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RESEARCH ARTICLE

THE EFFECT OF CRUDE OIL ON ORGANIC AND MOISTURE CONTENT OF THE SOIL

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ABSTRACT

The degreased in water penetration and gaseous exchange is brought about by Changing in soil physical properties such as compatibility. The activities of organisms and movement materials in soil is controlled by very important elements such as Ph., cation exchange capacity, organic and moisture content (Lasat, (2002). The study was carried out between the periods of August to September 2021 to generate knowledge concerning the effects of the crude oil on Moisture and organic content of the soil. The samples were taken from one of the oil fields and analyzed at the chemistry laboratory of the University of Juba. After removing approximately 3 cm surface layer, soil samples were pulled out from depth of 10 cm. The soil was dried, sieved through 5mm sieve and 4kg of sieved soil was filled into four 2 liter plastic jar. The crude oil was then added into the filled plastic jugs, with each receiving a given quantity of crude oil. The amounts of crude oil applied were 0g, 25g, 50g and 75g and each quantity serves as a treatment. The jar for treatment received no oil. The crude oil was mixed with the soil in jar using hand trowel and each treatment is replicated three times, the soil samples were obtained from each jar from top layer (0 cm- 1cm) and surface layer (about 15 cm) depth. The samples were collected on days (1, 2, 3, 4.) after crude oil application. The soil samples from each jar was well mixed together to obtain homogenous mixture. The results showed that There was significance difference at P = < 0.001 for all items tested. The results also showed that there was slightly positive correlation (**r** =0.0351) between the days and moisture content, as the days increase the moisture content increases, and there is slightly negative correlation (r =-0.2559) between the days and organic content, as the days increase the moisture content decreases. In conclusion, the crude oil had an effect on moisture content, and organic content of soil and that moisture content and organic content polluted with crude oil can be changed with time.

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INTRODUCTION

Oil pollution on land destroy soil fertility, hamper proper plant growth and destroy beneficial soil microbe (Ojimba, 2011). A number of oil spills contamination problems affecting some areas in South Sudan have been catalogued (Matthew Bliss cordaid, 2014). Most of the pollution cases involves accidental oil blowouts seepages and deliberate flushing activities which leaves a thick layer of crude oil over land, vegetation and water surfaces. The environmental effect of such blow-out is serious on soils and vegetation on which rural livelihoods depends. Cases of local oil pollution occur as a result of improper handling or mishaps such as burst pipes in many places (Mednick, 2020). There have been a limited studies carried out to assess the effect of crude oil on the moisture and organic content of soil in South Sudan. Therefore, the objective of this study is to identify the effect of the crude oil on moisture and organic content of soil.

MATERIALS AND METHODS

Area of the study: Crude oil samples were collected from one of the oil fields and the sandy loam soil was taken from botanical garden of the University of Juba. The experiment was carried out in the chemistry Laboratory of the University.

Sample collection: After removing approximately 3 cm surface layer, soil samples were pulled out from depth of 10 cm.

Experimental design: The soil was dried, sieved through 5mm sieve and 4kg of sieved soil was filled into four 2 liter plastic jar. The crude oil was then added into the filled plastic jars, with each receiving a given quantity of crude oil. The amounts of crude oil were 0g, 25g, 50g and 75g and each quantity serves as a treatment. The jar for treatment received no oil. The crude oil was mixed with the soil in jar using hand trowel and each treatment was replicated three times in CRD

(Complete Randomised Design) design, the soil samples were obtained from each jar from top layer (0 cm- 1cm) and surface layer (about 15 cm) depth. The samples were collected on days (1, 2, 3, 4.) after crude oil application. The soil samples from each jar was well mixed together to obtain homogenous mixture

Data collection

Percentage Moisture content: The percentage moisture content of soil samples was calculated using a modified form method of Schneekloth *et al*., (2008). 25g of soil was placed in a crucible of known weight, the crucible with soil was put an oven at 105 C for 1 hrs. The Weight of dried soil was detected using weighing balance. The soil moisture content was detected according to formula:

