Impact of Petroleum Product on the Soil around Automobile Workshops in Osun State

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Abstract: *Effects of petroleum product were investigated on the soil samples in automobile engineering workshops at eight different points in osun state. Composite samples were taken at two depths of 0-15cm and 15-30cm, therefore a total of sixteen samples were considered. From the properties determined, it was shown by the result that the soil samples were acidic. The P^H ranged from 4.61 – 6.25 and 4.30-7.45 EC,49.40-8500 (μ/cm) and 40.20-357($\mu s/cm$)^2 CEC, 1.00-168.25(meq/100g) and 2.10- 17.65 (meq/100g), TOC,0.83-40.22% and 0.10-3.75%, SAR,0.10- 0.98 and 0.12-0.60, Total nitrogen 0.05-0.20% and 0.02- 0.64%. The concentrations of heavy metals were also determined and the result indicates the favourable natural mechanism of high uptake of the metals.*

I.   Introduction.

Industrialization, technology, economic growth, improved life style, population growth and environmental pollution are interwoven. (Odiete, 1999) Heavy metal contamination and petroleum hydrocarbon emission today have great ecological significant due to their toxicity and accumulation. In recent years, the occurrences of metal contamination especially heavy metal in excess of natural load have become problem of increasing concern. This situation has arisen as a result of rapid growth in population, increase urbanization expansion of industrial activities, exploration and exploitation of natural resources and agricultural practices as well as lack of environmental regulations (Biney et al, 1994). Heavy metals are associated with various soil components in different ways and these associations determine their mobility and availability (Kabata- pendias and Pendias 1992, Sigh, 1997; Ahumada et al 1999). This soil texture (clay content), organic matter and Fe-Mn oxides have been found to be most important properties and component influencing the ability and biological update of heavy metals (Iyengar et al, 1981; Narwal and Sinhyg 1988; Ma and Rao, 1997; Karsczewska et al, 1998.)

Heavy metals, contrary to most pollutants (e.g. petroleum hydrocarbon) are not biodegradable and undergo a global ecological cycle (Nurberg, 1984). Heavy metals pollution can affect all environment but their effects are long lasting in solids due to the relatively strong absorption of many metals onto humid and clay colloids in soil. (Alloway and Arye, 1994). The duration of contamination may be hundreds and thousands of years in many cases, depending on the soil type and physicochemical parameters. Unlike organic pollutants which will ultimately be decomposed, metals will remain atoms although their speciation may change with time as the organic molecules binding them decompose or soil condition changes (Alloway and Arye, 1994).

Some heavy metals such as Zn, Cu, Mn and Fe are essential for the growth and well being of living organisms. However, they are likely to show toxic effect when organisms are exposed to levels higher than normal, such as Pb,Hg, and Cd are not essential for metabolic activities and exhibit toxic properties (Binery et al, 1994). Heavy metals are toxic to animal and plants, although plants and animals vary widely in sensitivity. (Clark, 1982; Odiete, 1999). Hence, abnormally high concentrations of metals create concern to the normal functioning of the ecosystem.

II.   Materials And Method.

Sample collection and preparation.

Soil samples were collected from eight different points of automobile engineering workshop within olorunda local government of osun state.

Composite samples were taken at two depths 0-15cm and 15-30cm. A total of 16 samples were considered. The samples were air dried, sieved through 2mm mesh size and stored at 4^0c until the analysis were carried out.

The soil P^H was determined in soil suspension (1:2.5 soil water ration) using a glass electrode p^H meter. Particule size distribution were determined using the pipette method of kilmer and Alexander (1949). Relative properties of sand, silt and clay were estimated.From dried sample Soil textures were then determined with the aid of a textural triangle. Cation exchange capacity of the soil samples was determined as the sum of basic cations extracted with neutral IM NH_4 and extractable acidity (Recumjk,1995). The NH_4 -extracted Na^+ , k^+,

Mg^{2+} were determined by flame Photometry and Ca^{2+} by atomic absorption spectrophotometer. The electrical conductivity was determined on the filterate obtained filtering the suspension used for pH measurement with the aid of conductivity meter. Total organic carbon of the sample was determined by using Bamgbose et al, 1999 method. Ammonium nitrogen was determined by nesslenzation. Nitrite-Nitrogen was determined by Greiss-llosvary method using napthylamine and sulphanlic acid . Nitrate nitrogen was determined by the phenoldisulphonic acid nethod. The total phosphorus contents of the soil was determined by $H_2 S0_4 – HC_4$ digestion and analyzed through the wetanabe and olsen ascorbic acid modification of the molybdate blue method (Olsen and Sommer, 1982). The sample solution was analyzed for Cu, Zn,Cr,Ni, Pb, Cd and Mn using air – acetylene flame atomic absorption spectrophotometer (AAS).

