

Impact assessment of chemical fertilizer industry on quality of soil in and around Vijaipur, district Guna, M.P. (India)

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ABSTRACT

A study was carried out on the impact of Chemical Fertilizer Industrial waste on the quality of soil in the vicinity. The Fertilizer Industry located at Jijaipur District Guna (M.P.) India, produce liquid ammonia and urea. All the solid waste generated are disposed off at dumpsites (Surrounding Fertilizer Plant). The effluent sludge and Soil sample were analyzed for physio-chemical parameters viz pH values, Phosphorous, Sodium, Chromium, bulk density, porosity, water-holding capacity, electric conductivity, organic matter and Cation exchange capacity of soil using standard methods. The results revealed that the dumpsite sludge sample recorded very high concentration of Potassium and Calcium. The effluent samples from the outside showed lower value of Potassium and Calcium. The Soil environment around the dumpsite was the most affected the highest mean value of potash and phosphorous respectively.

Keywords: Dumpsite, solid waste, soil texture, physico-chemical characteristic, sludge.

INTRODUCTION

Vijaipur Fertilizer Plant is located at Vijaipur village in Radhogarh Tehsil of Guna District (M.P.) India. The Fertilizer Plant Constructed by NFL-comprises of one 1350 TPD single stream ammonia plant based on stream reformation of natural gas and 2200 TPD Urea Plant consisting of two streams each of 1100 TPD capacity. It utilized as combination of natural gas naphtha, fuel oil and filler sand at varying condition for the production of different formulation of fertilizer products viz liquid ammonia and urea. Each production process result in the release of large quantity of nitrogenous and phosphorous containing wastes into receiving aquatic and terrestrial ecosystems. The attendant ecological problems associated with these discharges especially on the soil ecosystem has been undertaken in this study. Generally soil comprises physical, chemical and biological substances which show alternation due to impact

of various environmental factors and industrial contamination wastes.

The study of physico-chemical characteristics of soil were carried out by several workers, Sahai et.al. (1979) Sahai and Shrivastava (1988), Agrawal S. K. and Gupta H. (1992) and Kadeyarona (1989), Ahemed et. al (1996), Achrajee et. al. (1999). The main objective of this study is to assess the impact of the fertilizer effluent and other fertilizer wastes products on the quality of the receiving terrestrial eco-system as its effects cultivation and plantation in the host community.

Study area

This study was conducted primarily in one premises of Nitrogenous Chemical Fertilizer Industry at Vijaipur, District Guna (M.P.) India. The area of study is about 25 kms from the Guna town. Nearest railway station Reethiyai which is about 6 kms from the complex. Ruthiyai junction falls midway

between kota (North-West) and Bina (East). Delhi-Agra-Bombay National highway (NH-3) its 4 kms away on the eastern side the complex at the Vijaipur Fertilizer Plant. River Parvati flows on the western side of the plant, at a distance of about 4 km. Chopan river flows on Northern side, about 2 km always from the plant and ultimately joins river Parvati. Both rivers are main water receiving body for industrial effluents.

The area of study lying between latitude 77° to 77°15' longitudes to 24°15' to 24°40'. The geology of area of study presents a specific hydrogeological pattern. The top 0.5 to 1.0 m consists of black cotton followed by 3.0 m thick black basalt rock and down up to 60 m, it is hard rock. The selected area has an elevation of 421 m above mean sea level and the climatic conditions is semi-arid. The mean annual rainfall varies from 531 mm to 1972 mm. There is fairly high variability in rainfall from year to year and the probability of receiving mean annual rainfall varies from 40-50%. The maximum temperature goes up to 45°C while the minimum recorded is as low as 2°C.

