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Nitrate Pollution in Dug Well Water of Putki-balihari Colliery Area of Dhanbad District (Jharkhand)

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Abstract : The present Investigation was undertaken to ascertain the extent of Nitrate Pollution in Dug well water of a Coal Mining area of Dhanbad. The Nitrate content in water varied from 2 to 30 mg/l, 8-45 mg/l and 12-65 mg/l during December, 2006, March 2007 & June, 2007. It was observed that in 3 samples the Nitrate concentrations are very high. The principal source of Nitrate Pollution in the study area are municipal, industrial and agricultural wastes, out of which Industrial wastes are the most trouble some to control. In this area the removal of Nitrate is very necessary because high nitrates in water (above 45 mg/l) may cause methemoglobinemia in children.

Key words : Methemoglobinemia, Nitrate, Nitrosamines, Carcinomas.

Introduction

Drinking water is a major avenue by which toxic substances and pathogens can enter the human body. Presently most of the municipalities and corporations of India are observed to dump the town or city refuse in low-lying areas. The dumped wastes are known to seep slowly through the soil and contaminate the ground water sources. Modern agriculture is heavily dependent upon nitrogenous fertilizers. High quantity of this fertilizers is applied to soil to obtain higher productivity. A greater proportion of these nutrients is not consumed by the crops and is ultimately washed away to freshwater sources. Nitrate pollution is an important aspect of environmental problems. Due to rapid industrialization, artificial fertilizers activity and urbanization since independence and consequently possibility of nitrate pollution, however the problem of providing quality water for various human activities has become more critical now than ever before.

Putki-Balihari Colliery area is the largest colliery area in Dhanbad and is extending in all directions by population and industrial activity. Many villages have come up in outskirts of this area. This area have many soak pits and septic tanks which contribute nitrate pollution due to seepage into Dug well water. This area is also not covered with safe drinking water supply hence residents from these locations mainly depend on Dug well water. In this area Dug well receives considerable amount of pollutants due to indiscriminate discharge. The principal source of nitrate pollution in the study area are municipal, industrial and agricultural wastes, out of these, industrial wastes are the most trouble some to control. Nitrate pollution is causing lot of alarm and panic among the residents (Reddy *et al*., 1989). Therefore studies have been undertaken to obtain systematic assessment of nitrate levels in Dug well water in this area. The water from none of these Dug wells had ever before been analyzed for nitrate.

Site Description

The area under investigation is known as Putki-Balihari Colliery area situated in Dhanbad-Bokaro National Highway, 9 Kilometer away from Dhanbad Railway Station. This area was generally famous after the assistance of World Bank. It occupies a place of prominence for the production of coal. It is located in between 28° 27' N latitude and 86° 48' E. longitude at a height of 256.032 metres

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from main sea level. The rock of this area belong to a complex metamorphic group of Precambrian 1 (3000 Million years to 3500 million years or more). The average rain fall in this area is about 106.75 mm. It is the major coal producing area with a monthly capacity of 20.000 tons. This colliery complex has a population of about 70,000.

Materials and Methods

24 water samples were collected from 8 Dug well located in Putki-Balihari Colliery area (Table-1). These samples were collected in plastic buckets having one litre capacity in the month of March, 1997. Simultaneously the samples were also collected in three different seasons (December 2006, March, 2007 and June 2007) and Nitrate content variation was studied. The samples were analysed chemically for major cations (Na^+ K^+,Ca^{++}, Mg^{++}) and anions (Cl^-, SO_4^{2-}, CO_3^{2}, HCO_3^- and F^-) including other chemical parameters (pH. Electrical conductivity), by employing standard methods of analysis. Nitrate in water samples were analysed by ultraviolet method and use of spectrophotometer (APHA, AWWA, WPCF, 1978). The electrical conductivity of water and pH values were estimated respectively by conductivity meter (Systronics) and pH meter (Elico). Some of the experiments were carried out in the Laboratory of Central Mining Research Institute, Dhanbad.

Table 1 : Location of Dug Wells from Where Water Samples were collected.

Sample No.	Location
1.	Middle School Campus, Putki Bazar
2.	Near Electrical Transmission Circle, Putki
3.	Babutola, Putki
4.	Srinagar Ground Campus, Putki
5.	Mandir Campus, Srinagar, Putki.
6.	Bouri Tola, Putki.
7.	Near Putki Police Station.
8.	Aralgarhia, Putki.

