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ANALYSIS OF FILTRATION PROPERTIES OF LOCALLY SOURCED BASE OIL FOR THE FORMULATION OF OIL BASED DRILLING FLUIDS

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ABSTRACT

Oil based drilling fluids are mixtures of clays ,oil and other chemical additives suspended or dissolved such as solids and polymers .The environmental problems associated with oil-based drilling fluids are among the major concerns in the petroleum industry leading to increasing stringent regulations to ensure its environmental friendliness. This study examines the use of locally sourced oil like, groundnut oil, melon oil, vegetable oil, soya oil and palm oil as substitute for diesel oil in formulating oil base drilling fluids relative to filtration properties. The filtrate volumes of each of the oils were obtained for filtration control analysis. With increasing potash and industrial starch quantities during formulation, all the local oils had their filtration properties (filtrate volume and mud cake thickness) tending towards that of diesel oil at ambient temperature and atmospheric pressure. When temperature was increased to 70^0C and above, the filtration abilities of all the local oil reduced and degraded due to the flocculation of the clay suspension. The drilling fluids formulated with the local oil where restored by the addition of thinner and organic polymer which significantly stabilized the clay suspension. The polymer and the thinner clearly improved the filtration properties of the locally formulated oil based drilling fluids even when subjected at high temperature, The ranking from the results showing the order of better and effective filtration properties for the local oils are as shown; Melon Oil; Vegetable Oil ;Groundnut Oil; Soya Bean Oil and Palm oil.

INTRODUCTION

Generally, oil base fluids have shown proof of efficiency towards hostile drilling cases especially water sensitive shales or high temperature and high pressure wells. Diesel oil though effective as a base fluid in formulating oil based drilling fluids cause serious environmental and economic drawbacks (Chancy and Sargent,1986**).** As a result, more effort is being put into replacing diesel base oil with synthetic based oil. However due to increased subjection to more and more constraints as a result of fast evolution of environmental legislations, one of the possible ways to avoid this problem while keeping the advantages of oil base fluids is by substituting mineral oils with biodegradable oils . The application of oil base drilling fluids with environmental protection as a first priority continued to pose a big challenge in the drilling industry, the shortcoming was that no matter how careful one tries with diesel base fluids during

drilling, pollution and environmental degradation was inevitable. However, this degradation could be made as minimal as possible with improved safety and precaution.

Filtration control is another major challenge in the petroleum industry while using drilling fluids, therefore drilling fluids should be designed for good filtration properties to provide efficient hole cleaning and improved cutting transport (Fraser 1992).

MATERIALS AND METHOD

The materials are Potash, starch and local oil Samples (groundnut oil, melon oil, palm oil, soya bean oil, vegetable oil) sourced and prepared locally. Other material is the diesel oil. The equipment used are: Low pressure filter press filtration apparatus , nitrogen gas, $_P$H paper, Hamilton Beach Mixer, Mixing cup, Beaker, Mud balance, Filter paper and thermometer.

The starch was added in varying quantities of 2.0 grams and 2.5 and 4.5 grams. The potash was used as a thinner added in varying quantities of 0.172 grams, 0.344grams 0.516 grams and 0.688 grams. The fluid samples were heated to a maximum temperature of 70^0C. Each base oil samples and water were mixed in 70:30ratios. That is, 245ml of oil to 105ml of water for 350 ml total laboratory volumes respectively.

