CORRELATION BETWEEN DIFFERENT PHYSICOCHEMICAL PARAMETERS OF GROUND WATER AND SURFACE WATER IN BUNDI REGION, RAJASTHAN, INDIA

Rachana Jadon, Nitu Singh
Research Scholar, Department of Applied and Life Science, Career Point University, Kota, Rajasthan
Email Id- creationrj2203@gmail.com

Dr. Fatima Sultana
Associate Professor, Department of Zoology, J. D. B. Govt. Girls College, Kota, Rajasthan

Abstract

Water is extremely essential for survival of all living organisms. The quality of water is vital concern for mankind since it is directly linked to human welfare (10). The present study has been focused on determination of correlation between different physicochemical parameters (pH, Turbidity, Alkalinity, Total Hardness, Total dissolved solids, Conductivity, Chloride, Sulfate, Fluoride content) in major surface water and ground water bodies of Bundi Region. The deterioration in the quality of water could be accounted to rapid urbanization. The result of present work will help in analyzing pollution level in the selected sites of Bundi region of Rajasthan, India.

Figures: 10 References: 15 Table: 3

Key Words: Physicochemical parameters, Ground water, Surface water, Correlation.

Introduction

The most vital renewable resource on the blue jewel i.e. the earth is water. It is the fundamental ingredient of life. It is found in liquid form at the temperature mostly found on the earth. Water is one of the abundant resources on earth. About 97% of the earth water is saline water in the ocean and 3% is fresh water contained in the poles (inform of ice), ground water lakes and rivers which supply the most of human and animal needs. Nearly, 70% of this tiny 3% of the world's fresh water is frozen in glaciers, permanent snow cover, ice and permafrost. The other 30% percent of all fresh water is in ground most of it in deep, hard to reach aquifers. Lakes and rivers together contain just a little more than0.25% of all fresh water. Lakes contain most of it (4).

The adverse effects on ground water and surface water qualities are the result of man's activity at surface, unintentionally by agriculture, domestic and industrial effluents unexpectedly by sub surface or surface disposal of sewage and industrial wastes (5). The quality of ground water and surface water is of great importance in determining the suitability of particular ground water and surface water for certain use (public water supply, irrigation, industrial application, power house generation, etc.). Quality of ground water and surface water is the resultant of all the processes and reactions that have acted on the water.

Therefore, the quality of ground water varies from place to place and is primarily governed by the extent and composition of dissolved solids present in it. Most ground water quality problems are difficult to detect

and hard to resolve. The wide range of contamination sources is one of the many factors contributing to the complexity of water assessment (9).

Bundi is a city with 104,457 inhabitants (2011) and is in the Hadoti region of Rajasthan state in Northwestern India. The present water supply service level of Bundi is less than 135 lpcd. The water supply of Bundi is sourced partly from tube wells and partly from Mangli River. The major short coming of the Bundi water supply is inadequate water service and deficiency of storage. 60% of the population is supplied with water through pipes and partly from public stand post and hand pumps (14).Thus, regular physicochemical analysis of water resources must be carried out to determine the quality of it. The intensive use of water resources and the large production of waste in society pose a threat to ground water and surface water quality (3).

There is no water quality monitoring station in Bundi. The most nearest monitoring station is at Chambal River which is located 46 km from Bundi (14).

Materials and Methods

The present study was undertaken to determine the correlation amongst different physicochemical parameters of ground water and surface water in Bundi region of Rajasthan (India). Surface water and ground water was collected from following sites-

1) Jait Sagar Lake
2) Sukh Sagar Lake
3) Nawal Sargar
4) Phool Sagar lake

The surface water samples were collected from four sampling sites, (Jait Sagar Lake, Sukh Sagar Lake, Nawal Sagar Lake and Phool Sagar Lake). The water samples were collected in November 2017 in morning hours. The samples were collected in cleaned plastic bottles and brought to laboratory in ice box to avoid unusual change in water quality. Prior to the sampling all the bottles were washed and rinsed thoroughly with distilled water. The physicochemical parameters (TDS, TSS, pH, electrical conductivity, turbidity, total hardness, total alkalinity, Chloride, Fluoride, Sulfate, Nitrate, Potassium, Sodium, Lead content) were analyzed for the water samples. Standard methods defined by APHA 2005 (standard methods for the examination of water and waste water) were followed.

