UNIVERSITY OF NAIROBI

DEPARTMENT OF CHEMISTRY

DETERMINATION OF SELECTED PHYSICO-CHEMICAL PARAMETERS AND HEAVY METALS IN NGAMIA-5 OIL EXPLORATORY WELL RESERVE (WASTE) PIT IN TURKANA, KENYA

BY

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A Thesis submitted in partial fulfillment of the requirements for the award of the Degree of Master of Science in Environmental Chemistry.

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DECLARATION

This thesis is my original work and has not been submitted for award of a degree in another university.

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DEDICATION

I sincerely dedicate this work to the Almighty God who has faithfully led me through my academic journey to this level. His mighty power cancelled everything which would delay me from completing my study on time. Glory be to God.

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ABSTRACT

Oil and gas operations produce wastes that are potentially toxic to the environment. The wastes get disposed of into reserve pits which are surface impoundments excavated adjacent to the drilling rigs. Reserve pits can contaminate soil, groundwater, and surface water with heavy metals and other toxic substances if improperly managed. In an attempt to characterize the physical-chemicals and demonstrate the potential environmental impact of the heavy metal content of drill waste generated during the drilling of Ngamia 5 exploratory well in Turkana, Kenya, this study was developed to determine their toxicity and the potential environmental impacts following their disposal. Samples of drilling waste disposed of in a reserve pit were collected at prescribed depths and analyzed for heavy metals using Total x-ray fluorescence. The samples were also analyzed for other physico- chemical parameters (oil and grease, Electrical conductivity and pH), which are the key parameters used when determining disposal of drilling waste.

Results showed that the mean pH values ranged from 8.2 to 8.7 categorizing the drill waste as basic while Electrical conductivity values ranged from 1.28 to 2.16 mmhos cm^{-1}. Most physico- chemical parameters were generally within the limits of guidelines by regulatory authorities save for oil and grease values which were exceedingly very high (41.66 ± 25.74 mgl^{-1}) compared to the established limits. The trend of all the parameters showed that the values increased with depth. Calcium (Ca) had the highest concentration (1192.81 ± 150.73 mgl^{-1}) followed by barium (Ba) (1076.27 ± 147.32 mgl^{-1}) and then iron (Fe) (381.46 ± 62.23 mgl^{-1}) in that order while Arsenic had the lowest concentration (0.08 ± 0.002 mgl^{-1}) followed by nickel (Ni) 0.26 ± 0.03 mgl^{-1}.

The concentration of metals in the mud phase (bottom) was the highest followed by middle then the water phase (top) and was in the order of Bottom > Middle > Top. Generally, the values of most metals were higher than those of the United States Environmental Protection Agency, Federal Environmental Protection Agency and Directorate of Petroleum Resources Standards thereby implying possible negative impacts on the immediate environment. These high levels of some of the physico-chemical parameters such as oil & grease and heavy metals in the drilling waste as seen in this study may be source of environmental pollution. This therefore, underscores the need for due diligence in managing drilling waste discharges from the ongoing exploratory drilling activities in Kenya.

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