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RESEARCH ARTICLE

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CONTAMINATION OF SOILS WITH HEAVY METALS (Fe,Ni AND Cr) AROUND CEMENT FACTORY BAHTAR, PAKISTAN.

Abstract:
Metal induced dust pollution is concerning issue creating imbalances in environment. Dust pollution originating from Cement industry is relatively less studied in Pakistan. There is no available data regarding metal induced soil pollution status of famous Cement industry located in Bahtar, Taxila. Atomic Absorption Spectrometry was used to estimate amount of metals in soils. Present study was conducted to evaluate concentration of Iron, Nickel and Chromium in soils near dispatch gate of Cement factory. When compared with WHO standards these three metals were found significantly higher in amount. These metals are not only causing pollution but also altering geochemical balance of nutrients. So regular monitoring at small and more intensive scale is recommended for further study.
Keywords: Cement dust, Atomic absorption spectrometry, Concentration, ppm (parts per million)

Introduction:

Environmental pollution is concerning issue having problems relevant to plants and human population [1].Problems associated with pollution has increased tremendous during past few years [2]. The construction sector has progressed enormously during past few years in Pakistan. Pakistan has got reasonably good availability of raw material needed for Cement manufacturing, so cement has flourished as an emerging industry. Rapid growth in the field of industrialization has laid in a threatening situation of air pollution. Later on wet process was replaced by dry process that involves dry grinding and mixing of raw material. As this process does not involve water for mixing if raw substances it requires relatively less fuel supply. But Cement composition maintenance is relatively difficult with dry process. But in spite of its advantages over wet process this dry processing results in higher particulate matter emission and dust pollution. Cement industry accounts for 5% of global CO_2 production [3].Cement industry is major contributor to air pollution thus leading to environmental imbalances [4]. Main constituents of Portland cement are iron oxide, aluminum oxide, calcium oxide, silica, magnesium oxide and sulphur trioxide. The fuel used in processing also contributes to metal induced pollution [5]. Pollutants are released into environment during cement production by several processes such as mining, grinding of rocks, processing, packaging, dispatch and finally through transportation. Fine dust particles and particulate matter are constantly being produced by excavation of rocks, their grinding and kiln operations. These particles are light enough to be wind blown and get deposited in the surrounding environment [6]. As compared to gaseous pollutants, effects of particulate matter on biotic and a-biotic components are relatively less studied [7]. Dust and particulate matter are generally blown by turbulent movement of air currents. One of the main environmental concern regarding cement factories is dust emission [8,9] .It is being determined by previous studies that cement borne dust is enriched with toxic heavy metals such as Zn, Cd, Mn, Cu, Cr, Pb and As [10]. Regions around cement factories are facing the problems of soil alkalization because of alkaline dust and ash emission. So altering physiochemical properties of nearby soils [4].

Heavy metal induced soil pollution differs from water and air pollution because soil retains heavy metals for a longer period as compared to other components of biosphere. As a major cause of heavy metal contamination, effects of cement and brick kiln dust has been observed by many researchers [11].

Present study was aimed to find role of Cement industry towards Fe, Ni and Cr induced soil pollution.

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Material and Methods:

Study Area

To study heavy metals induced pollution Cement factory in Bahtar Taxila was chosen. Location Co-ordinates: Latitude 33.69075, Longitude 72.71422, Height above Sea level 491m.