RESULT

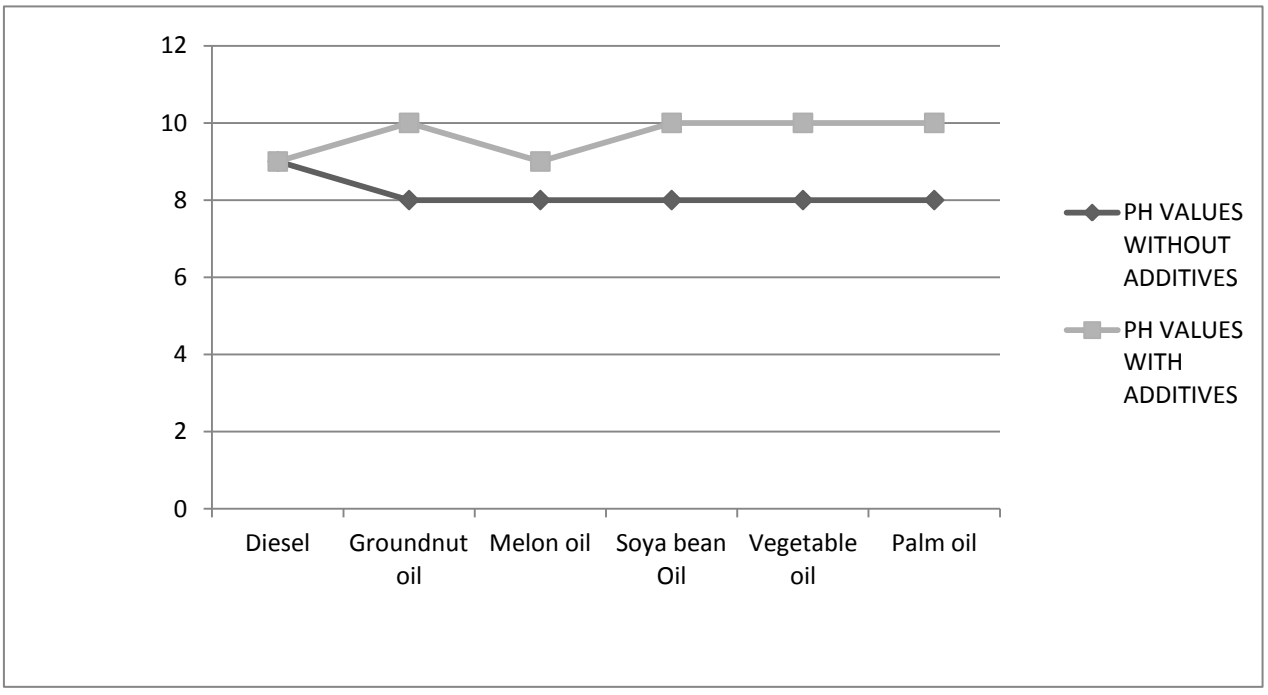

Figure 1: Comparison of $_P$Hvalues of the fluid samples with and without additives

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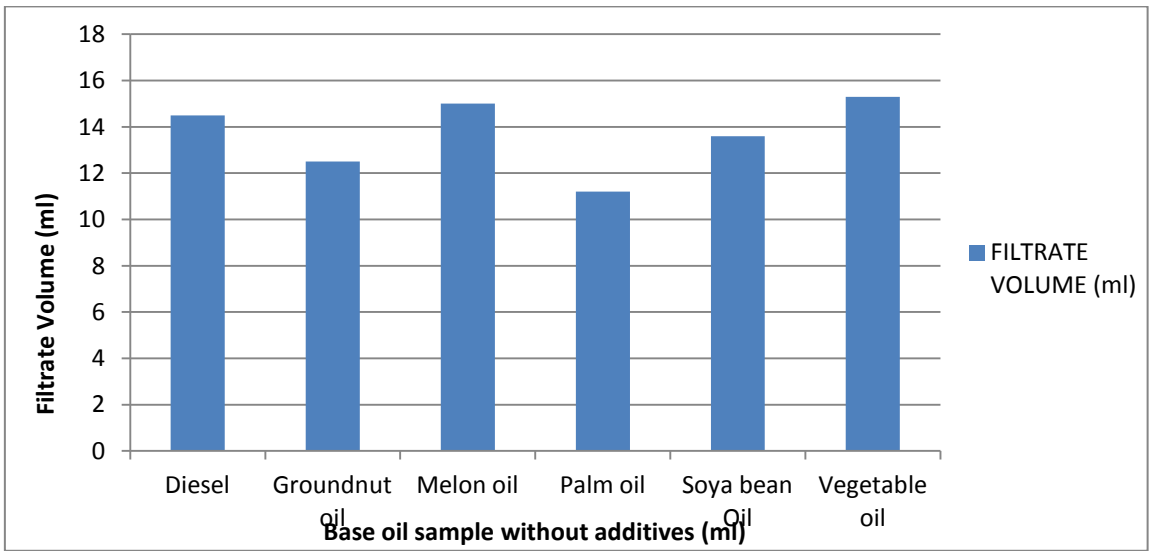

