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ANALYSIS OF PRODUCE WATER FROM EBEDEI FLOW PLANT STATION, DELTA STATE

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ABSTRACT
Produce water from Ebedei flow station (Delta State) at three points was analysed. Discharged point (A), midstream (B) and downstream (C) were a mile apart. The metal concentration of iron, zinc, cadmium, chromium, nickel, lead and manganese were carried out using standard methods. Lead levels at discharged point and down stream were higher than World Health Organization (WHO) standard limits. The polynuclear Aromatic hydrocarbon were determined using high performance liquid chromatography (HPLC). The total PAHs of sample (A) was 3.63ppm, (B) 52.05 and (C) 59.50 ppm respectively. The pH were within WHO limits of 8.10 and 8.20, conductivity in μs/cm was 20.10 and28.10 within acceptable range. Chloride was between 8, 130.00ppm and 22, 131.53 ppm higher than WHO and effluent discharge limits, while turbidity was between 46ppm-60ppm which was also higher. Hence there is need for holistic monitoring and remediation of produce water in the environment.
Keywords: Produce water, polyaromatic hydrocabons (PAHs), Carcinogenic Gas Chromatoraphy

INTRODUCTION
During the production of oil and gas, water is produced from underground during its formation, which is of environmental concern for oil and gas operators [1]. Produce water is a mixture of water-oil that is separated by flotation or gravity in large tanks or by other methods. The water left behind (produce water) usually contains contaminants as crude oil, trace metals, dissolved gases etc [2]. Produce water is of importance for process chemistry (control) and regulatory bodies. It is also needed by stakeholders. Analysis of produce water is a source of information for stakeholders. Hydrocarbons, radionuclide, trace elements can bioaccumulate in sediments and persist in food chain even in aquatic birds [3]. It can be deep-well injected or discharged to surface waters as permitted. Trace elements hydrocarbon (polyaromatic hydrocarbons) (PAHs) can bioaccumulate in water and persist in food chain. Polynuclear aromatic hydrocarbons (PAHs) have been a major health concern since they are toxic. They occur with crude oil usually three, four or more aromatic rings fused with no heteroatoms for substitution. They are identified as carcinogenics, mutagenic and tetragenic [4], both natural and anthropogenic sources contributes PAHs to the environment [5] studies have shown that PAHs mostly benzo(a) pyrene have toxicology effects such as haematological effects, reproductive and developmental toxicity and immunotoxicity but the carcinogenic and genotoxic potential of these compounds has attracted most attention [6]. High prenatal exposure to PAH is associated with lower intelligent quotient (IQ) [7] [8].

The aim of this study is to evaluate the influence of Ebedei flow station on the produce water physicochemical characteristics, heavy metals and polyaromatic hydrocarbons. Since the produce water will be viable for its usage and appropriate treatment processes for the water reuse [9].

Study Area
Produce water used was collected from Ebedei flow station, in Ukwani Local Government Area of Delta State, lying between latitude $5^0 5^1$N and $6^0 10^1$N of the equator and longitude $5^0 10^1$E and $5^0 48^1$E of the Greenwich meridian.

Materials and Methods
Sterile plastic bottles of 5 litres containers, containing 1:1ml concentrated hydrochloric acid to acidify the sample-produce water was collected from the well heads. This was taken to the laboratory for analysis.

Thirty (30ml) produce water sample was used for digestion using 30ml concentrated perchloric acid and 2ml concentrated HNO_3 and analysis for metals was carried out by atomic absorption spectrophotometer (Buck Scientific Model

200A). Perchloric acid and HNO_3 is used when only the organic matter is difficult to oxidized with HNO_3 and H_2SO_4 and eliminates interference from CN^-, NO_2^-, S_2^-, So_3^{2-}, $S_2O_3^{2-}$ and $CN5^-$.The PAHs valves was carried out using gas chromatography (Agilent 6890 series 4 Agilent Avundale USA) equipped with a HP (Cross-Linked (FID). Recovery studies were carried out by spike to evaluate the extraction efficiency for the targeted compounds. Turbidity was determined using HACH 2000N Turbidimeter using formaline standards supplied with the instrument. Conductivity was done using Thermo Oriental Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) by standard methods [10], while phosphorus was by ascorbic acid method.