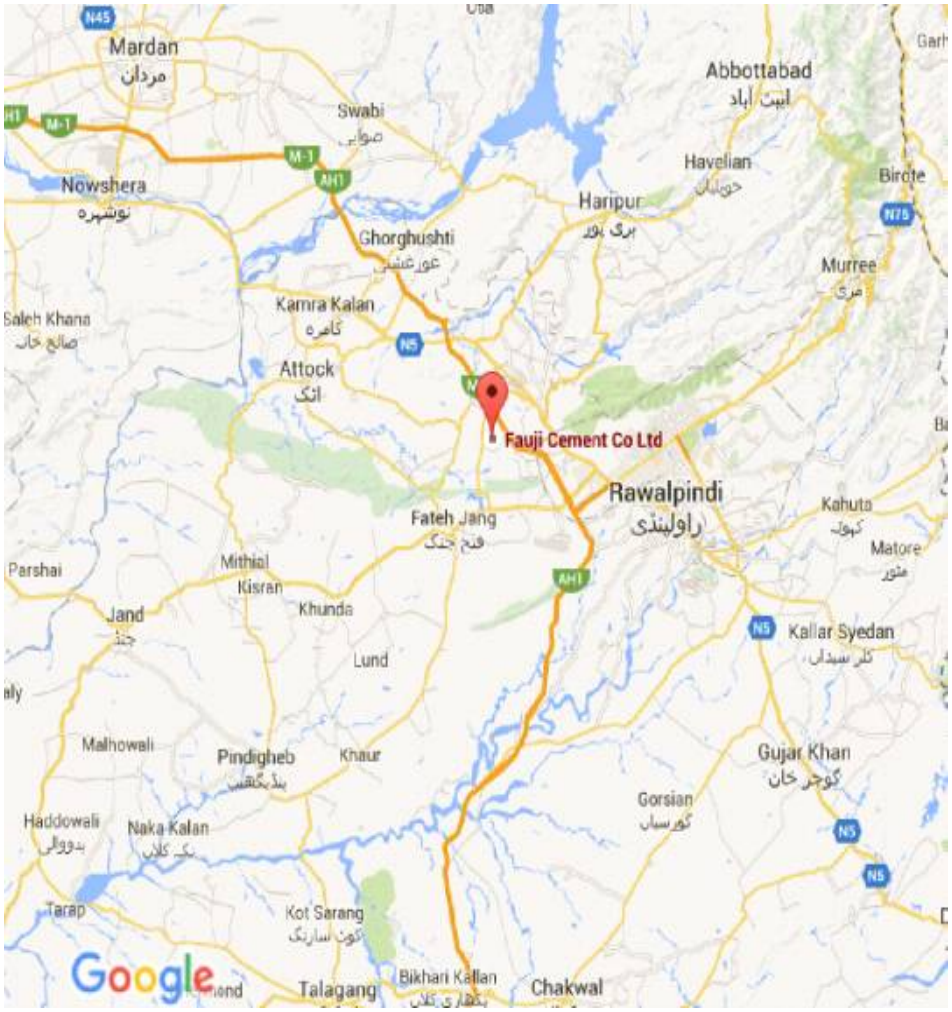

Figure 1: I Location of Cement Factory

Soil samples were collected from dispatch gate of factory according to systematic sampling strategy by maintaining a distance of 10 meters. Distance between all sampling sites was maintained constant. Samples were collected in polythene bags and sealed till analysis.

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Soil was sieved through 40mm mesh screen. One gram of soil was accurately weighed and placed in a beaker. Ten ml of concentrated Nitric Acid was added and placed in shaker for thirty minutes. Twenty ml of Hydrochloric Acid was added and samples are heated for ten minutes again. To have a clear solution in some samples, two ml of $HCLO_4$ was added. Samples were further digested to acquire a clear solution.

Acid digested soil samples were analyzed for estimation of Fe, Cr and Ni using Atomic Absorption Spectrophotometer (Model ZeeNit 700p).All estimations were repeated in triplicates.
Standard solutions used for analysis are of analytical grades by company PANREAC. Lambda Maximum for Fe, Cr and Ni were 248.3, 357.9 and 232 nm respectively.

Results and Discussion:
To find concentration of heavy metals in digested samples, standard curves for metals were made with standard solutions. These curves were then used to find concentration of metals in digested samples. Concentration of metals in soil samples are summarized in Table 1.Ecah concentration represents a mean of triplicates.

Iron is naturally present in soils as its ore hematite and magnetite. Concentration of Iron in Cement soils ranged from minimum of 31.69ppm to maximum of 62.76ppm.These values were significantly higher than limits quoted by Ekpete *et.al.* [12]. Nickel is one of important transition metal, its concentration in cement soils ranged between a minimum of 4.29ppm to 6.78ppm.All of these values were higher than Highest permissible limit but lower or equal to Maximum permissible limit prescribed by Ekpete *et.al.* [12]. In soil samples collected Cr concentration was above maximum and highest permissible limits with a minimum value of 0.9ppm and a maximum of 1.25ppm. Comparison of mean value of these three metals Fe, Ni and Cr with WHO permissible limits are shown in Table 2, which clearly reflects their presence in very high amount.

These metals originating from industrial activity are getting accumulated in upper layer depending on size and distance from origin. Their higher concentration near gate and variance on moving away clearly displayed their origin from industrial as well as traffic origin.
Present study was aimed to determine the pollution status of the Cement industry. When analyzed all samples were observed to be heavy metals contaminated. All studied metals were higher than WHO prescribed limits.
Presence of heavy metals in soils near cement factories were in accordance with results reported by Nanos and Ilias [13].

So regular monitoring should be done in order to control metal induced soil pollution. These metals are not only creating biochemical imbalances in plants but are also getting accumulated in soil which will create future environmental problems. So more intensive sampling is recommended for future study.

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Table 1. Heavy Metals in Soils of Cement Factory

S. no	Soil Samples	Elements (Conc. In ppm)		
		Fe	Ni	Cr
1	Sample 1	44.08	6.291	0.93
2	Sample 2	43.72	6.78	0.98
3	Sample 3	62.76	6.09	1.054
4	Sample 4	61.78	5.96	1.073
5	Sample 5	42.53	5.143	0.973
6	Sample 6	41.45	5.09	1.1
7	Sample 7	36.95	4.88	1.25
8	Sample 8	35.58	4.62	0.96
9	Sample 9	32	4.36	0.911
10	Sample 10	31.69	4.29	0.9
	Mean	43.254	5.3504	1.0131

Table 2. Heavy Metals comparison with WHO values [12]

	WHO limits			
Metal	Highest permissible limit	Maximum permissible limit	Conc. In soils around cement factory	
Fe	0.1	0.3	43.254	
Ni	0.5	6.5	5.35	
Cr	0.02	0.05	1.013	

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