Area lying within 0.5-1km of surface water collecting sites was selected for the collection of ground water samples for comparison with respective site. Total four bore wells in selected areas were chosen for the sample collection. Water quality parameters were selected, which are considered to be important as per the drinking water standard (2, 6, 11). After obtaining the readings of selected parameters for the analysis from the laboratory, the data was tabulated for comparative study. Simple linear correlation was calculated between the two tested parameters by using Pearson correlation equation.

$$r = \frac{N\sum(XiY_i) - (\sum X_i).(\sum Y_i)}{\sqrt{[N\sum X_i^2 - (\sum Xi)^2][N\sum Y_i^2 - (\sum Yi)^2)]}}$$

Where X_i and Y_i represents two different parameters and N is number of total observations.

Result and Discussion

To understand the relationship between different water quality parameters analyzed from selected sites, statistical parameters were calculated using Microsoft Office Excel 2007. The coefficient value can range between -1.00 to 1.00. If the coefficient value is in the negative range, then that means the relationship between the variables is negatively correlated, or as one value increases, the other decreases. If the value is in the positive range, then that means the relationship between the variables is positively correlated, or both the values increase or decrease together (15).

The correlation co-efficient (r) among various water quality parameters of ground water and surface water of selected sites in Bundi Region of Rajasthan (India) are tabulated in table 2 and table 3 respectively.

Table 1- Physicochemical parameters of surface and ground water in Bundi Region (Rajasthan)

S.No.	Parameter	Indian Standard	WHO Standard	Surface Water				Ground water			
				Site I	Site II	Site III	Site IV	Site I	Site II	Site III	Site IV
1	pH	6.5 – 8.5	7 – 8	7.1	7.2	7.0	6.9	7.4	7.7	7.0	7.5
2	Conductance		300 µmho/cm	478	297	812	446	549	528	962	908
3	Turbidity	5 – 10	5	1.2	1.1	2.7	3.3	4.3	3.4	3.9	5.1
4	Total solids	500– 2000	500	373	232	633	348	428	412	750	708
5	Total Hardness	187 – 500	(Calcium) 100	140	90	190	50	150	150	180	180
			(Magnesium) 100	70	30	170	140	80	70	230	150
6	Total Alkalinity	200 – 600	100-200	200	110	270	100	270	240	410	350
7	Cl^-	250– 1000	250	30	20	90	70	30	20	70	100
8	SO_4	200 – 400	250	2	3	2	3	3	4	5	7
9	F	1 – 1.5	1	0.40	0.24	0.32	0.34	0.47	0.41	0.48	0.42
10	NO_3	45	45	3	6	18	6	2	20	29	68
11	Na	200	200	16.6	6.2	81.9	46.3	31.4	9.9	70.1	54.2
12	K	12	12	2.9	4.7	22.9	6	3	2.3	5.2	1.1

(Except pH and conductivity all results are in mg/l.)

