Evaluation of Physico- chemical parameters of Narmada river, MP, India

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Abstract: The Narmada, also called Rewa is a river in central India and the fifth largest river in the Indian subcontinent. The bank of Narmada river is covered by tribal people, and their daily wastes are drained into this holy river, which alters the Physico-chemical parameters of the river. The present study was carried out for a period of one year from August 2009 to July 2010 to enumerate the various Physico-chemical parameters of Narmada river. Water samples were taken from sampling stations every month and were analyzed as per standard methods. Maxima of Phosphate, Nitrate, Alkanity and Sulphate were recorded in September and October and Maxima of Temperature, pH, Chloride and Total hardness were observed during summer. Transparency was recorded maximum in winter and minimum in rainy season. DO concentration was higher in winter and lower in summer. The results indicated that most of the Physico- chemical characteristics of Narmada water samples were within the WHO limits.
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Key words: - Narmada river, Physico chemical, water quality, parameters.

Introduction

Water is one among the prime necessities of life required for growth and activity of all living beings on globe. Only small amount of water that occurs in fresh water rivers, streams, lakes and tanks is available for the terrestrial life (Wetzel 1975). Rivers and streams have become the dump yards of domestic sewage and industrial effluents. Alarming increase in human population and unethical urbanisation has lead to the pollution of fresh water bodies to a great extent. Rivers are the major sources of drinking water, besides their usage in agriculture, washing, bathing etc. Pollution of these may invite unhygienic conditions and water born infectious diseases not only for humans but also the biota depending and living in it.

India's river system ranges from 14 major rivers, 44 medium sized rivers to 55 minor rivers with total linear length of 45,000 km. Some of the largest rivers in the world are in India and 80% of the total length is covered by 14 major rivers Belsare (2006). Bandyopadhyay (2007) summarized the characteristic features of river basins of the Indian subcontinent. There is a wide spatial and temporal variation in the precipitation and great diversity in the geo-hydrological features.

Among rivers, Narmada is considered one among the important rivers of the country and is the largest west-flowing river in India, originates from the Mekhala range in Shahdol district (M.P.), at an elevation of 1051 meters (Gazetteer of Hoshangabad, 1979). It flows 1300 km west through the states of Madhya Pradesh and Gujarat before draining into the Gulf of Khambhat in the Arabian Sea. It is said to be one of the most beautiful rivers in India. In terms of its catchment area it is the seventh largest among the fourteen major river basins in the country. With many short tributaries flowing into it from north and south, the Narmada basin forms a very important topographic feature of peninsular India.

Materials and Methods

Study Area:

The Narmada basin, hemmed between Vindya and Satpuda ranges, extends over an area of 98,796 km^2 and lies between east longitudes 72 degrees 32' to 81 degrees 45' and north latitudes 21 degrees 20' to 23 degrees 45' lying on the northern extremity of the Deccan Plateau. The basin covers large areas in the states of Madhya Pradesh (86%), Gujarat (14%) and a comparatively smaller area (2%) in Maharashtra. The river Narmada receives 41 principal tributaries (Alvares and Ramesh 1988), each with a catchments area exceeding 500sq. kms. Out of these 22 (21 in MP and 1 in Gujarat) joins the river from left bank and 19 (18 in MP and 1 in Gujarat) from right bank (Ghosh et al 2004). The total length of these principal tributaries is 3387 Kms.

Sampling stations:

(A) Indra Sagar Dam (S1)

Indra Sagar Dam is 10km away from Punasa village in Khandwa district of western Madhya Pradesh. It is 653 m long concrete gravity dam with a slightly curved alignment. It is about 92 m high from the deepest foundation level. Its catchment area is 61542 sq. kms.

Its longitude is 76°28'00'' and latitude 22°17'00''.

(B) Omkareshwar (S2)

Omkareshwar is a famous place of pilgrimage situated 77 km from Indore in Khandwa District, Madhya Pradesh. This station has a religious importance and is visited by pilgrims from all over the country to seek blessing at the temple of Shri Omkar Mandhata.

It's Latitude 22º15, 1"N and Longitude 76º8', 48"E.

(C) Maheshwar (S3)

Maheshwar is a small town in Khargone district of Madhya Pradesh state in central India. It is located 91 km away from Indore, the commercial capital of the state. The town lies on the north bank of the Narmada River.

It's latitude 22º10', 60"N and longitude 75º34' 60"E.

