from the solvent peak [12]. The diesel from Nembe local government has high carbon concentration of C_9, C_{12}, C_{17} and C_{30}, while the diesel from Yenagoa local government has high carbon concentration of C_{20}, C_{17}, C_{12} and C_{22}. The diesel from mega filling station has high carbon concentration of C_{28}, C_{27}, C_{17} and C_{23}.The result also shows that high carbon concentration (C_9, C_{12}, and C_{17}) in the locally diesel fractions are not within the carbon range of C_{17} to C_{20} as provided by [12]. This indicate thatthe locally refined diesel composed mainly of the carbon molecules of the kerosene fractions; hence usage of the locally refined diesel fraction will cause cracking sound and knocking in diesel engine, and the incomplete combustion of the locally refined diesel will cause production of smoky exhaust which will in turn caused gradation and deterioration of the environment. The Pr (pristane; 2,6,10,14-tetramethylpentadecane) and Ph (phytane; 2,6,10,14-tetramethylhexadecane) as in Table 3 are two isoprenoid species generally present in crude oils in sufficient concentration to be seen as irregular peaks alongside n-C_{17} and n-C_{18} peaks in gas chromatogram. The distribution of pristane and phytane relative to n- C_{17} and n-C_{18} are used to aid identification of crude oils and detect the onset biodegradation. The Pr and values for locally refined diesel fractions are low (average of) but that of diesel from mega filling station is high (Pr and Ph) and this indicates that total petroleum hydrocarbon of the locally refined diesel is below standard specification for diesel.From the summary result of Table 3and as visualized in Figure 6, the total petroleum hydrocarbon of the locally refined diesel samples (22725.39ppm and 23122.23ppm) are lower than the total petroleum hydrocarbon of the diesel from the mega filling station (35383.85ppm); this indicates that the locally refined diesel is pure kerosene and unsuitable for use in a diesel engines,: hence will burn with lots of smoke and incomplete combustion products.

IV. CONCLUSION

This research has shown that the locally refined petroleum product contain heteroatom which makes it incompatible and non compliance with the requirement for a standard filling station in Nigeria. The total acid number values of the locally refined product is higher than 0.015 (MgKOH/g) which indicates instability. The instability and incompatibility of the locally (bunkering) refined products has been attributed to either none purification of the products before refining, the refining techniques used, lack of reflux drum, lack of heat exchangers and pumps, the crude method of refining and handling the products, the type of crude oil used, none purification of the crude oil at the refining points, and lack of treatment of the products before sale. The inhabitants have suffered contaminated environment, degraded forests, air pollution, water pollution, soil pollution, loss in biodiversity, high atmospheric temperature, and health challenges. The high flash point of products have caused a lot of fire incidents, high smoke point of the products have caused suffocation of families due production of carbon monoxide which reduces the oxygen carrying capacity of blood, darken of kitchen pots and production of smoke when used in a combustion engine.

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