Alawode, B.O., 2026, 14:1
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

International Journal of Science, Engineering and Technology
An Open Access Journal

Evaluation of Phthalate Ester Levels in Topsoil of Selected Dumpsite in Ijebu North, Ogun State.

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Abstract - Phthalate Esters (PAEs) are environmental pollutants released to the soil directly or indirectly during production and disposal of the products in which they are present. Topsoil of three selected dumpsites (Oke Sopen {OKD}, Atikori {ATD} and Akeula Dumpsites {AkD}) were collected randomly for seven consecutive days. The topsoil samples were air dried in the laboratory and sieved using 2 mm mesh to obtained fine particles. 1 g of each samples were extracted using 1:1 acetone/n-hexane, sulfur was removed with activated copper. The mixture was vortexed (10minutes) and sonicated for 30 minutes before centrifugation at 3000 rpm. The organic phase was collected and re-extracted twice. Combined extracts were concentrated and purified using a pre-cleaned silica/alumina column. The eluates were concentrated using a rotary evaporator and reduced to 1 mL under nitrogen for final PAE analysis. Di ethyl phthalates (DEP), Di-n-butyl phthalates (DBP), Butyl-benzyl phthalates (BBP), Di- (2-Ethylhexyl) phthalates (DeHP), Di-n-octyl phthalates (DnOP) were present in the studied dumpsite topsoils. DeHP had the highest concentrations in the dumpsites with concentrations 4.55, 3.01 and 15.31 mg/kg in Oke Sopen, Atikori and Akeula dumpsites respectively. This high concentration may be attributed its wide application range in production process and increase in deposition of plastics materials on the dumpsite.

Keywords - Dumpsite, Evaluation, Ijebu North, Phthalate Esters, Topsoil.

I. INTRODUCTION

Synthetic chemical compounds known as phthalate esters (PAEs) are commonly used as plasticizers. They are mostly brought in by air deposition, landfill leachate, plastic garbage (Fagbemi et al., 2024) and are not chemically attached to polymers because they are widespread environmental dangers that leak out and contaminate soil, water, air and living things. They are utilized to give polymers their flexibility in a variety of products. Their emission has been linked to human health issues like endocrine disruption and developmental abnormalities, as well as ecological impact to aquatic animals. PAEs can travel vertically, affecting groundwater, despite their tendency to accumulate in topsoil (Gholaminejad et al., 2024). Particle size (clay, silt, sand), soil characteristics (pH, organic content) and proximity to pollution sources all affect their distribution (Wang et al., 2021). Although PAE concentrations are often lower in deeper soils, persistent substances like DeHP can have lengthy half-lives, particularly in deeper layers (Nasrabadi et al., 2024). According to risk evaluations, direct soil exposure poses few risks to people, both carcinogenic and non-carcinogenic (Liu et al., 2025).

However, there can be serious ecological dangers, notably to aquatic systems and delicate creatures, especially in the vicinity of landfills that release a lot of PAEs (Mohammadi et al., 2022). Enzyme activity, soil microbial populations and soil health can all be impacted by PAEs (Zhou et al., 2020). Building materials, medical equipment, cosmetics, surfactants, pesticide carriers, and household appliances are the most common uses for these plasticizers (Bulbul et al., 2022). Waste disposal presents significant environmental and issues related to public health in cities worldwide. Concerns about this have grown among rural and planners of cities. The dumping and breakdown of plastic items with other waste materials containing phthalate esters (PAEs) is the main way that PAEs enter dumpsite soil.

They can readily seep into the surrounding environment since they are not chemically bound to the plastic matrix. The aforementioned research indicates that understanding the dumpsite pollution level and how its leachate affects nearby ecosystems can be useful information for managing the environment.

II. MATERIALS AND METHODS

Extraction of Phthalate Esters and clean - up

The samples collected were air dried in the laboratory and sieved using 2 mm mesh to obtained fine particles. 1 g of each samples were extracted using 1:1 acetone/n-hexane, sulfur was removed with activated copper. The mixture was vortexed (10minutes) and sonicated for 30 minutes before centrifugation at 3000 rpm. The organic phase was collected and re-extracted twice. Combined extracts were concentrated and purified using a pre-cleaned silica/alumina column. The column was conditioned with MeOH, DCM, and n-hexane before eluting the sample with 60 mL acetone/hexane at 2 mL/min. The eluate was concentrated using a rotary evaporator and reduced to 1 mL under nitrogen for final PAE analysis (Zhang et al., 2022).

GC-MS Analysis

A gas chromatography system (model 7980A) coupled to a mass spectrometry system (5979 MSD) was used in the determination of phthalate esters present in the topsoil of the selected dumpsite soil.

