Study on Environmental impact on oil and gas activities in Ghana- Analysis by graphical approaches using Matlab

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***Abstract*— Environmental impacts are main factor in any country. This paper is focused about various types of impacts on oil and gas activities carried over in Ghana. We are studied different results for aquatic impacts on different ten areas around the country. pH and turbidity results given the polluted aquatic environment were analyzed by graphical values. Finally the effects of concentration of metals like Iron, cadmium and lead concentration with listed location are shown. Using standard methods Oil and grease value evaluated from the range of 6 to 44 mg/L. The graphical approaches are drawn using Mat lab 7.05.**

***Keywords*— oil and gas activities, water quality, environmental impacts, graphical approach**

I. INTRODUCTION

The discovery of commercial quantities of oil in 2007, Kosmos Energy announced off the western coast of Ghana. Located some 60 kilometres offshore in the Gulf of Guinea, near the districts of Ahanta West, Jomoro, Nzema East, Sekondi-Takoradi, and Sharma, the Jubilee field has estimated reserves of about 2 billion barrels of oil and 5000 billion cubic feet of gas. In 2011 there has been a significant discovery in the Voltaic Basin, and many other exploration licenses have been issued over the last couple of years that might turn into additional discoveries. Compared to its neighbouring country Nigeria, Ghana's oil reserves are small. However, with estimated revenues of about $1 billion per year on average, which is the same amount of development assistance Ghana receives per annum, it has the potential to boost Ghana's development. There is additional potential in developing a downstream gas sector, which can generate domestic energy supply. There are some high-skilled and specialized employment opportunities in the petroleum sector as well, and the Ghanaian private sector can be stimulated to participate in the petroleum sector through domestic contracting encouraged by local content policies. Oil and gas exploration and production operations have the potential for a variety of impacts on the environment. These 'impacts' depend upon the stage of the process, the size and complexity of the project, the nature and sensitivity of the complexity of the project, the nature and sensitivity of the complexity of the project, the nature and sensitivity of the pollution prevention, mitigation and control techniques. The impacts described in this section are potential impacts and, with proper care and attention, may be avoided, minimized or mitigated. The industry has been proactive in the development of management systems, operational practices and engineering technology targeted at minimizing environmental impact, and this has significantly reduced the number of environmental incidents. The ecological consequences of discharging drill cuttings on to the sea bed depend on the quantity of material discharged, the physical and chemical nature of the discharge, the depth of water, and prevailing hydro graphic conditions. The oil industry, especially the exploration of oil, has destructive environmental impacts or what Watts (2001) refers to as engendering ecological violence. Oil extraction involves several environmental pollution processes (Sebastian et al 2001). A UNCTAD (2007) report indicates that oil and gas exploration impact on the environment in many negative ways by exposing it to oil leakages and spills, gas flaring, and deforestation as a result of the creation of access routes to new areas.

II. MATERIALS

water samples are taken from rivers, streams, boreholes and tap water in the areas of Elembele1- River Asanta Upstream, Half Assini3- sea water, Rig 4 - south of the Rig, Elembele 2- River Asanta Downstream, Sea water –Elembele, Brackish water – Elembele,Rig1-North of the Rig, River Ankobra– Axim, Half Assini 2 -Sea Water, Rig 3 -East of the Rig.

III. METHODS

Several types of potential impacts are analysed. They include human, socio-economic and cultural impacts; and atmospheric, aquatic, terrestrial and biosphere impacts. When a significant discovery is made that the nature of the process changes into a longer term project to appraise, develop and produce the hydrocarbon reserves Proper planning, design and control of operations in each phase will avoid, minimize or mitigate the impacts. In assessing potential impacts, it is important to consider the geographic scale, like global, regional, local over which they might occur. Similarly, it is important to consider perception and magnitude of potential impacts, which will frequently depend on subjective interpretation of acceptability or significance.

A. Human, Socio-Economic and Cultural Impacts

Exploration and production operations are likely to induce economic, social and cultural changes. The extent of these changes is especially important to local groups, particularly indigenous people who may have their traditional lifestyle affected. The key impacts may include changes in:

1. Local population levels, as a result of immigration and in-migration of a remote population due to increased access and opportunities.
2. Socio-economic systems due to new employment opportunities, income differentials, inflation, differences in per capita income, when different members of local groups benefit unevenly from induced changes.
3. Transportation systems, due to increased road, air and sea infrastructure and associated effects Example. Noise, accident risk.
4. Planning strategies, where conflicts arise between development and protection, natural resource use, recreational use, tourism, and historical or cultural resources.

