

Water Quality of Kufa River and Effect Pollutants on It

Kasim Kadhim Alasedi and Karrar Aziz Hassan

University of Kufa - Collage of Science - Environment Department

e-mail: Krrory79@yahoo.com

الخلاصة

أجريت الدراسة الحالية لبيان التأثيرات البيئية المحتملة للملوثات المختلفة في نهر الكوفة وبواقع أربع محطات مختارة للفترة الممتدة من تشرين الثاني 2011 ولغاية نيسان 2012. شملت الدراسة قياس بعض الصفات الفيزيائية والكيميائية لمياه النهر. بينت نتائج الدراسة توافق واضح بين درجة حرارة الهواء ودرجة حرارة الماء في جميع المواقع إذ تراوحت بين (11-23.5) °م و (10.5-22) °م على التوالي. وتراوحت قيم الأس الهيدروجيني والتوصيلية الكهربائية مايكرو سيمنز/سم، والمواد الصلبة الذائبة الكلية (TDS) والمواد الصلبة العالقة الكلية (TSS) والملوحة (7.9-8.8) ، (1597.7-1099.7) مايكرو سيمنز/سم، (459.3-718.7) ملغم/لتر، (1.1-9.6) ملغم/لتر، (0.3-0.6) جزء بالألف على التوالي، أما قيم العكورة والأوكسجين الذائب والمتطلب الحيوي للأوكسجين فتراوحت بين (5.7-0.7) NTU، (6.57-12.83) ملغم/لتر، (0.4-4.2) ملغم/لتر على التوالي. أظهرت الدراسة أن مياه نهر الكوفة خلال فترة الدراسة كانت قاعدية عالية سادت فيها أيونات البيكربونات، إذ تراوحت قيم القاعدية الكلية بين (124-289) ملغم كاربونات الكالسيوم/لتر. تبين أن المياه في المنطقة المدروسة عسرة جداً تراوحت قيمها بين (315-524.4) ملغم كاربونات الكالسيوم/لتر. في حين كانت تراكيز الكالسيوم والمغنسيوم تتراوح بين (113.3-412.3) و (8.4-83.1) ملغم كاربونات الكالسيوم/لتر على التوالي. أظهرت المغذيات تذبذباً واضحاً في تراكيزها خاصة النتريت والنتريت والفوسفات التي تراوحت قيمها بين (0.003-0.192) و (0.5-1.3) و (0.001-0.04) ملغم/لتر على التوالي، وبالنسبة للكبريتات فقد تراوحت قيمها بين (196.1-413.2) ملغم/لتر. ونستنتج من الدراسة إن تذبذب مناسيب المياه ورمي فضلات مياه الصرف الصحي في النهر له تأثيرات سلبية على نوعية المياه.

Abstract

The present study was conducted to indicate the possible environmental effects on Kufa river in four selected sites along this area during November 2011 to April 2012. the physical and chemical water properties were investigated in this study. The results showed clear coordination between air and water temperature in all study locations. Air and water temperature ranged between (11-23.5) °C and (10.5-22) °C respectively. pH, Electrical Conductivity EC, Total Dissolved Solid TDS, Total Suspended Solid TSS, Salinity ranged between (7.9-8.8), (1099.7-1597.7) µs/cm, (459.3-718.7) mg/L, (1.1-9.6) mg/L (0.3-0.6) ppt respectively. Turbidity, Dissolved oxygen and BOD5 value ranged between (0.7-5.7) NTU (6.57-12.83) mg/L (0.4-4.2) mg/L. The study showed that the water of the river was high alkaline (124-289) mg CaCO₃/L and bicarbonate ions were dominant throughout the study period. The total hardness ranged between (315-524.4) mg CaCO₃/L, which was classified as very hard water, while the concentrations of calcium and magnesium were (113.3-412.3), (8.4-83.1) mg CaCO₃/L respectively. The nutrients showed clear fluctuation in their concentrations. Nitrite values were (0.003-0.192) mg/L and nitrate values were (0.5-1.3) mg/L, while reactive phosphate was (0.001-0.04) mg/L. The sulfate values were (196.1-413.2) ml/L. The present study was conclusion fluctuation water levels and cant swage water in river negative impact on water quality.