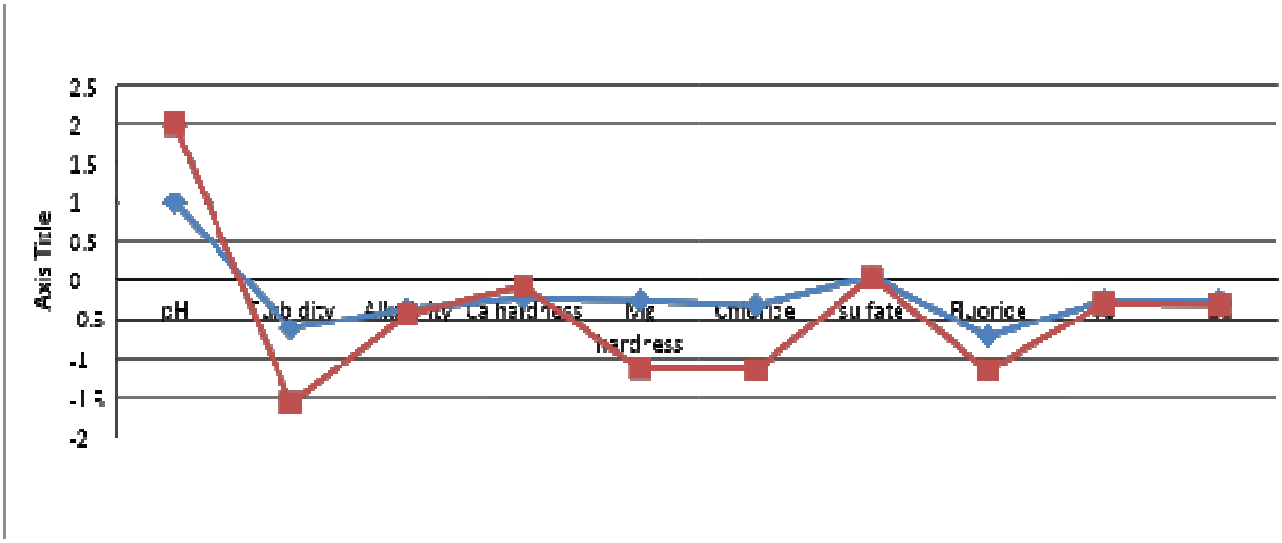
Table 2 .Correlation matrix for physicochemical parameters of ground water of selected sites in Kota Region of Rajasthan, India

Parameters	pH	Turbidity	Alkal.	Ca Hardness	Mg Hardness	Cl^-	SO_4	F^-	TS	EC
pH	1	-0.6178	-0.3689	-0.22942	-0.25917	-0.3224	0.03877	-0.7166	-0.2636	-0.2644
Turb			0.3532	0.522514	0.195714	0.77209	0.64542	-0.0330	0.47319	0.47346
Alk.			1	0.934947	0.986263	0.78847	0.60053	0.48570	0.96615	0.96630
Ca Hardness				1	0.895953	0.93704	0.84515	0.16439	0.99475	0.99470
Mg Hardness					1	0.6996	0.53334	0.49311	0.93539	0.93547
Cl^-						1	0.923936	1.71E-16	0.904473	0.904458
SO_4							1	-0.3612	0.78630	0.78597
F^-								1	0.25562	0.25632
TS									1	1
EC										1

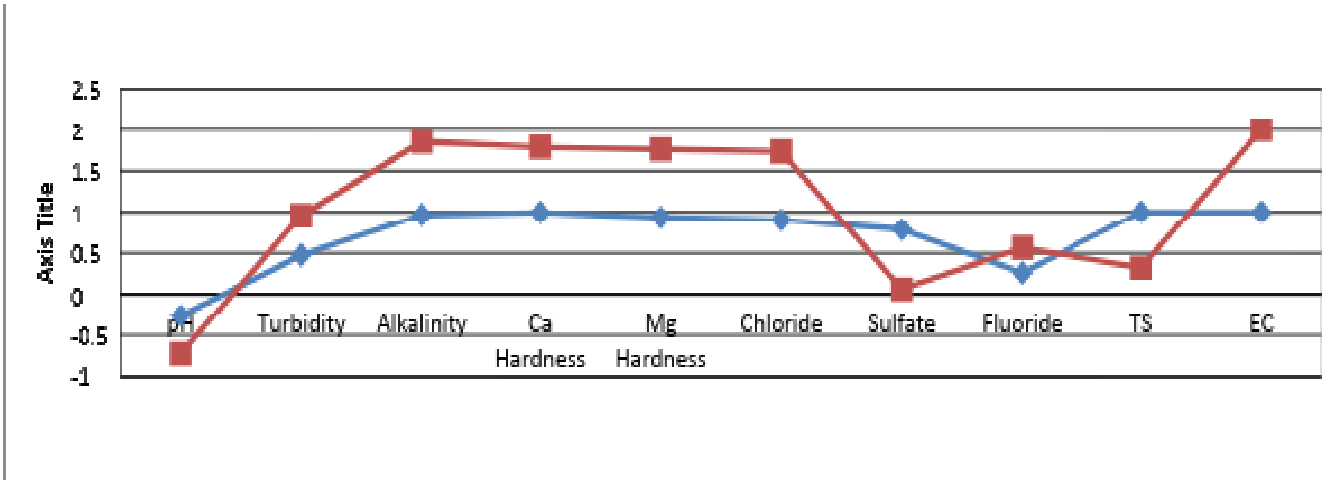
Table 3. Correlation matrix for physicochemical parameters of surface water of the selected sites in Bundi Region of Rajasthan, India.