Results and Discussion

Table 1: Content of produce water from three points (Mean Values)

[Mean values] Parameters ppm	Discharge point A	Mid point B	Down stream C	WHO standard	*Drinking standard	*Effluent discharge
Fe	0.400	0.160	0.210	0.3	0.3	0.5
Zn	0.240	0.300	0.200	3.0	3.0	0.2
Cd	0.001	0.001	0.002	0.003	0.003	0.001
Cr	0.010	0.050	0.010	0.005	0.5	0.5
Cu	0.020	0.010	0.041	1.0	1.0	0.01
Ni	0.020	0.020	0.021	0.01	0.1	0.01
Pb	0.015	0.010	0.200	0.01	0.20	40.0
Mn	0.010	0.010	0.002	0.4	0.20	40.0

Source: Values from National Environmental Standards and Regulations Enforcement Agency (NESREA,2010)

Table 2: Polyaromatic hydrocarbons (PAHs) concentration of produce water from three points (Mean values)

PAHs (PPM)	A Discharge point	B Mid-point	C Down stream
Nephthalene	0.0913	1.3810	2.0321
Acenaphthylene	0.0202	7.2100	2.0312
Acenaphthlene	0.7312	10.231	1.0859
Fluorine	0.5121	7.1830	10.3210
Phenanthrene	0.6110	6.1321	9.3210
Anthracene	0.8130	12.8110	4.2103
Fluorathene	0.4123	3.4121	13.1320
Benzo(a) anthracene	0.1002	2.1882	2.1320
Chrysene	0.0121	1.2171	1.3210
Benzo (b) fluoranracene	0.0021	0.0520	0.5891
Benzo (a) pyrene	0.4132	0.6128	1.3200
Indonol [1,2,3] pyrene	0.4136	3.2101	1.2000
Indenol [1,2,3,c,d] pyrene	0.1234	2.001	0.210
Total	**3.629**	**52.05**	**59.50**

Table 3: Physicochemical concentrations of produce water from three points

Parameter ppm (A)	Discharge point (B)	Mid-point (C)	Downstream	WHO standard	*Drinking water	*Effluent discharge, irrigation & reuse
pH	8.20	8.10	8.10	7.8-8.6	6.5-8.5	6.5-8.5
Conductivity (µs/cm)	20.50	20.10	28.10	1,200	N.A	N.A
Oil/grease	2.110	15,531	11,131	0.01	0.003	0.1
Chloride	10,011,17	22,131,53	8,130.00	350	350	350
Ortho-phosphate	0.06	0.51	3.3	3.5	3.5	3.5
COD	810.000	710.00	810.01	15	15.0	30.0
BOD	121,00	201.30	231.21	5.0	6.0	5.0
Turbidity	51	46	60	5.0	10	10

Figures 1 – 3 showed the polyaromatic hydrocarbons distribution in the samples

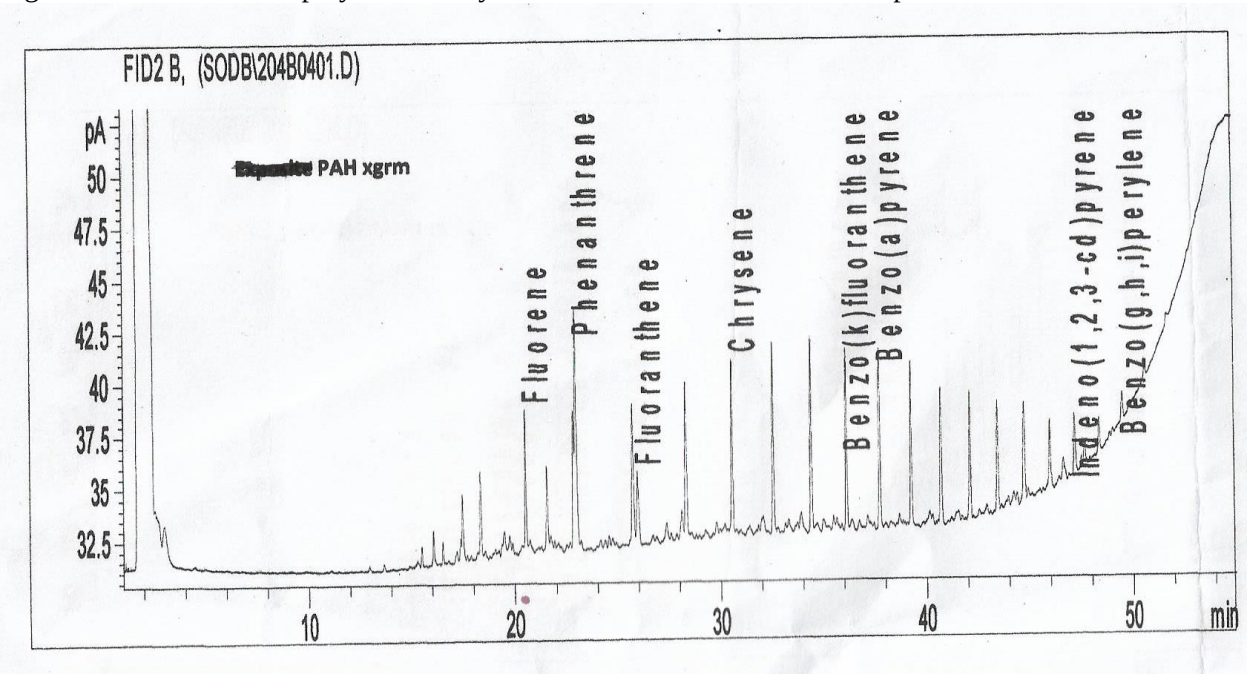

FIGURE 1A:

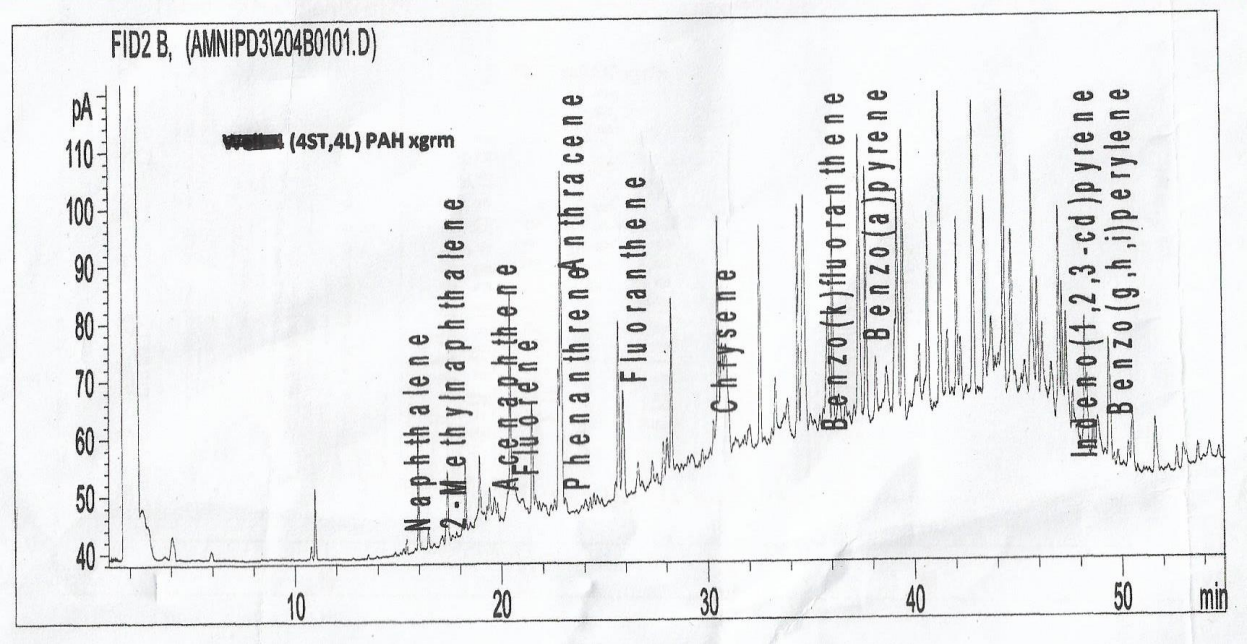

FIGURE 2(B)