Results

Table 1: Concentrations of Phthalate Esters In Topsoil of Selected Dumpsites In Ijebu North, Ogun State.

Phthalate Esters	Oke Sopen Dumpsite (Mg/Kg)	Atikori Dumpsite (Mg/Kg)	Akeula Dumpsite (Mg/Kg)
Di Ethyl Pthalates	0.17	0.08	0.09
Di-N-Butyl Phthalates	1.17	0.84	0.29
Butyl-Benzyl Phthalates	0.17	0.17	0.19
Di- (2-Ethylhexyl) Phthlates	4.55	3.01	15.31
Di-N-Octyl Phthalates	0.25	0.25	0.65

Keys DEP=Di ethyl pthalates, DBP= Di-n-butyl phthalates, BBP= Butyl-benzyl phthalates, DeHP=Di- (2-Ethylhexyl) phthlates, DnOP=Di-n-octyl phthalates. OKD=OKE SOPEN DUMPSITE, ATD=ATIKORI DUMPSITE, AKD=AKEULA DUMPSITE

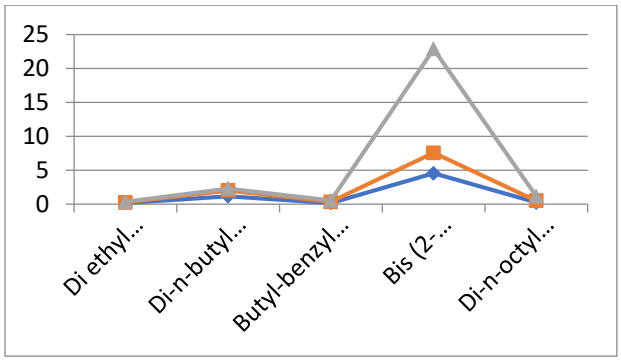

Figure 1: Concentration of Phthalate Esters in Topsoil of selected Dumpsites in Ijebu North, Ogun State.

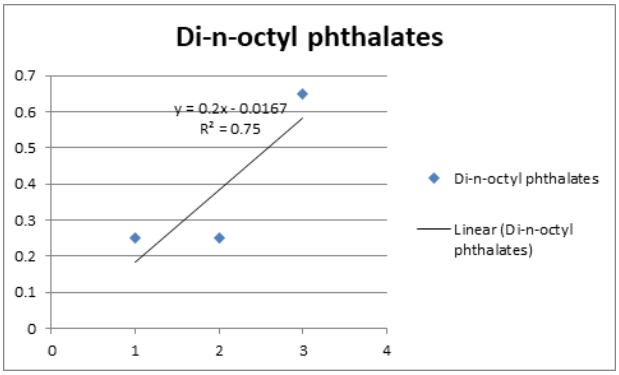

Fig 2: Concentration of DnOP in the studied Topsoils.

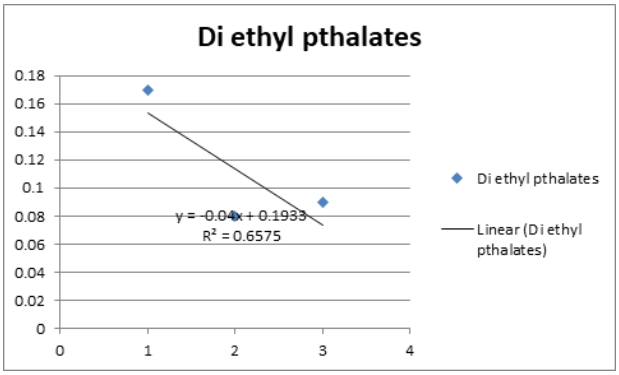

Fig 3: Concentration of DEP in the studied Topsoils.

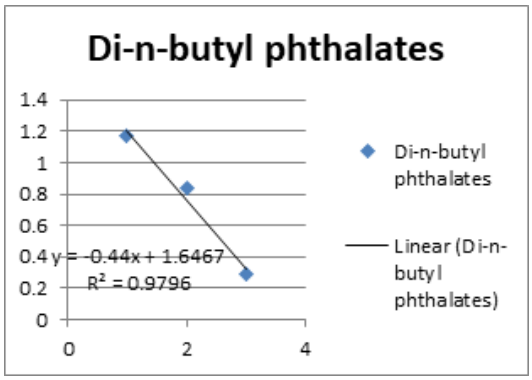

Fig 4: Concentration of DBP in the studied Topsoils.

