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# Study of Correlation Coefficient for Physico-Chemical Parameter to Assess the Water Quality of River Ganga at Kanpur, India

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**ABSTRACT:**In the present study we analyze the correlation between physico-chemical parameters of water samples of Ganga river at Kanpur and its significance. Water samples under investigations were collected from three sampling site bithor ghat, siddnath ghat and dhoni ghat in river Ganga at Kanpur sampling station during summer, monsoon and winter seasons in the year 2016-2017.

Correlation coefficients were calculated between different pairs of parameters to identify the positive and negatively correlated parameters and t-test was applied for checking significance. The observed values of different physico-chemical parameters like pH, temperature, dissolved oxygen(DO), Chloride, total dissolved solids(TDS), alkalinity, biological oxygen demand (BOD), chemical oxygen demand (COD), total solid (TS) and electrical conductivity (EC) of samples. It is found that significant positive correlation holds for TDS with DO(  $r = 0.994$ ), TDS with COD (  $r = 0.539$ ), DO with BOD (  $r = 0.891$ ), Chloride with Alkalinity (  $r = 0.282$  ) and a significant negative correlated parameters were found between Temperature with COD(  $r = - 0.033$ ), temperature with pH(  $r = - 0.617$ ), TS with Alkalinity (  $r = - 0.027$ ).

**KEYWORDS:** Physico-chemical parameters, correlation, t-test, Ganga river.

### I. INTRODUCTION

It is a fact that good water quality produces healthier humans than one with poor water quality. Water is one of the most important and abundant compounds of the ecosystem. All living organisms on the earth need water for their survival and growth. As of now only earth is the planet having about 70 % of water. But due to increased human population, industrialization, use of fertilizers in the agriculture and man-made activity it is highly polluted with different harmful contaminants. The top & famous in for tannery industries. Kanpur is the world famous for tannery industry after I.I.T. & their Education. But it is also famous for their pollution. The city of Kanpur also known their Pollution in world. Kanpur is the most polluted city in the world.

The main cause of the pollution in the Kanpur is due to the tannery. Tannery wastes pollute the water of Ganga. Therefore it is necessary that the quality of drinking water should be checked at regular time interval, because due to use of contaminated drinking water, human population suffers from varied of water borne diseases. It is difficult to understand the biological phenomenon fully because the chemistry of water reveals much about the metabolism of the ecosystem and explain the general hydro - biological relationship (Basavaraja Simpi et al. 2011). Ganga River is life line of Kanpur and its water is used for domestic and agriculture purposes therefore, effective maintenance of water quality is required through appropriate measurements. Physico-chemical and micro-biological characteristics may describe the quality of water (Sinha, 1986), therefore, an analysis on physico-chemical parameters of Ganga water was made by many workers (Mehrotra, 1990; Sinha et.al. 2000) Regular monitoring of all the parameters is very difficult and laborious task even if adequate manpower and laboratory facilities are available. Therefore, statistical correlation technique has been used for comparison of physico-chemical parameters.

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## II. MATERIAL AND METHOD

### 1. Collection of water sample

Water samples were collected from 3 different sites of River Ganga at Kanpur during summer (March - May), monsoon (July - September) and winter (November-January) phase in year Aug 2016 to April 2017. Water samples were collected in sterile bottles before collection of water bottles rinsed in KMnO<sub>4</sub>. The water samples were immediately brought into the laboratory for the estimation of various physico-chemical parameters such as pH, temperature, DO (Dissolved oxygen), TDS (total dissolved solid), Alkalinity, Chlorides, COD (chemical oxygen demand), TS (Total solid), conductivity, and BOD (biological oxygen demand) by using Indian Standard Procedures (Titration method).

### 2. Statistical analysis

To confirm the variability of data obtained and validity of results, all the data were subjected to statistical analysis using mean, t-test and correlation coefficient and used software SPSS 16.

