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RESEARCH ARTICLE

STATUS OF WATER QUALITY OF LIME STONE MINING AREA OF CENTRAL INDIA

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ABSTRACT

Increasing open cast mining and industrialization increase in living standard which result decrease in quality of the water. Limestone mines water [Lime stone Mine 1st situated at industrial area, Lime stone Mine 2nd situated at sensitive area and Pond 3rd (Man made) situated at residential area were analyzed for various physico chemical parameters Air Temp, Water Temp, transparency pH, TDS, Conductivity, Free CO_2. Alkalinity, Hardness, chloride, PO4, DO, BOD, COD, ammonia, mercury, Ca and Mg ions. Result of this study shown that water quality of mine 1st and mine 3rd was not polluted but mine 2 is more polluted with very hard water .Data indicate that TDS, alkinity pH, hardness, ca and mg ions were found beyond the permissible limit of water quality. The mines 1st and mines 3rd water is useful for all purpose but mines 2nd water is not useful for domestic and drinking purpose and fish culture.

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INTRODUCTION

Water is the elixir of life and abounds on earth, but this vast natural resource has been depleted and turned into scarce commodity with increased usage catering to the needs of ever-expanding population. There is almost a global shortage of water and the world's most urgent and front rank problem today is supply and maintenance of clean drinking water. The climate change and spells of droughts have even stressed regional water tables. There are strides to fight the grim battle of acute shortages of water. The problems relating to water attract the attention to the urgency for investigating causes and suggest remedies in a bid to prepare future plan of action for maintenance of potable waters and related development issues. The maintenance of a healthy aquatic ecosystem is dependent on the physico-chemical properties of water and the biological diversity. A large number of streams and rivers in India have been impounded to store the water for multipurpose beneficial uses like irrigation, fisheries, power generation and drinking water supply. Now-a-days, the ecology of water bodies is under stressed condition due to fast pace of development, deforestation, cultural practices and agriculture. These activities trigger the rate of sedimentation of the mines bed characterized by silt and organic suspended material which initiates different sites with an objective to indicate changes in the quality of waters at the beginning and lower end of the reservoir. The study will be helpful in estimating the impact of the mines on various physico-chemical and biological parameters of the water

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MATERIALS AND METHODS

Study of area: The area is select for study is Katni district. Katni district is located at the Northeastern part of Madhya Pradesh. It forms the northern district of Jabalpur Commissonerate division. The Katni district extends from 23037' N to 24080' N from 79057' E to 80058' E and height from the sea level is 392 m.

About the mines: Madhya Pradesh state government website refers Katni as a city of lime. Mining has been a very important part of the economic history of modern Katni, and has been around for over 200 years. The district is dotted with numerous mines, mostly opencast, and of various sizes and for various kinds of repository. There are many mines in Katni. Some assert they number close to 400 in all. They are mines for bauxite ores, dolomite, limestone, and marbles. But limestone mine is very important in katni district.