The percentage organic matter: The percentage organic content was calculated according the method defined by (Schulte, 1995).5g of soil sample was put in a crucible of a known weight and soil sample and crucible were put in in a tray on the left side of muffle furnace at 105 C ±5Cº. The sample was ashed for two hours at this temperature and removed from the furnace with tongs and put in a desiccator. The sample then weighed immediately while still warm to avoid moisture being absorbed. The crucible with sample was replaced on the left furnace and temperature was set at 360±5Cº. The sample was left for two hours at this temperature after which the furnace was put off and left open. The sample was removed from the furnace with tongs, put in desiccator and allowed to cool after which it was weighed. The percentage organic matter was calculate by using the formula in the method defined by (Schulte, 1995):

Where

a = weight of crucible
b = weight of crucible + sample after 105 C ±5Cº heating
c = weight of crucible + sample after 360±5Cº heating

Data analysis: By using (ANOVA) which stands for analysis of variance in Gen stat 14th edition, the data was analysed at 5% level of significance followed by least significance difference analysis (LSD) (P< 0.05) to determine statistical differences among the treatment means. Correlation analysis was also done to identify the relationship between the data obtained and amount of crude oil in the soil.

RESULTS

Soil moisture content analysis of variance: There was significance difference at P = < 0.001 for crude oil content, day and crude oil and day relation and LSD at 5% for soil moil moisture content study (Table 1.).

Table 1. Analysis of variance for a soil moisture content in relation of day and crude oil

Source of variation	d.f.	s.s.	m.s.	P value	LSD
CO	3	1.573	5.245	<.001	0.04878
DAY	3	1.989	6.630	<.001	0.04878
CO.DAY	9	7.412	8.236	<.001	0.09757
Residual	32	1.101	3.442		
Total	47	1.576			

Where: df = degree of freedom, ss = sum of square, ms = means of square, P = probability at <.001, SD = Least significant differences of means (5% level), and C0 = crude oil.

The moisture content of the soil increased with days of study (Fig. 1).

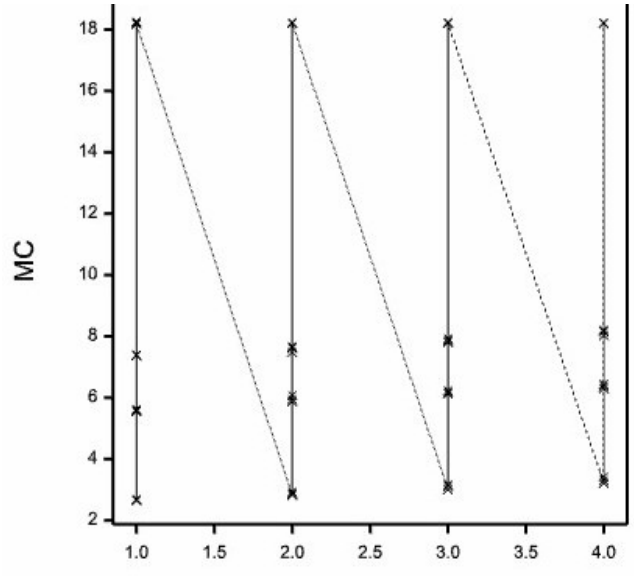

Figure 1. The moisture content of the soil contaminated with different concentrations of oil

Percentage organic content analysis of variance: There was significance difference at P = < 0.001 for crude oil content, day and crude oil and day relation and LSD at 5% for organic content study (Table 2.) The organic content decreased as the days of the study increased (Fig. 2).

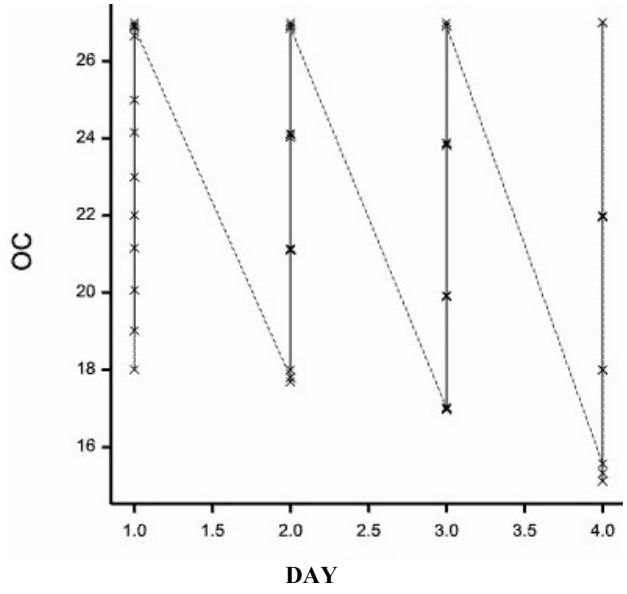

Figure 2. The organic content of the soil contaminated with different concentrations of oil

Days and Moisture content correlation: There is positive correlation between the days and moisture content, as the days increase the moisture content increases **(r** =0.0351) Figure 3.1 and Table 3.).

