Comparative Study of Seasonal Variation InPhysico-Chemical Properties of Ponds Around Thermal Power Plants At Warora, Chandrapur(Ms).

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Abstract

Water pollution is very common. It does not follow any mathematical route for its growth. It depends on increase in population and industrialization. In study area the problem of water pollution is a serious problem. This problem increases with the industrial revolution. In order to evaluate the quality of surface water in study area five water samples from different ponds surrounding thermal power plants Warora were collected in summer, monsoon and winter season in year 2014 and analyzed for different physico-chemical parameters such as temperature, conductivity, pH, TDS, turbidity, chloride, total alkalinity, hardness, calcium, magnesium, sulphate, The analysis of various parameters carried out using standard methods (APHA/NEERI) and then compared the value of different seasons and also with the standard guideline values recommended by the BIS (1991). Result of analysis shows that most of the parameters are within permissible limits but different ponds follows particular trend of variation for different parameters which depends on surrounding area. The Present paper deals with the contamination of water sources and seasonal variation in physico - chemical properties of water surrounding thermal power plant at Warora, Chandrapur.

Keywords: Ponds, seasonal comparison, Physico-Chemical Parameters, Thermal Power Plants ,Warora.

Introduction:

Coal-based thermal power is extremely water-intensive way to generate energy. In the last 20 years, India's power generation has tripled and the water requirements for power generation more than doubled. India now aims to add 100 GW of new capacity in the 12th Plan period, which at an 80% coal share will consume at least another 2,500 – 2,800 million cubic meters of water per year. Assuming 70% will be inland this is the equivalent irrigation water of up to 400,000 hectares of farmland (Grace Boyle et. al.2012). In recent years the global energy demand has increased with the advances in industrialization and this has been largely met by fossil fuels. Coal combustion in thermal power plant contributes to 52.32% of total electricity generation in India. Conventional generation of electricity from fossil fuels based sources like coal results in serious environmental problems reaching local and global implications. Major environmental problems associated with the use of coal in thermal power plant are likely contamination of air, water and land environment affecting the livelihood of the local people. Effluents from thermal power plants include ash bund disposal, thermal discharges, waste water effluents, cooling water, material storage runoff, metal cleaning waste water and sanitary waste water. Pollutants from industrial waste enter into the environmental system and then in to food chain, which affects the animal and human health. In thermal power plant water slurry is used to take the ash from the power plant to the ash pond for the disposal. There are two impacts associated with ash decant. The first point is that, this water slowly sleeps in to ground while carrying with it the ash lichgate. The water may contain harmful substances which have tendency to letch out over the period of time. Due to this ground water is polluted and

unsuitable for domestic use. Second factor affecting the water environment is release of ash pond in to local water bodies, such release increases turbidity of water bodies by decreasing the productivity. The leaching potential of ash ponds is higher due to diurnal and seasonal variations in temperature, Moisture and other parameters.

Study area- The Warora town is located in eastern Maharashtra at 20.23°N 79.0°E. It is a city & municipal council in Chandrapur district in the state of Maharashtra. During British Raj, the town was a part of central provinces and was coal mining centre. In Warora, a charity trust for leprosy treatment well known as 'Anandwan' is established by late Shri. Baba Amte&SadhanataiAmte. Warora is developing city since last five years due to industrialization. Industrial boom caused rapid growth of population and pollution which brought enormous problems and degradation of the environment.

Wardhawarora power plant is a coal based thermal power plant located at warora in Chandrapur district. The power plant is operated by KSK energy venture. It is a 540MW (4×135) project. These four units were commission in 2011. EMCO energy power plant is another power plant in warora. It is a 600MW (2×300) coal plant. The two units were commissioned in 2013. Wardha River flows nearly 6 km from these power plants. Source of water Wardhariver. The water for condenser cooling is pumped from Wardha River and water is returned after cooling in the cooling tower. The liquid effluents from the thermal power plants are being released to nearby streams. Naidev is a nearest village which is located just besides these thermal power plants and Nimsada village is located just 1km in the north east of the power plants.