Parameters	pH	Turb.	Alkal.	Ca H	Mg H	Cl^-	SO_4	F^-	TS	EC
pH	1	-0.9536	-0.06422	0.148734	-0.86785	-0.82054	1.99E-15	-0.42981	-0.0347	-0.46396
TURB		1	0.03402	-0.15134	0.889832	0.885507	0.131625	0.149501	-0.18684	0.484004
Alkal.			1	0.975581	0.486015	0.476735	-0.93335	0.363824	-0.60956	0.886945
Ca Hardness				1	0.310903	0.319634	-0.90272	0.220008	-0.6562	0.791489
Mg Hardness					1	0.989686	-0.31591	0.311495	-0.42905	0.826501
Cl^-						1	-0.26211	0.175573	-0.53377	0.828545
SO_4							1	-0.61159	0.294032	-0.72661
F^-								1	0.46955	0.307208
TS									1	-0.68156
EC										1

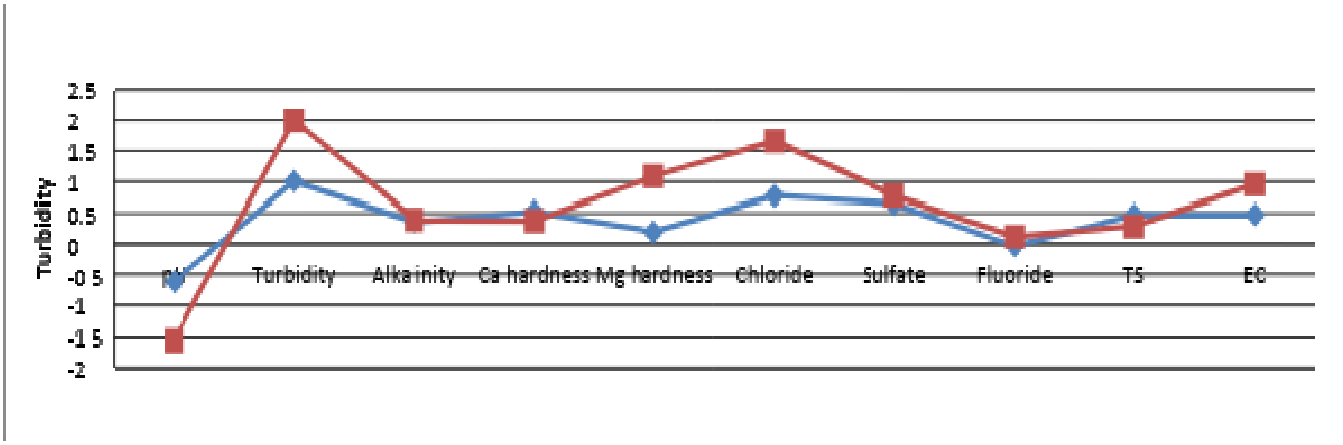
pH – pH shows the acidic or alkaline nature of water (1). pH value from 7 to 14 is alkaline, pH value 0 to 7 is acidic and pH 7 is neutral. pH shows high negative correlation with turbidity in both ground water and surface water (fig.1).