Days and Organic matter content correlation: There is negative correlation between the days and organic content, as the days increase the moisture content decreases **(r** =-0.2559) (Figure 3.2 and Table 3.).

Table 2. Analysis of variance for organic matter content in relation to days and crude oil

Source of variation	d.f.	s.s.	m.s.	P value	LSD
CO	3	634.6151	211.5384	<.001	0.09757
DAY	3	47.8744	15.9581	<.001	0.04878
CO.DAY	9	18.0974	2.0108	<.001	0.3955
Residual	32	7.2389	0.2262		
Total	47	707.8258			

Where: df = degree of freedom, ss = sum of square, ms = means of square, P = probability at <.001, SD = Least significant differences of means (5% level), and C0 = crude oil.

Table 3. Correlation coefficients (r) for moisture content and days of study

Trait	Mc	Day	Co
Mc	1		
Day	0.0351	1	
Co	-0.9245	-0.2559	1

Where: Co = crude oil and Mc = Moisture content

Table 4. Correlation coefficients (r) for Organic content and days of study

Trait	Co	Day	Oc
Co	1		
Day	0.0000	1	
Oc	-0.9464	-0.2559	1

Where: Oc = organic content, and Co = crude oil

DISCUSSION

The results of moisture content study is in line with results reported by Osuji, and Len C, (2004.) Who indicated that the addition of crude oil to a sandy soil could lead to an increase in the moisture content. Though it does not go in line with results of Gouse *et, al*, (1980) who pointed out that the crude oil lead to drought conditions in soil. The inverse relationship between the amount of crude oil added on the day of applications and moisture content of soil has some allegations. Firstly, there would be reduced availability of nutrients to plants as there was reduced water to dissolve them before uptake by the plants. This is because nutrients required by plants to grow are dissolved in soil water and soil water also serves as transporting agent (Verma and Agarwal, 2004). Secondly, as flow of water and dissolved substances depends on soil moisture (Ray R. Weil, 2016), such would decrease in crude oil contaminated soil and the reduction would increase as the amount of crude oil in the soil increases. The increase of the moisture contents of the soil as the duration of the days of study increases could mean that the soil contaminated with crude oil would have improve moisture content conditions if left for some time. This could further mean that the effect of crude oil on soil decrease as the duration increases. This could be produced by natural weathering (Epstein *et al*., 2000) of the soil which would lead to its degreased toxicity. The build-up of organic matter can let to acidify the soil because of creation of soluble complexes with non-acid nutrient cations (E.g. Ca^{2+} and Mg^{2+}) or donation of H^{+} to the soil (Ray R. Weil, 2016), the opposite relationship between the moisture contents and organic matter content detected in this study syndicates otherwise. Whereas the drop of organic matter content as the period of the study increased could be due to the decrease of organic carbon content(Burley, 2021), due to break down of crude oil, the increase in the moisture could be a sign of a good soil condition for microbial activity.

CONCLUSION

The study indicated that the crude oil affect moisture and organic content of soil and that moisture content and organic content polluted with crude oil can be altered with time.

Recommendations

As an oil production is essential for the economic development, it's important for oil companies to keep running oil production processes following the recommendations below;

- The drop down in moisture content of the soil due to the addition of crude oil can be improved if organic matter can to be added to the soil to increase the soil water holding ability. The crude oil polluted soil can be enhanced by application of sing or combined Cow-dung (addition of organic manure) or application of hydrogen peroxide (supplying oxygen to the soil) as remediating agents (Benson *et al*., 2016).
- Moisture content of the soil polluted with crude oil can be enhanced by letting such soil to stay for a while. By moving from one oil station to another one.
- Keeping nearby area residents as for as possible to avoid radiation emission. There should a compulsory rehabilitation of the residents for their safety by Government authorities.

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