Thermal Power Plants established in Warora greatly harms the natural environment. According to the results from the interviews with the local people, they are uneasy about their health because the power plant is very close to their settled area. In addition to this farmers are facing tremendous problems due to polluted water released in "DahiwalNala (TaasNala)" flowing through local villages nearby these industries. Due to the effluent discharge by the thermal power plants colour of water of DahivalNala changes to blackish brown after exit from power plant. According to news published in daily Lokmat dated 25th May 2013, eight goats and many fishes were killed by drinking polluted water released by thermal power plants. Opposition from local resident has intensified due to land and air pollution impacts, fly ash contamination of ground water, effect of thermal discharge on fisheries and other impacts.

The chemicals used in the process of water treatment before releasing in to the receiving environment cause a wide range of contamination. Thermal power plants create such variety of waste pollutant. In this perspective water recycling and reuse of treated effluent in high water consuming industrial sectors seem be to be a viable alternative to save valuable resources.

The suitability of water for drinking and other domestic use is determined by keeping in view the effect of various chemical constituents in water on biological system of human being and other living organism. The objective of this study is to

assess the environment impacts of effluent discharge on the surrounding environment focusing on the surface water quality in the vicinity of thermal power plant and also seasonal variations according to climatic conditions.

Experimental Section

To assess the water quality in study area water samples from five different ponds surrounding thermal power plants were collected in summer, monsoon and winter season. The samples were collected in sterilized polythene bottles and prior to the sampling all the sampling containers were washed and rinsed with the distilled water. Sampling points were chosen to cover all different directions of thermal power station after preliminary survey of area. The samples were collected & measured temperature with the help of thermometer. Then were sealed and brought to the environment laboratory for analysis. Various Physico-chemical parameters were analyses as given in standard manual of water and waste water analysis (APHA/NEERI).

Result and Discussion

Generally Ponds contain uniform water solution which undergoes constant physico-chemical changes due to change in the environment. Area surrounding the ponds also widely affects the water quality composition. Difference in result is found between different ponds in different season. Results of the Analysis of physico-chemical parameters obtained from this study are discussed bellow.

Temperature: Temperature is an important factor and all life processes are accelerated or slowed down by temperature changes in the environment. It influences the solubility of gases and salts in water. Volume as well as density of water depends upon temperature. During the present study it was noted that the water temperature fluctuated between 21°C and 31°C. Summer and monsoon season recorded comparatively same temperature and minimum temperature is recorded in winter season. Present study suggested that water temperature governed by atmospheric temperature, Garg(2009). Sample S-3 which is nearest to railway line used for transport of coal recorded highest temperature in all the three seasons.

pH : pH is a measurement of hydrogen ion concentration in water, which is either alkaline or acidic. (Harney et al 2013; Abir 2014). Most of the similar study suggested that water samples are slightly alkaline due to presence of carbonates and bicarbonates (Verma et al., 2012).The higher range of pH indicates higher productivity of water (Gopalkrushna, 2011) because availability of carbonates and bicarbonates in water enhance dissolve carbon dioxide level by dissociation and acts as a raw material for photosynthesis. Analytical study reveals that pH of first three ponds were maximum in winter and minimum in monsoon season while pH of ponds nearer to coolant were maximum in summer, medium in winter and minimum in monsoon season, which had value ranged from 8.24 to 9.23 during summer, 8.33 to 8.71 during winter and 7.64 to 8.12 during monsoon. Lowest value of pH in all season was measured at study site s-2 and highest value at

study site s-5, which was found cross the high limit (6.5 to 8.5) prescribed by the BIS (Bureau of Indian Standard).

Conductivity : Electrical Conductivity is another key factor that determines the quality of water. It is a measure of purity of water. The EC value in the present study was ranged between 0.22 to 0.70 mmhos/cm. It was maximum in winter season and minimum in summer season. The fluctuations in EC are due to fluctuation in total dissolved solids and salinity (Pandey and Pandey, 2003). The maximum values are observed in post monsoon(winter), respectively similar observation was made by Sulabha and Prakasam (2006).

