Assessment of Heavy Metals and PAHs in Soil from Tyre Pyrolysis Plant located in Egbeda Local Government Area, Oyo State

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Abstract

Background: Tyre combustions are reported to generate large amounts of hazardous, poisonous, mutagenic and carcinogenic compounds, such as volatile organics, polycyclic aromatic hydrocarbons, heavy metals, particulates and other products of incomplete combustion. These pollutants are known for their toxicity potential, tendency to bioaccumulation, high mobility and environmental persistence.

Objectives: This study is aimed to assess heavy metals and PAHs in soil from tyre pyrolysis plant Egbeda, Ibadan Oyo State. Soil samples were collected from seven strategic locations around the plant.

Methods: Five selected heavy metals name As, Cd, Cr, Pb and Zn were determined using Atomic Absorption Spectrophotometer (AAS). PAHs were extracted from soil samples through an accelerated solvent extraction system (ASE 200, Dionex, Sunny-vale, CA, USA) with a 1:1 (v/v) acetone/dichloromethane solvent mixture.

Results: The results of heavy metals showed that the average concentration of the five metals are As-0.2827 mg/kg, Cd-0.2177 mg/kg, Cr-0.1726 mg/kg, Pb-0.6753 mg/kg and Zn-1.0232 mg/kg and in decreasing order of abundance ranked Zn > Pb > As > Cd > Cr. One-way ANOVA reveals that all the results were significantly different from one another ($P<0.05$), similarly there was no correlation between all the five metals examined. The PAHs result showed that a total of 18 PAHs were determined with average concentration ranking of Naphthalene -381.25 mg/Kg, 1-Methyl Naphthalene -335.50 mg/Kg, 2-Methyl Naphthalene -236.25 mg/Kg, Anthracene -199.75 mg/Kg, Fluoranthene -173.65 mg/Kg, Phenanthrene -140.00 mg/Kg, Pyrene -78.78 mg/Kg, Chrysene -72.20 mg/Kg, Benzo(a)anthracene -48.78 mg/Kg, Benzo(a)pyrene -45.72 mg/Kg, Acenaphthene -36.68 mg/Kg, Indeno(1,2,3-cd)pyrene -31.26 mg/Kg, Benzo(b)fluoranthene -30.35 mg/Kg, Benzo(k)fluoranthene -27.54 mg/Kg, Fluorene -21.93 mg/Kg, Benzo(g,h,i)perylene -18.51 mg/Kg, Dibenz(a,h)anthracene -15.22 mg/Kg, and Acenaphthylene -12.98 mg/Kg. Seven of these PAHs are carcinogenic and tetratogenic. One-way ANOVA reveals that the concentration of all the PAHs identified were significantly different from one another ($P<0.05$), although correlation study indicated that there is strong positive correlation between all the PAHs. The degree of contamination and the pollution index of the study site ranks 13.8 and 2.2 respectively

Conclusion: The soil of the pyrolysis plant is moderately contaminated heavy metals and PAHs. It is also carcinogenic owing to the presence of carcinogenic PAHs.

Keywords: Pyrolysis, Scrap tyre, PAHs, Heavy metals, Environment, Concentration.