Figure -2: Filtrate volumes of oil Samples without additives

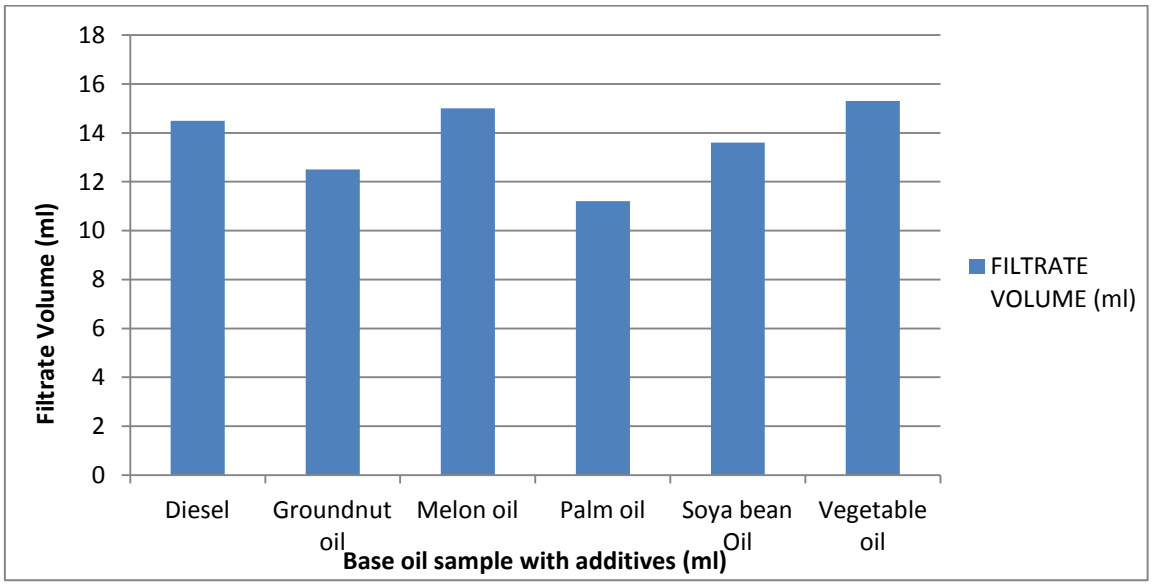

Figure -3: Filtrate volume of the oil samples with 0.172g of potash and 2.5 g of starch

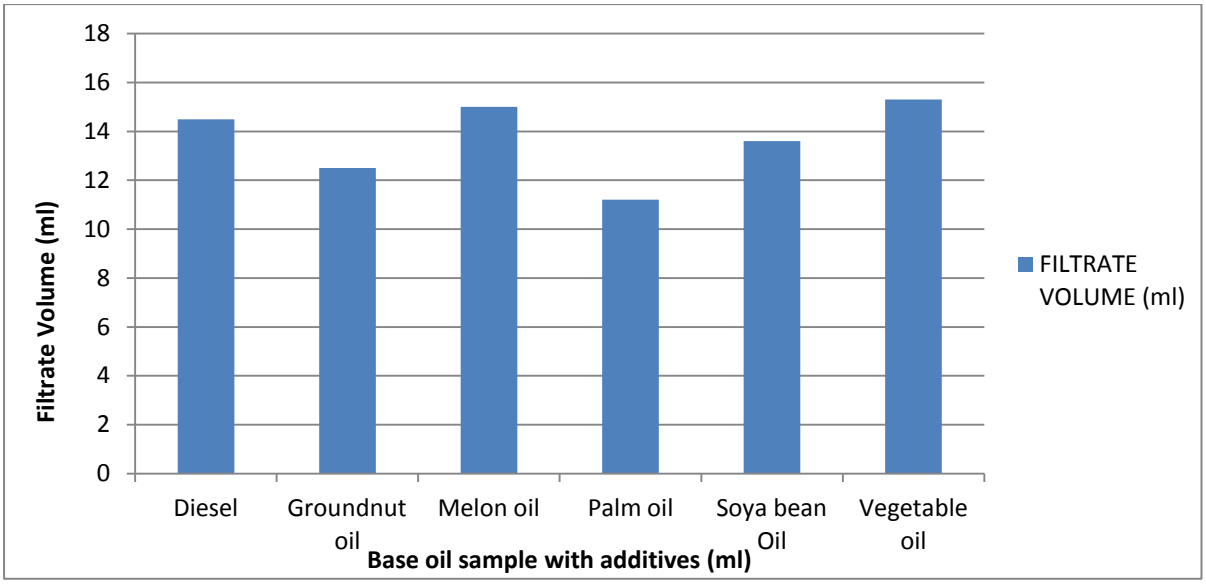

Figure -4: Filtrate volume of the oil samples with 0.344g of potash and 2.5 g of starch