## III. RESULTS AND DISCUSSION

It is very essential and important to test the water before it is used for drinking, domestic, agricultural or industrial purpose. Water must be tested with different physico-chemical parameters. Selection of parameters for testing of water is solely dependent upon for what purpose we are going to use that water and what extent we need its quality and purity. Water contains different types of floating, dissolved, suspended and microbiological as well as bacteriological impurities. Some physical tests should be performed for testing of its physical appearance such as temperature, color, odour, pH, turbidity, TDS etc, while chemical tests should be performed for its BOD, COD, dissolved oxygen, alkalinity, hardness and other characters. (Patil P N et al., 2012)

### Determine physico-chemical parameter

- 1. pH-** pH was alkaline values ranges from 7.5 to 8.4. The maximum pH value (8.4) was recorded in the season of winter and minimum (7.5) in the season of monsoon. Most of bio-chemical and chemical reactions are influenced by the pH. pH is most important in determining the corrosive nature of water. Lower the pH value higher is the corrosive nature of water. pH was positively correlated with electrical conductance and total alkalinity (Gupta 2009). Various factors bring about changes in the pH of water. The higher pH values observed suggest that carbon dioxide, carbonate-bicarbonate equilibrium is affected more due to change in physico-chemical condition (Karanth 1987).
- 2. Temperature-** In an established system the water temperature controls the rate of all chemical reactions, and affects fish growth, reproduction and immunity. Drastic temperature changes can be fatal to fish.
- 3. EC (Electrical Conductivity)-** Conductivity shows significant correlation with ten parameters such as temperature, pH value, alkalinity, total hardness, calcium, total solids, total dissolved solids, chemical oxygen demand, chloride and iron concentration of water. Navneet Kumar et al (2010) suggested that the underground drinking water quality of study area can be checked effectively by controlling conductivity of water and this may also be applied to water quality management of other study areas.
- 4. TDS (Total Dissolved Solids)-** Estimation of TDS is useful to determine whether the water is suitable for drinking purpose, agriculture and industrial purpose. The maximum value (0.474 ppt) was recorded in the month of April and sampling site of Siddnath ghat and minimum value (0.210 ppt) was recorded in the month of January and sampling site of Bithor ghat.
- 5. DO (Dissolved Oxygen)-** The value of DO fluctuates from 2.34 mg/l to 11.95 mg/l. The maximum values (11.95 mg/l) were recorded in the season of winter and site Dhoni ghat and minimum values (2.34 mg/l) in the season of summer and site of Siddnath ghat. DO is one of the most important parameters. The concentration of dissolved oxygen (DO) present in water sample was estimated by Winkler method for measuring dissolved oxygen.
- 6. Alkalinity-** The maximum value (108 mg/l) was recorded in the winter season and site of Siddnath ghat and minimum value (72 mg/l) in the summer season and site of Doni ghat. The alkalinity was maximum value in winter due to increase in bicarbonates in the water.

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7. **Chlorides-** Chlorides test was analyzed argentometric method(Mohar method).The maximum value (113.44 mg/l) was recorded in the siddnath ghat (summer) and minimum value (31.20mg/l) in the monsoon season and bithor ghat.
8. **BOD (Biochemical Oxygen Demand)-** BOD is a measure of organic material contamination in water, specified in mg/L. BOD is the amount of dissolved oxygen required for the biochemical decomposition of organic compounds and the oxidation of certain inorganic materials (e.g., iron, sulfites). Typically the test for BOD is conducted over a five-day period (Milacron Marketing Co).
9. **COD (Chemical Oxygen Demand)-** COD is another measure of organic material contamination in water specified in mg/L. COD was determined by titrating against ferrous ammonium sulphate.COD is the amount of dissolved oxygen required to cause chemical oxidation of the organic material in water. Both BOD and COD are key indicators of the environmental health of a surface water supply. They are commonly used in waste water treatment but rarely in general water treatment. (Milacron Marketing Co).
10. **TS (Total solid)-** The value of TS range was maximum same value in winter in siddnath ghat and monsoon season of doni ghat (1600mg/l) and minimum value in monsoon season of bithor ghat.

