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Environmental Chemistry Soil Degradation in Stone Crushing Areas - Reclamation Effect on Crop Productivity

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ABSTRACT

None of the natural resources is as valuable as land. Soil degradation is loss or reduction of soil energy. In recent years the pressure on this precious resource due to rapid industrialization, intensive agriculture and other anthropogenic activities has led to various kinds of degradation, environmental pollution and decline in the crop productivity and sustainability. Rapid urbanization and industrialization have seriously augmented the growing burden of chemical contaminants on the soil. The pollution loads in our soil environments resulting in contamination of ground water through leaching and their harmful constituents have often found their way through soil –plant uptake mechanisms. Prominent sources contributing to contaminated load of soils are geogenic, mining, and smelting, use of fertilizers, pesticides etc. The present studies throws light on impact of stone crushing on soil degradation and reclamation effect on crop productivity.

Key words- Overburden, soil degradation, spoil, strip mining, anthropogenic.

INTRODUCTION-

Soil is the essence of life and supports all living organisms in our planet. As all soil functions are based on energy, soil degradation can only be defined on the basis of specific soil energy forms, soil functions and soil uses. The pressure on land is expected to increase many folds, as the world population is expected to grow almost 9 billion in 2015. Feeding this population is not an easy task. Statistics shows that arable land per person has already shrunken from 0.24 ha to 0.12 ha at present, from last 60 years. Concerns have been expressed about the soil degradation from time to time and its resultant effect on agricultural productivity and conservation of natural resources including biodiversity. The human induced soil degradation map of the world revealed that 18% of land resources of Asia and 78.8% in India are affected from soil degradation.

Stone crushing plants are of prime economic importance. However, they are also one of the major air polluters. The dust emanating from these plants is potentially hazardous to the environment and to human health. Dust from stone crushing plants of various fractions (0.5mm-224mm) were added to soil at varying rates in replicated trials and there effects on various soil parameters were studied. Result subjected to statistical analysis show an overall decreased fertility of soil. The study reports the results for trace elements along with other parameters. The availability of plants for these nutrients in soil was significantly decreased with increasing rate of stone dust applied. The discharge of heavy metals into receiving soil may result in numerous physical, chemical and biological responses.

EXPERIMENTAL-

Stone dust samples of different sizes 0.5mm (A), 2mm (B), 4mm (C) were collected form stone crushing plants situated at village Bineka, about 50km away from Bhopal at NH-12 highway. The samples were brought to laboratory and sieved through the appropriate sieves i.e. sieves of 4mm, 2mm, 0.5mm. The collected samples were thoroughly mixed and air dried. 5gm of samples was fused with 10gm anhydrous Na_2CO_3 in a Nickel crucible. After 5-10 minutes of intense heating, bubbles of gas ceased to evolve indicating that the fusion was completed. The crucible was cooled and deionized water was added to the melt and was again heated to disintegrate the melt. The content was filtered and filtrate used for analysis of trace elements by AAS.

INCUBATION EXPERIMENT-

The three dust fractions were incubated separately with 200gm of soil. The different fractions were mixed thoroughly with the soil in amounts corresponding to control and incubated at field capacity moisture and a temperature of 25^{o}C for 6 months. Samples of soil-stone dust mixture were analyzed after 6 months for NPK and Zn, Cu, Fe, Mn and B.

RESULTS AND DISCUSSION-

The results of analysis of various fractions are given in table-1. These values represent the total concentration of elements in different sizes of stone dust. As can be seen that there were no major differencesamong the 5 trace elements viz. B, Fe, Mn, Zn and Cu in the different sizes fractions. The values of effect of incubation of stone dust sample with soil represent the soil available nutrient. It was observed that the concentration of available Zn decreased by 14 to 25mg/kg that is decreased by 77% for smaller size, whereas decreased for larger sized sample was 65%. All the three sizes fraction contribute significantly to decreased availability of Cu in soil being 52%, 64% and 50% respectively. These differences were not statistically significant. The reason for this maybe that the interaction between the application rate and stone dust sizes was not significant, again probably due to the thin coating of stone dust on larger fraction.

TABLE-1

Effect of stone dust on soil

Property/element	Size A of dust particle		Size B of dust particle		Size C of dust particle	
	BI*	AI**	BI	AI	BI	AI
pH	8.2	8.7	8.9	8.8	8.4	9.0
CEC (CM/kg)	5.8	6.0	5.5	5.6	4.9	5.3
N(mg/kg)	98	8.8	113	15.2	89	9.3
P(mg/kg)	208	198.7	200	189.7	195.2	186.8
K(mg/kg)	2015.3	1850	1823.2	1352	1512.3	1455
Cu(mg/kg)	11.20	5.8	20.8	13.3	12.2	6.05
Mn(mg/kg)	150.3	31.26	133.4	14.67	113.0	10.17
Zn(mg/kg)	105.2	80.06	102	82.6	98	73.2
Fe(mg/kg)	297.5	102.5	245.6	75.2	227.9	33.2
B(mg/kg)	0.490	0.401	0.394	0.372	0.404	0.335

*BI is before incubation. **AI is after incubation

Addition of stone dust brought about decrease of 195.6 mg/kg of Fe representing a decrease of 78% in the available Fe content in soil.

The effect on available Mn and B were similar as Fe. Increase in dust application significantly decreased these contents in the soil irrespective of the sizes of dust. Percentage decreased for three fractions were 79.6%, 89.2% and 90% (for Mn) and 18%, 13% and 17% (for B) respectively.

The pot culture experiment was to observe any change in concentration of these contents in wheat when grown in soil amended with stone dust.

CONCLUSIONS-

These experiments lead to the conclusion that addition of stone dust to soil does in fact decrease trace element concentration in soil as well as in plants grown thereon. Mining particularly by open cast methods destroy a large tract of land by deforestation, top-soil degradation by mechanical means and enhanced gully and sheet erosion. Therefore it is strongly recommended that these type of activities and reclamation should go concurrently. Ecofriendly management of soil fertility is needed as stone dust of stone crushing plants deteriorate soil fertility and decreases the crop yield.

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