The uneven distribution of benefits and impacts and the inability, especially of local leaders, always to predict the consequences, may lead to unpredictable outcomes. With careful planning, consultation, management, accommodation and negotiation some, if not all, of the aspects can be influenced.

B.Atmospheric Impacts

Atmospheric issues are attracting increasing interest from both industry and government authorities worldwide. This has prompted the oil and gas exploration and production industry to focus on procedures and technologies to minimize emissions.

1. Flaring, venting and purging gases.
2. Combustion processes such as diesel engines and gas turbines.
3. Fugitive gases from loading operations and tanager and losses from process equipment.
4. Particulates from other burning sources, such as well testing.

The potential for emissions from exploration activities to cause atmospheric impacts is generally considered to be low. However, during production, with more intensive activity, increased levels of emissions occur in the immediate vicinity of the operations. Emissions from production operations should be viewed in the context of total emissions from all sources, and for the most part these fall below 1 per cent of regional and global levels.

Flaring of produced gas is the most significant source of air emissions, particularly where there is no infrastructure or market available for the gas. However, where viable, gas is processed and distributed as an important commodity. Thus, through integrated development and providing markets for all products, the need for flaring will be greatly reduced. Flaring may also occur on occasions as a safety measure during start-up, maintenance or upset in the normal processing operation.

C. Terrestrial Impacts

Potential impacts that may result from poor design and construction include soil erosion due to soil structure, slope or rainfall. Left undisturbed and vegetated, soils will maintain their integrity, but, once vegetation is removed and soil is exposed, soil erosion may result. Alterations to soil conditions may result in widespread secondary impacts such as changes in surface hydrology and drainage patterns, increased siltation and habitat damage, reducing the capacity of the environment to support vegetation and wildlife.

D.Aquatic Impacts

The principal aqueous waste streams resulting from exploration and production operations are Produced water, Drilling fluids, Cuttings and well treatment chemicals; Process, Wash and drainage water; sewerage, sanitary and domestic wastes; spills and leakage; and cooling water.

Again, the volumes of waste produced depend on the stage of the exploration and production process. During stage of the exploration and production process, the main aqueous effluents are drilling fluids and cuttings, whilst in production operations after the development wells are completed—the primary effluent is produced water. The make-up and toxicity of chemicals used in exploration and production. Water-based drilling fluids have been demonstrated to have only limited effect on the environment. Oil-based drilling fluids and oily cuttings, on the other hand, have an increased effect due to toxicity and redox potential. Discharges of water-based mud and cuttings have been shown to affect benthic organisms through smothering to a distance of 25 meters from the discharge and to affect species diversity to 100 metres from the discharge.

The high pH and salt content of certain drilling fluids and cuttings poses a potential impact to fresh-water sources. Produced water is the largest volume aqueous waste arising from production operations, and some typical constituents may include in varying amounts inorganic salts, heavy metals, solids, production chemicals, hydrocarbons. Impacts may result particularly where ground and surface waters are utilized for household purposes or where fisheries or ecologically important areas are affected. This paper mainly focused about aquatic impact of oil and gas activities such as:

I. pH and Turbidity Analysis

One and half litre of the water samples were collected into sampling containers that has been rinsed with 1:1 conc. HNO_3 acid and double distilled water and fixed with identification labels. The samples were stored in an ice – chest at a temperature of 4˚C and later analyzed in the ANUC laboratory. pH, turbidity of the samples were determined using hand potable pH, turbidity meters.

II. Analysis of Samples

The method for the analysis of the water samples in this work was based on standard methods for analysis of heavy metals adopted by the US Environmental Protection Agency and American Water Works Association. The determination of the heavy metals in the samples was carried out by the Ghana standard authorities. The concentrations of Iron, Cadmium and Lead were determined using flame Atomic Absorption Spectrophotometer Perkin Elmer model 520 after double distilled water has been used to zero the instrument, the concentrations of Iron, Cadmium and Lead in the blank were also measured and then followed by the determination of the concentrations of Fe, Cd and Pb in the digested samples.

III. Procedure for Oil and Grease in the Samples

100 mL of the sample and 20 mL of acetone is added in to a separating funnel. The mixture was shaken vigorously for 20 mins after which it was allowed to settle into organic and aqueous layers respectively by clamping the funnel in a retort stand for 10 mins. The aqueous layer was collected into a separate beaker and the organic layer drained into a pre-weighed evaporating dish. The aqueous layer was then transferred into the separating funnel and 20 mL of acetone. The mixture was shaken thoroughly for 20 mins, after which it was allowed to settle into aqueous layer and organic layer. The organic layer further was drained into the pre – weighed evaporating dish whilst the aqueous layer was also drained into the beaker. The process was repeated for three consecutive times. The organic layer in the evaporating dish was evaporated to dryness on water bath at 95°C. The dish was allowed to cool to room temperature and re–weighed again. The difference in weight of the evaporating dish was mass of the oil/grease in the sample after which the concentration of the oil/grease in the samples was determined.