Key Word: Water Quality , Kufa River

Introduction

The water enters in all biological, industrial processes, and no living creature in whatever form, kind or size to live without it, different animals needs in order to live, and plants are also need it in order to grow, Cell biology has proved that water is the important component in the installation cell material, a unit of construction in all living plant or animal, and biochemistry demonstrated that the water necessary for the occurrence of all interactions and transformations that take place within the bodies of the livings. It is either the center or within or catalyst in the reaction product or with it,

also physiology has shown that water is essential for the establishment of each organ, without which its functions are not available to its aspects of life and its components.

Water is used for the purposes of human, agricultural, industrial and civic wide, making it vulnerable to pollution, direct and indirect, and because of that the world has a growing interest in water resources and how to treat contamination. The organism is surrounded by a number of vital events organized by the water, where the solvent for ionic materials. Water provides metals for the food plants of the metals and surrounding area and constitutes majority of the hemisphere [1]. Water quality refers to the physical, chemical and biological characteristics of water [2], It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose[3]. It is most frequently used by reference to a set of standards against which compliance can be assessed. The most common standards used to assess water quality relate to health of ecosystems, safety of human contact and drinking water.

Study Site

At Al-Kifl city, the Euphrates subdivided into two parts: Al-Abassia and Al-Kufa river, the last one extends from Al-Kifl city via Al-Najaf government to Al-Diwania city, The total length of Kufa River is about 36 Km, its capacity about $375 \text{ m}^3 \cdot \text{sec}^{-1}$, but the actual capacity reaches to $552 \text{ m}^3 \cdot \text{sec}^{-1}$. The water level in this river undergoes large fluctuations, the highest level occur during the flooding season (end of March early April), the lowest water level occur in the summer [4]

A lot of villages and farms (animal, crop, and vegetation farms) are found along the River; there are domestic, municipal wastewater and agriculture drainage discharged to the river; in addition to the industrial wastes, which come from: the industrial region in Al-Najaf city, the leather industry, and the cement factory. All of the above have many effects on water quality. In this study, four stations were chosen as following: **st.1** (control station) beside Imam Ali Bridge, **st.2** beside old Al-Kufa Bridge (Al-Kufa municipal wastewater discharge), **st.3** after buffalo's farm, and **st.4** located in the last part of Kufa River (near Cements Factory Bridge, after Al-Barakya municipal wastewater treatment plant discharge) (Figure 1).



Fig. 1: The Study Sites

Material and Methods

The air temperature was measured by mercuric thermometer which was divided until 0.1 C°. The water temperature and pH were measured directly in the field by digital portable pH meter; WTW, which is made in Germany. Water electrical conductivity and salinity were measured directly in the field by digital portable multi meter; model 340i/SET, which is made in Germany.

Water depth was measured during the study period by ironic ruler, which is divided from 0-400 cm. Water flow (cm/sec) was measured during the study by flow meter, which is made in USA. Water turbidity was measured in the laboratory by turbidity meter(type WTW, made in Germany).

T.S.S. and T.D.S were measured according to APHA [5]. Dissolved Oxygen DO and Biological Oxygen Demand BOD were measured according to Azide-modification by Winkler method [5]. The results were expressed as mg/l. EDTA titration method was used to determine total hardness and calcium as recommended by APHA [5]. Mathematical equation was used to calculate Magnesium concentration, which is explained by APHA [5]. Chloride ion concentration was measured according to the method explained by APHA [5]. The bicarbonate concentration was measured according to APHA [5]. The sulfate concentration was measured by turbid metric method which is explained by APHA [5]. After the collection of the samples, they were filtered by filter papers (0.45 GF/C). The reactive phosphate, reactive nitrite and reactive nitrate were measured according to the procedures which is explained by [5].