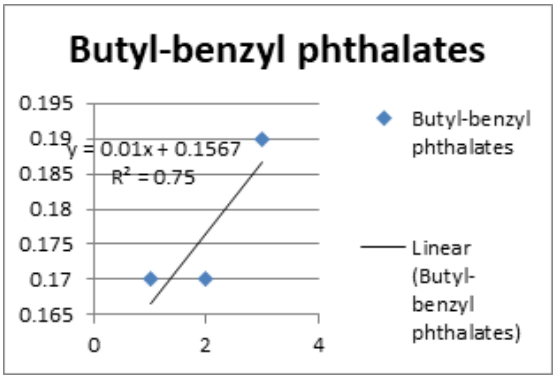

Fig 5: Concentration of BBP in the studied Topsoils.

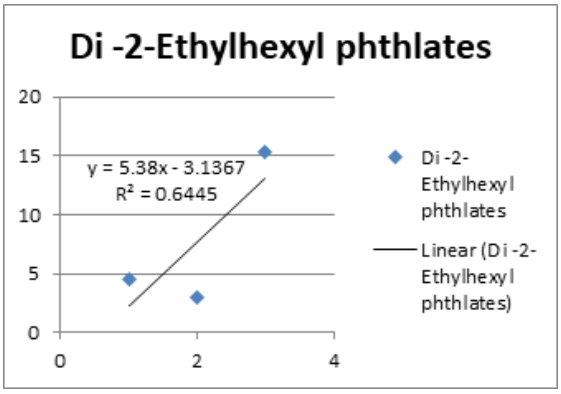

Fig 5: Concentration of DeHP in the studied Topsoils

Discussion

Table 1 revealed the concentrations of phthalate esters present in the studied dumpsites. DEP, DBP, BBP, DeHP and DnOP were confirmed in the three selected top soils which indicate the widespread contamination of soils by plasticizers and are commonly found in plastics, packaging and consumer product. DEP concentration in OkD, ATD and AKD were 0.17, 0.08 and 0.09 mg/kg respectively. This is consistent with other research by

Okoro et al., 2024 and on landfills and dumpsites, where the primary sources of total phthalates in soils and sediments are DeHP and DBP. DEP can damage the male reproductive system of animals in the womb, reduce sperm concentration and when in excess, it can cause abnormal large prostate gland (Al-Hachamei et al., 2023). The concentration of DBP ranged from 0.29 – 1.17 mg/kg in the studied dumpsite soils. OkD had the highest DBP concentration while AKD had the least concentration. DBP is associated with endocrine disruption, food contamination pathways, developmental and reproductive effects. Di-(2-ethylhexyl) phthalates (DeHP) showed the highest concentrations in all dumpsites. DeHP and DnOP are among the more hazardous PAEs, Akeula (AKD) has by far the highest DeHP (15.31 mg/kg) and DnOP (0.65 mg/kg), indicating the greatest overall phthalate load and probably the highest ecological risk. Additionally, studies of landfills and dumpsites show that DeHP and DBP are the primary contributors to total phthalates in soils and sediments (Khishdost et al., 2023).

Oke Sopen (OKD) shows intermediate contamination overall, but has the highest DBP (1.17 mg/kg); DBP is often a key risk driver in soils and sediments (Vasseghian et al., 2023). Atikori (ATD) had the lowest values for DEP, DBP, and DeHP, suggesting comparatively lower contamination, although BBP and DnOP are similar to Oke Sopen (OKD). The concentrations of DeHP and DBP in the range of a few to tens of mg/kg are linked to non-negligible ecological harm to soil and aquatic organisms close to waste dumps in various countries (Xu et al., 2025). Akeula (AKD) is unquestionably the most affected site, particularly for high-molecular-weight PAEs (DeHP, DnOP), and all three dumpsites are contaminated with various phthalates, with DeHP being the predominant contaminant. While Atikori is somewhat less polluted but still not insignificant, Oke Sopen (OKD) has significant DBP contamination. These trends align with phthalate profiles seen in landfill and dumpsite soils across the globe, where the primary sources are plastics and mixed municipal garbage.

III. CONCLUSION

The study confirms the presence of the following phthalate esters in order of DeHp > DBP > DnOP > BBP > DEP. It can be deduced that All the three dumpsites were contaminated with phthalate esters, but Akeula Dumpsite (AKD) was confirmed with the most severely impacted with DeHP. There is a need for monitoring regulation and remediation measures to reduce risks of environmental and human exposure. Public awareness and improved waste management practices (e.g., segregation, recycling, reduction of plastic waste) could help limit future contamination.