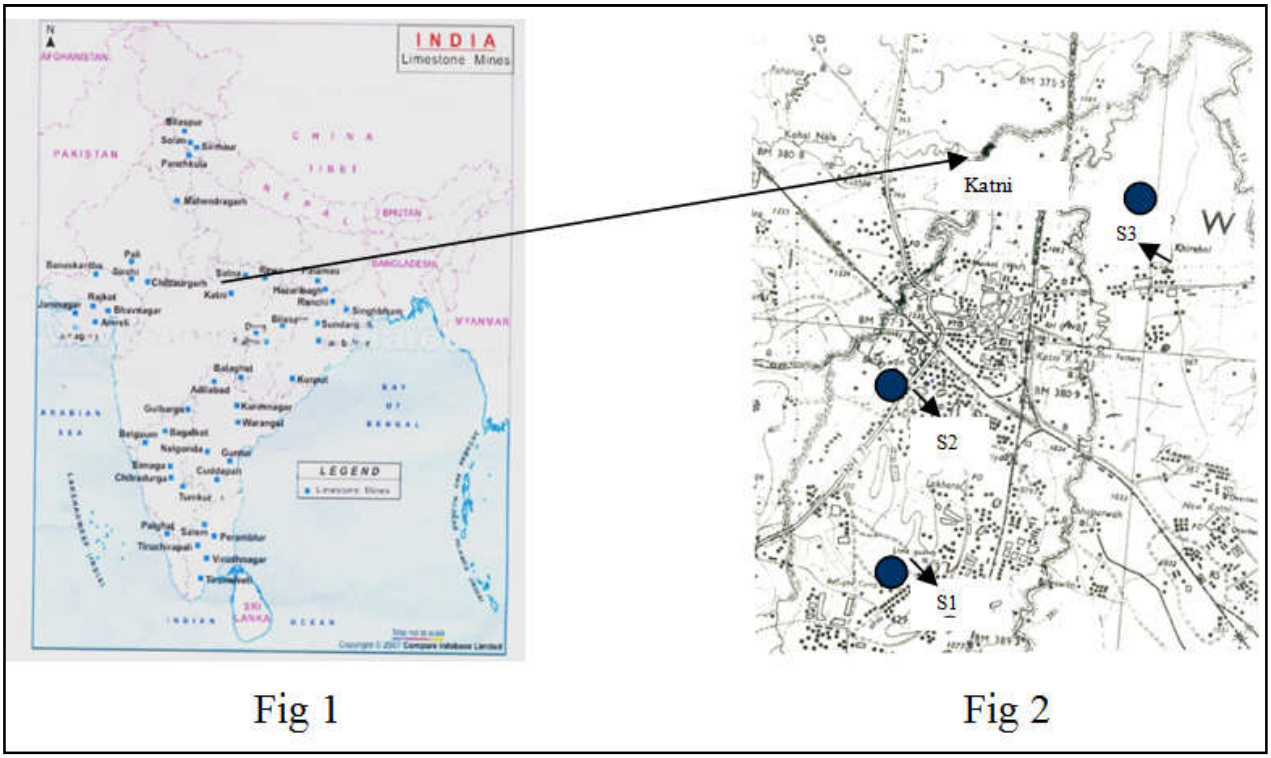

Fig. 1. Location of limestone mines Fig. 2. Location of samplings sites

Table 1. Minimum and maximum value of physico- chemical parameters lime stone mines stations during Dec. 2008 to Nov 2010

Physicochemical parameters	S1	S2	S3
Air Temperature°C	14.33-31.77	15.66-29.88	17.89-35.98
Water Temperature(°C	17.22-30.01	16.21-19.33	18.22-29.17
Transparency (M.)	15.2-25.7	14.4-20.6	20.3-31.5
conductivity-(m S/cm)	269.55-385.55	284.99-349.66	234.67-295.59
PH	7.2-8.7	8.4-8.9	6.8-8.1
Free C02 (mg/L)	NIL	NIL	NIL
alkalinity (Caco3) (mg/L)	59.5-89.2	58.2-83.1	64.1-90.1
Total Dissolved solids, (mg/L)	380.3-788.1	409.1-708.9	280.3-698.2
hardness (Caco3)(mg/L)	141.9-168.7	407.8-463.8	139.3-170.5
Calcium, (mg/L)	350.77-452.66	458.77-610.77	80.44-90.33
Magnesium (mg/l)	354.88-476.80	358.77-570.87	90.94-110.73
chloride, (mg/L)	39.08-123.33	60.99-140.33	30.88-45.88
COD (mg/L)	6.5-7.6	7.4-23.6	8.4-25.6
DO(mg/L)	6.8-7.5	2.33-4.44	8.5-8.2
BOD (mg/L)	4.3-5-4	3.8-7.9	3.2-8.9
Ammonia mg/l	0.078-0.096	0.087-0.092	0.065-0.098
Mercury (mg/L)	0.001-0.002	0.023-0.031	0.001-0.003
Phosphate, (mg/L)	0.032-0.062	0.031-0.069	0.056-0.63

The long period of association and the dominance of the activity enable the suggestion that a number of social and economic characteristics observed are linked to the existence of mining in the region. Katni has developed infrastructure to support its mining operation.

Selection of sampling points

1- Lime stone Mine 1st (S1) In the industrial area
2- Lime stone Mine 2nd (S2) In the sensitive area
3-Pond (Man made) (S3) In residential area

First two study Of sites mines were situated on left side of the city and man made pond was on the right side. The water of the mines is generally used for washing the clothes, drinking purposes and fish culture near the settlements.