Results and Discussion

The air temperature during the study period ranged between (11°C - 23.5°C), the lowest value (11°C) was in December in station (1), while the highest value (23.5°C) was in April in the station (4). The water temperature ranged between (10.5°C - 22°C), the lowest value (10.5°C) was in December in station (1), while the highest value (22°C) was in April in station (4) these are clear in the **Figures 2 And 3**. Their main reasons for these results may be due to sun irradiating periods and length of the day period; while the differences in air temperature among the stations within the one day may be caused by the difference in sampling time ; Solar energy and air temperature are the two main factors that influence water temperature, but there are other influences, like flood, drought, and climatic conditions[5]. Water temperature follows air temperature clearly, that may be because the water is shallow, this Phenomenon was confirmed by many researcher in many lakes and water bodies [7-11]; inflows and outflows (creeks, streams, groundwater seepage, etc.) the shape and depth of the water body basin; wind and waves; even the color of the water can influence temperature [12, 13].

During the study period water depth ranged between (0.7 -3.5) m , the lowest value (0.7 m) was in November in station (1), while the highest value (3.5 m) was in February and March in station (2).

Readings of the turbidity during the study period was between (0.7 - 5.7) NTU, the lowest value (0.7 NTU) was in February in station (3), while the highest value (5.7 NTU) was in November in station (1), these are clear in the figure (4,5). Light penetration is an important parameter because light affects both the biological and chemical reactions in a water-body. If a water-body is very turbid, light will not reach through the water column and many processes, especially photosynthesis, will be limited. When water is turbid, the floating particles absorb heat from the sun, raising water temperature and thus lowering dissolved oxygen levels [14].

T.S.S values ranged between (1.1 – 9.6) mg/l , the lowest value (1.1 mg/l) was in March in station (4), while the highest value (9.6 mg/l) was in November in same station,.

This study showed (T.D.S) values during the study period ranged between (459.3 - 718.7) mg/l , the lowest value (459.3 mg/l) was in February in station (1), while the highest value (718.7 mg/l) was in December in the station(4),.

The results of the present study showed water salinity values during the study period ranged between (0.3 ppt –0.6ppt); the lowest value (0.3 ppt) was in February in all stations, while the highest value (0.6 ppt) was in November in all stations; This study showed the water electrical conductivity values ranged between (1099.7 – 1597.7) $\mu\text{s}/\text{cm}$, the lowest value (1099.7 $\mu\text{s}/\text{cm}$) in February in station (2), while the highest value (1597.7 $\mu\text{s}/\text{cm}$) in November in the station (3), as shown in **Figures 6-9**. The lowest salinity values were registered during February , this is caused by increasing of rainfall and raise of water levels which will dilute dissolved salts and another dissolved solids materials [10,15]. While the highest salinity values, which were registered during November, was caused by decreasing the water levels

and increasing the evaporation ratio [10,16,17]. Furthermore, the dissolved ions are concentrated by evaporation and diluted by freshwater input .

During the study period, water pH values ranged between (7.9 – 8.8), the lowest values (7.9) was in January in station (1), while the highest value (8.8) was in February in station (3) and (4); these are clear in the **Figure 10**.

The results showed the presence of monthly variations in pH values (in alkaline level) at the study period in the all studied stations; which may be due to the ability of water to be as buffer solution to regulate pH values. It is well known that Iraqi waters mainly tend to be alkaline, this agree with results of [18-22].

The results of this study showed the total alkalinity concentration values ranged between (124.2 - 289.7) mg/l , the lowest value (124.2 mg/l) was in November in station (4), while the highest value (289.7 mg/l) was in March in station(2); **Figure 11**. The total alkalinity of this study showed the bicarbonate alkalinity is common in Iraq water. Many factors affected alkalinity value such as temperature, increase decay organic matter, increase CO₂ concentration, rise water levels and magnesium concentration raise alkalinity caused by the throw of used bicarbonate ions that considered as carbon source in photosynthesis process in phytoplankton and aquatic plants .All Iraqi water appear to be alkalinity this affirmed by the present study where show that Iraqi water characterize heel become alkalinity and are capable to regulate pH.

