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ASSESSMENT OF SOIL QUALITY NEAR A CEMENT INDUSTRY USING ALTERNATIVE FUEL RESOURCES NEAR NEEMUCH, KHOR VILLAGE, MADHYA PRADESH (INDIA)

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Abstract: Soil is one of the most significant environmental factor, which is caused from the surface rocks and plants based on it for their nutrition, water supply and mineral supply. The exchange of fossil fuels by optional fuels in the manufacture of cement clinker is of great significance both for cement manufacturers and for environment. The objective of the study was to analyze the effect of cement industry on soil present in nearby areas of cement industry of ACC cement plant in khor village Neemuch district, Madhyapradesh. The 5 nearby Areas of Cement plant selected for study are Nayagaon, Jawad, Suwakheda, Aathna, and Ummedpura Neemuch District, Madhya Pradesh. In addition, the utilization of alternative fuels can decrease the expenses of concrete production. It has been seen that steady drop of cement dust on soil causes pollution. Chemical analysis of soil in and around the industrial zone of a cement industry was examined and it was seen that as the distance from industry builds, the impact of soil contamination reduces, extensively for pH, Nitrogen, Phosphorus and Potassium content.

Keywords: Soil analysis, pH, Nitrogen, Phosphorous, Potassium, Minerals.

I. Introduction

Controlling pollution in air, water, soil and biotic resources, treatment of industrial effluent released from industrial processes, management of solid and liquid wastes of various sources and recycling of wastes and valuable materials are the major areas of concern in the environmental protection of the whole globe. Among the various strategies used to reduce the environmental problems, recycling, reusing and Co-processing are the essential techniques appropriate for growing international countries like India. Co-processing refers to the usage of waste substances in industrial processes as Alternative Fuels and Raw Materials (AFR's) to get better strength and material from them. This technique is an environmentally pleasant and sustainable technique of waste disposal in comparison to secured land filling and thermal destruction due to lowered emissions and there may be no residue after the waste management. Waste must be constantly taken into consideration as a threat for further use. Co-processing is a growing concept in industrialized environment, which considers the most awesome features of the flow of information, assets and power of an surroundings. It aims at humanizing the substitute of natural resources in the business world. Co-processing is a key element for sustainable development. Utilizing by-product or waste as a gas is going to decrease the amount of fossil fuel necessity and as a result reduces the connected environmental effects of outcomes obtained in production, transporting and burning these fuels as done in hazardous waste control. It additionally reduces the stress on localized stable waste landfills, waste incineration and minimizes their environmental effect which incorporates groundwater pollutants, methane production and dangerous ash residues. Cement kilns are ability units to get better energy from several non-hazardous wastes as well as a few hazardous wastes.

II. Study Area

Vikram Cement Works has an existing Cement Plant Complex comprising of Cement Plant (4.0 MTPA) & two Limestone Mines {Limestone Mine – I (442.923 ha) with production capacity of 5.5 MTPA & Limestone Mine – II (342.612 ha) with production capacity of 1.5 MTPA} in Village: Khor, Tehsil: Jawad, District: Neemuch (Madhya Pradesh).

Geographical locations of Vikram cement plant is Latitude24^0 32' 38.79" to $24^0$34' 46.56" (N), and Longitude $74^0$47' 2.02" to 74^0 49' 33.31" (E).

Figure 1: Map of Vikram Cement in Neemuch District

Vikram Cement Works has now proposed a New Limestone Mine – III (564.106 Ha) with production capacity of 2.0 MTPA at Villages Nayagaon, Kesharpura, Damodarpura, Khor & Kanka; Tehsil Jawad, District Neemuch (Madhya Pradesh). It will increase the plant life by another 9 years.

- **Description of Environment**

Baseline observes of the study place turned into performed in the course of winter Season. The awareness for all of the 10 AAQM stations for PM10 stages from forty.18 to 79.82µg/m3, SO2 stages between 6.1 to 10.67 µg/m3 and NO2 stages between 9.1 to 19.57µg/m3. The ground water evaluation for all of the 5 sampling stations indicates that pH varies from 7.12 to 8.01, overall hardness varies from 121.20 mg/l to 456.52 mg/l & generally dissolved solids varies from 202.00 mg/l to 936.00 mg/l. The evaluation consequences for soil indicates that soil is impartial to moderately alkaline in nature as pH fee tiers from 7.02 to 7.92. Potassium stages from 129.98 kg/ha to 176.73 kg/ha. The concentration of Nitrogen, Phosphorus has been discovered to be in correct quantity in the soil samples.