Conductance – Conductance is the measure of water's capacity to pass electric flow which depends on mobility of ions (12). Conductance shows highest positive correlation with alkalinity, calcium hardness, magnesium hardness Chloride content in both surface water and ground water (fig. 2).

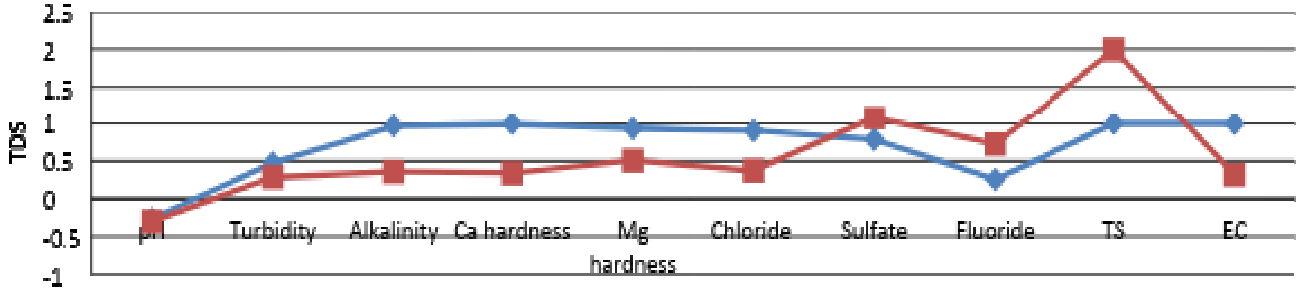


Turbidity – Turbidity is a measure of the degree to which the water loses its transparency (13). Turbidity shows positive correlation with Chloride content in both surface water and ground water (fig. 3).



Total Solids -Total Dissolved Solids and Total Suspended Solids together constitute the Total Solids in water (11). It is an important parameter which determines the potability of water. Total solids show positive correlation in maximum parameters of ground water whereas negative with surface water parameters (fig. 4).

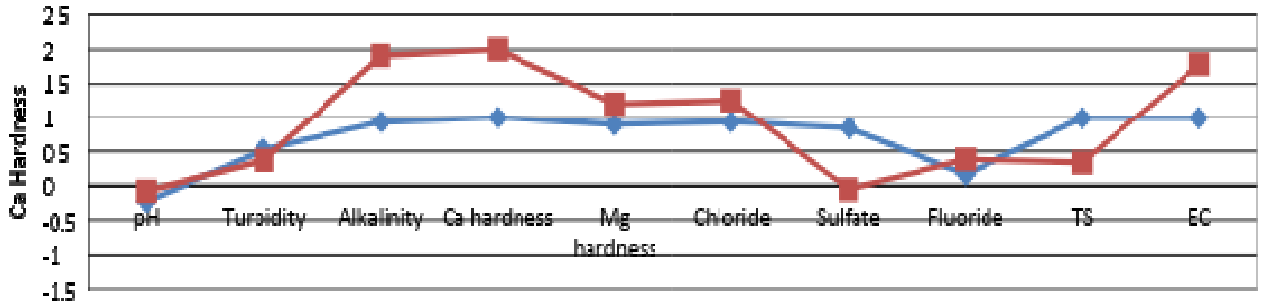
Figure 4. Correlation matrix for TS



Total Hardness – Total Hardness generally represents the concentration of Calcium and Magnesium ions. Hardness affects the amount of soap that is needed to produce foam or lather (11). Both Calcium and Magnesium hardness exhibits high positive correlation with Conductivity in both surface and ground water (fig 5, 6).

