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Research Article

Evaluation of Ground and Surface water Quality in and around Vedanta Aluminium Company at Jharsuguda, Odisha, India

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Abstract

Vedanta Aluminium Limited (VAL), is an aluminium smelter located at Jharsuguda, Odisha and it is using a large amount of fresh water from Vheden river for different purposes like cooling, washing of materials, finishing etc., and is producing a very large amount of waste water .In present study physico-chemical analysis of ground water and surface water in and around Vedanta Aluminium Company at Jharsuguda, Odisha is done. Ground water samples were collected from tube well and Surface water samples were collected from Vheden River. After the analysis it was found that the ground water and surface water in and around Vedanta Aluminium Limited (VAL), is not polluted.

Keywords: *Vedanta Aluminium Limited (VAL), Physico-chemical analysis, water*

1. Introduction

The importance of water for sustenance of life cannot be overemphasized and groundwater being a part of the hydrologic cycle needs attention for its proper evaluation and management not only to meet our need for the present but also for the future generations to come. Water is a boon to man by nature. It is acting as medium for most of chemical, biochemical reactions and highly essential for all human activities. Global Literature survey reveals that 70% of earth surface is covered by the water. Although it is surprising but in spite of such abundance of water, there is shortage of pure fresh water in the world because more than 97.3% of water is marine, which is unsuitable for human use. Only 2.7% of the total waters in the rivers, lakes, swamps, damp, and tanks are fresh and soft water which is suitable for human consumption and other uses. It has been also estimated that out of total fresh water 77.6% is in the form of 'cold storage' frozen in ice caps and glaciers. Most of the remaining supplies of fresh water 22.4% are ground water and soil moisture. Near about 0.35% of fresh water is contained in lakes and swamps and less than 0.01% in rivers and streams. It has been also estimated that only 0.00192% of the total water on the earth is useful for human consumption (S. M Dhonde and G. B Kulkarni, 2012). Fresh water is essential for agriculture, industry and human existence; it is a finite resource of earth. Without adequate quantity and quality of fresh water sustainable development will not be possible (N. Kumar, 1997, H.B Mahananda et al., 2005). But Fresh water resource are becoming deteriorate day-by-day at the very faster rate. Now water quality is a global problem (H.B Mahananda et al., 2005). In India almost 70% of the water has become polluted due to the discharge of domestic sewage and industrial effluents into natural water source, such as rivers, streams as well as lakes (Sangu .and Sharma, 1987). Sewage contaminated storm water out-falls and the dumping of industrial waste pose a major health and environmental hazard. The surface water is the main source of industries for waste disposal. Untreated or allegedly treated effluents have increase the level of surface water pollution up to 20 times the safe level in 22 critically polluted areas of the country. It is found that almost all rivers are polluted in most of the Stretches by some industry or the other (Modak et al., 1990 and Lokhande et al., 2011). Although all the Indian industries function under the strict guidelines of the Central Pollution Control Board (CPCB) but still the situation of environmental pollution is far from satisfactory. Different norms and guidelines are given for all the industries depending upon their pollution potentials. Most of the major industries have treatment facilities for industrial effluents. But this is not the case with small scale industries, which cannot afford enormous investments in pollution control equipment as their profit margin is very slender. Consequently, the water pollution problem particularly due to toxic heavy metals has become menacing concern. As a result in India there are sufficient evidences available related with the mismanagement of industrial wastes (Ram S. Lokhande et al., 2011). The day by day increasing tremendous industrial pollution in India has prompted us to carry the study of Physico-chemical properties of ground water and surface water in and

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around Vedanta Aluminium Company at Jharsuguda, Odisha. Jharsuguda is an upcoming industrial hub, basically in the metal and cement sectors. It is popularly known as the power house of Odisha due to large number of thermal power plants located nearby.