IV. RESULTS AND DISCUSSION

A.Effect of pH value and Turbidity

Figure 1. Shows the various pH values for the different location in Ghana. pH of the water samples ranges from 7.33 to 8.47 pH units. These values falls in line with the WHO acceptable guideline values for pH for marine, brackish and natural resources.

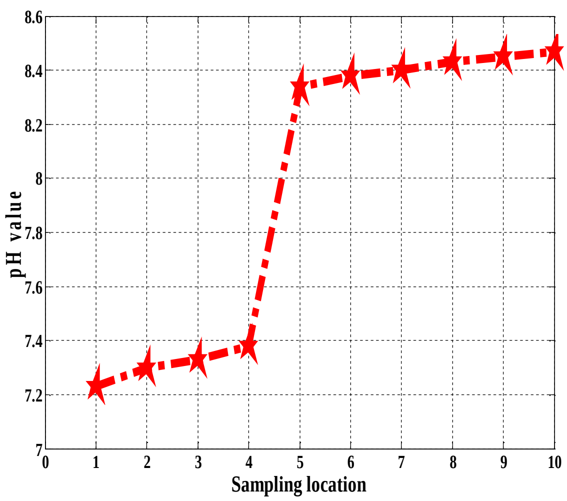


Fig.1 Amount of pH Vs Different listed Sampling location

Figure2. Shows the various turbidity values for the different location in GhanaTubidity of the water samples ranges from 1.46 to 2.83. These values falls in line with the WHO acceptable guideline values turbidity for marine.

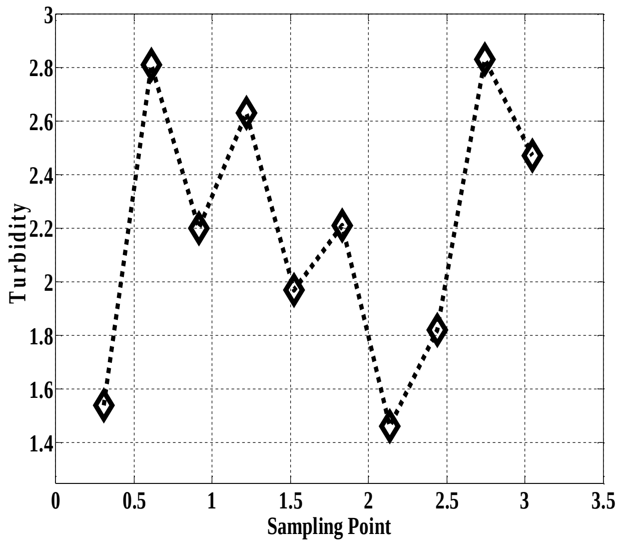
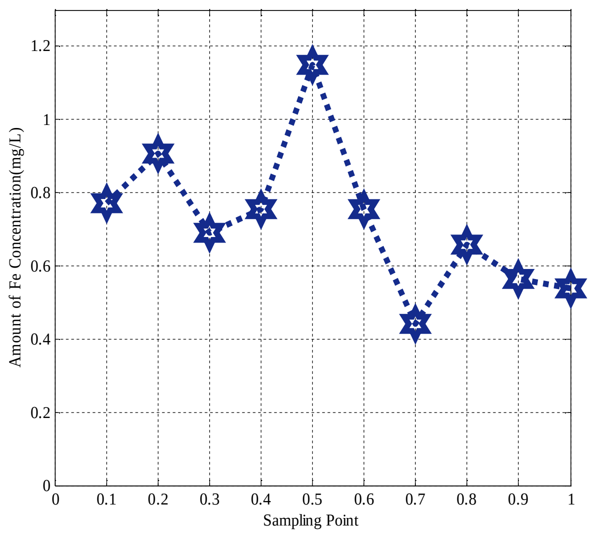


Fig.2 Turbidity value vs Listed Sampling Point

B. Impact of Iron concentration

From figure 2 discussed about the total iron concentration ranges from 0.44 to 1.18 mg/L. The presence of high iron could be as a result of chemical weathering of the host granitic and metamorphosed rocks, which could have resulted in the dissolution of iron that ultimately, percolate through the overburden to enrich the groundwater in storage. The Sea at Axim could also account for the elevated levels of iron.