- **Alternative fuels**

Alternative fuel usage inside the cement business began in the 1980s. Beginning in calciner process studied to very nearly one 100% elective fuel consuming on the pre-calciner portion quickly completed. Alternative fuels are mainly utilized tires, animal residues, sewage sludge's, and waste oil, as might be unmistakable in Table 1. The last are strongly recovered fuels recovered from business waste streams and to a developing volume moreover from municipal resources. These waste-derived fuels are pre-treated light parts prepared by mechanical or air partition.

Waste determined fuels incorporate shredded paper, plastics, foils, materials and rubber and furthermore contain metal parts or mineral pollutions. Elective fuel use in cement kilns keeps on being advancing. While in a couple of ovens up to one 100% substitution extent have been accomplished, in others local waste markets and permitting conditions do now not allow for higher rates of AFR. In other case, AFR usage requires the version of the burning strategy. Present day multi-channel burners intended for the utilization of opportunity powers and thermograph frameworks permit chief of the flame form to examine the burning process of the fuel and the fuel consuming conditions for the clinker. Table 2 shows the calorific estimations of different fuels utilized in cement production plant [9-12].

Table 1: Alternative fuels resources options for the cement industry

Liquid waste fuels	Solid waste fuels	Gaseous waste
petrochemical waste	battery cases	Landfill gas
asphalt slurry	plastic residues	pyrolysis gas
paint waste	wood waste	
Petroleum coke	rubber residues	

Table 2: Wastes used for alternative fuel resources and their energy content (N.Chatziaras et. al. 2014)

Wastes	Energy (MJ/kg)
Used tire	23.03 11.72
Husk	19.93
Industrial plastic	18.21
Waste oil	14.65
Scrap paper	14.23
Contaminated waste	14.23
RDF plastic	11.72
Sewage sludge	8.37

Five soil samples were collected from different distances and places of Vikram cement industry are situated at khor village in Neemuch district.

The importance of soil analysis is to know the nature of soil because the production of crop of this region depends on the properties of soil. All human being indirectly related with soil. The soil collected nearby the cement areas with the following process—

In clean separate polythene packs, the soil is taken from various separations of cement processing plant territory with an angle boring about deep 5 inches checked and pulled it up, the samples of collected soil dried over the polythene bags. After enough drying of soil and takeout of outside matter like roots and little stones have done. The dried samples after granulating in wooden pestle and mortar were blended all together and passed by 2 cm the diameter sized sieve and afterward are prepared to use for examination.

Table 3. Comparative study of compound with distance

SN o.	Village	Village Distance from Factory (In KM)	pH	$CaCO_3$	Organic carbon	Nitrogen (Kg/hectare)	Phosphorous (Kg/hectare)	Potassium (Kg/hectare)
1.	Nayagaon	4 Km	8.40	22.48	2.40	490.03	4.40	460
2.	Jawad	5 Km	8.10	17.25	2.12	360.24	7.38	412.2
3.	suwakheda	6 Km	8.02	16.10	1.98	390.25	9.32	330.1
4.	Aathna	8 Km	7.70	13.38	1.60	460.40	10.16	310.4
5.	Ummedpura	9 Km	7.40	7.60	1.20	290.30	11.38	301

