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Impact of Explosive Industry effluents on Soil quality parameters and Heavy metal load - A study of RECL (Rajasthan Explosive and Chemical Limited) Dholpur, Rajasthan, India

Bhargava Priti and Dutta Subroto
Department of Environmental Science, MDS University, Ajmer, Raj, INDIA

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Abstract

Environmental pollution by metals became extensive as mining and industrial activities increased in the late 19th and early 20th century the current world wide mine production of Cu, Cd, Pb and Hg is considerable. They present a risk for primary and secondary consumers and ultimately humans. This study was carried out to investigate the effect of explosive industry effluents on soil characteristics. Field experiment was conducted in and around Rajasthan explosive and chemical limited in Dholpur in Rajasthan. Waste water and soil samples were collected to determine pH, Ec, TDS, Organic carbon, Cu, Pb. Effluent from explosive industry show differences in levels of pH 7.9 to 8.5, electrical conductivity 0.65 to0.95µs, TDS 1825 to 2500mg/l, and heavy metals like Cu 2.40 to 3.70 mg/l and Pb 0.32 to 0.48 mg/l maximum than permissible limit. Soil analysis show differences in levels of pH 8.0 to 8.7, electrical conductivity 0.25 to 0.40µs, organic carbon 0.22% to 0.68% and heavy metals like Cu 150 to 225mg/kg, Pb 550 to 725 mg/kg were higher than permissible limit.

Keywords: Environmental pollution, industrial effluents, heavy metals, explosive.

Introduction

Large scale urbanisation, a consequence of economic development is leading to production of huge quantities of effluents and pollutants in India. These pollutant ultimately derived from a growing number of diverse anthropogenic sources such as mining, smelting, electroplating energy, fuel production, military operation, electric appliance manufacturing. They present a risk for primary and secondary consumers and ultimately humans.

The use of industrial waste water can cause damage to agriculture land and resultantly the crops grown on these lands may cause the hazardous effects to the human health through food chain[1]. Heavy metals are elements having atomic weight between 63.546 and 200.59. Presence of heavy metals even in traces is toxic and detrimental to both flora and fauna. A heavy metal is a member of a loosely defined subset of elements that exhibits metallic properties. It mainly includes the transition metals, some metalloids and actinides. Heavy metals are very harmful because half lives. Excess metal levels in surface water and agriculture products may pose a health risk to human and to the environment. Heavy metal accumulation in soils is of concern in agricultural production due to the adverse effects on food quality (safety and marketability), crop growth (due to phytotoxicity). Ingestion of metals such as Pb, Cd, Hg, As, Ba and Cr may pose greater risk to human health[2]. High concentration of lead in soils may decrease soil productivity and a very low lead concentration may inhibit some vital process i.e. photosynthesis, wilting of older leaves, stunted foliage[3]. Copper is one of the most important micronutrient, essential for plant growth[4]. It is an integral component of numerous enzymes, and is actively involved in lignifications. Lead is neither an essential nor a beneficial element for plant growth. However, temporal accumulation of the heavy metals in waste amended agricultural soils at higher concentration can be toxic for plant growth due to their adverse effects on plant development and growth[5].The objectives of this investigation were to determine the physico chemical parameters and heavy metal load in soil and water samples.

Material and Methods

Study area: Rajasthan, situated at the north-western part of India is the biggest state in the country of India and lies between 23°30' and 30° 11' North latitude and 69° 29' and 78° 17' East longitude. The state shares its north-western and western boundary with the Indo-Pakistan international border that extends about 1,070 km and touches the major districts Barmer, Bikaner, Ganganagar and Jaisalmer. The district of Dholpur has been formed from Bharatpur district in the state of Rajasthan. The climate of Dholpur is generally hot.

The economy of the district is mainly based on agriculture. The major crops produced in Dholpur are pearl millet, paddy, sugarcane, wheat, barley, pulses, Indian mustard, red chillies and guar seed. Dholpur is also known worldwide for the Dholpur stone.

Sampling and analysis: A total of twenty samples of soil and

water samples were collected from and around the RECL (Rajasthan explosive and chemical limited) Dholpur, Rajasthan. The samples of soil were collected in polythene bags and waste water was collected in plastic bottles (1L). Soil and water samples were analysed for the following parameters-pH, Electrical conductivity, TDS, Organic carbon, and Heavy metals (Cu, Pb).