Table 1: Correlation Coefficient and T- Test Value Of Paired Parameter

Pair	Paired parameter	Correlation coefficient (r) value	t-test value
1.	Temperature and COD	-0.033	6.843
2.	TDS and COD	0.539	7.85
3.	DO and BOD	0.891	3.224
4.	TS and EC	-0.027	9.9
5.	Cl <sup>-</sup> and Alkalinity	0.282	24.11
6.	Temperature and pH	-0.617	89.02
7.	TDS and DO	0.994	2.116

Observation shows that significance correlation between TDS, COD and DO .The correlation coefficient shows between in figure 2 and figure 7 a significant strong positive correlation  $r = 0.539$  ( $t = 7.85$ ,  $p < 0.01$  for COD ) and  $r = 0.994$  ( $t = 2.116$ ,  $P < 0.01$  for DO) .this relation showing that TDS increases COD and DO also increases. DO and BOD also shows positive correlation in figure 3. The positive correlation coefficient  $r = 0.891$  ( $t = 3.224$ ,  $p < 0.01$  for BOD). Chlorides and alkalinity shows weak positive correlation in figure 5 .the correlation coefficient  $r = 0.282$  ( $t = 24.11$ ,  $P < 0.01$  for alkalinity).

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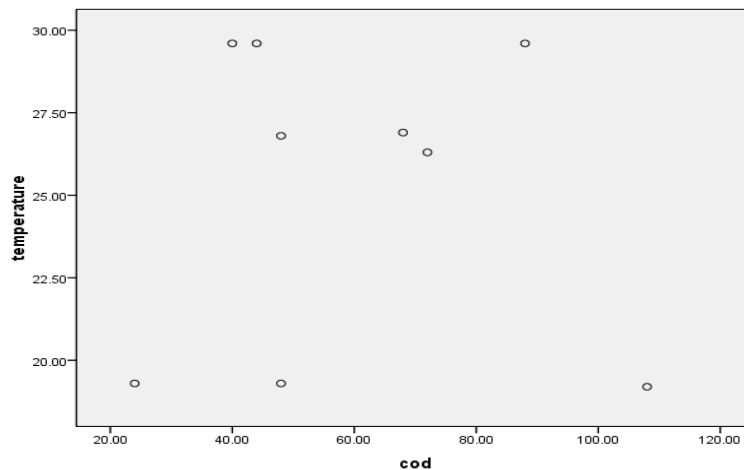


Figure 1: The Correlation Coefficient Between Temperature And COD Level Concentration ( $R = -0.033$ ,  $T = 6.843$ )

Temperature, COD and pH shows negative correlation. Correlation coefficient in figure 1 and figure 6 shows negative correlation  $r = -0.033$  ( $t = 6.843$   $P < 0.01$  for COD) and  $r = -0.617$  ( $t = 89.02$   $P < 0.01$  for pH) this means if value of temperature increases then value of COD and pH decreases. These correlation analysis shows that level of these parameters are highly correlated with each other in sampling site. TDS and COD shows negative correlation coefficient  $r = -0.653$  ( $t = -0.785$   $P < 0.01$  for COD). TS and EC also shows negative correlation coefficient in (figure 4)  $r = -0.027$  ( $t = 9.9$   $P < 0.01$ , for EC).

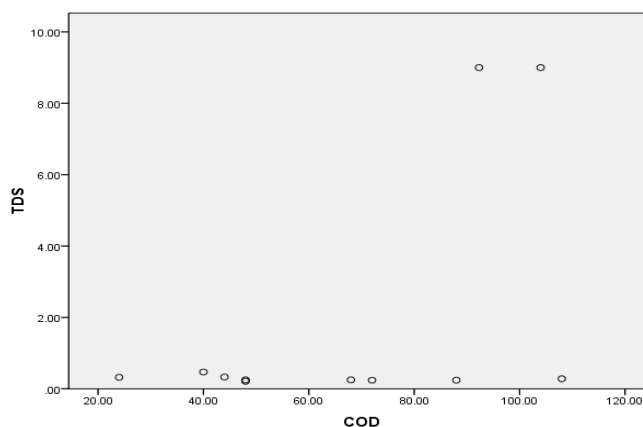


Figure 2: The Correlation Coefficient Between TDS And COD Level Concentration ( $R = 0.539$ )