Climate

The climate of the study area is tropical monsoonal with three distinct seasons. The atmospheric temperature ranged between a minimum of 8ºC in December and January, and maximum of 42ºC in June during the study period. The maximum rainfall (230 mm) occurred in July, whereas the humidity ranged from 47% (May) to 92% (January).

Methods

Following characteristics were analyzed in the study:

1. Physical Characteristics: The physical characteristics included temperature conductivity, turbidity, total dissolved solids (TDS),

2. Chemical Characteristics: The chemical characteristics included alkalinity, hardness, pH, dissolved oxygen (DO), chemical oxygen demand(COD), biological oxygen demand (BOD), calcium, magnesium, ammoniachloride and phosphate, The water were collected and analyzed from three study sites at monthly intervals during dec 2008 through nov 2010. All water samples for the estimation of different parameters were collected in the early hours of morning on a specified date. The samples were pretreated in the field to fix the samples and immediately brought to the laboratory for an on spot physical, chemical and biological analysis of various parameters following the standard methods (APHA, 1998) Trivedi and Goel (1984).

RESULTS AND DISCUSSION

The quality of natural water is generally governed by various physico-chemical parameters. The maximum and minimum values for various parameters during the study period are presented in Table 1.

Air temperature

Measurement of temperature is an important parameter required to get an idea of self-purification of reservoirs and lakes. Air temperature plays an important role in aquatic ecosystem health. The temperature of drinking water has an influence on its taste. The minimum value of air temperature found in winter season in mine 1^{st}14.33 and maximum value is 35.98 found in summer season of mine 3^{rd}.

Water temperature

The maximum and minimum temperatures of mines water were observed in the months of June and January respectively on all the sites. Values ranged between 17.22-29.17 0C. Steady change in the atmospheric temperature with the change in the seasons results in the corresponding change in the water temperature. There is a very close similarity between the temperature of atmosphere and water due to the depth of mines water. High summer temperature and bright sunshine accelerate the process of decay of organic matter resulting into the liberation of large quantities of CO2 and nutrients.

Turbidity

The maximum value of turbidity was recorded during July to September (monsoon period) and minimum during winter period on all the sites. The increased turbidity during rainy months was attributed to soil erosion in the nearby catchment and massive contribution of suspended solids from sewage. Surface runoffs and domestic wastes mainly contribute to the increased turbidity of the reservoir. But in this region, the suspended solids play an important role in governing the turbidity, which enter the mines water through land erosion.

Conductivity

Conductivity is a numerical expression of the ability of an aqueous solution to carry electric current. This ability depends on the presence of ions, their total concentration, mobility, valence and relative concentrations and on the temperature of measurement.

Total dissolved solids (TDS)

The values of TDS were maximum in the months of April and May. The minimum values were observed in the months of June on sites 1 and 2, and in August on site 3 (Table).

Alkalinity

Alkalinity of water is a measure of weak acid present in it and of the cations balanced against them. Alkalinity plays an important role in controlling enzyme activities. Maximum and minimum values of alkalinity on different sites of the present study showed variations in different months).

Hardness

The water hardness on all study sites of mines water was higher during summer months which might have caused increased concentration of salts by excessive evaporation as also observed by Bhatt *et al*. (1999). The hardness of mines increases in the polluted waters by the deposition of calcium and magnesium salts).

pH

The pH is affected not only by the reaction of carbon dioxide but also by organic and inorganic solutes present in water. Any alteration in water pH is accompanied by the change in other physicochemical parameters. pH maintenance (buffering capacity) is one of the most important attributes of any aquatic system since all the biochemical activities depend on pH of the surrounding water. In the present study, the range of pH on the study sites was between 7.2 to 8.1. pH increased during summer months and decreased during monsoon and winter months. Maximum values during summer may be due to increased photosynthesis of the algal blooms resulting into the precipitation of carbonates of calcium and magnesium from bicarbonates causing higher alkalinity. The decrease in pH during winter may be due to decrease in photosynthesis, while during monsoon it may be due to greater inflow of water.

