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Physico-chemical characteristics of a fish pond near Roorkee

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Abstract

This paper deals with the physical and chemical characteristics of the water of a fish pond near Roorkee. The present study was carried out from the month of January 08 to December 08 (1 year). The physico-chemical parameters such temperature, turbidity, pH, conductivity, dissolve oxygen, COD, BOD, free CO_2, total solids, TDS, TSS, total hardness, Ca hardness, Mg hardness, alkalinity, acidity, and chlorides were analysed during the course of study. The minimum and maximum range of physico - chemical properties were as, temperature 18.15 - 32.47 °C in January and July respectively, turbidity 62.25 - 236.25 JTU in January and August respectively, conductivity 582.75 µmho/cm in February and 1164.25 µmho/cm in July, total solids were 327 mg/l in February and 792 mg/l in July, total dissolved solids were 290.75 - 581.5 mg/l in February and July, total suspended solids were 31.75 mg/l in January and 242.25 mg/l in August , pH 7.78 – 8.43 in July and March respectively, dissolve oxygen was 5.9 mg/l in August and 7.02 mg/l in February, BOD was 4.27 mg/l in October and 4.82 in March, COD 8.5 – 9.9 mg/l in November and April respectively, free CO_2 was 2.38 – 3.38 mg/l in September and March, Acidity was ranged between 7.75 – 8.72 mg/l in September and March respectively, alkalinity 229 – 311 mg/l in August and December respectively, hardness 193 mg/l in February and maximum 386 mg/l in July, calcium 25.32mg/l in February and 50.26 mg/l in July, magnesium 31.51 in February and 63.26 mg/l in July, and chloride was minimum 31.3 mg/l in January and maximum 42.27 mg/l in August.

Keywords: *Physical Parameters* | *Chemical parameters* | *Pond water quality*

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Introduction

Much of the current concern with regards to environmental quality is focused on water because of its importance in maintaining the human health and health of the ecosystem. The ever-growing demands for water resources coupled with the rate at which much of the earth's fresh waters are being adversely affected by human activities, demonstrates a developing crisis in the not-too-distant future if environmental water resources are not appropriately managed (Peter et al. 1997). It

is therefore obligatory to have most relevant information for arriving at conclusive rational decisions that will ensure sustainable development of all these resources. Accurate and reliable information on the water resource system can therefore be a vital aid to strategic management of the resources (Gupta and Deshpande, 2004). Physicochemical factors are very important in estimating the constituents of water and concentration of pollutant or contaminant. Water quality generally means the component of water which must be present for optimum growth of aquatic organisms. The determinant of good growth in water body includes dissolved oxygen, hardness, turbidity, alkalinity, nutrients, temperature, etc. Conversely, other parameters like biological oxygen demand, and chemical oxygen demand indicate pollution level of a given water body. Accurate assessment depends on the results generated by specific monitoring activities which define the physical, chemical and biological condition of the resource (Khanna *et al*. 2007). Ponds, Lakes and Reservoirs, as integral components of our planet's life support systems, are essential for the maintenance of human life. These exists a strong interdependence between human population and aquatic ecosystems. The monitoring of the pond water is an essential step to mark the trend pattern of pollutants and their effect on living systems in today's developing life.

Materials and Methods

Pond is situated 5 Km. away from Roorkee in village Paniyala. The area of the pond of 75 Bhiga.The source of water in pond is rain water. Pond is situated at height of 268 meter from the mean sea level (longitude 77 degree 53 minute East and latitude 29 degree 51 minute North). The depth of pond is 2.8 meter and minimum 0.6 meter, mean depth is 1.7 meter and surface area of the pond is 2,92,500 square meter , catchments area is 2,92,400 square meter. Analysis of water samples were done according to standard methods as prescribed in APHA (2005), Trivedi and Goel (1986), and Khanna and Bhutiani (2008). Monthly samples were collected from pond from different location sites. The samples collection was completed during morning hours between 7:00 A.M. To 09:30 A.M. Physico-chemical parameters such as temperature, dissolved oxygen, electrical conductivity and pH value were measured directly in the field. Temperature (by using precise mercury thermometer), hydrogen ion concentration (by using pH-meter), electrical conductivity (by using EC-meter), turbidity level (by using turbidity-meter), dissolved oxygen (titrimetric methods), biological and chemical oxygen demand (titrimetric methods),carbonate and bicarbonate were determined directly by titration with standard 0.02 N HSO using phenolphthalein and methyl orange as indicators. The total chloride was measured by titration of 50 ml of sample against silver nitrate (0.0141 N) solution using potassium chromate as indicator.