Water samples were collected from ganga river during summer, monsoon and winter and analyzed physico-chemical parameter in three sampling sites. Maximum alkalinity was notice during monsoon in siddnath ghat. The higher alkalinity itself harmful to aquatic environment .The lower value of DO (2.34 during summer and sampling site of siddnath ghat) due to lower oxygen carrying capacity in warmer temperature 29.60C.

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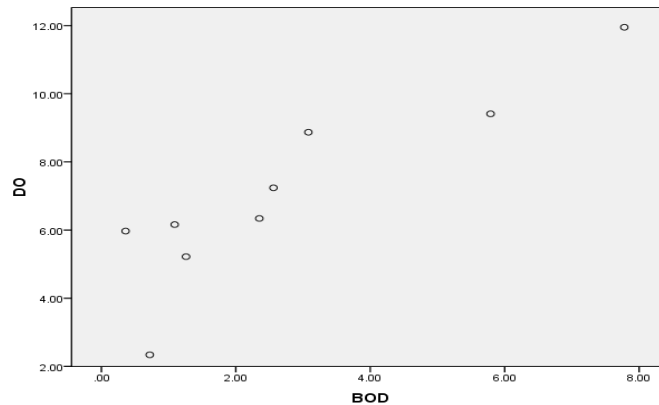


Figure 3: The Correlation Coefficient Between DO And BOD Level Concentration ( $R = 0.891$ )

In the progress of summer, dissolved oxygen decreased due to increase in temperature and also due to increased microbial activity (Moss 1972, Morrissette 1978, Kataria, 1996).maximum value of BOD (7.78) and COD (108 ) in winter season and sampling site of doni ghat due to high load of organic.

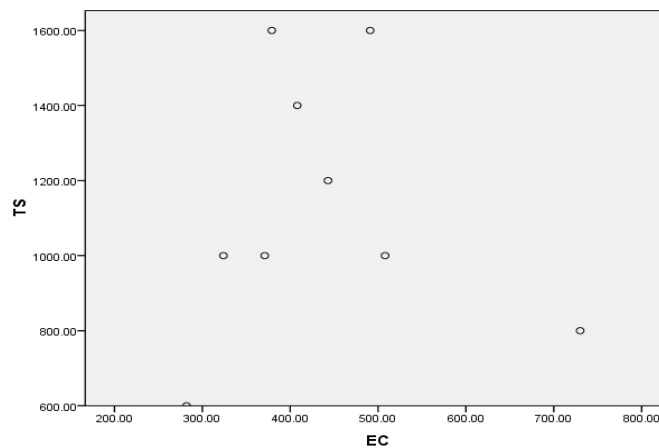


Figure 4: The Correlation Coefficient Between TS And EC Level Concentration ( $R = -0.027$ )

The mean seasonal DO level of water sample analyzed and find that mean DO value increases in winter (10.08) and lower value in summer (4.9). the variation in DO value may be changes in river ganga water. the mean value of alkalinity higher level (88.67) in monsoon season and lower level in winter (70.93) season due to higher alkalinity levels in surface water would buffer acid rain and other acid waste and prevent pH changes that are harmful to aquatic life. Large amount of alkalinity imparts bitter taste in water.

