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# Physicochemical analysis of soil in the vicinity of stone crushing plant in Chhatarpur district, India

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**ABSTRACT: The present study assessed the impact of dust emissions from the crusher plant on physicochemical properties of soils of the area near crusher plants in Alipura and Chaubara villages of Chhatarpur district of Madhya Pradesh state. Increasing trend was observed with the available P, K and N content and decreasing trend was observed with calcium (as $CaCO_3$) and soluble sulphate with the increase of distance from the plant. The basic nature of the soil and higher content of $CaCO_3$ near the crusher plant is due to higher dust fall.**

## I. INTRODUCTION

Stone crushing industry is an important industrial sector in the country. The crushed stone is used as raw material for various construction purposes such as construction of roads, bridges, buildings and canals. Hard lime stone is used as raw material for manufacturing crushed stone. Soil gives a reservoir of nutrients required by crops and hence for animals. Soil analysis determines the amount of available plant nutrients in the soil and describes the important factors responsible for soil health. Soil gets polluted and loses its fertility due to the human-made chemicals or other alteration in the natural soil environment. As a result soil becomes eroded. Both physical degradation and chemical contamination of soils are caused by industrial activity, agricultural chemicals and improper disposal of waste. Physical degradation of soil includes erosion, compaction and structural damage resulting from construction activities and mining. The top most layer of soil is composed of minerals of various sizes and organic matters along with pores filled with air and water. The most prominent organic chemical groups are fuel hydrocarbon, poly nuclear aromatic hydrocarbons (PAHS), polychlorinated biphenyls (PCBs), chlorinated aromatic compounds, detergents, and pesticides. Inorganic species include nitrates, phosphates and heavy metals like cadmium, chromium and lead, inorganic acids and radionuclide. The sources of these contaminants are industrial waste materials, agricultural runoffs, acidic precipitates and radioactive fallout [1]. This study assessed the impacts of dust emissions from the crusher plant on physicochemical properties of soils of the area near crusher plant in Alipura and Chaubara villages of Chhatarpur district of Madhya Pradesh state.

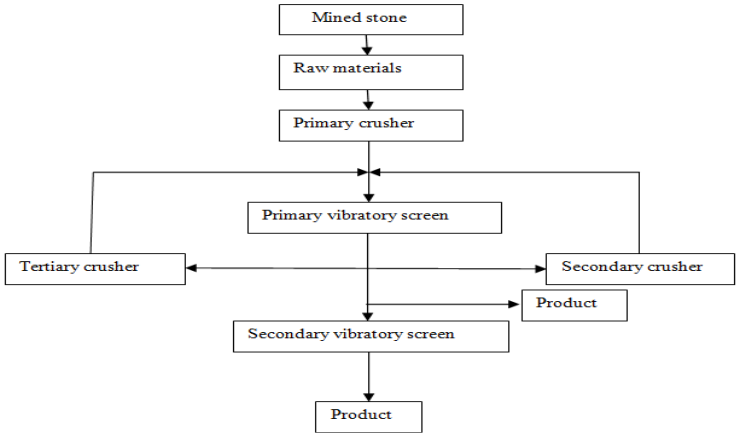


**Fig. 1.** Stone crushing process flow

**Study area:** Alipura is a large village located in Nowgaong tehsil of Chhatarpur district, Madhya Pradesh, India. It is located at an altitude of 432 m above sea level. Alipura a village in Bundelkhand with history and character, has population of 8341 of which 4375 are males while 3966 are females as per Population Census 2011. Average sex ratio of Alipura village is 907 which is lower than Madhya Pradesh state average of 931. Alipura village has lower literacy rate of 65.68% as compare to 69.32% of Madhya Pradesh. According to Census 2011 information the location code or village code of Chaubara village is 457712. Chaubara village is located in Nowgong Tehsil of Chhatarpur district in Madhya Pradesh, India. It is situated 4km away from sub-district headquarter Nowgong and 25km away from district headquarter Chhatarpur. The total geographical area of village is 256.98 hectares. Chaubara has a total population of 608 peoples. There are about 137 houses in Chaubara village. Nowgong is nearest town to Chaubara which is approximately 4km away [2].


**Fig. 1.** Location of Chhatarpur district, Alipura village and types of soil in Madhya Pradesh.

## II. MATERIALS AND METHODS

The soil samples were collected from Alipura and Chaubara villages of Chhatarpur district. These soil samples were subjected to physicochemical properties like texture, structure, organic carbon, nitrogen, potassium, phosphorus, calcium, sulphur, water holding capacity and heavy metals analysis.

**Objective.** The objective of the study is to identify environmental risks by studying the inter-linkages and dynamics between various activities during crushing of stones and to assess direct, indirect and cumulative impacts on soil and also provide suitable mitigation measures.

**Scope.** The study evaluates the predicted impact of the various activities of crushing process on the environment. It covers the various remedial measures like pollution control systems, green belt development plans and reuse of solid wastes and other environmental management system to control environmental degradation.