Results and Discussion

The physico-chemical parameters are important determinant of the quality of water. Temperature is one of the most important among the external factors which has a profound influence, and direct and or indirect effect on biota of an ecosystem. The average water temperature was maximum (32.47 °C ± 2.43) in July and minimum (18.15°C ± 1.02) in January. Garg et al. (2010) reported the water temperature increased during warmer

months and decreased during colder months. Islam (2007) observed the same fluctuation pattern in temperature in a Pond of Rajshahi University, Bangladesh. Turbidity is a very general term that describes the "cloudiness" or "muddiness" of water. Turbidity is caused by wide variety of suspended matter, which range in size from colloidal to coarse dispersion depending upon the degree of turbulence and also ranges from pure inorganic substances to those that are highly organic in nature. The average values of turbidity ranged between 62.25 JTU ± 6.57 minimum to 236.25 JTU ± 18.69 maximum in the month of January and August respectively. Conductivity of Paniyala pond fluctuate from 582.75 µmho/cm ± 31.76 minimum to 1164.25 µmho/cm ± 40.37 maximum in February and July respectively. ARLE (2002) reported that mineral concentrations and dilution affects the value of conductivity. It also support to present findings as high values of conductivity was registered in summer months during this period the concentrations of most of the micronutrients were at the highest level. Total solids refer to suspended and dissolved matter in water. They are very useful parameters describing the chemical constituents of the water and can be considered as a general of edaphic relations that contribute to productivity within the water body. The maximum values of total solids were observed 792 mg/l ± 28.57 in July, and minimum 327mg/l ± 24.92 in February. The concentration is high during the monsoon, which may be due to addition of solids from the runoff water. Marker (1977) has made the same observation. The average value ranges of total dissolved solids were 290.75mg/l ± 12.91 to 581.5 mg/l± 37.83 minimum in February and maximum in July month. Total suspended solids were found maximum 242.25 mg/l± 21.87 in August and minimum 31.75 mg/l± 9.76 in January.

pH is defined as the intensity of the acidic or basic character of a solution at a given temperature. The pH was found fluctuate between (8.43 ± 0.18) maximum, and (7.78 ± 0.23) minimum. The maximum value was found in the month of March and minimum value in the month of July. This is in accordance with earlier reports by Wetzel (1975) who reported that the value of pH ranges from 8 to 9 units in Indian waters. The fluctuation of pH lies in slightly alkaline range as the similar results were observed by Khanna and Bhutiani (2003). Oxygen content of water is one of the important factors, and it is very necessary for all living organisms (WHO, 2006). Dissolved oxygen concentration more than 5.00 mg/l favours good growth of flora and fauna (Das, 2000). During the present investigation the amount of dissolved oxygen ranged between minimum5.9 mg/l ± 0.10 to 7.02mg/l ± 0.31maximum in August and February respectively. The minimum values were observed during rainy months and maximum values were noticed in February in the pond. This present result was in conformity with Kumar & Singh (2000). BOD is the measure of the extent of pollution in the water body. In the present study biological oxygen demand observed maximum 4.82mg/l ± 0.23 in March and minimum 4.27 mg/l± 0.40 in October. The COD of water increases with increasing concentration of organic matter (Boyd, 1981). Chemical oxygen demand was found maximum 9.9mg/l ± 0.87 in April and minimum 8.5mg/l ± 0.45 in November. However, the increase in COD during hot period is mainly attributed to the increase in the air and water temperatures, facilitating the decomposition and oxidation of organic