Water analysis

The water samples were collected from the three selected sampling stations viz., Indra Sagar Dam (Punasa) = S1 , Omkareshwar = S2 and Maheshwar = S3 in the Narmada River for the period of one year from August 2009 to July 2010. In the analysis of the physico- chemical properties of water, standard method prescribed in limnological literature were used. Temperature, Transparency, pH, Dissolved Oxygen were determined at the site while Biochemical oxygen demand, Chloride, Phosphate, Nitrate, Alkanity, Sulphate, Total Hardness were determined in the laboratory. The Physico- Chemical parameters were determined by standard methods of APHA (2002), Welch (1998), Golterman (1991). All the chemicals used were of AR grade.

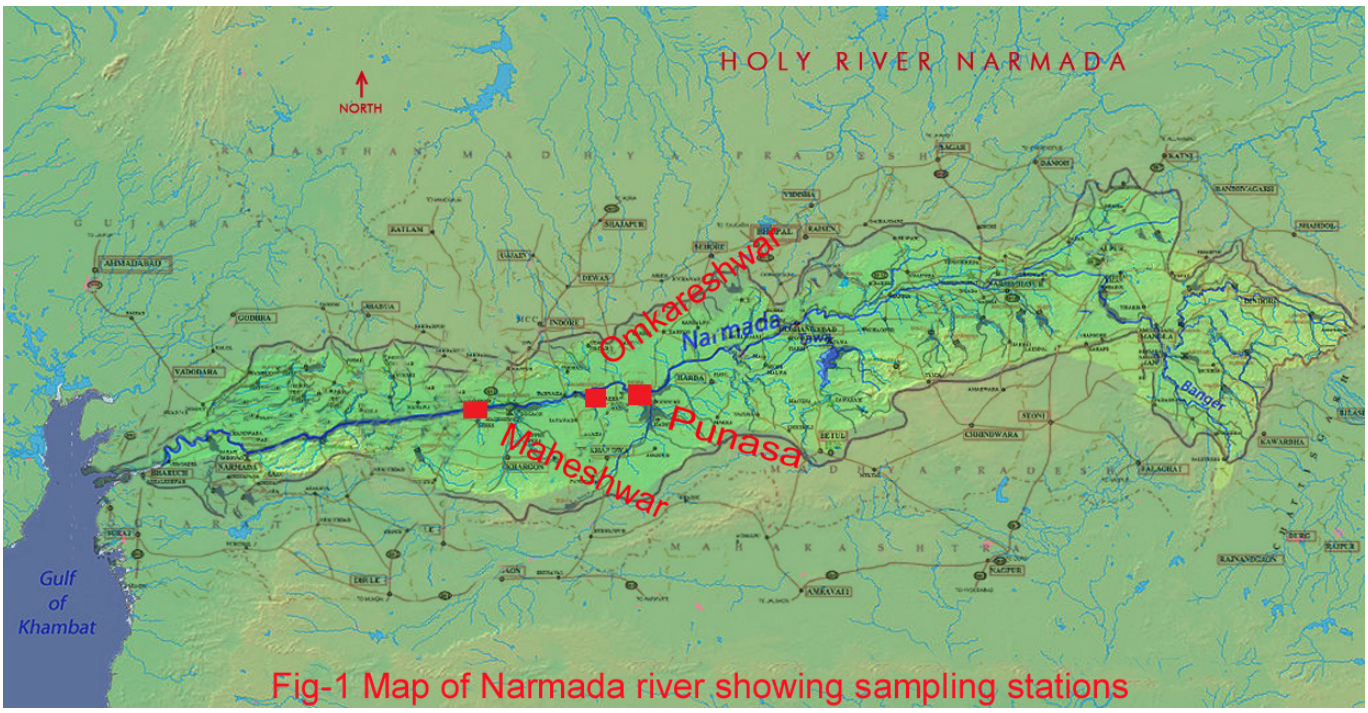

Fig-1 Map of Narmada river showing sampling stations


Fig-1 (a): anthropogenic activity at S2


Fig-1 (b) View of S1

Result and Disscussion:

Temperature:

Temperature is one of the most important parameters that influence almost all the physical, chemical and biological properties of water and thus the water chemistry. In the present study temperature varied from 20°C to 33°C. The minimum temperature was recorded in the month of January at S2 and maximum was recorded in the month of May at S1. In the present study water temperature was recorded between 20-33°C (Fig-2). Sharma et al (2001), Yogesh et al (2001) also reported the same type of fluctuation in various freshwater bodies.