**Material and Methods.** In a homogenous field, soil samples from plough layer (0-15cm) should be selected randomly in a zigzag manner. The samples should not be collected from near the bunds, water channels, field paths and heaps of crop straw, stubbles, manure, etc. Sampling locations were selected in the study area. Sampling was done during November 2015. Once the soil is collected, the bulk soil is mixed thoroughly and desired quantity of soil sample is obtained by quartering method. The physicochemical analysis of soil samples were carried out in accordance to standard analytical methods (APHA, BIS). Soil pH was determined by glass electrode pH meter in 1:2 soil water suspensions. Electrical conductivity was measured in the supernatant liquid of 1:2 soil water suspensions by conductivity meter.

## III. RESULT AND DISCUSSION

Life on the Earth has been possible only because of presence of air, water and soil. In the present study the soil samples were collected in the vicinity of different areas near crusher plant in Alipura and Chaubara villages situated in Nowgong tehsil of Chhatarpur district in Madhya Pradesh. Ratings of soil test parameter, components of soil and the physicochemical characteristics of soil samples are presented in the given table no. 1,2 and 3 respectively.

The organic content and available nitrogen content in soil are independent and correlate with each other, therefore the effect of stone dust in the area near crusher unit on organic matter being non significant though increasing trend was observed with increase in distance from the plant. Similar trend was observed with the available P, K and N content. However decreasing trend was observed with increase in distance with calcium (as $CaCO_3$) and soluble Sulphate from 5.58 to 3.25%, and from 2.09 to 0.93% respectively. Heavy metals are not found in the soil samples. Thickening and cracking of skin, severe akin damage from chemical burns can observe in contact with the dust. Silica exposure can lead to lung injuries [4].

**Table 1: Ratings of soil test parameter [3].**

| **Ratings of soil test parameter** | | | |
|---|---|---|---|
| Nutrients | High | Medium | low |
| Organic carbon (%) as a measure of available N | <0.5 | 0.5 - 0.75 | >0.75 |
| Available N by alkaline permanganate method (kg/ha) | < 280 | 280-560 | >560 |
| Available P by Olsen's method (kg/ha) | <10 | 10-24.6 | >24.6 |
| Available K by ammonium acetate method (kg/ha) | <108 | 108-280 | >280 |

**Table 2: Component of soil.**

| **Component of soil** | % |
|---|---|
| Organic mineral matter | 45 |
| Organic matter | 05 |
| Soil water | 25 |
| Soil air | 25 |

**Table 3: Physicochemical characteristics of soil samples.**

| S. No. | Test Parameters | Unit / % | Method No. | Alipura Village | Chaubara village |
|---|---|---|---|---|---|
| 1 | pH | - | IS-2720 Part -26 B | 7.94 | 8.17 |
| 2 | Electrical Conductivity | µmhos/cm | IS-2720 Part -21 | 258.90 | 128.0 |
| 3 | Texture | - | IISS | Clay Loam Silt | Silt Clay |
| 4 | Grain Size Analysis | % | IS- 2270 (1985) | Clay - 40%<br>Loam – 40%<br>Silt - 20% | Silt - 30%<br>Clay – 60%<br>Sand- 10% |
| 5 | Water Content | % | IS- 2720 ( Part-2) | 3.31 | 1.09 |
| 6 | Calcium (as $CaCO_3$) | % | IS- 2720 ( Part-23) | 3.25 | 5.58 |
| 7 | Soluble Sulphate | % | IS- 2720 ( Part-27)-A | 0.93 | 2.09 |
| 8 | Organic Matter | % | IS- 2720 ( Part-22) | 0.52 | 0.61 |
| 9 | Phosphorous | Kg/ha | IBM- 2012 | 12.45 | 3.58 |
| 10 | Potassium | Kg/ha | IISS | 470.57 | 245.72 |
| 11 | Nitrogen | Kg/ha | USEPA Method - 351.3 | 329.28 | 285.38 |
| 12 | Water Holding Capacity | % | IISS | 50% | 41.80 |
| 13 | Copper as Cu | PPM | IISS | ND | ND |
| 14 | Zinc As Zn | PPM | IISS | ND | ND |
| 15 | Cadmium as Cd | PPM | IISS | ND | ND |
| 16 | Nickel as Ni | PPM | IISS | ND | ND |
| 17 | Lead as Pb | PPM | IISS | ND | ND |
| 18 | Iron as Fe | PPM | IISS | ND | ND |

Method of sampling and test: BIS

Soil Health can be defined as the capacity of a soil to function within ecosystem to sustain biological productivity, maintain environmental quality and promote plant, animal and human health [5].

## CONCLUSION

The physical and chemical constituents of the soil are usually changed due to the contact with dust emitted during crushing process of stone. The dust tends to be highly alkaline due to its high calcium carbonate content. Hence it is revealed that soil contaminated by stone dust will have high pH value. The impact is observed most within the radius of 0-3km from the stone crusher plant. Soil pollution can be prevented by making people aware about the concept of reduce, recycle and reuse and by avoiding the application of chemical fertilizers and pesticides in the fields.

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