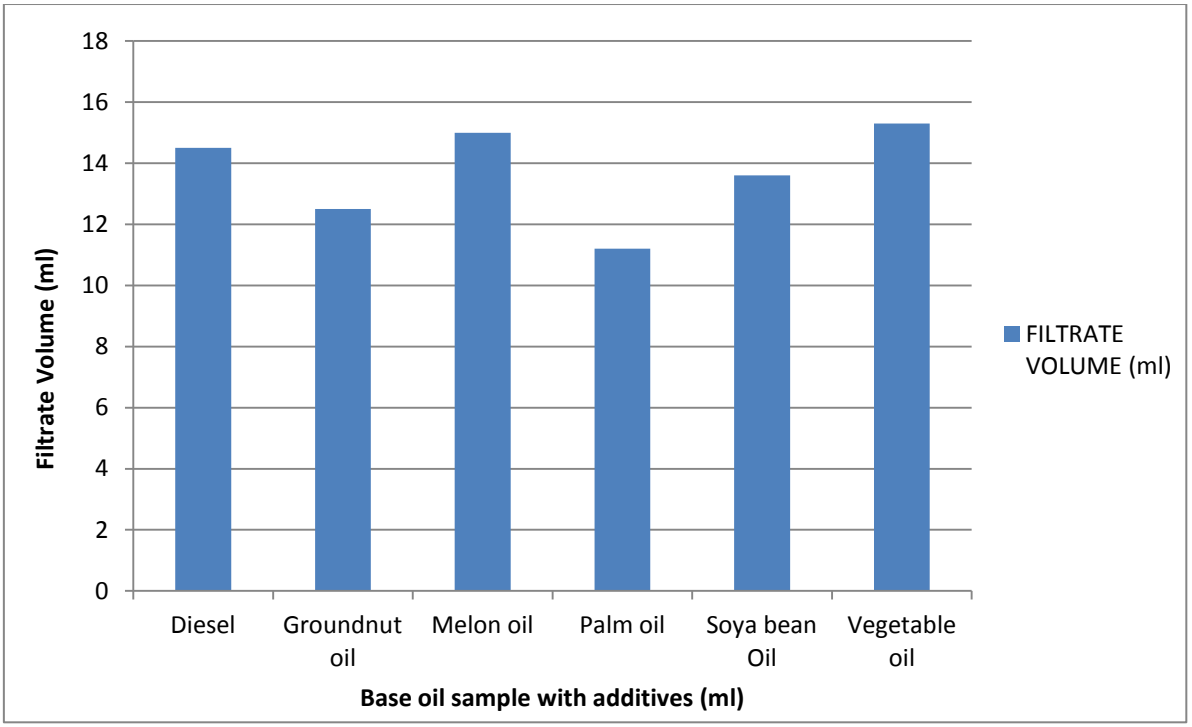

Figure -5: Filtrate volume of the oil samples with 0.516g of potash and 2.5 g of starch