Preparation of water sample-water samples were digested with 5 ml HNO_3.Boil and evaporate a sample on hot plate, then cool it and make up the volume to 100 ml[6]. Preparation of Soil sample-2 gm air dried sieved soil sample were taken in 250 ml glass beakers and digested with 8 ml of aqua regia on a sand bath for 2 hr. after evaporation to near dryness, the samples were dissolved with 10 ml of 2 % HNO_3 , filtered and then diluted to 50 ml with distilled water[7]. Analytical method- The determination was carried out on water and soil samples. The pH, Electrical conductivity, Total dissolved solids (TDS) were determined by digital meters, Organic carbon by walkley and black method, Heavy metals(Cu, Pb) by AAS method[8].

Results and Discussion

The pH of different water samples ranged from 7.9 to 8.5.the minimum7.9 and maximum 8.5 were observed in w1 (far from source) and w10 (near source) water sample (figure-1). Electrical conductivity of the samples ranged from 0.65 to 0.95µs (figure-2). Total dissolved solids ranged from 1825 to 2500 mg/ (figure-3). The concentration of Cu ranged from 2.4 to 3.7 mg/l (figure-4). All water samples contain high concentration than permissible limit. The concentration of Pb varied from 0.32 to 0.48 mg/l (table-1 and figure-5). The pH of different soil samples ranged from 8 to 8.7. Sorption of heavy metals is strongly dependent. Sorption increase with increasing pH[9] (figure-6). Electrical conductivity of soil samples ranged from 0.25 to 0.40µs (figure-7). The organic carbon of soil also affects the mobility of heavy metals. The organic carbon of different soil samples varied from 0.22 to 0.68% (figure-8). The concentration of Cu in soil samples ranged from 150 to 225 mg/kg (figure-9).The concentration of Pb varied from 500 to 725mg/kg (figure-10) which are much higher than permissible limit (table-2).

Table-1
Different parameters for different water samples

Sample	pH	Ec(µs)	TDS(mg/l)	Cu(mg/l)	Pb(mg/l)
W1	7.9	0.65	1825	2.4	0.32
W2	8.1	0.69	1965	2.54	0.35
W3	8.0	0.72	2054	2.58	0.37
W4	8.2	0.78	2198	2.60	0.39
W5	8.3	0.81	2245	2.80	0.41
W6	8.45	0.83	2328	2.9	0.38
W7	8.0	0.84	2375	3.1	0.42
W8	8.1	0.89	2422	3.2	0.45
W9	8.4	0.91	2480	3.5	0.47
W10	8.5	0.95	2500	3.7	0.48
standard	6-9	-	3000-5000	<2.0	<0.2

Table-2
Different parameters for different soil samples

Sample	pH	Ec(µs)	Organic carbon (%)	Cu(mg/kg)	Pb(mg/kg)
S1	8.0	0.25	0.22	150	500
S2	8.1	0.27	0.28	164	545
S3	8.16	0.28	0.32	169	585
S4	8.21	0.30	0.37	172	592
S5	8.29	0.32	0.40	178	615
S6	8.3	0.31	0.44	185	638
S7	8.41	0.33	0.59	191	678
S8	8.46	0.35	0.61	198	704
s9	8.6	0.37	0.63	215	718
S10	8.7	0.40	0.68	225	725
Standard	7-9	-	-	190	550