TDS : Total dissolved solids (TDS) value of water varied 84 to 180 mg/L of which higher value of s-1 and s-3 was reported in summer season and the lower value in winter season while s-2, s-4, s-5 which are more close to power plants recorded higher value in monsoon season and lower in summer. Higher values of TDS in summer season may be due to evaporation of water (kavitasahni and sheela yadav,2012). Higher value in monsoon season may be due to fly ash and other industrial waste carried to the pond with rain water.

C**hloride:** Chloride is present abundantly in natural surface and groundwater in varying level. Chlorides are mainly come from inorganic salts like NaCl, KCl and $CaCl_2$ etc. which are generally obtained from soil, natural layers of chloride salts, municipal and industrial sewage and animal wastes (Gopalkrushna,2011). Chloride is generally not harmful to humans but higher level of chloride increase the corrosive property of water. Our result shows higher value of S-1 and S-3 in summer season and the lower value in monsoon season while S-2, S-4, S-5 which are more close to power plants recorded higher value in winter season and lower in summer.The chloride content of studied water sample within the permissible limit prescribed by BIS.

Alkalinity: Alkalinity is measuring the acid neutralizing capacity of water. Total alkalinity is the combined activity of the values of carbonates and bicarbonates in water (Nirmala et al 2012). The observed values of total alkalinity varied from 100 – 140 mg/l during summer,120 – 160 mg/l during monsoon and 114 – 166 mg/l during winter season. For samples S-1 and S-3 values are almost constant for summer and monsoon season while samples S-2, S-4, S-5 shows higher value of alkalinity in monsoon season. The values are within the WHO permissible limits.

Hardness: Total Hardness values ranged from 78 to180 mg/L of which higher value was found in monsoon season for sample S-1, and the lower value in summer season for sample S-5. Hardness of water is due to the presence of high content of calcium and magnesium in addition to sulphate and nitrates. (Angadi*et. al.*, 2005). This is the property of water to precipitate soap byformation of complex with calcium, magnesium present onwater. As per APHA standard, total hardness was ideallyrange from 0-30 soft, 30-60 moderate soft, 60 -120 moderate hard, 120- 180 hard and greater than 180 very hard. Data indicatedthat, total hardness of samples S-2, S-4, S-5, were maximum inwinter, medium in monsoon and minimum in summer season, While S-1 and S-3 shows higher value in summer.

C**alcium:** The higher calcium content of the water is an indication of pollution and eutrophication of wetland (Jagadeshappa K.C.et. al. 2011.) Calcium hardness of first four ponds were maximum in summer, medium in monsoon and minimum in winter while S-5 reported highest value in summer season. The mean value of calcium hardness ranged from 32 mg/l to 100 mg/l during summer, 62 mg/l to 84 mg/l during monsoon and 45 mg/l to 88 mg/l during winter. Sample S-5 possess 32 mg/l with lower concentration of calcium hardness where as S-2 possess 100 mg/l with higher concentration of calcium hardness. Organic substance and agricultural waste increase calcium hardness. (Tidame&Shinde 2012).

Magnesium: Magnesium is often associated with calcium in all kind of water but its concentration remains generally lower than calcium (venkatasubramani and Minambell,2007). Magnesium contents varied from 24mg/l to 92 mg/l being maximum (92mg/l) during monsoon season for sample S-1, and minimum (24 mg/l) in summer season for sample S-2. Among the different samples S-1, S-2 recorded higher values in monsoon season while S-3, S-4, S-5 recorded higher values in winter. All the samples recorded lower value in summer season

Sulphate : Sulphate are naturally occurring anions in all kind of natural water. Seasonal analysis showed higher values of sulphate in summer season most of the samples and lower values in winter season. These findings reported by Kadamet.al(2005). Values are within permissible limits.