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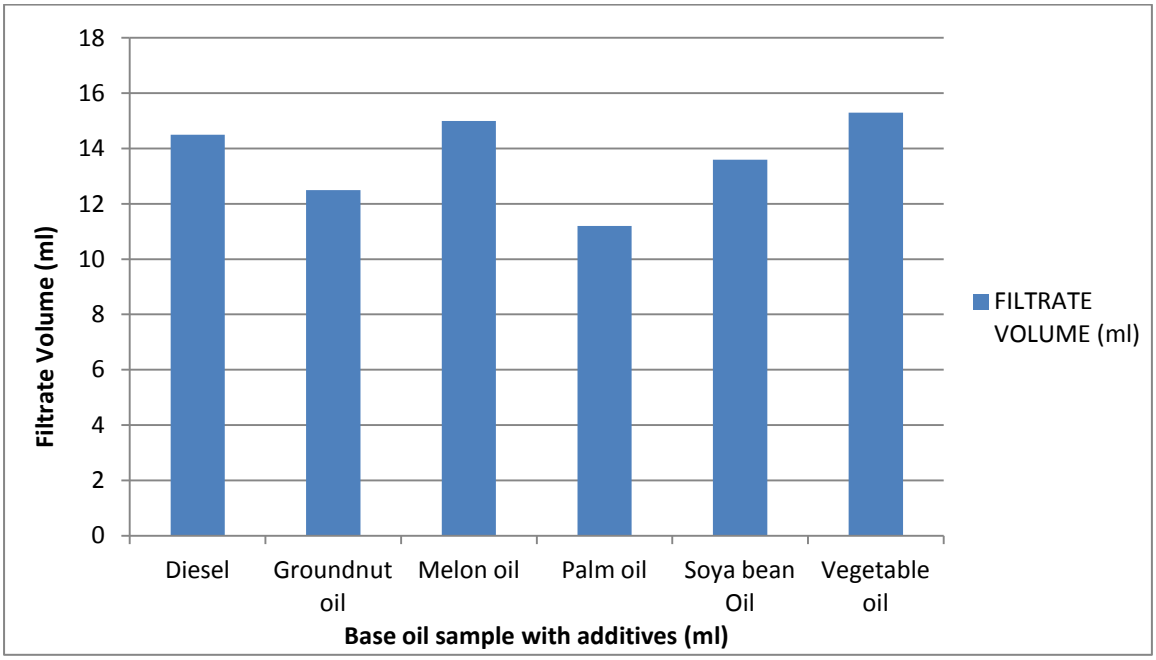

Figure -6: Filtrate volume of the oil samples with 0.688g of potash and 2.5 g of starch at 70^0c

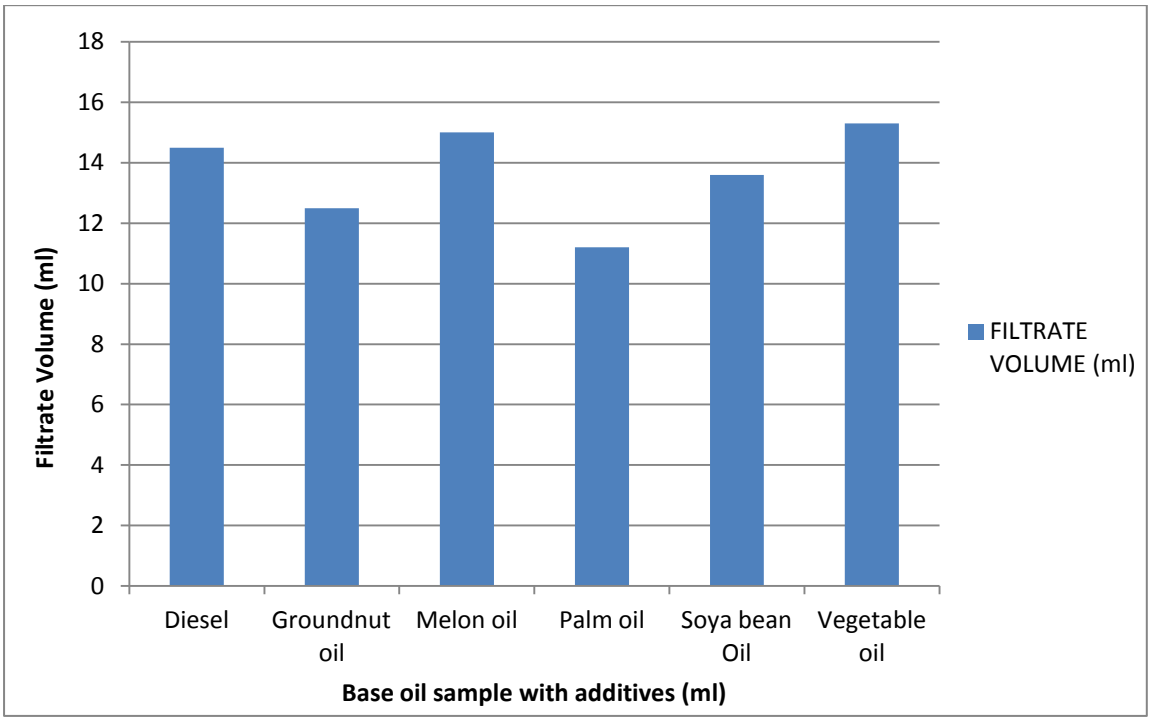

Figure -7: Filtrate volume of the oil samples with 0.688g of potash and 4.5 g of starch at 70 ^{o} C