matter. The similar conclusion was supported by Abdo, M.H. (2005). Free carbon dioxide refers to carbon dioxide gas dissolved in water. The average value of Free CO_2 was ranged 2.38 mg/l± 0.76 to 3.38mg/l ± 0.91 minimum in September and maximum in March. Acidity was record maximum 8.72 mg/l± 0.93 in March, and minimum 7.75mg/l ± 0.93 in September. Total Alkalinity of water is a measure of acid present in it and of the cations balanced against them. The highest average concentration was recorded 311mg/l ± 9.75 in December, and minimum 229 mg/l± 8.67 in the month of August. The low alkalinity during the monsoon may be due to dilution. Jain *et al.* (1996) also reported similar findings in their study. The total hardness value in the pond which is the sum of calcium and magnesium hardness concentrations was found to be significantly higher in the wet season max (386 mg/l ± 19.29) in July and minimum in winter (193 mg/l ± 15.45) in February. This is similar to the findings of Bhatnagar and Singh (2010). Calcium maximum 50.26mg/l ± 4.93 in July, minimum 25.32mg/l ± 2.03 in February and magnesium maximum 63.26mg/l ± 4.37 in July, minimum 31.51mg/l ± 2.01 in February. Desia (1982) reported similar trend in magnesium in Kankari lake. Chloride occurs naturally in water as man and other animals excrete chloride together with nitrogenous compounds. The water body gets chloride in it when it flows through the area when salt is deposited. The chloride ranged between (42.27mg/l± 4.93 to 31.3mg/l ± 3.57) minimum in January and maximum in August with higher concentration in summer season and lower concentration in winter season. Lendhe and Yeragi (2004) and Garg et al., (2006) have held similar view regarding seasonal variation of chloride in water.

The correlation coefficients between the physico-chemical parameters are presented in table-3. The analysis shows the high degree positive correlation between temperature and conductivity, temperature and TDS, temperature and Total Hardness, temperature and calcium, temperature and magnesium, temperature and chlorides, turbidity and TS, turbidity and TSS, turbidity and calcium, conductivity and TS, conductivity and TDS, conductivity and Total Hardness, conductivity and calcium, conductivity and magnesium, TS and TDS, TS and TSS, TS and Total Hardness, TS and calcium, TS and magnesium, TDS and Total Hardness, TDS and calcium, TDS and magnesium, TSS and Total Hardness, TSS and Acidity, COD and chlorides, Free CO_2 and Acidity, Acidity and magnesium, Total Hardness and calcium, Total Hardness and magnesium, calcium and magnesium, calcium and chlorides, magnesium and chlorides.

The analysis show the high degree negative correlation between temperature and DO, Turbidity and DO, Conductivity and pH, TS and Alkalinity, TDS and pH, TSS and Alkalinity, pH and Total Hardness, pH and magnesium, DO and calcium, BOD and chloride, COD and Alkalinity, Free CO_2 and calcium, Acidity and Alkalinity, Alkalinity and calcium, Alkalinity and chlorides. This study of fish pond indicated that positive correlation dominated significantly.

Parameter /	Temperature (°C)	Turbidity (JTU)	Conductivity (µmho/cm)	Total Solids (mg/l)	T.D.S. (mg/l)	T.S.S. (mg/l)
JAN	18.15±1.02	62.25±6.57	717±16.92	390±26.71	358.25±15.67	31.75±9.76
FEB	19.47±1.23	66.75±7.04	582.75±31.76	327±24.92	290.75±12.91	36.25±12.56
MARCH	24.47±1.58	72.25±7.16	781±37.48	428.75±30.53	390±18.58	38.75±11.92
APR	26.75±0.79	74.75±12.89	783.75±33.57	433.25±29.42	392.25±19.03	41±8.09
MAY	30.27±2.11	92.5±13.67	784.5±36.32	433.5±27.19	391.5±22.85	42±9.57
JUNE	31.55±2.08	128.5±17.45	1055.75±48.05	605±39.05	528.25±33.08	76.75±13.79
JULY	32.47±2.43	167.5±18.09	1164.25±40.37	792±28.56	581.5±37.83	210.5±19.49
AUG	28.8±1.76	236.25±18.69	924.5±32.81	706±37.51	463.25±21.89	242.25±21.87
SEPT	27.47±1.02	146.75±15.91	838±33.79	520±22.06	420.25±15.43	99.75±14.83
OCT	27.2±1.45	131.75±13.03	832±27.29	486.5±19.48	417±17.81	69.5±11.93
NOV	21.57±1.07	106.75±10.08	700.75±30.05	404.25±16.76	353.25±11.72	51±9.65
DEC	19.2±1.63	73.75±8.09	658±37.98	368.75±15.54	330±18.37	38.75±8.54

Table 1: Average value of Physical parameters of the Pond water (2008)