2. Study Area

Jharsuguda is located at 21°51′N 84°02′E21.85°N 84.03°E. It has an average elevation of 218 metres (715 ft.). Jharsuguda is situated at the western end of Odisha state. It is 515 km from Kolkata. State highway 10 and National highway 200 pass through Jharsuguda. The Ib River flows along the Western side of Jharsuguda town and the river Vheden flows in the south. The area of the town is 70.47 km^2. and population of 579,499 (as per 2001 Census).The town situated at 21.82° north longitude and 84.1° latitude at a height of 700–750 feet above mean sea level. The highest temperature recorded in summer is 48.0°C and it has an average rain fall of 1527 mm. It is an upcoming industrial hub, basically in the metal and cement sectors. It is popularly known as the power house of Odisha due to large number of thermal power plants located nearby. The Ib River flows along the Western side of Jharsuguda town and the river Vheden flows in the south. Vedanta Aluminium Limited (VAL), currently setting up a 0.5 million-tonne aluminium smelter and 135*9 MW captive power plant at Jharsuguda in Odisha, has chalked out a massive 4.6 billion dollar expansion for the project.

Figure-1 :Map showing location of study area .(Source-vedanta aluminium limited jharsuguda - Google Maps)

3. Materials and Methodology

Sampling

Ground and Surface water Samples were collected from in and around Vedanta Aluminium Limited at Jharsuguda, Odisha for analysis of various physical and chemical parameters .The different sampling locations is described below in table-1. Samples were collected and preserved by following the standard procedures prescribed by APHA 1995. All analytical work was carried out in the Lab of P.G Dept. of Environmental Science, F.M University, Balasore in the month of March 2013.

Table – 1: Sampling Stations

Sample no.	Source of Sample	Description
S1	Ground Water	From tube well inside Vedanta Plant
S2	Ground Water	From bore well inside Vedanta Plant
S3	Surface Water	From tributary of Vheden river which is mixed with the main river after crossing the Vedanta Plant
S4	Surface Water	From Vheden river bridge side adjacent to Vedanta (upstream)
S5	Surface Water	From Vheden river bridge side adjacent to Vedanta (downstream)

Methods for physico-chemical analysis of water samples

The water samples were analysed for nine physicochemical parameters i.e. pH, EC (Electrical conductivity), Total Hardness, Calcium hardness, Magnesium hardness, Chloride ,Iron, Phosphate and Sulphate . Samples were analysed in the laboratory by following the procedures prescribed by APHA (1995). pH of the samples was noted using potentiometric method using pH meter .EC is the measure of the ability of an aqueous solution to convey an electric current. This ability depends upon the presence of ions, their total concentration, mobility, valence and temperature. EC was determined by conductivity meter. Hardness of water is due to presence of dissolved calcium, magnesium, iron and aluminium compounds in it which prevent soap from lathering and increase its boiling point. These are present mostly as bicarbonates, sulphate and chlorides. Total Hardness, Calcium, Magnesium were measured by EDTA titration method. Chloride was measured by volumetrically by silver nitrate titrimetric method using potassium chromate as indicator and was calculated in terms of mg/L. The concentrations of Iron was determined by spectrophotometric method at 510nm. Sulphate from the water samples were determined by turbidity method using conditioning reagent and Barium chloride ($BaCl_2$) by spectrophotometer at 420nm. Phosphate from the water samples were determined by stannous chloride method.

Table-2: Physico-chemical parameters of different Water samples

Sl. No	Parameters	S1	S2	S3	S4	S5	IS:1O500
1	pH	7.4	7.3	7.7	7.6	7.5	6.5-8.5
2	Conductivity (µmho/cm)	170	150	730	280	400	-
3	Total Hardness(mg/l)	76	60	212	136	116	300
4	Calcium Hardness(mg/l)	9.619	12.825	35.27	24.048	19.238	-
5	Magnesium Hardness(mg/l)	12.669	6.822	30.212	18.517	16.568	-
6	Chloride(mg/l)	36.92	42.61	139.16	42.63	68.16	250
7	Iron(mg/l)	0.76	0.92	1.03	1.01	0.59	0.3
8	Phosphate(mg/l)	0.092	0.079	0.121	0.109	0.096	-
9	Sulphate(mg/l)	0.007	0.012	0.009	0.024	0.016	200