Table 1: Sludge characteristics

S.No.	Characteristics	Value
1	pH (1:10 sludge Characteristic)	8.9
2	Organic matter	18.80
3	Chromium as Cr	0.45
4	Total Nitrogen as N	0.28
5	Potassium as K	0.63
6	Phosphorous as P	0.26
7	Sodium as Na	1.08
8	Zinc as Zn	0.152
9	Copper as Cu	0.0070`
10	Calcium as Ca	31.20
11	Iron as Fe	2.25
12	Nitrate NO ₃	28 to 49
13	Cadmium as Cd	ND

ND-not deducted, value (concentration % dry wet basis except PH)

Table 2: Physico-Chemical characteristics of soil

S. No.	Parameters	Sampling Points					
		Z1	Z2	Z3	Z4	Z5	Z6
1	Soil Texture	SIC	SIL	SI	SIL	SIL	LS
2	Bulk Density (g/cm ³)	1.573	1.256	1.403	1.493	1.516	1.38
3	Porosity (%)	27.3	35.9	36.0	31.0	32.	41.9
4	Water-Holding Capacity (WHC)	36 to 48	35 to 49	38 to 49	40 to 49	38 to 46	36 to 49
5	pH	7.5	8.3	7.9	9.4	8.1	8.5
6	Electrical conductivity (mmhos/cm)	0.16	0.55	0.44	0.27	0.21	0.18
7	Cation exchange capacity (meg/100 of soils)	54.0	31.5	66.9	57.4	36.4	30.0
8	Organic Matter (%)	5.35	6.31	8.31	9.01	9.11	8.32
9	Calcium (mg/Kg)	0.18	0.96	0.58	0.38	0.26	0.19
10	Potassium (mg/Kg)	0.046	0.015	0.03	0.02	0.153	0.01
11	Chloride (mg/Kg)	0.09	0.07	0.08	0.08	0.14	0.05
12	Sulphate (mg/Kg)	0.22	0.19	0.04	0.18	0.05	0.27

(1:2 Soil-Water Chemical extract, SIC=Silty-Clay, SIL=Silty-Loamy, SI=Silty, LS=Loam-Silty)

MATERIALS AND METHODS

Soil samples at a depth of 04 to 16 m of the top soil were collected cross sectionally using an auger from 6 major location along with sludge around the dumpsite of fertilizer plant. The study was conducted for period of one year (June, 2008 to May, 2009). The sample location are about 5 km apart from plant site and the soil of these location were silty, clay and loamy. Soil sample were analyzed for physical and chemical characteristics. In each case the soil sample of totaling six location were subjected to pretreatment which included air dried, cleaned, crushed and passed through 2mm mesh sieves and analyzed in laboratory (1:2 soil-water extract) using standard method. The chemical parameters determined were inorganic compound such as Kjeldahl Nitrogen (N), Calcium and metal such as Na, K, Fe, Zn, Ni, Cr etc. The determination of total Nitrogen was done using total (Kjeldahl) Nitrogen method whereas Phosphorous determination was done spectro-photometrically using molybdovanadate method, the sodium and potassium were estimated directly in the extract using flame photometer, whereas Ca was determined EDTA titration and other metals were determined using AAS. pH value was measured by method described by Anderson and Ingran (1989) using a standard pH meter. Similarly the conductivity measurement were made by a standard conductivity meter. The results are expressed in mg/L as well as in g/100g(%).

RESULTS AND DISCUSSION

The result of the present study is presented in Table 1 and Table 2. The result of sludge characteristic value is given in Table 1. It indicate high value of pH, organic matter, potassium, chromium content and also other metals.

Similarly the result of the sampling station of outside of plant about 5 km apart from plant about 5 km apart from plant side are given in table-2. The soil in the region normally alkaline (pH 7.5 to 9.4) in nature with high porosity, high cation, exchange capacity and somewhere water holding capacity are very low. At some places the soil is silty-loamy to silty-clay and rarely loamy.

CONCLUSION

The present study has indicated that the quality of soil especially around the Industrial premise was affected by high levels of Phosphorous, Nitrogen and Potash when compared to soil sample location the vicinity of the plant although impact of the pollutants assessed appeared to be more on the soil, there may be risk for ground water quality in the vicinity. The overall implication of this study call for the management of the fertilizer complex to check there waste management practices so as to circumvent the discharge of its pollutants in to surrounding eco-systems that may pose associated health risks and hazards.

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