During the study period dissolved oxygen values ranged between (6.57 – 12.83) mg/l ; the lowest value (6.57 mg/l) was in April in station (3), the highest value (12.83 mg/l) was in November in station (1) these are clear in **Figure 12**. These results are many factors play an important role in increasing and decreasing of dissolved oxygen concentration in water, in addition to photosynthesis such as temperature; the raise of temperature leads to decline in dissolved oxygen concentration in water [14,23], as well as, the decomposed organisms use the dissolved oxygen to degraded the organic matter by self-purification [24,25]; in addition to that the salinity values were high at summer and this lead to decrease the solubility of oxygen gas in water [10, 26, 27]. The results of the present study showed that the high dissolved oxygen concentration values were in winter season at the same time with decreasing of temperature, while the lowest values were at the autumn seasons at the same time with increasing of temperature, these results agree with another researchers [10,21,25,27,28, 29,30,31].

Biological oxygen Demand values were ranged between (0.4 – 4.2) mg/l ; the lowest value (0.4 mg/l) was in January in station (1), the highest value (4.2 mg/l) was in February in station (3); these are clear in **Figure 13**.

Total hardness values throughout the study period ranged between (315 - 524.4) mg/l ; the lowest value (315 mg/l) was in April in station (3), while the highest value (524.4 mg/l) was in December in station(4);.

Calcium ion concentration values during the study period ranged between (113.3 - 412.3) mg/l ; the lowest value (113.3 mg/l) was in November in station (1), while the highest value (412.3 mg/l) was in December in station (4);

This study showed that magnesium ion concentration values ranged between (8.4 -83.1) mg/l; the lowest value (8.4) was in April in station (3), while the highest value (83.1 mg/l) was in November in station(4) ; these are clear in **Figures 14-16**. high hardness values which were recorded in winter season, caused by rain where rain usually wash the lands and that leads to dissolve salts in the lands and carry it to the water [31,32,33,34]. Generally calcium ion was more than magnesium ion concentration at all of the study period, When the carbon dioxide reacts with calcium ion more than its reaction with magnesium ion, so dissolved bicarbonate with calcium will be more than magnesium [7, 35], this agree with many studies about Iraqi water [29,36].

Sulfate concentrations during the study period ranged between (196.1 – 413.2) mg/l ; whereas the lowest value (196.1 mg/l) was in February in station (1), while the highest value (413.2 mg/l) was in December in station (3); these are clear in **Figure 17**.

The sulfate shares in large amounts in the structure of the salts in water of Iraqi marshes [37,38]; high sulfate concentration values were at the December when the temperature is high , which causes increasing the evaporation rate, as a result the sulfate concentration should be increased and available for aquatic macrophyte to absorpe it, and this is important for plant growth because sulfate is important to the photosynthesis enzymes structure, especially in the enzymes which regulate the capacity of the roots to respire both aerobically and anaerobically, which lead to increase aquatic macrophytes growth[39].

This study showed reactive phosphate concentrations throughout the study period ranged (0.001 - 0.04) mg/l ; the lowest value (0.001 mg/l) was in November in stations (1)(2) and in February in stations (1)(2) and(3), while the highest value (0.04 mg/l) was in March in station (4), these results are clear in **Figure 18**.

Phosphorus is considered one of the main important nutritious components to the growth of aquatic plants. Generally, the concentrations were low at the study period , this results agree with the previous studies [15,21,27,40], that may be because the Pollution sources may be the cause , which have a few reactive phosphates . While the high concentration may be pollution sources in station (3) as well as releasing amounts of reactive phosphate from the bottom sediments to water and degradation of aquatic plants, phytoplankton and others organic matter in addition to the decreasing of water levels, that lead for increasing the reactive phosphate concentrations during this period [11,8,41].