DISCUSSION

(1) $_{P}$H analysis

The $_{P}$H values of the various base fluids were measured with and without potash/starch additives. The $_{P}$H values of all the fluids increased when the additives where added. The $_{P}$H value of melon oil was exactly the same as that of diesel when 0.688grams of potash and 4.5 grams of starch were added while the $_{P}$H values of the other base fluids remained 10 as shown in Figure -1

(2) Filtration Analysis

The filtrate volume of all the local oil base fluids used without additives varied from that of diesel oil base fluid, Figure-2. The palm oil based fluid showed the least deviation from diesel oil. However, with the addition of potash and starch at different quantities, the filtrate volume for the local oil base fluids gradually decreased towards the value of diesel oil. The disparity in the filtrate volume of the various local oil base fluids from that of diesel oil base fluid was much less with 0.688g of potash and 4.5 grams of starch, Figure-7. As temperature was increased to 70^{0}C with additives of 0.688 grams of potash and 2.5 grams of starch the filtrate volume increased slightly, figures 6 and 7. This means that the local oil based fluids have most promising result at ambient temperature compared to diesel oil particularly the melon oil.

Mineral oil-based drilling fluid are toxic and not readily biodegradable, thus have cumulative impact on terrestrial, coastal and marine habitats. The locally sourced oil is renewable and highly biodegradable and therefore has several advantages over mineral oil-based due to the biodegradable nature and non-reactive nature with clays and shale. Also, they posses some superior operating parameters such as higher flash point and fire point to meet the increasing technical and environmental challenges of current and future drilling operations. However, the drawbacks of the use of this locally sourced oil to develop oil based drilling fluids are their inherent high pour point and viscous characteristics. The flow properties and the viscous characteristics of oil based drilling fluids are strongly dependent on these inherent viscous characteristics of the sourced base oil.

For the effectiveness of these sourced local oils, appropriate polymers like, Polyethylene oxide, Hydroxylethylcellulose, Carboxylmethylcellulose,High molecular weight acrylic copolymers must be used as major filtration control agents in order to withstand high temperature and high pressure drilling conditions to then minimize fluid filtration loss and prevent fermentation.

REFERENCES

Amanullah, M.D. (2005): ‘‘Physio-Chemical Characterization of Vegetable Oils and Preliminary Test Results of Vegetable Oil-based Muds’’: A paper presented at the SPE/IADC Middle East Drilling Technology Conference and Exhibition, Dubai, United Arab Emirates. SPE 97008

Chancy B.P. and Sargent T.L. (1986): ‘‘Law colloid/polymer mud provides cost effective prevention of well bore enlargement in the Gulf of Mexico’’, Trans. AIME, 285 pp. 466-72

Fraser L.J. (1992): ‘‘Field Application of all the Oil Drilling Fluid Concept’’, SPE Reprint series No 44. Pp82.

Scientia Africana, Vol. 13 (No.1), June 2014. Pp171-177
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Harder R.B., Carpenter. T., Freeman, S., Brookey. T.E. and Gandy, R.G. (1993): ‘‘Optimisation of Oil-Based Mud Chemistry for cementing’’. SPE 25183 presented at SPE international symposium on oilfield chemistry, New Orleans U.S.A

Kadaster, A.G., Guild G.J., Hanni, G.L and Schimdt, D.D. (1997): ‘‘Field Application of PHPA Muds’’, SPE Reprint series No. 44.

Kelessidis, V.C, Tsamilaki, C, Pasadakis, N, Repouskou, E. and Hamilaki, E (2006): ‘‘Permeability, Porosity and Surface Characterization of Filter Cakes from Water Bentonite Suspension’’ paper presented at the 6th International Conference on Advances in Fluid Mechanics, Skiathos, Greece.

Michal, S. and ken, M. (2003): ‘‘The Application of HTHP Water Based Drilling fluids on a Blowout Operation’’, AADE 03-NICE-37 presented at the American Association of drilling engineers National Technical Conference, Texas. USA

Oatman G.J. and A.RS, Drinkwater, Nederlandse Aardolie Mij. B.V. (1990): ‘‘Responsible Approach to the Use of Oil Based Muds’’: A paper presented at Europac 90, The Hague, Nedetherlands. SPE paper 16525/1.

Veil, J.A., (2002) "Drilling Waste Management: Past, Present, and Future," SPE 77388, SPE Annual Technical Conference and Exhibition, San Antonio, TX,