Dissolved oxygen (DO)

DO is a very important parameter of water quality and an index of physical and biological process going on in water. In the present study, the maximum concentration of dissolved oxygen was observed in the month of June after the snow melting due to heavy rainfall, which favors solubility of oxygen among the study sites. The highest concentration (8.56 mg/l) was recorded on site 2 but the range was not narrow for other sites. A definite trend in DO concentration was observed on all the sites showing highest values in June and lowest in September. DO is of great importance to all living organisms. It may be present in water due to direct diffusion from air and photosynthetic activity of autotrophs. Concentration of DO is one of the most important parameters to indicate water purity and to determine the distribution and abundance of various algal groups.

Chemical oxygen demand (COD)

COD is a measure of pollution in aquatic ecosystems. It estimates carbonaceous factor of organic matter. The range of values of COD in the present study was 5.9 to 39.4 mg/l. The maximum values of COD at sites 2 and 3 indicated the higher degree of pollution compared to that of site 1. Higher concentration of COD in summer and rainy months may be due to high temperature and higher concentration of suspended and dissolved solids.

Biochemical oxygen demand (BOD)

BOD is the amount of oxygen required by the living organisms engaged in the utilization and ultimate destruction or stabilization of organic water (Hawkes, 1963). It is a very important indicator of the pollution status of a water body. The values of BOD clearly showed higher concentration during most of the summer and rainy months and comparatively low during winter months. Many workers like John (1952), Robert (1969) and Richard (1966) showed higher BOD during summer due to low level at river discharge. This is supported by the results of present study (0.3 to 4.7 mg/l) as the river had low flow during the winter season.

Free carbon dioxide

Free carbon dioxide in the waters accumulates due to microbial activity and respiration of organisms. This imparts the acidity to the waters because of the formation of carbonic acid. Free co2 of all station was nil.

Chloride

Chloride is one of the important indicators of pollution. Chlorides are present in sewage, effluents and farm drainage. The value of chloride concentration in the present study was highest on site 2 (140.3 mg/l) and site 3 (30.88 mg/l). These values are usually in the lower range of values for different rivers of India (Sabata and Nayar, 1995). The low value in the present study may be attributed to the absence of major pollutants.

Calcium

Calcium is essential for all organisms and regulates various physiological functions. The calcium ions contribute to the hardness of water. The concentration of calcium was highest in the month of April on sites 1 and 3, and in May on site 2.

Magnesium

Magnesium occur in all kind of natural water but its cocentratration is lower than calcium .the minimum value of magnesium is 90.94 and maximum value is 570.87 of the site 2.

Phosphates

Phosphorus is a nutrient for plant growth and a fundamental element in the metabolic reaction of plants and animals. It controls algal growth and primary productivity. In most natural waters, phosphorus ranges from 0.005 to 0.020 mg/L. Algae require only small amounts of phosphorus. Excess amounts of phosphorus can cause eutrophication leading to excessive algal growth called algal blooms. minimum value of po4 is 0.031 and maximum value of po4 is 0.056 of all 3 side

Mercury

The major source of mercury in the environment is the natural degassing of the earth's crust. It can exist in the environment as the metal, as monovalent and divalent salts and as organo-mercurides, the most important of which is methyl mercury. Methyl mercury may be produced from organic mercury by microorganisms found in aquatic sediments. Inorganic mercury compounds are readily accumulated in the kidney. The major effects of mercury poisoning take the form of neurological and renal disturbances, which are primarily associated with organic and inorganic mercury compounds. The greater toxicity of methyl mercury compared to inorganic mercury is due to its lipid solubility, which permits it to cross biological membranes more easily than inorganic mercury, especially in brain, spinal cord and peripheral nerves and across placenta. The minimuto imptthe m value of mercury is 0.001and maximum value of 0.023 of all side.

Conclusion

The present study deals with following conclusion

- Result of this study shown that water quality of station 1 and station 3 was not polluted but site 2 is more polluted with very hard water.
- Data indicate that TDS alkinity pH hardness ca and mg ions were found beyond the permissible limit of water quality.
- The site 1 and site 3 is useful for all purpose but site 32 is not useful for peoples health and fish culture.
- To improve the water quality of water there should be continuous monitoring of the pollution level of the site 2.

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