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RECOVERY AND PRODUCTION OF LUBRICATING GREASE FROM NIGERIAN TAR SANDS HEAVY OIL

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Abstract: Two types of lubricating grease were prepared from heavy oil extracted from the Nigerian Tarsands. The laboratory prepared greases were subjected to tests in accordance with the National Laboratory for Grease Institute (NLGI) specifications. This paper gives the results from the study. Toluene was used to extract the heavy oil from the tar sands by soxhlet extraction method. Conventional laboratory methods were then employed to produce the two types of grease (soap-based and clay-based) from the Nigerian tarsands-derived oil. Test results indicated that the two types of grease from the tarsand oil conform with the NLGI specifications and that the greases will be suitable for lubricating plain and roller bearings. Also, it was found that the grease from tarsand oil exhibited a better resistance at high temperature than the conventional grease from petroleum oil.

Keywords: Heavy Oil, Tarsand, Grease, Bitumen, Production and Lubricate

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INTRODUCTION

Nigeria spends about N8 billion per year for the importation of heavy crude oil from Venezuela. The imported crude is used in Kaduna refinery for the production of lubricating oil, lubricating grease, bitumen and asphalt which is of increasing demand[1] In fact it has not been possible for the 50,000 barrels/day Kaduna refinery to meet the increasing domestic demand for these products. For example almost 100 percent of lubricating grease and 68 percent of lube oil consumed in the country in 2016 were imported according to data obtained from Nigeria National Petroleum Cooperation (NNPC).

While both the heavy crude oil and some finished products such as greases are being imported, evidence shows from previous studies[2-7] the existence of about 31-40 billion barrels of heavy oil trapped in non-conventitional formation tarsands found in Ondo and Ogun States of Nigeria.

Heavy oils from these sands have been extracted and the results of these studies have been reported and have shown that the properties of the heavy oil trapped from the Nigerian tarsands are similar to those of the imported heavy oil from Venezuela.

In an effort to fully utilize the abundant resource of the tarsands oil, there is need to determine its suitability for producing the various products mentioned earlier. This paper reports the suitability of the tarsand oil in producing lubricating grease. In this study, the heavy oil extracted from the tarsands was used in producing laboratory prepared grease by conventional method.

EXPERIMENTAL

(i) Sample and Sample Preparation:

Tarsands sample used in this study was collected from the deposit between ofosu and Agbabu in Ondo State.

The raw sample was dried, ground and sieved. The 2.5mm + 1.0mm size fraction was used for the extraction. Table 1 shows the proximate and ultimate analyses of this size fraction.

Table 1: Analyses of the Nigerian Tarsands Sample Used for Extracting the Oil

Proximate; air dried	(%wt)
Moisture	3.3
Volatile Matter	13.9
Ash	77.9
Fixed Carbon	4.9

Ultimate, dry ash-Free Basis	(%wt)
Carbon	41.61
Hydrogen	5.64
Nitrogen	0.77

(ii) Heavy Oil Extraction:

Toluene was used to extract the 2.5 + 1.0mm size fraction of the sample using the soxhiet extraction method. About 240 gm of the sample was extracted with 200 ml of solvent for 10 hours in each run. The oil extracted was then analyzed using the ASTM standard methods for gravity, viscosity, flash point and pour point.

(iii) Preparation of the Lubricating Grease:

Two types of grease ware prepared - clay-bas ea grease and a soap-based grease. Conventional laboratory methods12 were employed in the preparation.

The soap-based grease was made by heating a mixture of sodium-based soap and the tarsand oil for about 30 minutes. The soap was made by reacting sodium hydroxide with palm oil (a local source of palmitic acid). The heated mixture of soap and tarsand oil was allowed to cool.

The clay grease was made by mixing about 30gm of 75 microns clay with tarsands (ii. The mixture was heated and continuously stirred for about 30 minutes, after which it as allowed to cool.

Additives as rust inhibitor, structural stabilizers, bleeding, water resistance etc. which are usually added to commercial grease were not added to the laboratory prepared greases in this study.

(iv) Testing of the Greases:

The two types of grease were quickly subjected to the following tests and analysis: Kinematic viscosity using a Tar Viscometer, constituency, drop point. The consistency test was conducted using the standard ASTM method (ASTM D—217). Grease produced from conventional petroleum crude was also subjected to the tests and compared with those made from the tarsands oil. The properties of the greases were also checked with the specifications of the National Laboratory for Grease Institute (NLG1).

