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RESEARCH NOTE

TOXICITY OF SOIL IN AGUNJI MARBLE MINING AREA OF KWARA STATE, NIGERIA

Olatunji, K. J.

Mineral Resources Engineering Department
Kwara State Polytechnic, Ilorin, Nigeria
E mail add: tunjikay2005@yahoo.com

ABSTRACT

Soils in areas of mining operation are used in cultivating crops in Kwara State. This makes it imperative to monitor the concentrations of toxic heavy metals in the soil. The concentrations of Mn, Fe, Cu, and Zn at 10m intervals from the centre of marble quarry were determined up to 110m distance. Values of extractable Mn varied from 1.73 to 10.8, Fe 6.0 to 19.8, Cu 0.55 to 2.8 and Zn from 0.03 to 0.66 mg/kg. The values are suitable for crop production.
Keywords: mining, soil, toxic, heavy metals, marble, quarry.

INTRODUCTION

Spoil heaps which are made up of soil, rock and ore are left on the surface soil in mining areas. The wastes contain heavy metals which constitute health hazard when they exceed certain limits with respect to crop production and general human existence. The heavy metals are sources of pollution to soil which are grown to food crops such as vegetables, cereals, cassava and yam. Minerals from mines contain heavy metals such as Fe, Pb, As, Zn, Cu, Cd and Ag. As the wastes from quarries and mines get into the soil, the metals are taken by crops which man eventually consume. This could cause silent epidemic of environmental poisoning (Jimoh, 2001). There is therefore need to monitor continuously concentrations of heavy metals in soil of quarry areas. In this work the concentration of Mn, Cu, Fe and Zn in soil of a marble mine in Kwara State of Nigeria are evaluated.

MATERIALS AND METHODS

The quarry studied was located at Agunji (5^0 15^1 E and 8^0 30' N) in the guinea savanna zone and middle belt of Nigeria. The mineral being mined is marble, $CaCO_3$. Surface soil (0-10cm) samples were collected using hand auger at 10m apart from the quarry pit. Sample was also collected at an unmined site (control) 1km away. The samples were transported in polythene bag, air dried, 2mm sieved and digested using wet-digestion method ($HNO_3/HClO_4$ acids) (AOAC, 2006). The resulting filtrates were analyzed using atomic absorption spectrophotometer and concentrations of Mn, Fe, Cu and Zn were determined at their respective resonance lines using standard calibration method.

RESULTS AND DISCUSSION

Mn

At the marble site, soil Mn reduced with distance from the quarry. (Table 1). It reduced from 10.8 to 6.7 mg/Kg between 0 to 110m .

Value for control site was 1.05 mg/Kg. The least value of 1.73 mg/Kg was recorded at 70m from quarry site. The manganese value of 20- 25 mg/Kg has been found to be tolerable (Oluwatosin and Ogunkunle, 1991, Akinrinde and Obigbesan , 2000).

Table 1: Manganese concentration in soil of Agunjin marble quarry site (mg/Kg)

Distance from quarry (m)	Concentration (mg/Kg)
0	10.79
10	10.48
20	6.73
30	4.09
40	10.72
50	7.22
60	6.28
70	1.74
80	10.44
90	3.85
100	5.05
110	6.68

Iron

At Agunjin marble site, concentration of iron in soil reduced with distance away from the quarry (Table 2). Fe reduced from 19. 80 to 10.62 mg/Kg at 110 m from quarry. The least value of 6.05 mg/Kg was recorded at 70m from quarry. The value for control site was 5.33 mg/Kg. Hence, the site was contaminated by iron. Oluwatosin and Ogunkunle (1991) and Akinrinde and Obigbesan (2000), reported iron value of 5-9 mg/Kg as no threat to lives.

Table2: Iron concentration in soil of Agunjin marble quarry (mg/Kg)

Distance from quarry (m)	Concentration (mg/Kg)
0	9.64
10	15.80
20	19.78
30	6.61
40	11.04
50	11.96
60	12.10
70	6.05
80	14.53
90	7.84
100	9.61
110	10.62

Copper

The Cu concentration reduced with distance from the quarry site (Table 3). It reduced from1.75 to 1.73 mg/Kg at 110m from quarry. The least value of 0.55 mg/Kg was recorded at 50m from quarry. Control site value was 0.569 mg/Kg. This indicates contamination of quarry site by Cu. According to Federal Ministry of Environment (1991), Cu value less than 5mg/Kg is not toxic.

Table3: Copper concentration in soil of Agunjin marble quarry (mg/Kg)

Distance from quarry (m)	Concentration (mg/Kg)
0	1.75
10	1.80
20	2.76
30	1.16
40	1.53
50	0.58
60	0.77
70	1.19
80	1.06
90	0.55
100	0.62
110	1.73

Zinc

Table 4 shows that Zn varies from 0.35 (at 0m distance) to 0.14 mg/kg (at 90m distance) and increased to 0.66 and 0.36 mg/Kg at 100 and 110m respectively. There is relative variations along the distance. The value at control site was 0.028 mg/kg, hence the soil was contaminated by Zn. The Zn values are less than critical value of 1.0-2.0 mg/Kg reported by Akinrinde and Obigbesan (2000).

Table 4: Zinc concentration in soil of Agunjin marble quarry (mg/Kg)

Distance from quarry (m)	Concentration (mg/Kg)
0	0.35
10	0.17
20	0.39
30	0.49
40	0.54
50	0.20
60	0.04
70	0.03
80	0.20
90	0.14
100	0.66
110	0.36

This study concludes that manganese, iron, copper and zinc concentrations observed for soil in the quarry area are suitable for crop production and are not yet toxic. The values of 1.74- 10.79 mg/Kg Mn, 9.6-19.8 mg/Kg Fe, 0.55-2.76 mg/kg Cu and 0.04- 0.48 mg/kg Cu in soil recorded in this work fall within accepted limits. Kparmwang *et al* (2004) recorded that 2.0- 50mg/kg Mn, 8.4- 34.0 mg/kg Fe, 2.0- 6.0 mg/Kg Cu and 20 - 4.8 mg/Kg Zn were sufficient for crop production in Nigeria. Nonetheless, quarry waste contaminated the soil with heavy metals. Soils in far distances away from the quarry were less contaminated by heavy metals.

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