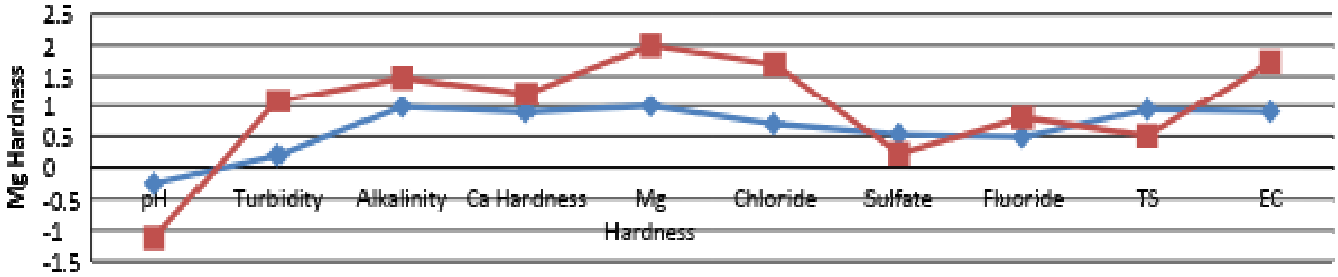
Calcium Hardness

Figure 5. Correlation matrix for Ca Hardness



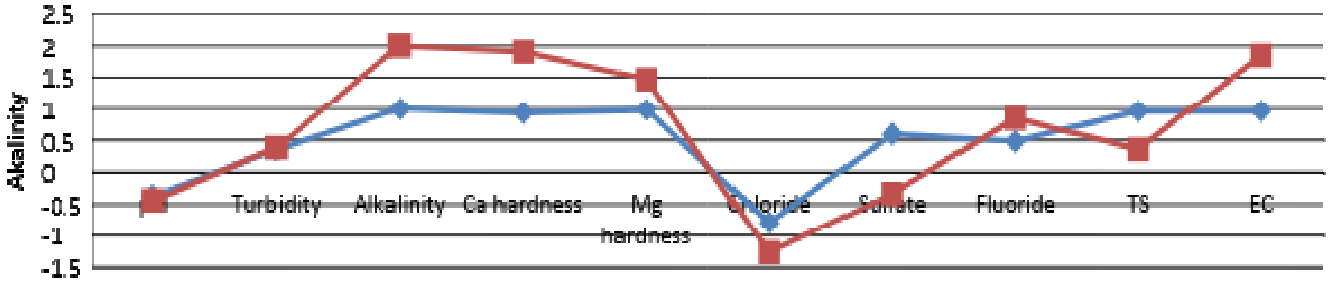
Magnesium Hardness

Figure 6. Correlation matrix for Mg Hardness



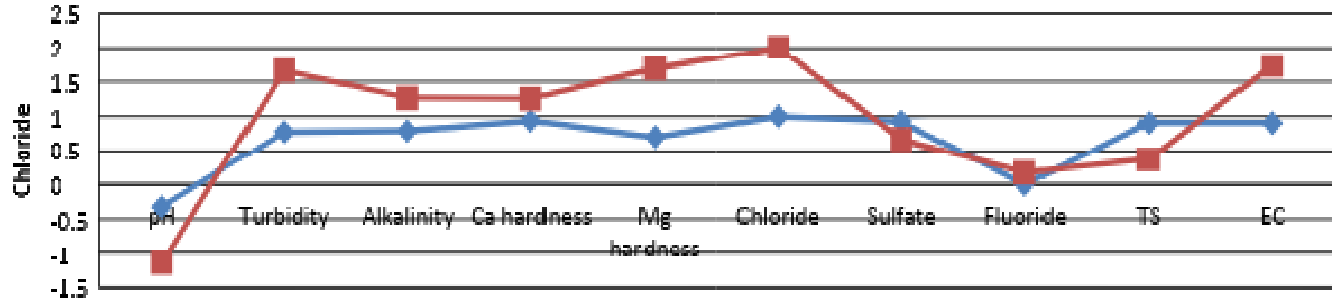
Total Alkalinity – Alkalinity is the capacity of bases to neutralize acids (11). In the present study alkalinity is positively related to Turbidity, Fluoride, Calcium hardness, magnesium hardness and conductivity and negatively to pH and Chloride content in both surface and ground water (fig.7).