Results and Discussions

Water samples were collected and analysed for Nitrate content in water and a summary is presented in Table 2,3 and 4. The Nitrate content in water varied from 2 to 30 mg/l, 8-45 mg/l and 12-65 mg/l during December, 2006, March, 2007 and June 2007 respectively. It indicted that Nitrate content in water was high by June, 2007 (Table-4). The magnifying level of Nitrate showed fertilizers of the soil entered into Dug well during rainfalls. Nitrates are contributed to freshwaters through discharge of sewage and industrial wastes and run off from agricultural fields. Some ground waters naturally have high nitrate concentration. Concentration above 45 mg/l can cause methemoglobinemia in children. Natural waters in India have been found to have nitrate concentration ranging from traces to 20 mg/l Table 2 shows the maximum and minimum concentration of nitrate as observed maximum concentration of Nitrate was observed as 250 mgl. It was observed that some of samples have high nitrate concentration was very high, but in 4 samples it was slightly higher. Most of the samples are in the range of 0-20 mg/l. The analaysed results show that the concentration of nitrate ion is considered to be negligible as compared to other anions are present in high quantity (Table-2).

Nitrate is known to cause respiratory deficiencies in aquatic animals (Liu and Kuo, 1994) and human beings (Broadberry *et al.*, 1994) by reacting with haemoglobin to form methomoglobin, thereby interfering with oxygen transport. The disease produced is called methemoglobinemia. This leads to various ailments as damage to respiratory and vascular system, blue colouration of skin and even cancer. This disease is also known as Blue-baby disease in infants. A healthy person contains 0.8% of methemoglobin where as in methemoglobinemia this level reaches to 10% in the blood. At above 20% there occurs headache, giddiness and above 60%, there begin consciousness, stiffness etc. At 80% death occurs Nitrate poisoning is frequent in Rajasthan due to hard and saline water. Several children have died due to this problem.

Table 2 : Physico-Chemical Characteristics of Dug Well Water of Putki Colliery Area (Dhanbad District).

Sl.No.	Properties	Minimum Mg/l.	Maximum Mg/l.
1.	PH	7.20	9.30
2.	EC (umho/cm)	340	8150
3.	CO32-	1	126
4.	HCO3-	3	809
5.	Cl-	38	1396
6.	SO42-	8	720
7.	Ca+	4	280
8.	Mg++	9	430
9.	NO3-	3	250
10.	CaCo3	32	1230

Table 3 : Percentage frequency of Nitrate in Dug well water of Putki-Colliery Area (Dhanbad District).

No3 range mg/l.	No. of Samples	Average values of Nitrate mg/l
0-20	12	3
20-50	5	30
50-100	4	72
100-500	3	140
500-1000	—	—
Above 1000	—	—

Table 4 : Seasonal Variation of Nitrate in Dug Well Water of Putki Colliery Area.

	Dec., 2006	March, 2007	June, 2007
Nitrate (mg/l.	December, 2006	March, 2007	June, 2007
	2-30	8-45	12-65

In 1976, there were cases of nitrate poisoning of cattle in Nagpur. In Rajasthan Nitrate levels in water are very high. 800 mg/litre which is much beyond the permissible concentration of 45 mg/l by WHO. Trivedy and Mathur (1986) observed hih nitrate concentration 1400 mg/l in ground water of Churu District (Rajasthan). The relationship between nitrate consumption and cancer is still controversial, but nitrosamines that can be formed by the reaction of nitrate with various proteins during digestion are known to be mutagenic and Carcinogenic (Weng *et al*, 1992). In southern China, positive correlations between the amounts of volatile n-nitrosamines in salted fish and the occurrence of nasopharyngeal carcinomas have recently been reported (Zou *et al*., 1994). According to Heckman *et al*., (1997), the combined amounts of nitrate and nitrite, as well as the low pH make several wells in and near Pocone, Mato Grosso (Brazil) dangerous as water resources. Nitrate may also react with creatinine (Present in vertebrate muscles) to form nitrosarcosine which can be carcinogenic(Simmons, 1974).

Conclusion

From the above investigations, it is clear that the dug wells are extensively used by all the peoples of this colliery area for drinking purpose. Some of the samples collected show high content of nitrate. This made the Dug well water unsuitable for drinking in some cases. Keeping the above background in view, some actions are perhaps necessary from the side of the Government as well as BCCL (a subsidiary of Coal India Ltd.) Firstly the future use of ground water by the Industrial Sector should be monitored and regulated keeping the overall perspective in view. Sewage connections should be provided where soak pits and septic tanks are located. If water supply has high nitrates, use of canned milk or food for babies must be banned. The children should be provided with vitamin 'C' containing food which increases the immunity to diseases.

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