The results of the present study show that reactive nitrite concentrations were ranged between (0.003 – 0.192) mg/l ; the lowest value (0.003 mg/l) was in April in station (4), while the highest value (0.192 mg/l) was in January in the same station .

Reactive nitrate concentrations during the study period ranged between (0.5 – 1.3 mg/l), the lowest value (0.5 mg/l) was in November in station (1), while the highest value (1.3 mg/l) was in April in station (4), these clear in figure (19,20). Nitrogen is the most abundant nutrient in commercial fertilizers. It enters the water from human and animal waste and runoff of fertilizer from lawns and crops [10,14,42,43].

The results of the present study showed that the nitrate and nitrite concentrations values in the water were present in low concentrations in all of the study stations; whereas these concentrations were in higher values in spring this may be due to increasing the reduction the

nitrate to nitrite in high temperature, in addition to increasing the solubility of the organic materials [44,45].

The lower concentrations values of nitrate and nitrite were measured at winter season in the stations (3 and 4) the cause may be the increasing number of phytoplankton species that consume more amount of these nutrients [24,29,31,40,45,46,47] as well as increasing the water levels at winter season leads to dilute these concentrations [25].

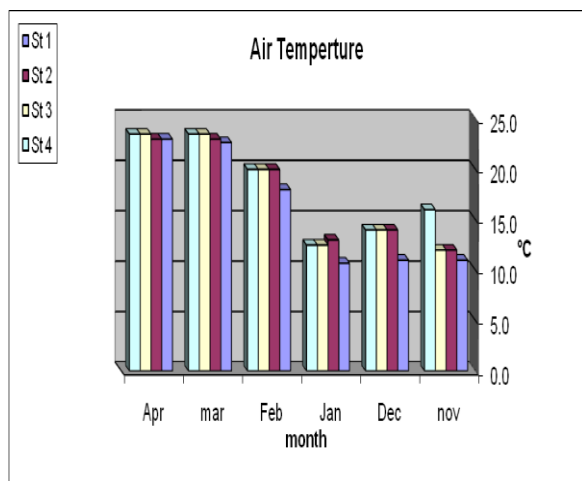


Fig. 2: Monthly Air temperature L.S.D=0.2 measured (C°)