Figure 7. Correlation matrix for Alkalinity



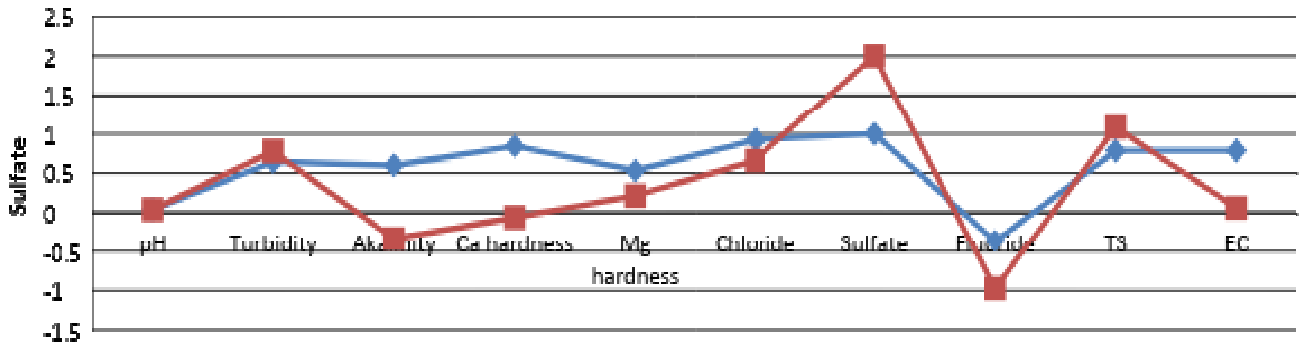
Chloride – Chloride level in water indicates the extent of sewage pollution in the water body. The present study expresses the correlation of chloride with other physicochemical parameters and reveals that it is positively correlated to Turbidity, Alkalinity, Calcium hardness, Magnesium hardness, Conductivity and negatively to pH in both Surface water and Ground water samples of the selected sites.

