Effect of Traffic Density on Heavy Metal Content of Soil and Vegetation along Roadsides in Osun State, Nigeria

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Abstract

The study examined the impact of automobile exhaust emissions on heavy metal load of soils and vegetation along two roads with contrasting traffic densities in Osun State, Nigeria. Soils and vegetation along the two roads, one heavy traffic density (HTD) with average daily traffic density (ADTD) of 5,364 vehicles, and the other low traffic density (LTD) of 1,358 vehicles per day, were sampled. The concentrations of lead (Pb), zinc (Zn), cadmium (Cd), nickel (Ni) and vanadium (V) in soils decrease away from the road. There was positive correlation between the level of the metals in soils and vegetation. The concentration of Pb in the plant samples varied from 50.52 µg/g at 1-m distance away from the road-edge to 1.18 µg/g in places 50-m away from the road-edge. At similar locations (i.e. 1-m and 50-m distances away from the road-edge), the plant sample content varied from 41.20 to 1.16 µg/g for Zn, 1.35 to 0.02 µg/g Cd, 3.45 to 0.44 µg/g Ni and 6.60 to 0.58 µg/g V for the HTD road side. The concentrations of these metals in the plant samples along the LTD were significantly lower than for the HTD at similar locations. Furthermore, the metal concentrations in soils and vegetation were related positively to traffic densities, with the soils and vegetation along the HTD having significantly higher ($P > 0.05$) level of the investigated metals than those along the LTD roads. The concentrations of metals in the soils and vegetation within the right of way (ROW) were significantly higher ($P > 0.05$) than those beyond. Appropriate land-use and management strategies that will mitigate the impacts of heavy metals in automobile emission in roadside soils and vegetation were discussed.

Introduction

Pollution in recent years has increased considerably as a result of increasing human activities such as burning of fossil fuels, and industrial and automobile exhaust emissions. Exhaust emission and combustion of fossil fuels were identified as primary sources of atmospheric metallic burden (Aribike, 1996), and it is now well established that a variety of motor vehicles introduce a number of toxic metals into the environment, most of which are released adjacent to roadways (Williamson, 1973; Moore & Moore, 1976). Lagerwerff & Specht (1970) reported the release of lead (Pb), cadmium (Cd), nickel (Ni) and zinc (Zn) into areas adjacent to the roads, while other workers (Cannon & Bowles, 1962; Quinche *et al.*, 1969; Motton *et al.*, 1970) observed that Pb emissions from motor vehicles produce elevated concentrations of the element in roadside vegetation.

In Nigeria, within the cities, atmospheric Zn and Cu concentrations were reported to be a function of traffic density (Fatoki & Ayodele, 1991). Ademoroti (1986) noted that organometallics such as tetraethyl lead $[(C_2H_5)_4Pb]$, an additive to gasoline (petrol), is an important source of Pb in automobile exhaust emission. He observed that 58.3-143.5 µg Pb/g plant was obtained in areas of very high traffic volume (greater than 1000 vehicles/h) as against 15.2-15.8 µg Pb/g plant in low traffic volume (< 200 vehicles/h).

Nigerian crude oil is known to have about