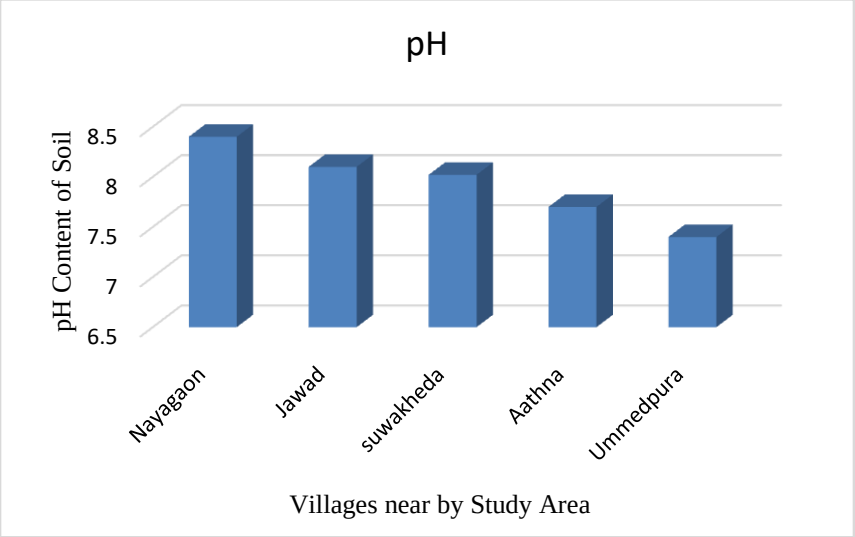

Figure 2: pH Content of Soil with respect to nearby Study area

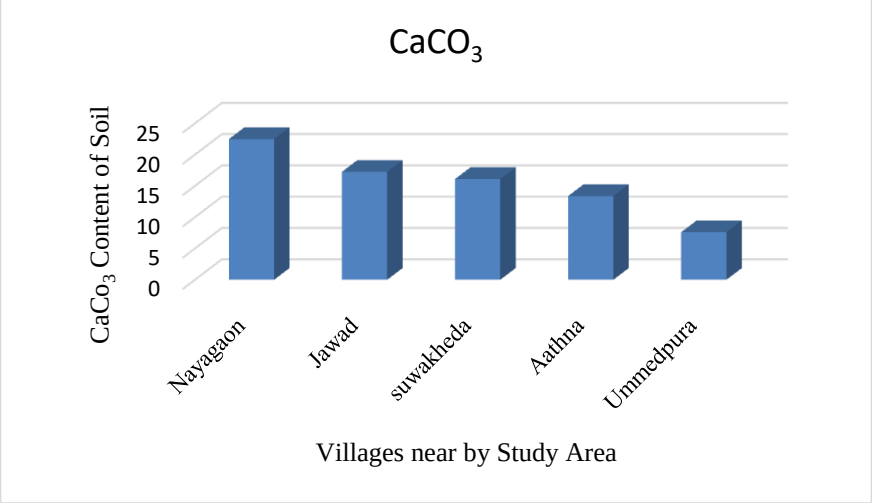

Figure 3: $CaCO_3$ Content of Soil with respect to nearby Study area

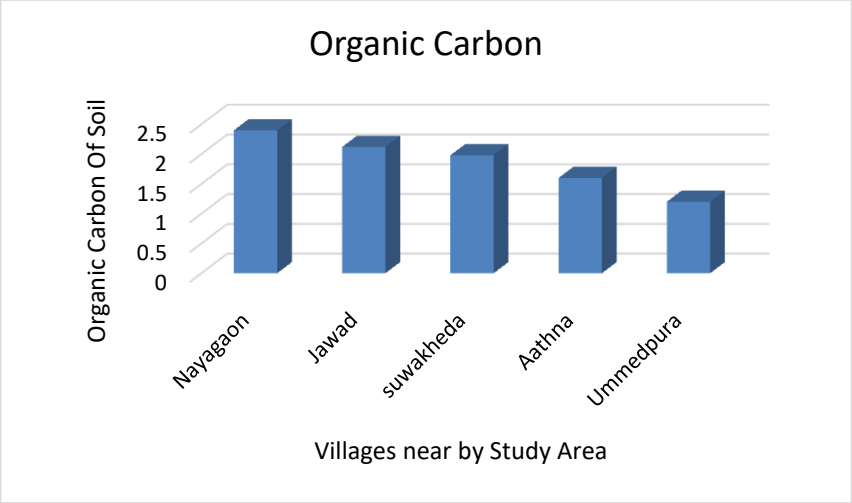

Figure 4: Organic Carbon Content of Soil with respect to nearby Study area

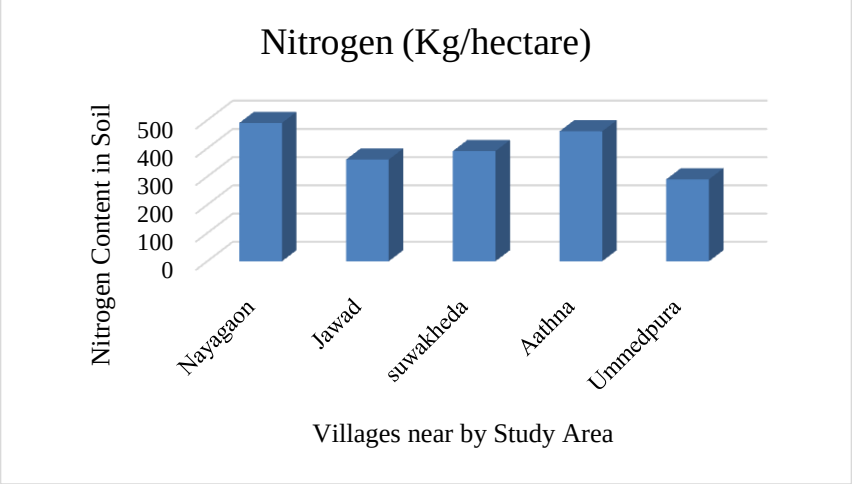

Figure 5: Nitrogen Content of Soil with respect to nearby Study area

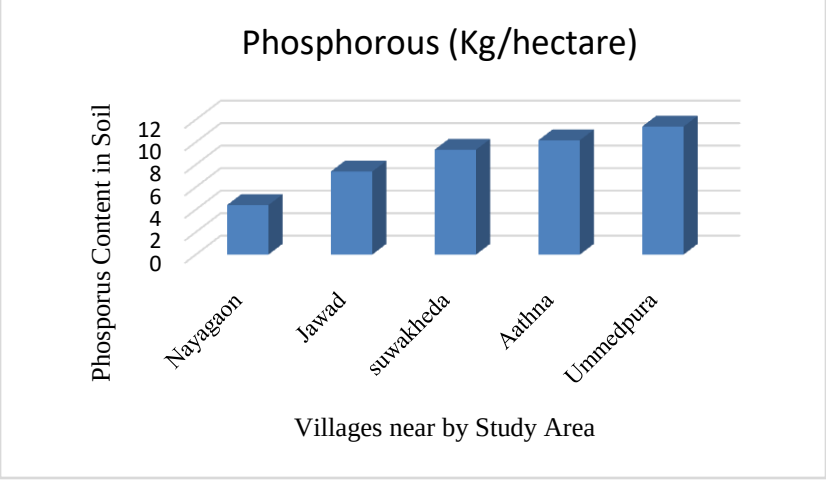

Figure 6: Phosphorous Content of Soil with respect to nearby Study area

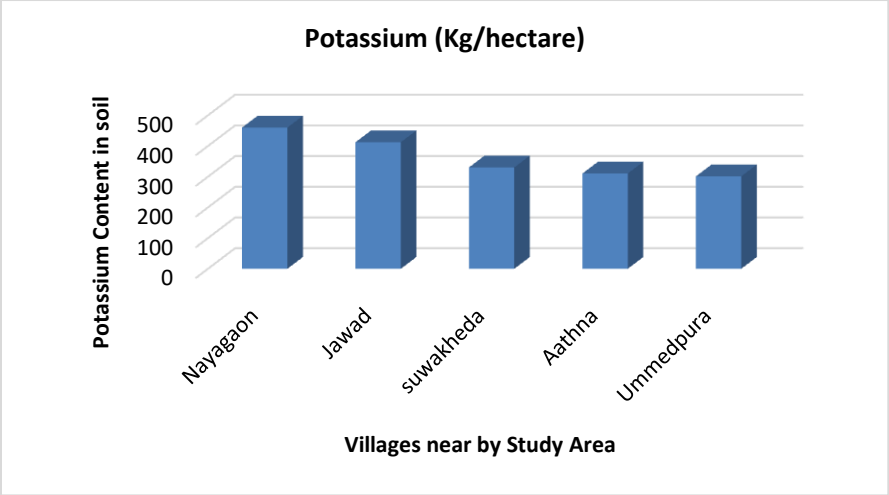

Figure7: Potassium Content of Soil with respect to nearby Study area

III. Methodology

The process and methodology for getting soil tests vary as per the reason for sampling. Analysis of soil tests might be required for building and farming purposes. In this study, soil testing for farming intention is described which is improved for soil fertility assessment and fertilizer suggestions for crops. The outcomes of even deliberately performed soil investigation are as good as the soil sample itself. In this study, the productivity of soil testing administration based on the care and expertise with which soil tests are collected.

➢ *Sampling tools and accessories*

Based on the purpose and precision required, following tools may be required for taking soil samples.

- Soil auger- it may be a tube auger, post hole or screw type auger or even a spade for taking samples.
- A clean bucket or a tray or a clean cloth for mixing the soil and sub sampling.
- Cloth bags of specific size.
- Copying pencil for markings and tags for tying cloth bags.
- Soil sample information sheet.