Parameter / Month	pH	D.O. (mg/l)	BOD (mg/l)	COD (mg/l)	Free CO_2 (mg/l)	Acidity (mg/l)	Alkalinity (mg/l)	T. Hardness (mg/l)	Calcium (mg/l)	Magnesium (mg/l)	Chlorides (mg/l)
JAN	8.22±0.38	6.75±0.32	4.6±0.28	8.92±0.28	2.55±0.57	7.93±0.89	302.5±7.98	237.5±17.86	29.33±3.97	39.89±2.97	31.3±3.57
FEB	8.28±0.17	7.02±0.31	4.77±0.43	8.95±0.37	3.23±0.87	8.48±0.81	302.5±8.93	193±15.45	25.32±2.03	31.51±2.01	33.01±4.03
MARCH	8.43±0.18	6.97±0.29	4.82±0.23	9.3±0.58	3.38±0.91	8.72±0.93	299.25±11.57	260±17.11	30.11±2.77	44.88±3.65	35.69±4.66
APR	8.32±0.45	6.55±0.37	4.77±0.38	9.9±0.87	3.24±0.46	8.67±0.98	256.25±10.79	261±18.60	32.42±3.65	43.71±4.87	37.67±3.96
MAY	8.28±0.19	6.17±0.19	4.77±0.49	9.82±0.94	3.05±0.44	8.42±0.77	270.5±6.03	260.75±13.91	35.9±4.01	41.54±4.04	40.03±4.98
JUNE	7.86±0.25	6.1±0.11	4.6±0.67	9.62±0.87	3±0.89	8.35±0.83	277.5±9.49	351±23.39	40.52±5.67	60.67±5.48	41.25±3.38
JULY	7.78±0.23	6.1±0.09	4.5±0.69	9.47±0.79	2.85±0.81	8.6±0.69	251.25±13.65	386±19.29	50.26±4.93	63.26±4.37	40.7±4.11
AUG	8.12±0.18	5.9±0.10	4.42±0.46	9.55±0.82	2.45±0.87	7.79±0.77	229±8.67	308±12.58	44.32±4.51	47.91±3.91	42.27±4.93
SEPT	8.24±0.11	5.95±0.17	4.35±0.32	9.2±0.56	2.38±0.76	7.75±0.93	281.25±12.94	278.75±19.11	40.01±3.97	43.43±2.97	38.95±3.97
OCT	8.21±0.15	6.07±0.23	4.27±0.40	8.62±0.56	2.58±0.67	7.87±0.89	295.25±11.78	277.5±9.86	37.82±3.02	44.45±4.56	35.6±2.88
NOV	8.21±0.19	6.5±0.18	4.35±0.37	8.5±0.45	2.58±0.71	7.85±0.81	303.25±10.59	234.25±16.84	32.89±4.52	36.93±3.69	35.41±3.51
DEC	8.2±0.31	6.67±0.21	4.35±0.27	8.77±0.90	2.79±0.69	8.02±0.75	311±9.75	218.5±13.26	27.14±2.99	36.6±2.98	31.68±3.86

Table 2: Average value of Chemical parameters of the Pond water (2008)

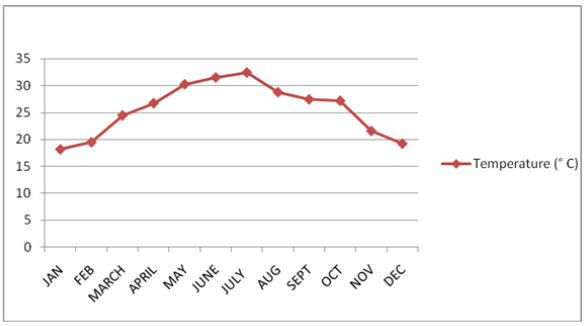

Fig.-1. Showing monthly fluctuation in temperature (°C) of fish pond

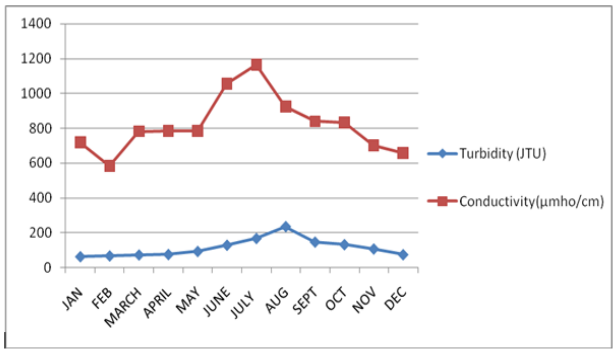

Fig.-2. Showing monthly fluctuation in turbidity (JTU) and conductivity (µmho/cm) of fish pond