Table. 1-Description of Water Sampling Sites:

Sample Code	**Location of ponds**
S - 1	Pond Near NimsadaVillege. 500 Mt away in North East Direction from Power Plant
S - 2	Pond Near Entrance Gate of GMR Power plant
S - 3	Pond Near Railway Line used for Coal Transportation to power Plant
S - 4	Pond Back side of GMR Power Plant, Just behind the coolant.
S - 5	Pond West to Wardha Power Plant , Near Coolant

Pond 1 (S1)

Pond 2 (S2)

Pond 3 (S3)

Pond 4 (S4)

Figure.1- Sampling Sites

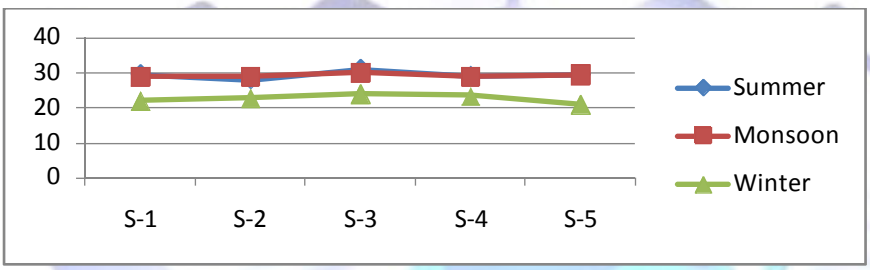

Figure. 2: Graphical presentation of Seasonal comparison of Temperature in °C

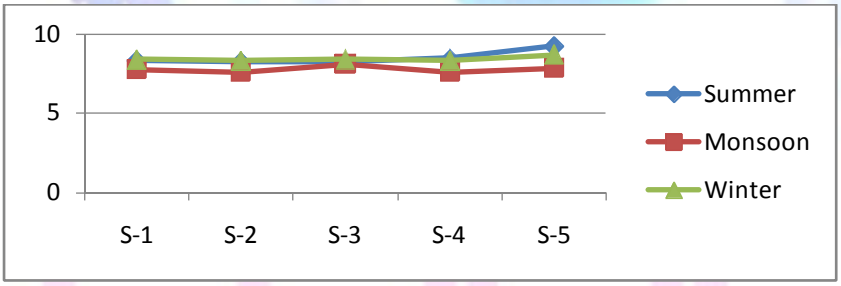

Figure. 3-Graphical presentation of Seasonal comparison of pH

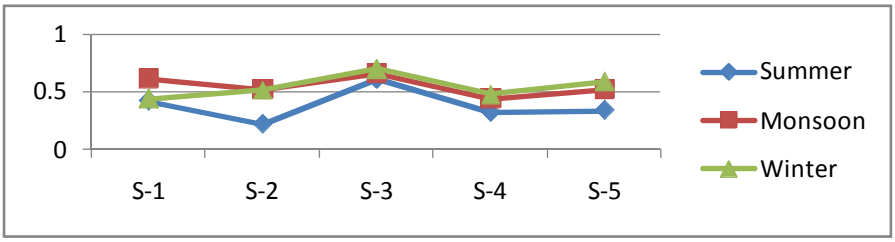

Figure. 4- Graphical presentation of Seasonal variation of conductivity in m mhos/cm