III.   Result and Discussion.

Table 1 reports the particle size and some general characteristics namely; percentage organic carbon, conductivity, cation exchange capacity (CEC), sodium adsorption ratio (SAR) of the soils examined. At p > 0.05 there is a significant spatial variation in physicochemical characteristics of the soil samples examined. The particle size distribution was predominantly clay fraction in both surface and subsoil. The P^H, CEC^c, Organic carbon and carbonate are among several components of soil that affect the availability, retention and mobility of metals with increasing pH (Hanna, 1998). The pH of the examined soil indicated high tendency of metal availability. Hence, this is a favorable natural mechanism of high uptake of the metal. pH values were predominantly higher in the 15-30cm depth except for few sites that have pH values higher than those of top soils. Result showed high total organic carbon (TOC) at all sites. The TOC values were abnormally high in some sites like, sites 5A and 6A have TOC value of 37.85% &, 40.22 respectively. The abnormally high TOC content of these soil samples could probably be due to the contribution of organic carbon from petroleum products used for the engines in it workshop. However, about 82% of the top soil samples had TOC value less than 3%. Electrical conductivity (EC) is used as a means of appraising soil salinity, EC increases with soluble salt content of soil. The EC value of 4000 µS/cm which correspond to an osmotic pressure of 3-5 atmosphere in soil at field capacity, is generally accepted (Odu et al, 1985). The mean levels of electrical conductivity of the soil examined are high due to the contributions of elevated level in EC in the heavily impacted soils, for example siteS 5A, and 6A have EC value of 8500.µs /cm, and 1126 µs/cm respectively for top soil, the EC values are greater than the acceptable limit. The exceptionally high conductivity of these site could be attributed to the components of some used materials in the workshop for example the engine oil, brake oil, and other petroleum products. Above all, 69% of the examined soil have EC levels less than 200 µs/cm and with value corresponding to that of typical Niger Delta soil (Isiri, mah 1987). Cation exchange capacity (CEC) is the amount of exchangeable cation per unit weight of clay soil that plays important role in soil fertility. Nigeria soils with cation content of 2 meq/100g soils are considered for calcium and magnesium while 0.2 meq /100g soils and above are adequate for potassium ion Codu et al, 1985). 50% of the soil examined has CEC below $3.00meq/100_g$. Sites with high TOC value showed corresponding high cation exchange capacity. Cation exchange capacity showed positive correlation with TOC (r = 0.828: p = 0.07). Suggesting that the binding sites on the organic matter, such as negatively charged humic acids contribute to the retention of cation in the soil (Abollino et al,2002). Table II showed the total metal concentration in the investigated soils. The acidic nature of the soil examined has favoured the mobilization of heavy metals (Cu,Cr,Zn,Ni Pb, Cd, Mn) that are manifested in low abundance. (Bhattacharya et,al 2002). The examined soil can be considered unpolluted; since their concentration fitted Cu. According to reviews by Hindsay, 1979 ; Kabata – Pendias and Pendias, 1992 and Alloway 1995, normal concentration ranges of these metals in soils are 0.01 – 0. $7mgkg^{-1}$ for Cd; 1– 1,000 mg kg^{-1} for Cr, 2 – $250mgkg^{-1}$ for Cu,0.4 – 1,000 $mgkg^{-1}$ for Ni; 2 – $200mgkg^{-1}$ for Pb, and 1 – 900mg kg^{-1} for zn. The concentrations of cadmium in the topsoil exceed at the upper limit except for site 2. The concentration of copper, chromium, zinc, nickel lead, cadmium and manganese were higher in the soil than the subsoil except sites. The concentration of the of heavy metals reported in this study were by lower compared to earlier reports for contaminated sites. (Helmissar, et al. 1995 Ma and Rao 1997, Bangbose et, al. 1999, Rocks Zyk and szerzen, 1998, Kabala and Sigh 2001) .The concentration of nicke and chromium reported in this study are comparable with levels. Reported by lavado et,al. Ma and Rao (1997) and are higher than value reported for soil around smelter complex in Poland . copper, chromium, and nicked showed positive significant correlation. This can be explained by chemical similarity and common source. Copper, cadmium and manganse are positively correlated with total organic carbon (TOC) suggesting that these metals are attached to the binding sites on organic matter, such as the negatively correlated humic acids. This contributes to the retention of these metal cations (Abollino et al 2002). CEC is not related to any of the metals concentration except cadmium, probably because such metals are mainly bound to the soil matrix and are present in the exchangeable forms only in very low percentage (Abollino et, al, 2002). The positive correlation of cadmium with cation exchange capacity implied that non- specific adsorption controls cadmium adsorption.

IV.   Conclusion

The data presented here indicated that the soil samples examined were acidic.This showed a high tendency of metal availability. Heavy metal contaminations of the impacted soils were primarily restricted to the surface horizons. The distribution Patten of heavy metals was in the following order Mn > Ni > Zn> Cr > Pb > Cu > Cd and Mn > Zn > Ni > Pb > Cr > Cu > Cd for the top and su soil respectively. The result also indicated that except for cadmium and lead, the levels recorded did not exceed background levels for unpolluted soil. This study revealed that the concentration of the heavy metals have increased in several folds when compared to the baseline levels of these metals recorded before the usage as mechanic workshop. However, metal build up is a gradual process, farmlands, fishing ponds and water bodies around these facilities will be at risk over time if a monitoring programme is not put in place.

Total heavy metal concentration to a great extent measures the degree of contamination. There is a large consensus among the scientific community to believe that the risks for living organism associated to the presence of heavy metal in our environment is determined for a large part by the solubility of the various heavy metal bearing phases present rather than by the total elemental concentration. As a consequence, knowledge of the total heavy metal in soils provided only limited information, as this does not show how strongly the metal is bound to soil constituents. By indentifying those heavy metal bearing phases and their solubility in a aqueous fluids, one can infer the potential and bioavailability of toxic metal.

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