*All the values are in mg/l, except pH and otherwise stated

4. Results and Discussion

In the present study to evaluate the pollution status, the samples were analysed and its results were compared with the standard values of Indian water quality Standards. pH is a measure of the acidity or alkalinity of water and is one of the stable measurements. pH is a simple parameter but is extremely important, since most of the chemical reactions in aquatic environment are controlled by any change in its value. Anything either highly acidic or alkaline would kill marine life. Aquatic organisms are sensitive to pH changes and biological treatment requires pH control or monitoring. The toxicity of heavy metals also gets enhanced at particular pH. Thus, pH is having primary importance in deciding the quality of water .In present work the pH of the water samples was observed to be basic i.e., the value varies between 7.3-7.7 which indicates that the pH value ranges in between the permissible limit. Conductivity of the water samples is in between 150 – 400 µ mho/cm. Total hardness of the water samples were varied from 60 to 212 mg/l. Hardness is an important water quality parameter attributed due to presence of bi-carbonate, sulphate, chlorides and nitrates of calcium and magnesium. The range of calcium and magnesium are 9.619 to 35.270 mg/l and 6.822 to 30.212 mg/l respectively, which are well within the prescribed limit. The chloride content ranges from 36.92 to 139.16 mg/l which indicates that the chloride content is well within the norm. Sulphate ion is one of the most important anion present in natural water produces cathartic effect on human being when it is present above permissible limit. The sulphate concentration varied from 0.007 to 0.024 mg/l which indicates that in all the sample water, the sulphate values are well within the limit. Phosphate in drinking water indicates the degree of pollution of water system. The phosphate concentration in water samples varied from 0.079 to 0.121 mg/l which are well within the prescribed norm. But in case of iron, some samples having iron content is high as per drinking water standard. It ranges between 0.59 to 1.03 mg/l. Iron in excess of 0.3 mg/l creates problem in staining of cloths and utensils. Also higher concentration is not suitable for food, beverages, dying, bleaching and so many items. The above results are showing that the ground water and surface water quality in and around Vedanta Aluminium Limited is not polluted.