REFERENCES

1. Fagbemi, O., Ogunfowokan, A., Oyekunle, J., Cheng, F., Deobald, L., & Adelagun, R. (2024). Distribution and Risk Assessment of Phthalate Esters in Refuse Dumpsite Soils of Obafemi Awolowo University, Ile-Ife, Nigeria. Soil and Sediment Contamination: An International Journal, 34, 621 - 633. https://doi.org/10.1080/15320383.2024.2371602.
2. Gholaminejad, A., Mehdizadeh, G., Dolatimehr, A., Arfaeinia, H., Farjadfard, S., Dobaradaran, S., Bonyadi, Z., & Ramavandi, B. (2024). Phthalate esters pollution in the leachate, soil, and water around a landfill near the sea, Iran.. Environmental research, 118234. https://doi.org/10.1016/j.envres.2024.118234.
3. Wang, Q., Lv, K., Wang, A., Liu, X., Yin, G., Wang, J., Du, X., Li, J., & Yuan, G. (2021). Release of phthalate esters from a local landfill in the Tibetan Plateau: Importance of soil particle-size specific association.. The Science of the total environment, 151281. https://doi.org/10.1016/j.scitotenv.2021.151281
4. Nasrabadi, A., Ramavandi, B., Bonyadi, Z., Farjadfard, S., & Fattahi, M. (2024). Landfill leachates as a significant source for emerging pollutants of phthalic acid esters: Identification, occurrence, characteristics, fate, and transport.. Chemosphere, 141873.

https://doi.org/10.1016/j.chemosphere.2024.141873

5. Liu, H., Liu, X., Wang, K., , X., Gao, H., Liu, X., & Yan, C. (2025). The occurrence and safety evaluation of phthalic acid esters in Oasis agricultural soils of Xinjiang, China.. Ecotoxicology and environmental safety, 290, 117593. https://doi.org/10.1016/j.ecoenv.2024.117593.
6. Mohammadi, A., Malakootian, M., Dobaradaran, S., Hashemi, M., & Jaafarzadeh, N. (2022). Occurrence, seasonal distribution, and ecological risk assessment of microplastics and phthalate esters in leachates of a landfill site located near the marine environment: Bushehr port, Iran as a case.. The Science of the total environment, 156838. https://doi.org/10.1016/j.scitotenv.2022.156838.
7. Zhou, B., Zhao, L., Wang, ., Sun, Y., Li, X., Xu, H., Weng, L., Pan, Z., Yang, S., Chang, X., & Li, Y. (2020). Spatial distribution of phthalate esters and the associated response of enzyme activities and microbial community composition in typical plastic-shed vegetable soils in China.. Ecotoxicology and environmental safety, 195, 110495. https://doi.org/10.1016/j.ecoenv.2020.110495
8. Mehta Bulbul., Sharmila Bhattachariya., Yadav Ankit., Pushpit Yadav. and Ambili Anop. (2022). Occurrence, distribution and sources of phthalates and petroleum hydrocarbons in tropical estuarine sediments (Mandovi and Ashtamudi) of western Peninsular India. Journal of Environmental Research. Vol. 214. 113679.
9. Zhang K., Gao L., Zhang C., Feng T., Zhuang H. (2022). Analysis of volatile flavor compounds of corn under different treatment by GC-MS and GC-IMS. Frontiers in Chemistry, 10:725208.
10. Al-Hachamei et al., A. M. (2023). The Effect of Metformin on the Reproductive Pathway of the Male Sailfin Molly Poecilia latipinna (Lesueur, 1821). Egyptian Journal of Aquatic Biology and Fisheries, 27(3), 747-766. doi: 10.21608/ejabf.2023.305585.
11. Okoro, H., Abdulmojeed, M., Iwuozor, K., Popoola, S., Emenike, E., Zvinowanda, C., & Ngila, J. (2024). Ecological Risk Assessment and Phthalate Ester Concentrations in Sediment Samples from Ilorin Metropolis, North Central Nigeria. Regional Studies in Marine Science. https://doi.org/10.1016/j.rsma.2024.103444.
12. Khishdost, M., Dobaradaran, S., Goudarzi, G., Takdastan, A., & Babaei, A. (2023). Contaminant occurrence, distribution and ecological risk assessment of phthalate esters in the Persian Gulf. PLOS ONE, 18. https://doi.org/10.1371/journal.pone.0287504.
13. Vasseghian, Y., Alimohamadi, M., Drăgoi, E., & Sonne, C. (2023). A global meta-analysis of phthalate esters in drinking water sources and associated health risks.. The Science of the total environment, 166846. https://doi.org/10.1016/j.scitotenv.2023.166846.
14. Xu, Y., Pei, M., Li, Z., Xu, J., Yang, X., Chen, L., Zhang, C., Zhu, L., Wang, J., & Gao, P. (2025). Ecotoxicological effects of phthalate esters: A review.. Environmental pollution, 126664. https://doi.org/10.1016/j.envpol.2025.126664