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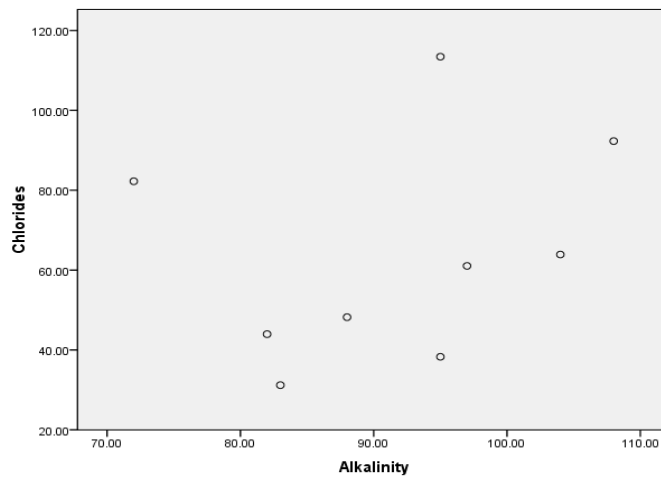


Figure 5: The Correlation Coefficient Between Chlorides And Alkalinity ( $r = 0.282$ )

COD mean level increased 62.67 in monsoon season and lower value 57.33 in summer season due to tannery wastes, which contain toxin and biologically resistant organic substances. Temperature value was recorded all the season and find higher level in summer, normal in monsoon and lower in winter season which is normal feature of water.

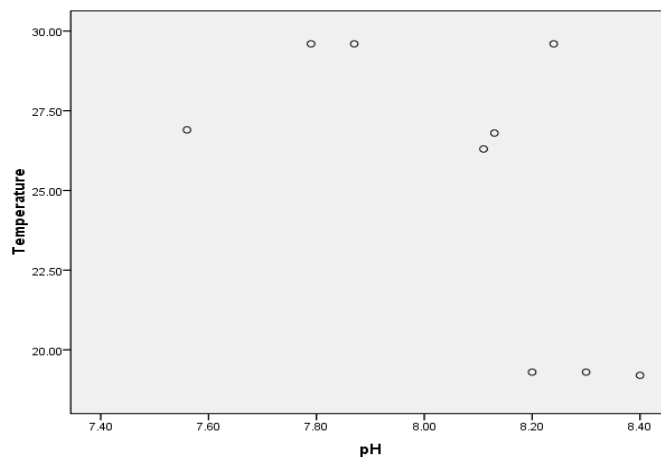


Figure 6: The Correlation Coefficient Between Temperature And pH ( $R = -0.617$ )

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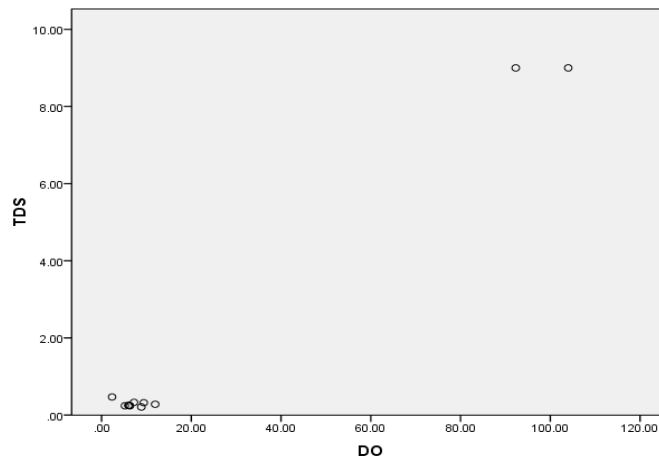


Figure 7: The Correlation Coefficient Between TDS And DO ( $R = 0.994$ ,  $T = 2.11P < 0.01$ )

## IV. CONCLUSION

The quality of water in the river system is seriously affected by pollutants which enter through besides other pollutants also contain high concentration drains that bring domestic as well as industrial effluents. The present paper undertaken to account to bring an acute awareness among the people about the quality of water.

To minimize the contaminations of Ganga river water at Kanpur the values of correlation coefficients and their significance level will help in selecting the proper experimental methods used for treatment of water. To create increasing awareness among the people to maintain the Ganga river water at its highest quality and purity levels, the present study may prove to be useful in achieving this goal (trivedi et al, 2009).

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