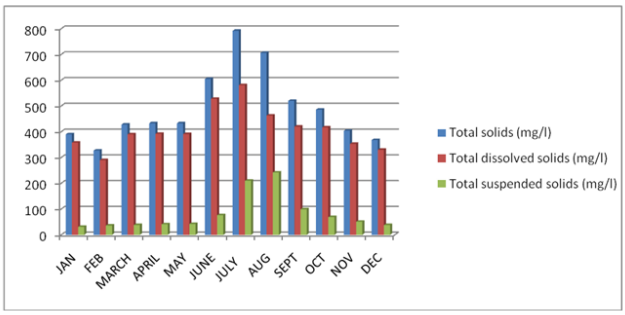

Fig.-3. Showing monthly fluctuation in Total solids, T.D.S. and T.S.S. (mg/l) of fish pond

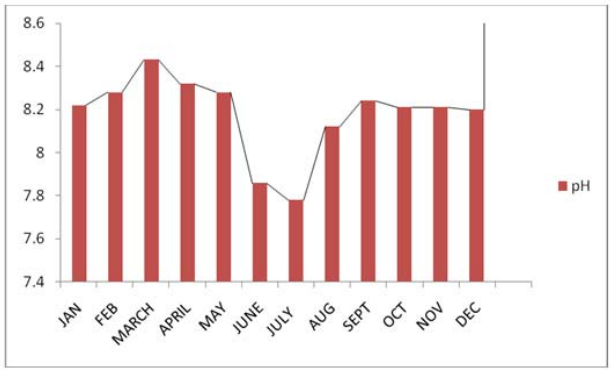

Fig.-4. Showing monthly fluctuation in pH of fish pond

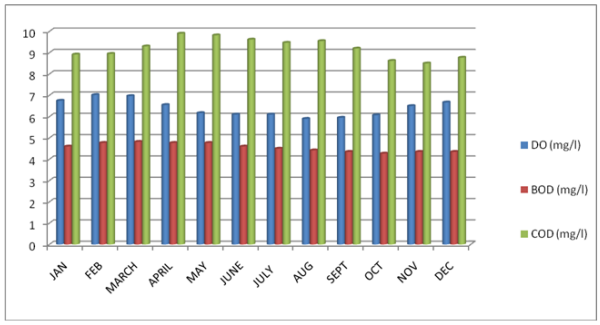

Fig.-5. Showing monthly fluctuation in DO, BOD and COD (mg/l) of fish pond

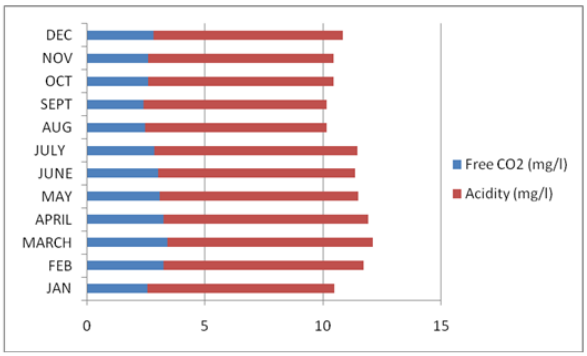

Fig.-6. Showing monthly fluctuation in Free CO_2 and Acidity (mg/l) of fish pond

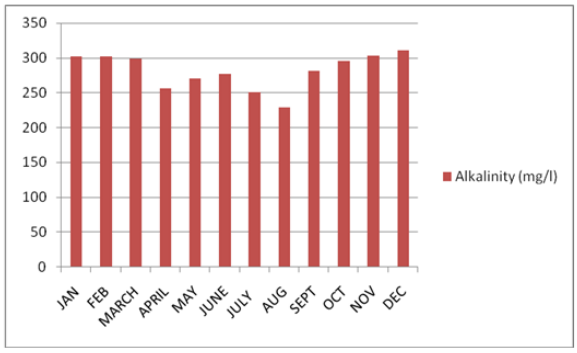

Fig.-7. Showing monthly fluctuation in Alkalinity (mg/l) of fish pond

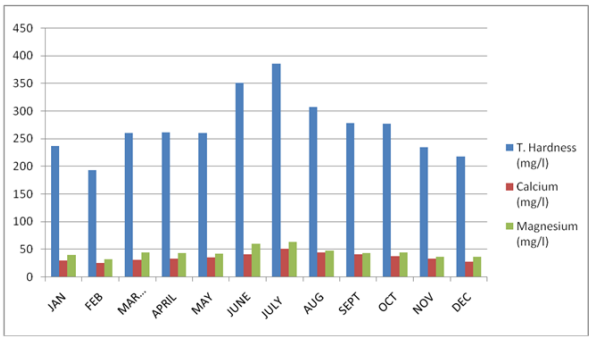

Fig.-8. Showing monthly fluctuation in Total hardness, calcium and magnesium (mg/l) of fish pond

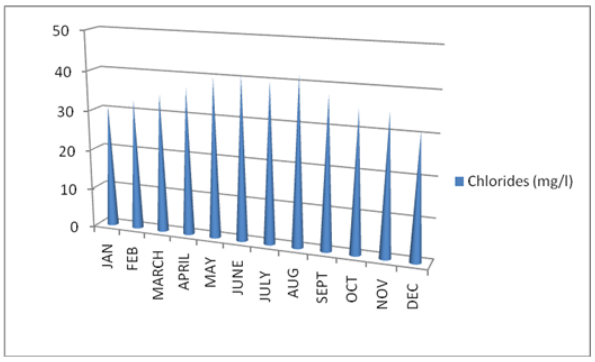

Fig.-9. Showing monthly fluctuation in chlorides (mg/l) of fish pond

	Temperature	Turbidity	Conductivity	Total Solids	T.D.S.	T.S.S.	pH	D.O.	B.O.D.	C.O.D.	Free CO2	Acidity	Alkalinity	T. Hardness	Calcium	Magnesium	Chloride
Temperature	1	0.6306051	0.8577819	0.7857238	0.8571444	0.5782843	-0.5424567	-0.7765098	0.0051562	0.675376	0.0250335	0.2361544	-0.7427521	0.8589428	0.8574184	0.8136494	0.9335032
Turbidity		1	0.67207	0.8583735	0.6766916	0.931057	-0.5374538	-0.8193956	-0.5023088	0.2127651	-0.5519629	-0.3848197	-0.7396965	0.6764017	0.8551388	0.551478	0.7502523
Conductivity			1	0.9353095	0.9999167	0.7120582	-0.8117017	-0.6927835	-0.1476719	0.4875158	-0.1268576	0.1575069	-0.6627315	0.9999038	0.9201875	0.98283	0.7862374
