

NOTE**Water Quality Near Phosphatic Fertilizers Plant at Paradeep**

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Paradeep, located beside NH-5, is a port town in India with large industrial activity. Two phosphate based fertilizer plants are located here. Effluent water from the plants are fed to a creek to be released eventually to river Mahanadi. The water from the creek is slightly turbid, having slow sedimentation causing greyish precipitate. The water sample were characterized in terms of pH, density, total hardness and concentration of metal ions like iron, aluminium, sodium, potassium, magnesium and calcium. Presence of fluoride, phosphate, sulphate and chloride in the water sample has also been ascertained. Some measures for effluent treatment have been suggested to check water pollution.

Key Words: Water Quality, Phosphate, Fertilizer, Paradeep.

Paradeep is the deepest natural port in the east coast of India. It is located about 120 km north-east of the Orissa state capital Bhubaneswar, India. Considered the hub of industrial activity, the town has two major phosphate based fertilizer plants located within 5 km radius of it. It also houses a phosphoric acid plant claimed to be the world's largest plant¹. Besides there are large sulphuric acid plants in the nearby locality. Investigations on phosphate based fertilizer plants, located in different parts of the globe, have revealed² that these cause considerable extent of air pollution by producing noxious, acidic fumes of sulphuric and hydrofluoric acid. Acidic conditions and contaminants in the form of toxic metal ions, phosphorous and ammonia have also been reported³ even in the ground water in and around such plants.

This prompted us to study the water quality in Paradeep area and as a first leg of study, the present paper reports the water quality from about 250 meters from the plant complex. Need for water treatment and possible remedial measures have also been reported.

Water samples were collected in the lean season between February-March from the creek where effluent water from mainly fertilizer plants were released. After the conventional tests to ascertain physical parameters like density, pH, conductance, *etc.*, the water sample was subjected to qualitative analysis to detect the presence of cations and anions in it. Emphasis was laid on the quantity of metal ions present and hence quantitative analysis for these ions were carried out using flame photometer (Esico Model 1381), UV-visible spectrophotometer (Shimadzu

1700) and complexometric titration with EDTA. The pH-meter used in the study is systronics model- μ pH 361 with glass and calomel electrodes, while the conductance was measured using systronics model 304 instrument.

The alarmingly high acidity of the water sample (Table-1) most likely results from the two large sulphuric acid plants, each having a capacity of 3500 tonnes per day and the phosphoric acid plant with capacity of 2650 tonnes per day in the fertilizer complex area at Paradeep. The density and conductance values are also indicative of soluble ingredients in the water sample. Qualitative tests for anions reveal the presence of fluoride, chloride, phosphate, sulphate while the same tests for cations confirm the presence of iron, aluminium apart from alkali and alkaline-earth metal ions of Na^+ , K^+ , Mg^{2+} and Ca^{2+} . Total hardness of water was determined by EDTA titration and was found to be 50 ± 5 ppm. A silt like substance deposits at the bottom of the container where the water sample is stored with an estimated volume of about 1/20th part of the total volume. However analysis of silt is not included in the present study and is yet to be completed.

TABLE-1
PHYSICAL PARAMETERS AND CHEMICAL CONTENTS OF THE WATER
SAMPLE COLLECTED FROM FERTILIZER PLANT AREA AT PARADEEP

pH	Conductance (ms)	Density (g/mL)	Fe^{3+} (ppm)	Al^{3+} (ppm)	Ca^{2+} (ppm)	Mg^{2+} (ppm)	Na^+ (ppm)	K^+ (ppm)
1.93	23	1.01826	8.5	13	20.04	36.94	4200	1300

Estimation of metal ions: The amount of iron in water sample is determined spectrophotometrically by Fe-orthophenanthroline method using acetic acid-sodium acetate buffer. A calibration curve is obtained by plotting absorbance vs. $[\text{Fe}^{3+}]$ of a number of Fe-orthophenanthroline solutions containing different but known amounts of iron. The sample water when mixed with calculated amount of buffer solution gives a white precipitate which is separated by filtration and the filtrate is then mixed with *o*-phenanthroline to give requisite colour. All measurements are made at 510 nm. The amount of Fe^{3+} in the collected water sample is found to be 8.5 ppm.

The report⁴ jointly prepared by the Ministry of Environment and Forests, Government of India; Central Pollution Control Board, Delhi and State Pollution Control Board, Orissa, on the water quality collected from different parts of a fertilizer plant at Paradeep, reveals that these contain very high concentration of phosphate (24-7400 mg/L) and fluoride (2-2050 mg/L). Research shows⁵ that when phosphates are applied to soil, they quickly bind the soil particles. Soil bound phosphates create pollution only when soil erosion occurs. In case of Paradeep, the high acid content in the water collected from the plant area is very likely the cause of soil erosion, which in turn leads to phosphate pollution. The high phosphate level in water is known to support over production of algae and water weeds, which is what observed in all water bodies in and around Paradeep.

From the results shown in Table-1, as well as the above discussion, it is clear that the major problem as regards the water quality at Paradeep lies in its acidity, by controlling which the phosphate pollution can be checked. In fact control of pH is critical to the effectiveness of waste water treatment operations and special major to neutralize the water by chemical or biotechnical method must be made before releasing the same to the river. However, the fluoride pollution is menacingly large and needs further study for control operations. The fluoride is usually formed during the production of phosphoric acid from fluorapatite and is released in the form of CaF_2 , SiF_4 or H_2SiF_6 of which the last mentioned one is the most toxic⁶. The poisonous fluosilicic acid may be converted by neutralization with limestone or milk of lime to form a precipitate of calcium fluoride and silica. These may be collected by filtration and dumped as solid waste. Alternatively, there are various ways of using fluosilicic acid as a raw material to produce essential fluorine-containing materials like aluminium fluoride, cryolite, hydrofluoric acid, fluorspar, etc. on an industrial scale.

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