Figure 8. Correlation matrix for Chloride

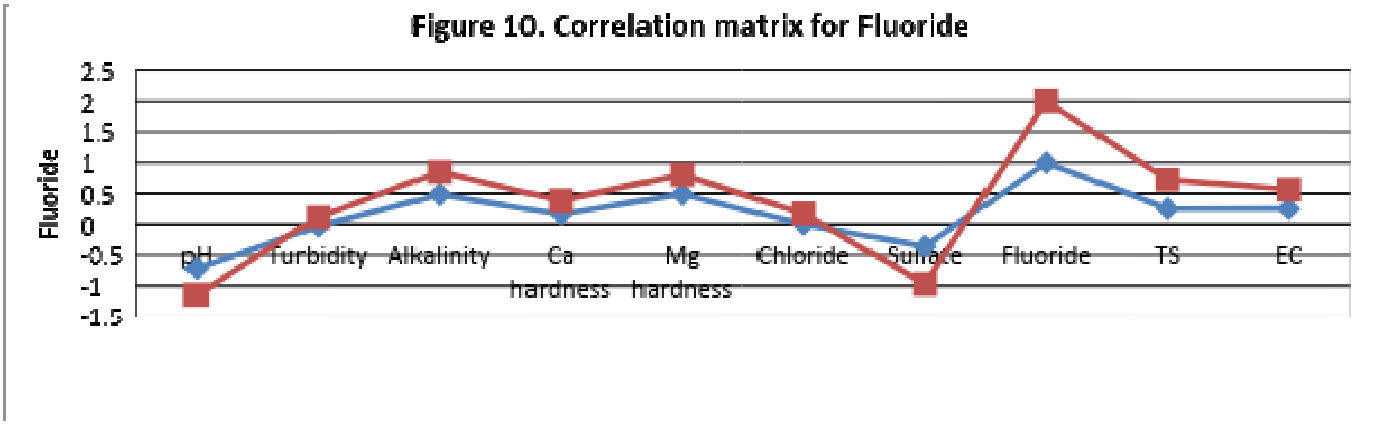


Sulfate – Sulfate is a nontoxic anion but ailment like Catharsis, Dehydration and Gastrointestinal irritation have been linked with it when concentration is high (12).Sulfate has negative correlation with Fluoride in both surface water and ground water (fig. 9).

Figure 9. Correlation matrix for Sulfate



Fluoride – The low concentration of fluoride has been considered beneficial but high concentration may cause dental fluorosis (tooth motting) and more severely skeletal fluorosis (7). As per present study fluoride is negatively correlated to pH in both, surface water and ground water (fig.10).



Summary and Conclusion

Bundi Region of Rajasthan is known for its ancient monuments, lakes and wells. But with the increase in pollution level the quality of water in water resources is gradually deteriorating. The present study uses the Pearson's formula to derive the correlation between the two tested parameters. The study of correlation reduces the range of uncertainty associated with decision making for mitigating pollution level (r shyamla). This analysis gives an idea of pollution in water resource. The study will be helpful in maintenance and development of the water resources in Bundi city (Rajasthan).

Acknowledgement

I am grateful to Dr. Shala Alam (Senior Chemist), Tarun Sharma (Junior Chemist), Akelgarh Kota (Rajasthan) and Akelgarh laboratory for their assistance in the lab work.

References

1) Ajay Kumar Rajawat and Praveen Kumar (2017), 'Physicochemical Aspects of Yamuna River at Golkul Barrage, Mathura (UP) India'. Flora and Fauna: 23 (2); 359-362.
2) APHA (2005) AWWA. WFCW in Standard Method for the examination of water and waste water. American Public Health Association, New York.
3) Chakraborty R.N., Saxena K.L., and Khan A.Q. (1965), 'Stream pollution and Its Effects on Water Supply' A report of survey, Proc. Symp. Problems in Water treatment. Oct. 29-30, Nagpur. 211-219.
4) EL-Dessouki, HT and Ettouney (2002), Fundamentals of Salt Water Desalination. 1st edition, Elsevier, Amsterdam, ISBN-10:00 80532128,690.
5) Esrey S A, Feachmen R G and Hughes J M (1995), Intervention for the Control of Diarrheal Diseases Among Young Children: Improving Water Supplies and Excreta Disposal Facilities, Bulletin of the WHO, 63;(4): 757-772.
6) ISI, Indian Standard Drinking Water Specification New Delhi, 1991, 5:6.
7) Pizzo G., Piscopo M.R. and Giuliana G. (2007), 'Community Water Fluoridation and Caries Prevention, A critical Review.' Clin Oral Investing: 11(3); 189-193.
8) R. Shyamala, M. Shanthi and P. Lalitha (2008), 'Physicochemical Analysis of Borewell Water Samples of Telungupalayam Area in Coimbatore District, Tamilnadu, India'. E-journal of Chemistry: 4(5); 924-929.

9) R.S. Sawant and AB Telave (2009), Seasonal Variations in Physicochemical Characteristics of four Aquatic Ecosystem in Gadhinglaj Tehsil of Maharashtra, Nature Environment and Pollutio Technology 8(3) 509-514.

10) V.T. Patil and P.R. Patil (2010), 'Physicochemical Analysis of Selected Ground water Samples of Amalner Town in Jalgaon District, Maharashtra, India', e-journal of Chemistry, 7(1), 111-116.

11) WHO, 2011, Guidelines for Drinking Water Quality, 4th edition.

12) www.cwejournal.org.

13) www.lenntech.com.

14) www.ruidp.rajasthan.gov.in.

15) www.study.com.