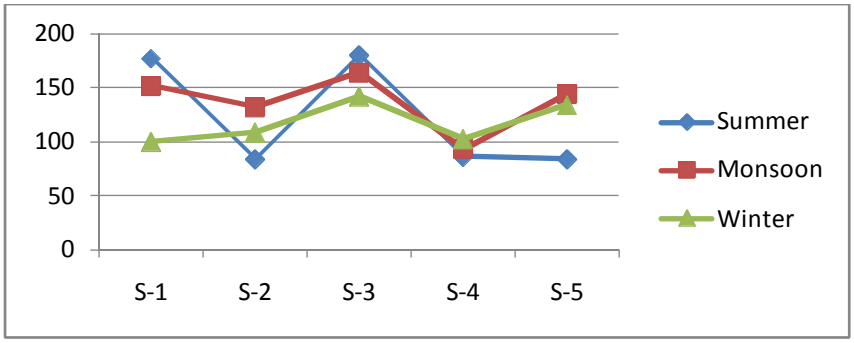

Figure. 5- Graphical presentation of Seasonal variation of TDS in Mg/Lit

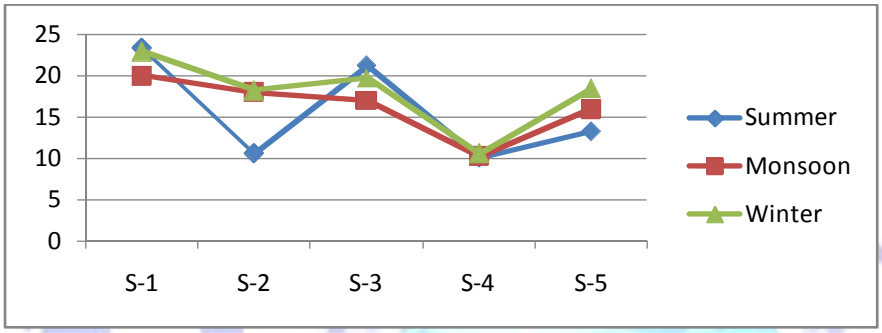

Figure. 6-Graphical presentation of Seasonal variation of chloride

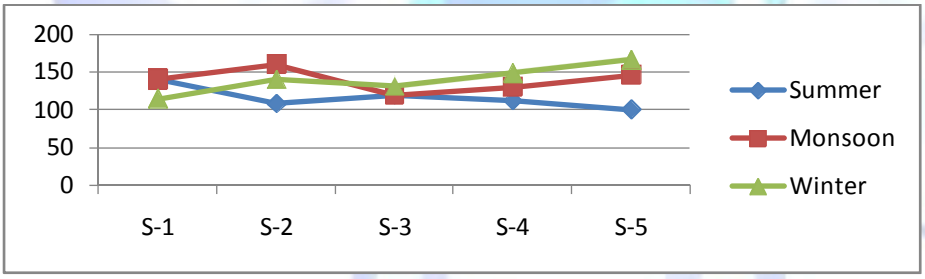

Figure. 7:- Graphical presentation of Seasonal variation of alkalinity in Mg/Lit

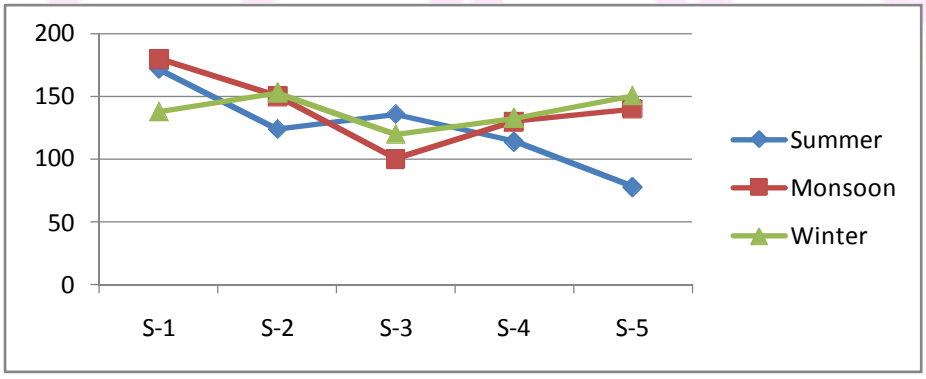

Figure. 8 - Graphical presentation of Seasonal variation total hardness in Mg/Lit