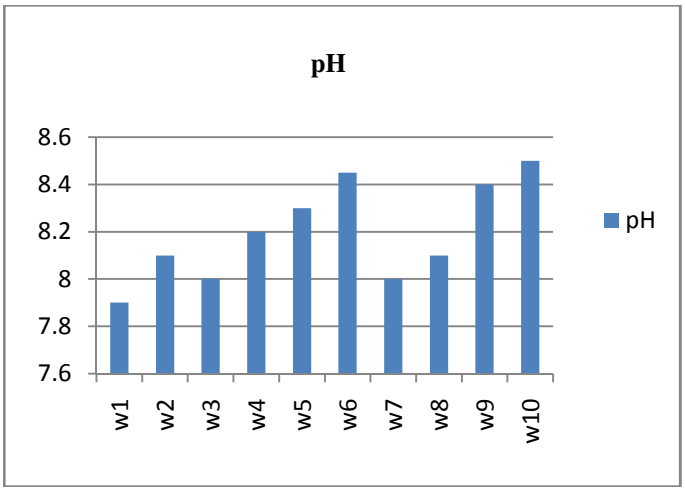

Figure-1
Values of pH in water samples

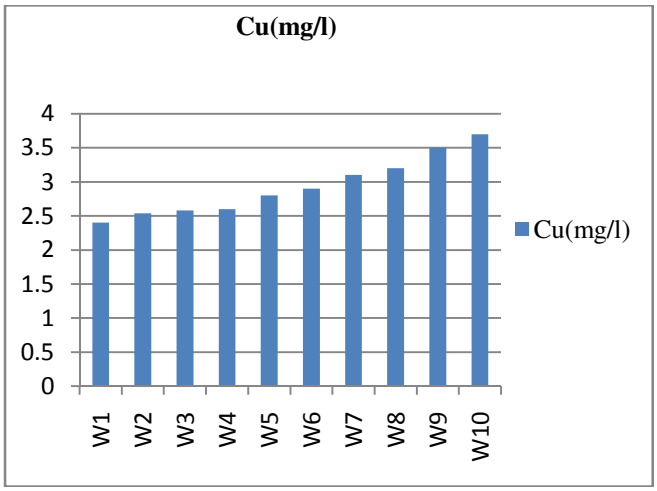

Figure-4
Concentration of Cu (mg/l) in water sample

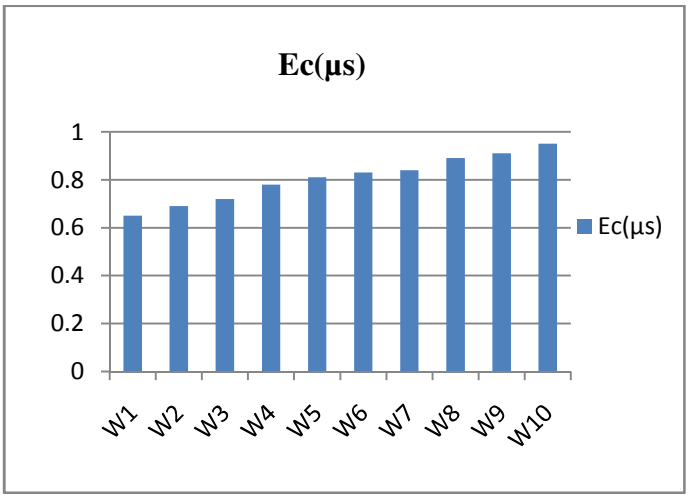

Figure-2
Values of Ec (µs) in water samples

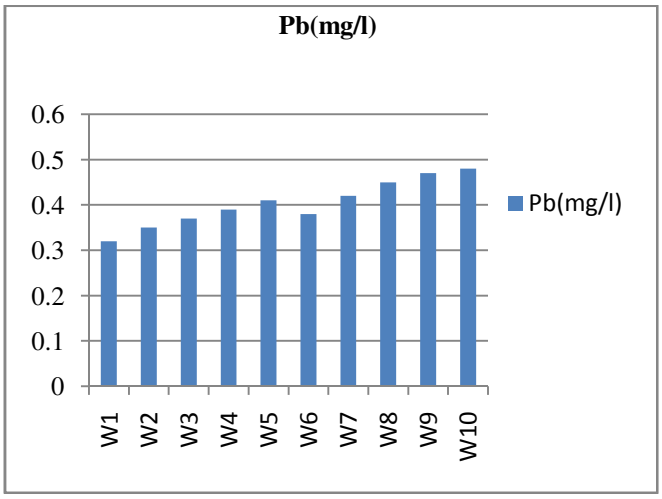

Figure-5
Concentration of Pb (mg/l) in water samples

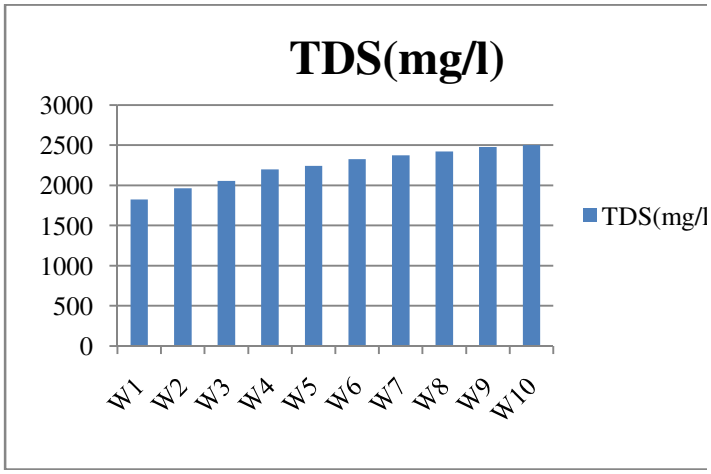

Figure-3
Values of TDS (mg/l) in water samples

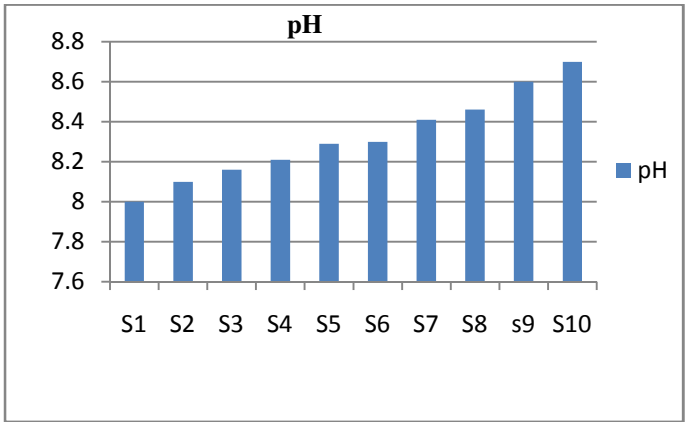

Figure-6
Values of pH in soil samples

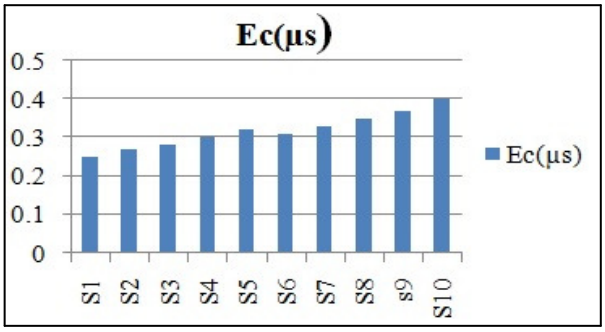

Figure-7
Values of Ec (µs) in soil samples

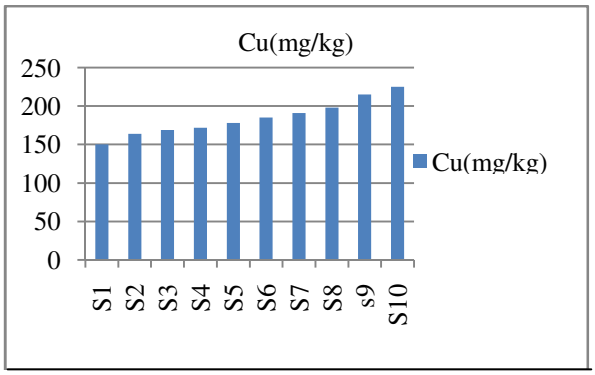

Figure-8
Concentration of Cu (mg/kg) in soil samples