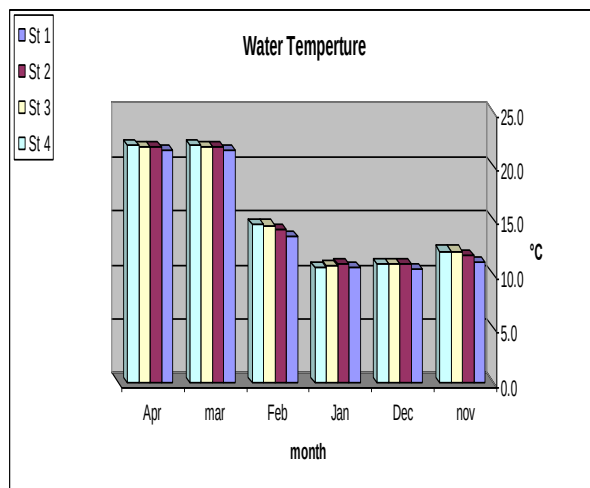


Fig. 3: water temperature variations L.S.D 0.05=5

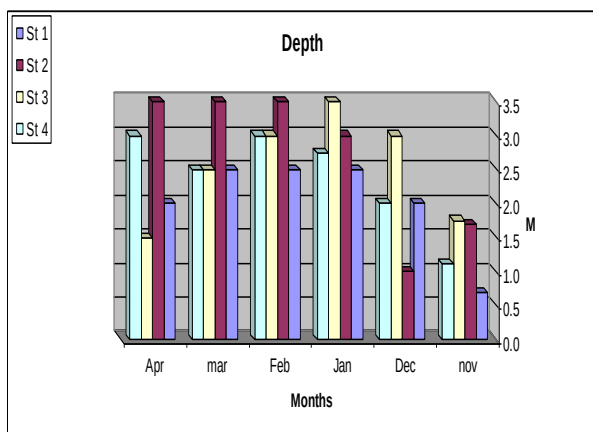


Fig. 4: Monthly Depth variations (m) L.S.D 0.05=0.3

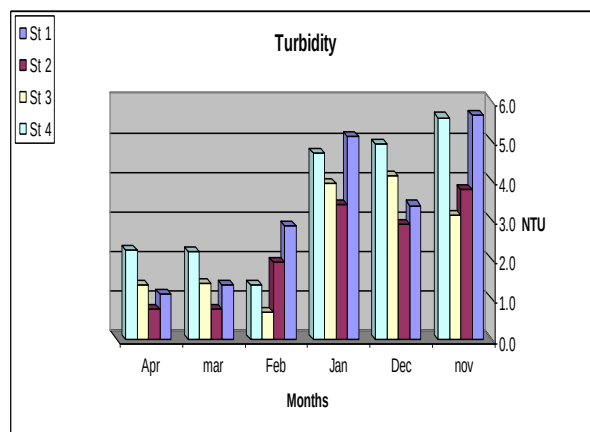


Fig. 5: Monthly Turbidity L.S.D 0.05=1.4 variations (NTU)

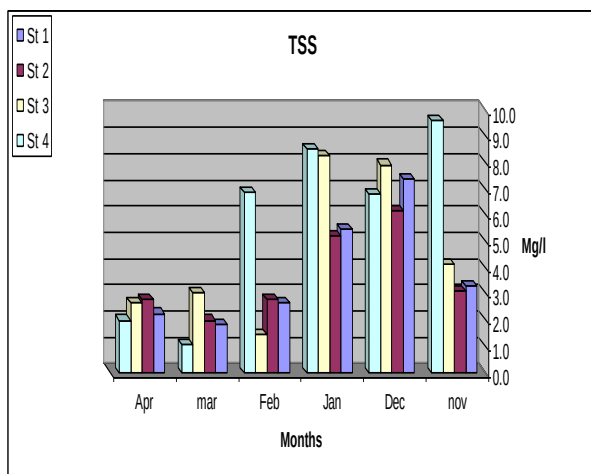


Fig. 6: Monthly TSS variation L.S.D 0.05 =2.7(mg /l).

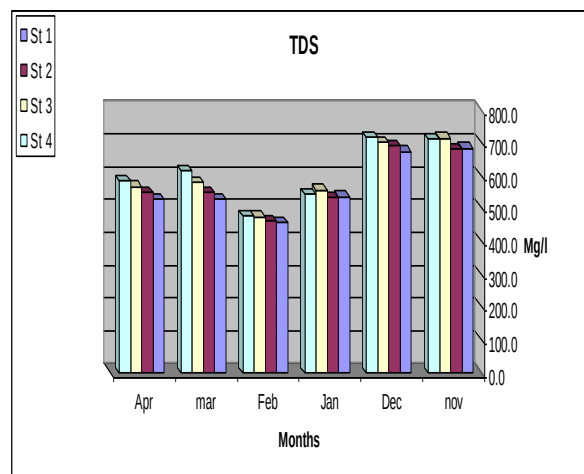


Fig. 7: Monthly TDS variation L.S.D 0.05 =10 (mg\l)

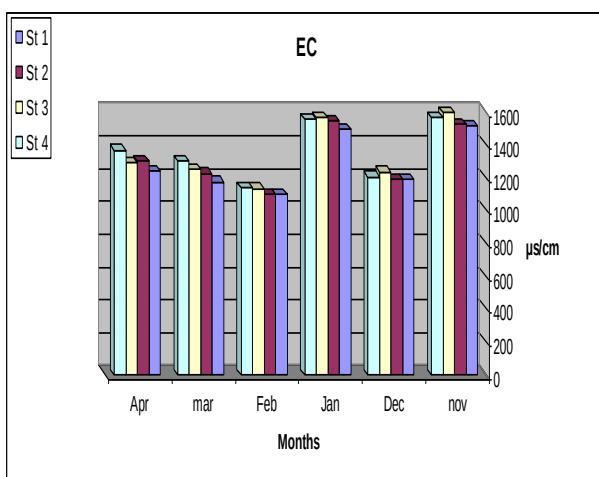


Fig. 8: Monthly EC variation L.S.D 0.05 =18.7 (µs/cm)