Transparency:

Transparency is a characteristic of water that varies with the combined effect of colour and turbidity. It measures the depth to which light penetrates in the water body. In the present study the value of transparency varied from 12 cm to 53cm (Fig-3), the maximum transparency was recorded at S1. The transparency of the river was found to be lowest (12 cm) during rainy season and highest (53 cm) in winter. Reduced transparency during rainy season may be due to erosion of soil carried by runoff from the catchment areas. Jain and Sharma (2000) also reported lowest transparency in rainy season and maximum in winter.

pH:

pH–Potential of hydrogen, is the measure of the concentration of hydrogen ions. It provides the measure of the acidity or alkalinity of a solution. In the present study the observed pH values ranging from 7.4 to 9.1 show that the present water samples are slightly alkaline (Fig-4). These values are within maximum permissible limited prescribed by WHO (1993). Our results tally with the findings of Sharma et al (2004).

Dissolved Oxygen (DO):

Dissolved oxygen in natural and waste water depends on the physical, chemical and biological activities in the water body. Dissolved Oxygen (DO) content, plays a vital role in supporting aquatic life and is susceptible to slight environment changes. DO an important limnological parameter indicating level of water quality and organic pollution in the water body (Wetzel and Likens, 2006). In present study concentration of DO in Narmada water samples varied from 6.3 mg/l to 9.0 mg/l with minimum in the month of May at S1 and maximum in the month of January at S1 and S2 (Fig-5). The present study reports a gradual decrease in DO from winter to summer. The seasonal variation of DO in water depends upon the temperature of the water body which influences the oxygen solubility in water.

Biochemical oxygen demand:

The biochemical oxygen demand, abbreviated as BOD, is a test for measuring the amount of biodegradable organic material present in a sample of water. In present study the BOD was ranged between 0.28 mg/l to 1.20 mg/l with minimum at S2 in the month of January and maximum at S1 in the month of May (Fig-6). In the present study usually the BOD values were obtained maximum in summer months at all sampling stations, which might be due to high temperature, this inurn promotes microbial activities and minimum BOD values obtained in winter might be due to low temperature and sufficient amount of water in the

river. Similar observations were confirmed by many other workers such as Pathak and Mudgal (2005), Khanna (2003).

Chloride:

Chloride is one of the major inorganic anion in water and waste water. In present study the values of chloride varied between 17 mg/l to 54 mg/l with minimum in December at S3 and Maximum in June at S1 (Fig-7). Seasonally, the values were highest in summer and lower in winter and intermediate values were recorded in rainy season. Similar results have been observed by Tripathi (1982) and Shukla et al (1989) and Ahmad (2004).

Phosphate:

Phosphorous is one of the most important nutrients limiting the growth of autotrophs and biological productivity of the system. High phosphorus content causes increased algal growth, often as blooms, till nitrogen becomes limiting. During the present study the values of phosphate fluctuated between 0.14 mg/l to 0.98 mg/l. the maximum phosphate was recorded at S3 in the month of September and minimum was also recorded at S3 in the month of April (Fig-8). The values of phosphate were recorded highest in monsoon season and were lowest in the summer season. Similar values were also observed by Jain (2000). The increased use of fertilizers, use of detergents and domestic sewage greatly contribute to the heavy loading of phosphorus in the water.