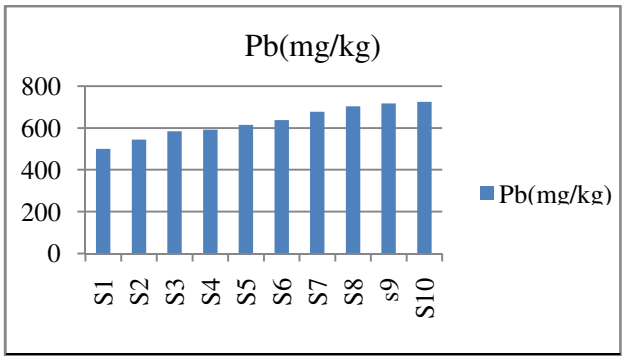

Figure-9
Concentration of Pb (mg/kg) in soil samples

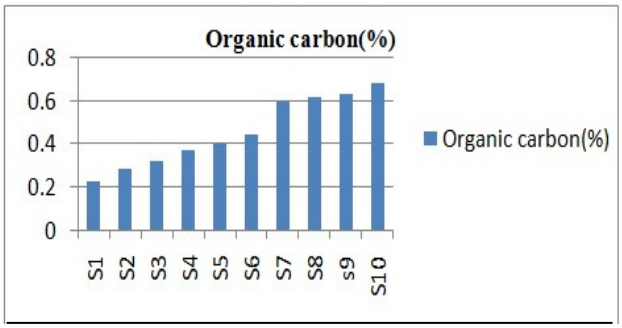

Figure-10
Concentration of Organic carbon (%) in soil samples

Conclusion

The study reveals that the physico chemical quality (pH, TDS) were within permissible limit. The heavy metal concentrations in waste water samples were higher than permissible limits. The concentration of Cu and Pb in soil samples was also higher than standards[10]. This shows that the long term application of waste water deteriorate the soil production and accumulation of toxic metals in plants cause severe health hazards in human being through food chain.

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