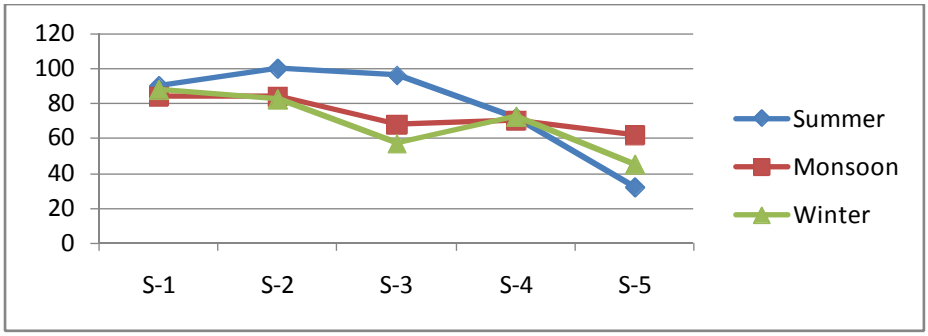

Figure.9- Graphical presentation of Seasonal variation of calcium in Mg/Lit

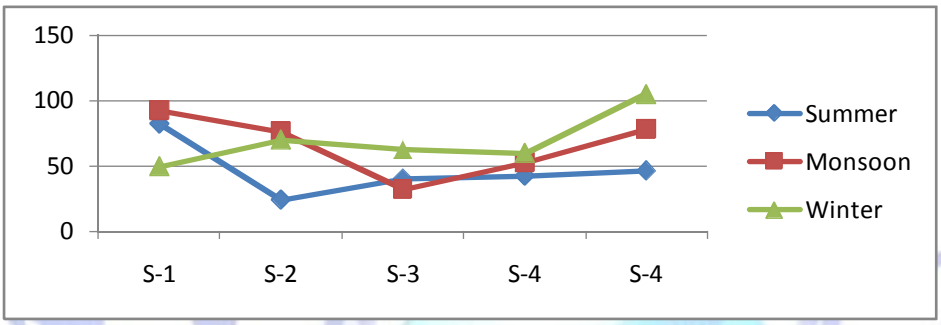

Figure. 10- Graphical presentation of Seasonal variation of magnesium in Mg/Lit.

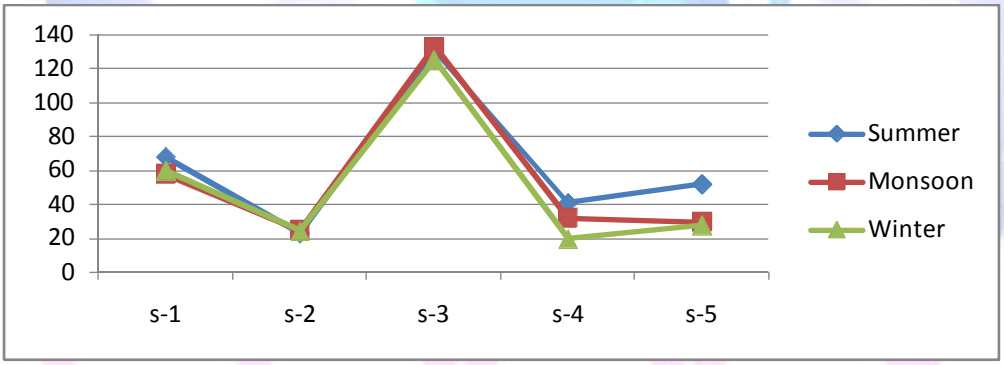

Figure. 11-Graphical presentation of Seasonal variation of sulphate in Mg/Lit

Conclusion:

From analysis results it can be concluded that all sampling stations show permissible range of concentration of physico-chemical parameters but in some case it is beyond permissible limits given by bureau of Indian standards, but by slight treatment the water can be useful. The results from this study showed that physico-chemical water quality parameters showed strong seasonal variation amongst the various stations. Water quality parameters did not show a similar pattern in all locations, but electrical conductivity showed some similarity in most of the locations. TDS, alkalinity, chloride, Hardness, sulphate did not show a similar pattern in the way they varied in all the locations. Sample S-1 and S-3 showed higher values in summer season for these parameters while S-2, S-4, S-5 which are more close to power plants shows maximum value in monsoon or winter

season. The effects of season and runoff are the two major causes of variation in water quality but waste from power plants have interfered with this cycle and cause increase the value in monsoon and post monsoon seasons. This suggests that power plant waste can mixed with rain water and carried to the ponds which are more close to power plants. This means that the ash content carried in the different locations studied were not the same it affect more to the area which is closer to power plants. Industrial area especially in case of thermal power plants needs regular monitoring of water sources because it can affect the health of local biota.

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