RESULTS AND DISCUSSION

Table 2 shows some properties of the tarsands derived oil used in making the grease in this study. From the data presented on Table 2, it is obvious that the oil extracted from the tarsands could be classified as heavy oil. The °API gravity was about 14.6. This property made it a good candidate for the production of lubricating grease and lubricating oil. Also noticed is the fact that the' pour point for the tarsands oil was higher than in most petroleum crudes. This may be a sign of the presence of asphaltene and branched-chain paraffin in the tarsand oil. These are desirable components in lubricant to provide good stability. Asphaltene content in oil extracted from Nigeria tarsands has been reported from previous study to be higher than in conventional petroleum crude oil. The high ash content in the tarsands oil is not surprising because of the high ash content of the parent tarsands. **(See Table 1)**.

Table 2: Some Properties of Nigerian Tarsands - Derived Heavy Oil

Carbon (%wt. dat)	89.3
Ash (5 wt)	3.4
Specific Gravity at 60 °F/60 °F	0.9686
°API	4.6
Kinematic Viscosity at 180°F (CST)	28.25
Flash Point (°F)	89
Pour Point (°F)	20

Table 3 shows the results of the consistency test by cone penetrometer method for the two types of grease produced from the tarsands-derived oil. Also shown are the corresponding National Laboratory for Grease Institute (NLG1) Classification Number for the two types of grease. Average of three runs for each grease was also calculated and shown on the table. Theme and value for the consistency test was 220 — 230 and 270 — 280 for the soap grease and clay grease respectively. These correspond to NLGI classification of 3 and 2 respectively. It therefore, implies that the lubricating greases conform to the NLGI specification. Table 4 shows the NLGI grease Classification and corresponding recommended uses. The data on this table suggests that the two types of grease made from Nigerian tarsands derived oil will be suitable for use in lubricating plain and roller bearings and also as good sealant.

Table 3 Results of the Consistency Test (Cone Penetrometer Method)

Test No.	Temperature (0C)	Time (Sec.)	Soap Grease	Worked Penetration Clay Grease
1	25	5	180-190	250-260
2	25	5	220-230	270-280
3	25	5	260-270	280-290
Mean Value			220-230	270-280
NLGI Specification			3	2

Table4: National Laboratory for Grease Institute (NLGI) Grease Classification 12

NLGI No.	Worked Penetration	Explanation / Application
0 0 0 0 0	445-475 400-430	Semi-fluid grease, used for Lubricating gear boxes and couplings
1 2 3	310 -340 265-295 220-250	Best grease for lubricating Plain and roller bearings
4 5 6	175-205 130 - 160 85 - 115	Stiffer greases, used when prime requirement is for sealing, rather than lubrication as in glands.

Despite the fact that additives were not added to the grease prepared from, the tarsands oil, adequate ability to withstand good working temperature was demonstrated as illustrated by the results of the drop point test. The drop point for the grease from tarsands oil was found to be 83 C while that of the normal petroleum grease (742 EP Texaco) was 78°C.

Table 5 shows the results of the results of the viscosity temperature history for the clay grease and soap grease made from the tarsands oil and the 742 EP Texaco grease from petroleum oil. Although the different grease was subjected to different temperature ranges, some useful inferences can be drawn from the results. For example, the viscosity of the petroleum grease at 120°C was only 1 second while that of the soap tarsands oil grease at same temperature was 13.5 seconds. This implies that the grease from the tarsands oil has higher thermal resistance and can therefore perform better than the petroleum grease at high temperatures.

However, further tests need to be done in this area.

Table 5: Viscosity-Temperature History of Grease

Type of Grease	Temperature ^0C	Tar Viscometer Readings (Seconds)
Soap Grease from Tarsands Oil	120 130 140 150	13.5 8.5 3.5 2.0
Clay Grease from Tarsands Oil	60 70 80 90	6.0 4.5 3.0 1.5
Commercial Soap Grease from Petroleum	85 95 105 120	11.0 7.0 4.0 1.0

CONCLUSIONS

From the study reported here, the following conclusions can be drawn:

(i) Lubricating grease can be successfully made from tarsands-derived heavy oil

(ii) The grease made from tarsands oil conforms with the NLGI specifications.

(iii) The tarsands-oil lubricating grease is suitable for use in lubricating plain and roller bearings and as sealants

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