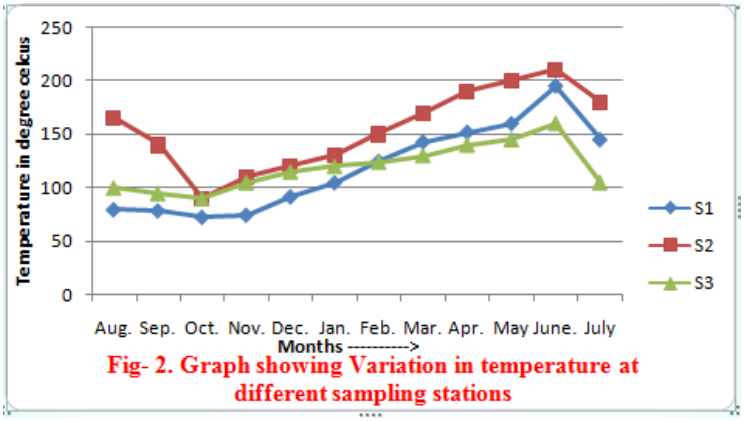

Fig- 2. Graph showing Variation in temperature at different sampling stations

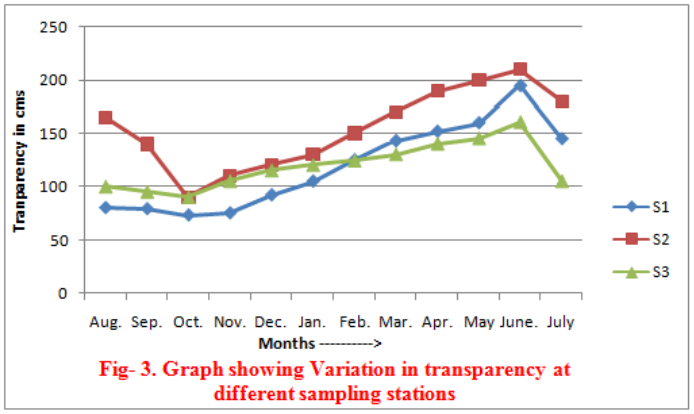

Fig- 3. Graph showing Variation in transparency at different sampling stations

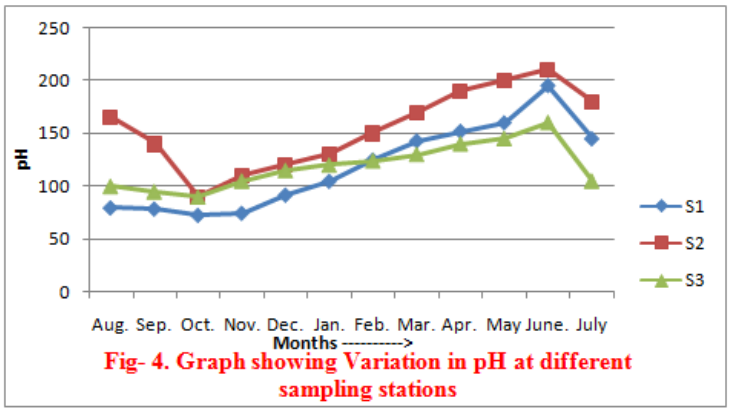

Fig- 4. Graph showing Variation in pH at different sampling stations

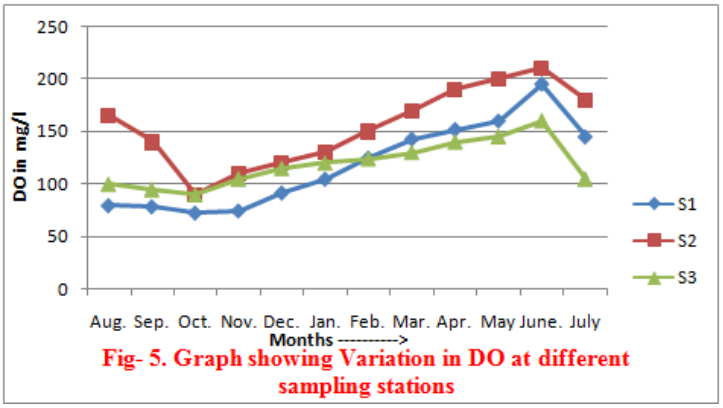

Fig- 5. Graph showing Variation in DO at different sampling stations

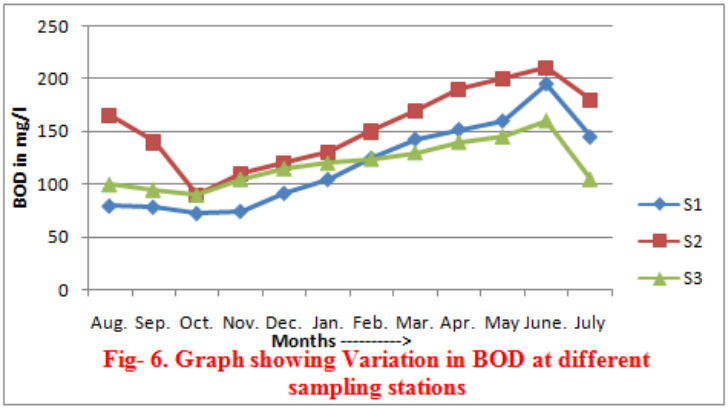

Fig- 6. Graph showing Variation in BOD at different sampling stations

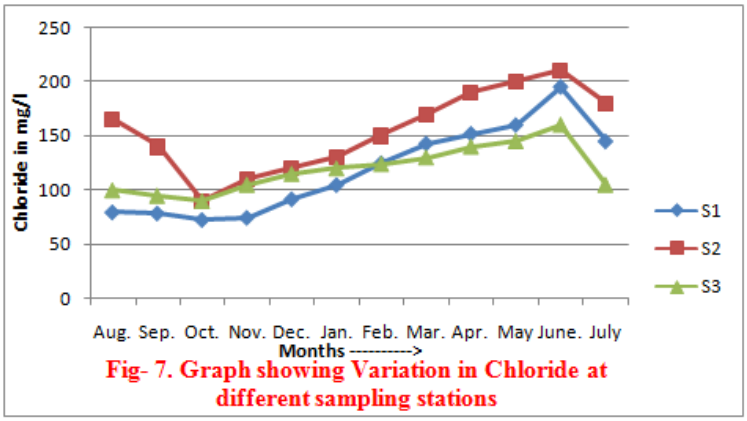

Fig- 7. Graph showing Variation in Chloride at different sampling stations

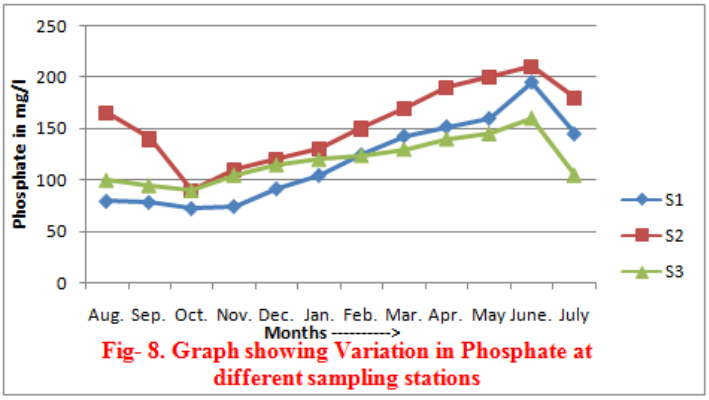

Fig- 8. Graph showing Variation in Phosphate at different sampling stations

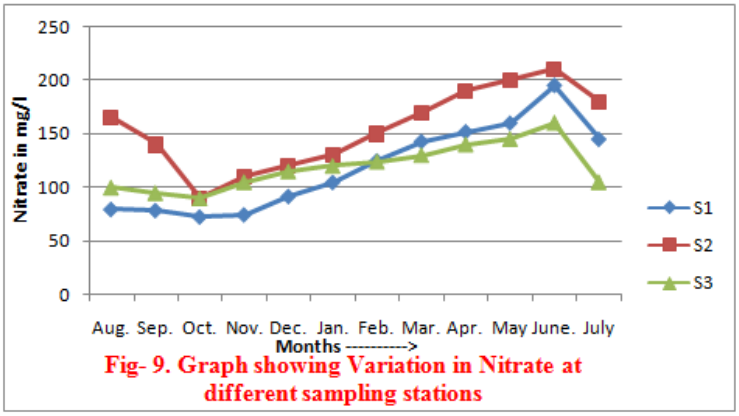

Fig- 9. Graph showing Variation in Nitrate at different sampling stations

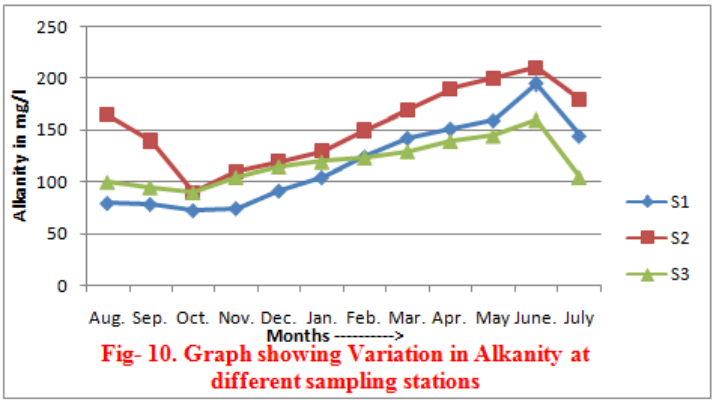

Fig- 10. Graph showing Variation in Alkanity at different sampling stations

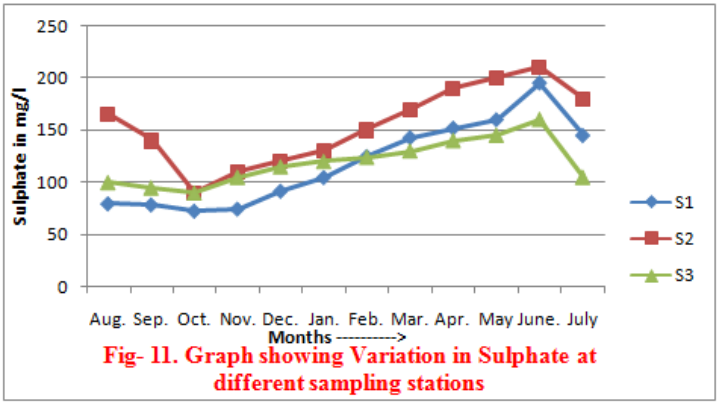

Fig- 11. Graph showing Variation in Sulphate at different sampling stations

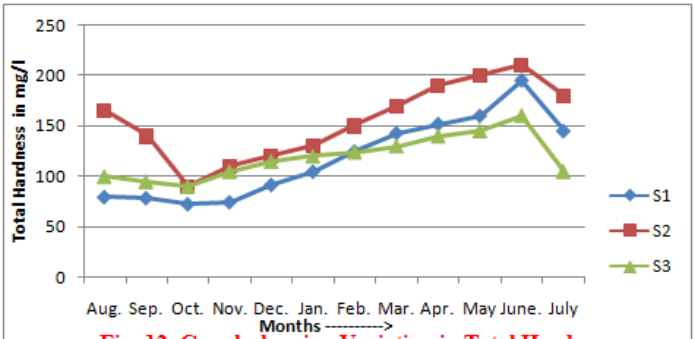

Fig- 12. Graph showing Variation in Total Hardness at different sampling stations

Nitrate:

Nitrates are the most oxidised forms of nitrogen and the end product of the aerobic decomposition of organic nitrogenous matter. Nitrogen is an essential building block in the synthesis of protein. The evaluation of nitrogen is therefore an important parameter in understanding the nutritional status of water bodies. The concentration of nitrate in Narmada water was found to be in the range of 0.17 mg/l to 0.89 mg/l. Minimum nitrate concentration was recorded at S2 in the month of May and minimum was also recorded at S2 in the month of September (Fig-9). Nitrate is attributed mainly due to anthropogenic activities such of run of water from agricultural lands, industrial wastes, discharge of house hold and municipal sewage from the market place and other effluents containing nitrogen. Such observations were also reported by Royer et al (2004).

Alkanity:

Alkanity of water is a measure of weak acid present in it and of the cations balanced against them (Sverdrap et al 1942). The observation of alkanity reveals that the monthly variation ranged from a minimum of 100 mg/l at S2 to a maximum of 230 mg/l at S2. Seasonally the values were highest in the post monsoon season, gradually decreases n winter months and were recorded lowest in the summer season (Fig-10). Same results were also reported by Choubey (1991) and Sharma et al (2004).

Sulphate:

Sulphates are found appreciably in all natural waters, particularly those with high salt content. Besides industrial pollution and domestic sewage, biological oxidations of reduced sulphur species also add to sulphate content. Soluble in water, it imparts hardness with other cations. Sulphate causes scaling in industrial water supplies, and odour and corrosion problems due to its reduction to hydrogen sulphide. The observation of sulphate reveals that the monthly variation ranged between 4.1 mg/l and 9.2 mg/l. Minimum sulphate was recorded at S3 in the month of March and maximum was recorded at S1 and S3 in the month of September (Fig-11). Similar fluctuation in sulphate values were reported by Sharma et al (2004) in Yashvant Sagar reservoir India.

Total hardness:

Total hardness is the parameter of water quality used to describe the effect of dissolved minerals (mostly Ca and Mg), determining suitability of water for domestic, industrial and drinking purposes and attributed to presence of bicarbonates, sulphates , chloride and nitrates of calcium and Magnesium (Taylor 1949). The observation of total hardness reveals that the monthly variation in the water samples of Narmada river ranged between 73 mg/l to 210 mg/l with minimum at S1 in the month of October and Maximum at S2 in the month of June (Fig-12). The lower values of hardness in post monsoon might be due to settlement of anions and cations.

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