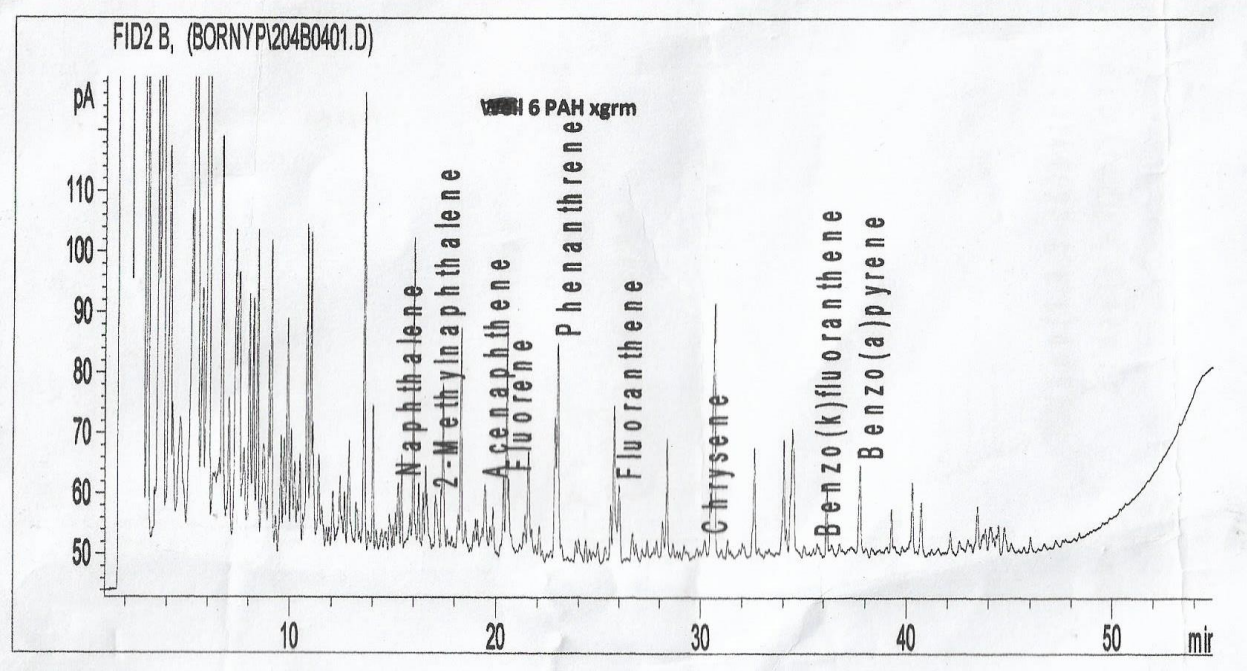

FIGURE 3(C)

Table 1 showed the metal contents of iron, zinc, cadmium, chromium, copper, nickel, lead and manganese. Lead content was higher at the down of stream than the other two points and higher than that of WHO – World Health Organization and NESEREA limits. This is of concern because of its health implication on human and its environment [11]. Table 2 showed the distribution for fourteen PAHs concentration for A is 3.629, with the range of 0.0021 – 0.813ppm, B has total of 52.05ppm ranges between 0.0520 – 12.811pm and C 59.50 ranged between 0.2100 – 13.1320ppm C>B>A that were detected at the gas phase for 2 – 6 rings PAHs. For sample B, Anthracene, Acenaphthlene and Acenaphthylene were most abundant, for sample B. Anthracene and Acenaphthene were the most abundant, while sample C has fluocene and fluoranthene as the most abundant. Naphthalene, acenaphtylene, acenaphtene, fluorine, phenanthrene, anthracene, fluoranthene are 2 two to three rings, high molecular weight (HM-PAHs) benzo [a] anthracene, chrysene, benzo[b] fluoranthracene, benzo [a] pyrene, indenol [1,2,3] pyrene, dibenz [a,h] anthracene and indenol [1,2,3, - c,d] anthracene and indenol [1,2,3 – c,d] pyrene contains four to six rings. The low molecular weight polyaromatic hydrocarbons 2 – 3 rings were the most dominant species. From the values on table 2 and figures 1-3C low molecular weights have weaker carcinogenic properties and are the most abundant in most urban atmosphere. They react with other pollutants to form toxic derivatives. Most of the studies do not contain high molecular weight PAHs, but in this case, it may be due to the low liquid oil solubility of these compounds, since there is the presence of dissolved solids that have these compounds (PAHs) attached to them. PAHs were increasing as you move away from site A to C indicating that the farther sites were more polluted from the discharge point (A), this could be as a result of accumulation of PAHs [12]. According to World Health Organization, the concentration of individual PAHs in surface and coastal waters are generally is 0.05μg/l and concentration above this point indicates some contamination. A study carried out by WHO revealed that Benzo(a) pyrene concentration of 0.7μg corresponds to an excess lifetime cancer risks of 10^{-5}. Benzo (a) pyrene is the most studied (PAH) because it is the most dangerous. It is used as an index for the level of polynuclear aromatic hydrocarbon contamination for this reason. All the samples were above NESEREA permissible limit of 0.01ppm. The higher molecular weight indentified are also known mutagenic and tetragenic species.

The physicochemical data of the Ebedei produce water is shown in Table 3 with pH within 8.10-8.20. Turbidity were higher than WHO [13] and NESREA [14] limits Oil and grease were also higher than the set limits for various purposes. Chloride was also higher but phosphate was below NESREA set limits of 350 for the 3 (three) points as shown in Figures 1 - 3. The Chemical Oxygen Demand (COD) is a measure of the oxygen demand of biodegradable organic pollutants and the oxygen demand of non-biodegradable oxidizable pollutants (inorganics) and were higher than WHO and NESREA set limits of 15.00pm. Biochemical Oxygen Demand values were higher than WHO [15] and NESREA values from drinking water, effluent discharge and irrigation.

CONCLUSION

The properties of produce water (Physical and Chemical) depends on the geology, hydrocarbon composition, geographical and water injection into it. Thus it is not consistent. From the analysis, produce water from these three points were heavily contaminant with PAHs, inorganic matters, oil and grease. It should be monitored and properly treated before its discharged to the water bodies, injected into the soil and the environment.

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