ASSESSMENT OF THE EXPOSURE OF SERVICE STATION ATTENDANTS TO VOLATILE ORGANIC COMPOUNDS (VOCs) IN NAIROBI

By

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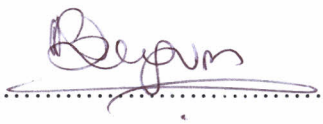
DECLARATION

This thesis is my own original work and has not been submitted for examination in any other University.



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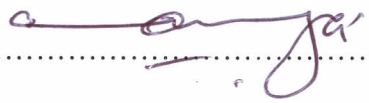

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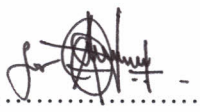

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ABSTRACT

Petroleum refueling emissions have increased relative to vehicular related emissions corresponding to the growth in motor vehicles. Although exposure to VOCs at service stations is hazardous to the workers and the environment, policy on its assessment, monitoring and regulation in Kenya is yet to be implemented by the government. Consequently, this study was conducted to identify and quantify VOCs, to which service station attendants are exposed, in selected service stations in the city of Nairobi.

Air samples were obtained using passive samplers attached to the clothing of service attendants performing routine daily activities for an 8 hour period. Soil was collected from a central point, sieved, dried, packed in a box and placed strategically at the service stations and sampled after 8 hours. Effluent from service station was collected into glass amber. All samples were sealed, transported and stored at 4°C before extraction.

The samples were analyzed with Agilent 6890N gas chromatograph equipped with flame ionization detector (GC/FID) and analytical fused silica J&W DB WAX (polar - polyethylene glycol) colunm whose dimensions were 0.25 μm film thickness, 0.25 mm I.D., approximately 30 m in length. White spot nitrogen was used as both the carrier and makeup gas, while hydrogen was used as fuel and compressed air as the flame gas.

A total of 40 air samples, 60 soil samples and 45 water samples were routinely monitored for BTEX, chloroform, hexane, isooctane, naphthalene and 2-propanol every other week over a period of three months. The recovery of the analyte were between 89.975% and 99.313% while detection limits ranged from 0.019 ppb (0.005 $\mu g/m^3$ for toluene) to 0.763 ppb (0.156 $\mu g/m^3$ for chloroform). Benzene, toluene, ethyl benzene and isomers of xylene, which are collectively

referred to as BTEX, since their similar chemical structures, fate and transport properties, constituted the major VOCs detected in the air samples. The most abundant compounds in personal air at the service station in order of decreasing concentration (units: $\mu g/m^3$) were: ethyl benzene (52.847), benzene (40.64), chloroform (12.72), (2, 2, 4-trimethylpentane (5.57), hexane (4.645), m,o,p-xylene (3.44), naphthalene (3.2) and toluene (3.06). Benzene time-weighted average (TWA) to service station attendants ranged from 0.92 to 182.13 $\mu g/m^3$ and were below WHO guidelines (319.43 $\mu g/m^3$).

Benzene, hexane, chloroform, and 2, 2, 4-trimethylpentane were mainly found in the soil samples. The most abundant compounds in soil at the service station in order of decreasing concentration (µg/Kg) were: Hexane (36.20), Ethyl benzene (31.86) and Benzene (23.88). Benzene was the most abundant of the VOCs in water samples, with a mean of 2.84 mg/L followed by chloroform (0.42 mg/L), n-hexane (0.27 mg/L) and isooctane (0.20 mg/L). Mean chloroform levels detected in air, soil and water samples were 16.66 $\mu g/m^3$, 133.12 µg/Kg and 7.67 mg/L respectively. The concentrations of the target VOCs were comparable in all the service stations suggesting minimal external interference. There is need to monitor, regulate and further determine occupational health effects by analyzing the levels in urine, blood and skin of the service attendants.