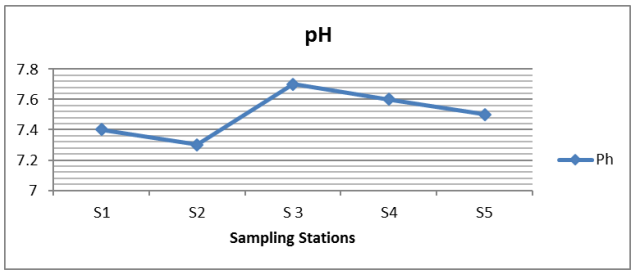

Fig.2-Values of pH in different Sampling stations

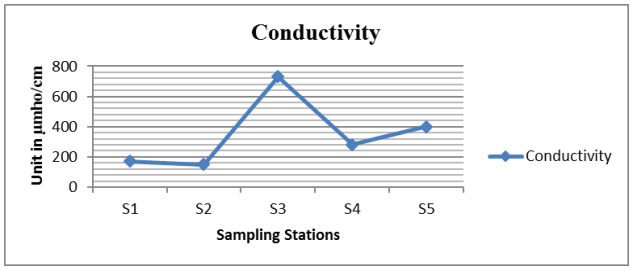

Fig.3-Values of Conductivity in different Sampling stations

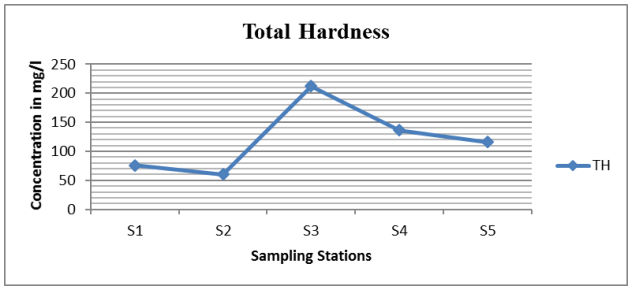

Fig.4-Concentrations of Total hardness in different Sampling stations

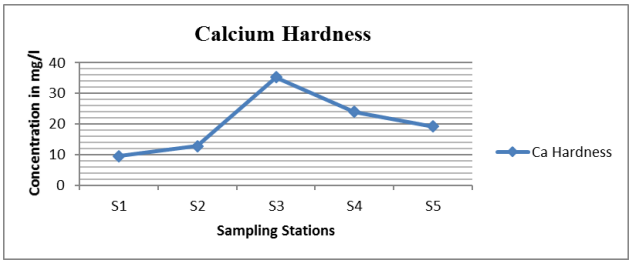

Fig.5-Concentrations of Calcium hardness in different Sampling stations

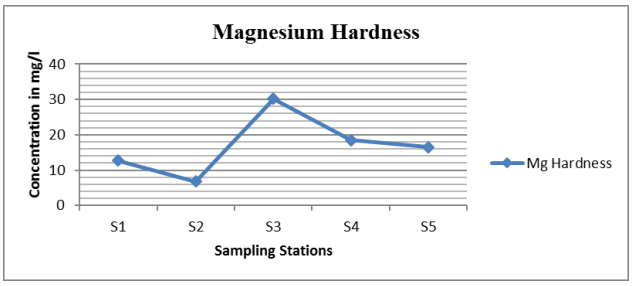

Fig.6-Concentrations of Magnesium hardness in different Sampling stations

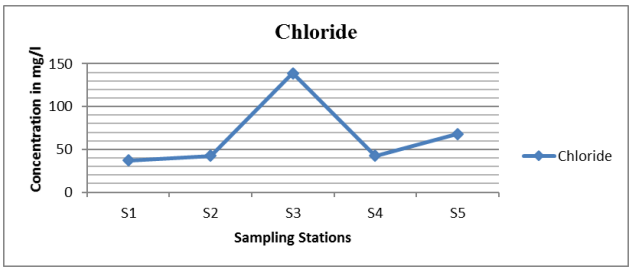

Fig.7-Concentrations of Chloride in different Sampling stations

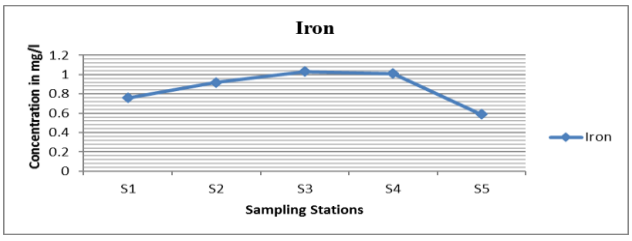

Fig.8-Concentrations of Iron in different Sampling stations

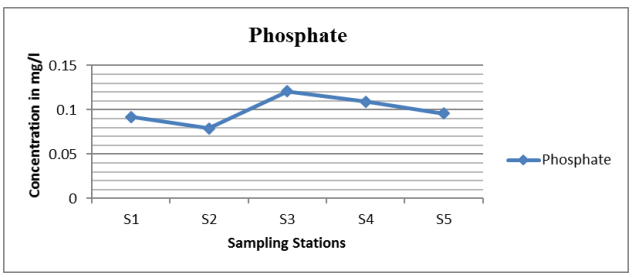

Fig.9-Concentrations of Phosphate in different Sampling stations

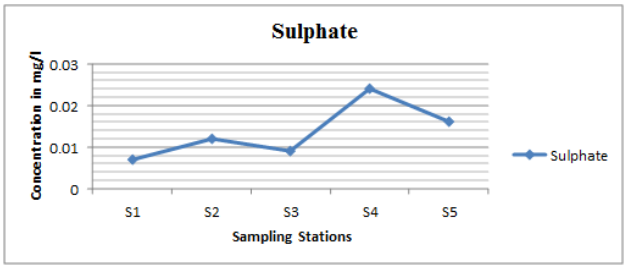

Fig.10-Concentrations of Sulphate in different Sampling stations

5. Conclusion

The major source of surface and ground water pollution is injudicious discharge of untreated industrial effluents directly into the surface water bodies resulting in serious surface and ground water pollution .From the present research study, it was concluded that although the Physico chemical parameters of ground water samples and surface water samples in and around Vedanta Aluminium Company at Jharsuguda, Odisha are somewhat in line with the safe limits of Indian standard for drinking water quality (IS: 10500) but the toxic level of harmful materials can mix up with the ground water if no precautionary measures were taken for effective treatment of the industrial effluents.

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