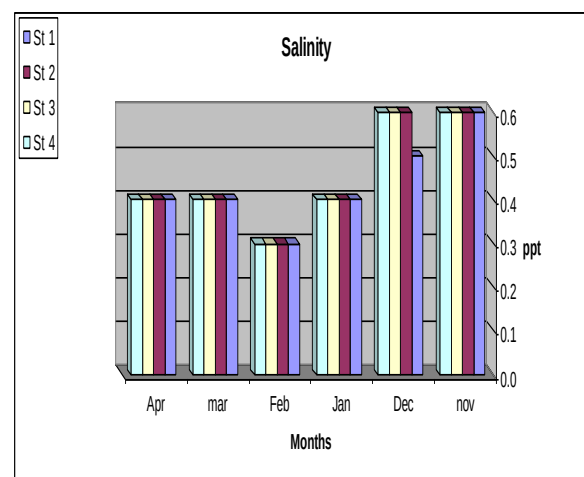


Fig. 9: Monthly Salinity variation L.S.D 0.05 =0.02 (g/l).

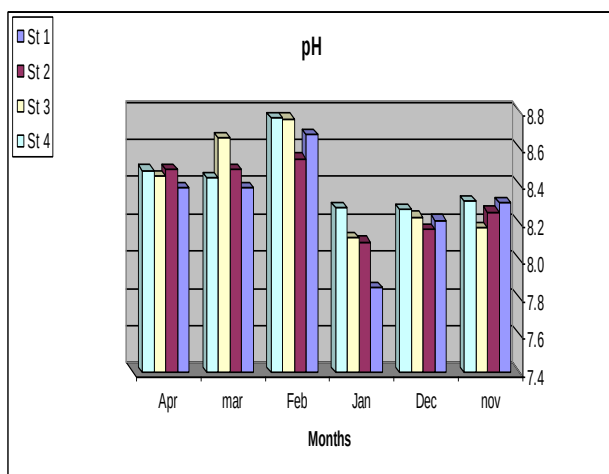


Fig. 10: Monthly pH variation L.S.D 0.05= 0.2

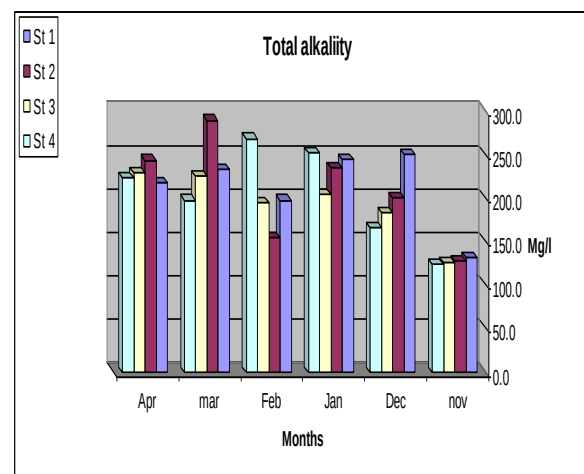


Fig. 11: Monthly Total Alkalinity variation L.S.D 0.05=71 (mg /l)