Total Solids				1	0.9362753	0.9143728	-0.7747295	-0.7330335	-0.2671011	0.4216899	-0.2836895	-0.0011657	-0.7788275	0.9358501	0.9583246	0.8723753	0.7980423
T.D.S.					1	0.7138865	-0.8127661	-0.6975764	-0.1575718	0.4817421	-0.1350078	0.1486258	-0.6621393	0.9999621	0.9222439	0.9818886	0.7871893
T.S.S.						1	-0.6078468	-0.6571594	-0.3510748	0.2850015	-0.4099887	-0.1735102	-0.789133	0.7130779	0.8475333	0.6073347	0.6833143
pH							1	0.5382236	0.3088984	-0.1698822	0.2376507	0.0008528	0.4026167	-0.8089764	-0.7271899	-0.8029437	-0.4958608
D.O.								1	0.5305277	-0.2986793	0.5805418	0.4106195	0.6422873	-0.6962379	-0.8585142	-0.579914	-0.7819368
B.O.D.									1	0.5821663	0.8541142	0.8213765	-0.0599535	-0.153762	-0.3423093	-0.0519024	-0.7819368
C.O.D.										1	0.4227937	0.5585129	-0.7459589	0.4841961	0.3958655	0.5023248	0.7056058
Free CO2											1	0.9313764	0.0876675	-0.1305818	-0.3739658	-0.0042986	-0.0641131
Acidity												1	-0.1275123	0.1522254	-0.0889352	0.2617044	0.1160743
Alkalinity													1	-0.6634642	-0.7538811	-0.5834029	-0.8456492
T. Hardness														1	0.9215205	0.9822915	0.7885936
Calcium															1	0.8324747	0.8430607
Magnesium																1	0.7197871
Chlorides																	1

Table-3: Correlation coefficients of different physico-chemical parameters of pond water

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