C. Analysis of Cadmium Concentration

Cadmium ion levels in all the water samples collected for this study ranged from 0.004 to 0.116mg/L as shown in above figure. The cadmium concentrations in some cases were found to be above the WHO acceptable value of 0.05 mg/L. Exposure to elevated levels of cadmium poses significant health hazard to both aquatic organisms and human beings who consume such organisms.

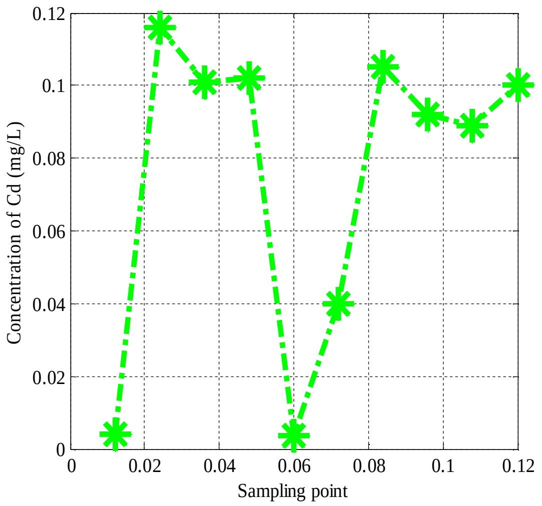


Fig4. Amount of Cadmium Concentration Vs Listed sampling point

D. Impact of Lead Concentration

Lead ranged from 0.05 to 0.477 mg/L as shown in figure. High concentration in drinking water may lead to damage of the brain, red blood cells and kidneys. Generally the concentration of lead in most cases exceeded the WHO permissible guideline values of 0.015 mg/L.

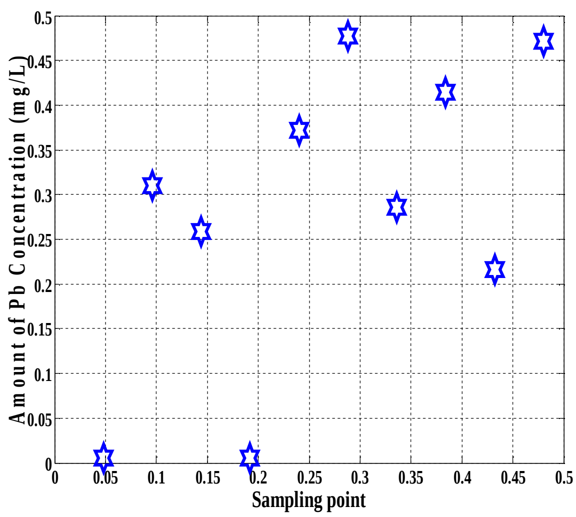


Fig4. Amount of Pb Concentration Vs Listed sampling point

E. Impact of Oil and Grease in water sample

Oil and grease content in the samples were used as a measure of oil pollution from oil and gas exploration activities the concentration of oil/grease in the water samples ranges from 6.0 to 44 mg/L. These increasing oil and grease activities gradually polluting marine water and other water bodies which have serious implications for marine organism and human being.

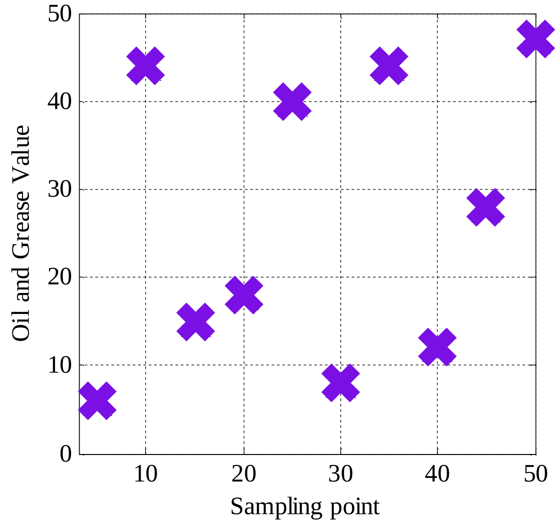


Fig.5 Amount of Oil and grease value Vs Listed sampling point

Conclusion

The graphical approaches was carried out using Mat lab 7.05.The review found that the highest pH and turbidity values from the sample, we can conclude that Ghana marine water quality affected. The discharge of polluted fluids with the metals composition affects human socio economical and sea resources. Also the distribution of the iron content affects ground water storage in the specific areas of Ghana. Oil and grease quantity affects mainly organisms in ocean. The EPA should make sure that the strict regulation for the environmental activies.

In Future graphical review will be for hydrocarbon activities Total dissolved solids and total suspended solids in marine environment

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