➢ *Soil sampling and Analysis*

All the Soil samples were controlled by a organized sampling approach at 0 to 20 cm depth below the soil surface. The samples were dried and passed throughout a 2 mm sieve to arrange them for testing. All the samples were tested using a standard technique by following the "Methods Manual-Soil Testing in India" [13]. All the samples were studied and analyzed for soil properties like pH, electrical conductivity (EC), phosphorus (P), potassium (K) and Organic carbon (OC).

➢ *Tools and Techniques*

Minimum, extreme, mean, and standard deviation (SD) is figured for estimated soil parameters. Descriptive statistical analysis and Pearson's correlation analysis are utilized to analyze soil tests information. Factors utilized for investigation in this examination incorporate pH, natural carbon (OC), phosphorus (P), potassium (K), and electrical conductivity (EC). Utilizing EXCEL and S.P.S.S. all statistical examination is performed.

IV. Results and Discussion

Soil pH: Data of the pH analysis of different soil samples are given in table. It is varied from 6.73 to 9 at study area. Hence soil was found to be alkaline type and having decreasing pH with the increase of distance. It retards the germination of seeds and growth of seedlings.

Calcium Carbonate: The data given in table and it varied from 22.48 to 7.60 in study area in order to increase the distance from factory to 8 km. It shows that calcium carbonate content decrease with increasing distance. The higher content of CaCO3 and its basic nature near cement factory due to higher dust fall.

Organic Carbon: Results shown in table, the data clearly showed gradual decrease in organic carbon content from 3.02% to 1.0% in the soil in accordance to distance from the cement factory. The amount of organic carbon accumulation is faster than the decomposition which makes soil unfertile.

Phosphorous: The results are shown in table Phosphorous showed a positive trend towards the increment of distance from the cement-factory. It was 4.40 kg/hectare at factory and 11.38 kg/hectare at 4 km. from factory. These results shows that availability of phosphorous is heavily dependent upon the soil acidity (pH) and form of phosphorous in the soil, significant decrease in soluble reactive phosphorous concentration due to formation of CKD calcium phosphate.

Potassium: Total potassium content of the soil has been analyzed and results are tabulated in table-1. 460 kg/hectare at 4 km. from Neemuch, and cement dust cause increase in potassium content and it remains higher than Na, P and Mg in the affected soil.

Nitrogen: The analytical results for available N in polluted soil are given in table. 490.03 kg/hectare was found at 4 km.and 290.30 kg/hectare 9 km from Vikram cement Industry. It showed a clear trend of reduction in total Nitrogen content in soil with increasing distance. It confirms the trend of organic carbon content in polluted area. On the basis of above results it can be concluded that the contents of cement dust highly affected the properties of soil.

Cement dust is mainly containing CaCO3. It raises the pH of soil and makes the soil alkaline. Nitrogen mineralization process also decreases as N content increases. Ca forms with P thus availability of P is decreases. Potassium content was shown higher. Physiological and Biological process of the plant are also affected by dust pollution. These conditions are not favorable for growth of plants and microbes thus make soil unfertile and tend towards the low crop yield.

V. Conclusion

The utilization of alternative fuels will help decrease the prices of cement manufacturing. The common energy requirement for the producing of 1 ton of cement is approx 3.3. GJ, which corresponds to 120 kg of coal with a calorific price of 27.5 MJ in keeping with kg. Energy charges account for 30–40% of the entire expenses of cement production. The substitution of opportunity fuels for fossil fuels will assist reduce electricity expenses, providing a aggressive facet for a cement plant the use of this source of energy. Furthermore, much less waste will have to be dumped or burnt, as a way to imply much less dumping sites. Therefore, using waste-derived alternative fuels by cement plant will be also beneficial to the surroundings. The conditions in rotary kilns, inclusive of high temperature, the excessive velocity of the gas flow and the long particle-storage segment, assure that the use of alternative fuels is ecologically safe. Vikram (Ultratech) cement uses alternative fuels utilized in cement kilns. And the usage of superior generation system's to recycle the waste complies with all safety measures for environment pollutants. This study shows that the soil of the studied area could be moderately polluted. The value of different parameter in soil samples, showed the pH and electrical conductivity values are suitable for growth. The analytical results of nitrate and sulphate concentration level showed that in some areas the ratio of sulphate and nitrate are adequate for the growth of plant. The value of lead is very small and it does not harm the qualities of the soil samples. There is a positive correlation between calcium and electrical conductivity. According to several chemical studies the area nearby industries illustrated that the further area from the factories the percentage of soil pollution decreases.

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