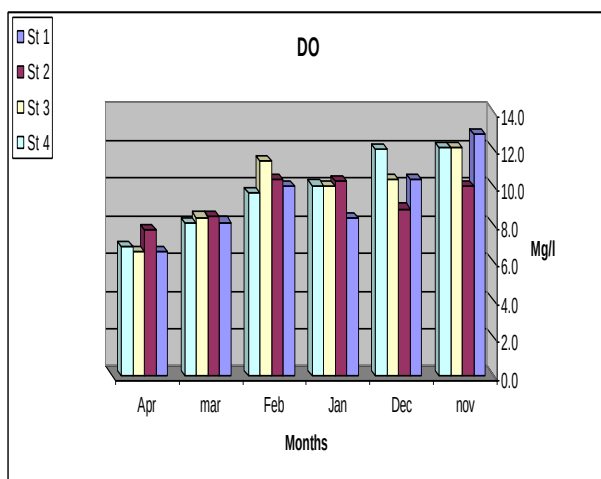


Fig. 12: Monthly DO variation L.S. D 0.05
=0.2 (mg /l)

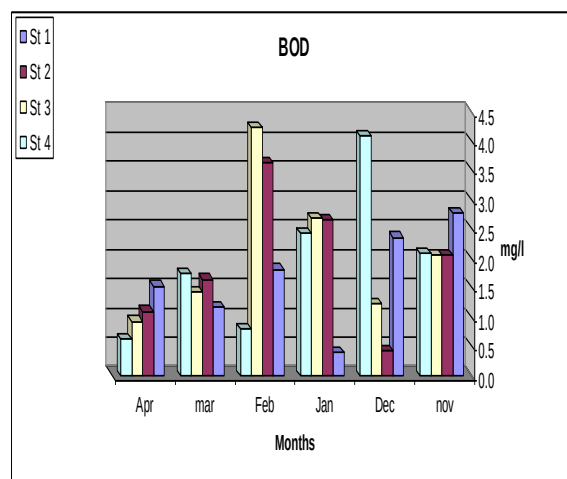


Fig. 13: Monthly BOD variation L.S.D 0.05
=0.1 (mg /l)

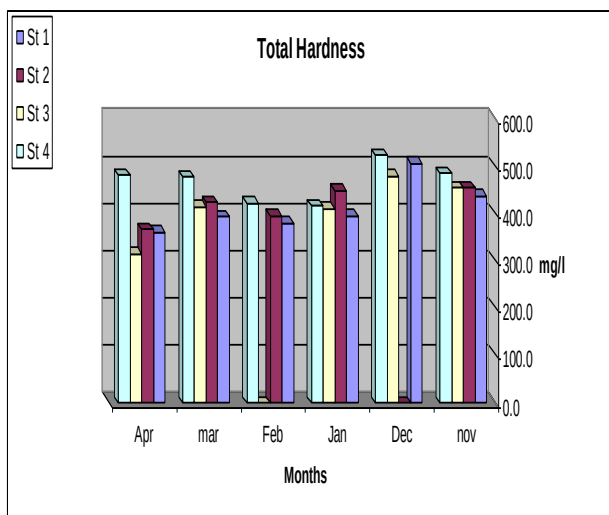


Fig. 14: Monthly Total Hardness variations
L.S.D 0.05=35.1 (mg /l)

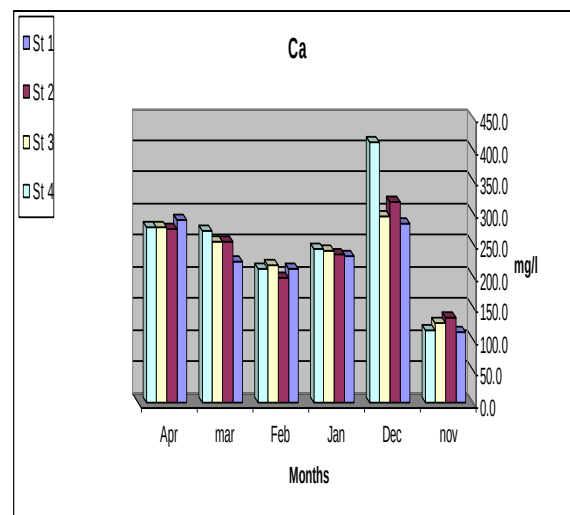


Fig. 15: Monthly Calcium variations L.S.D
0.05=39.8 (mg /l)

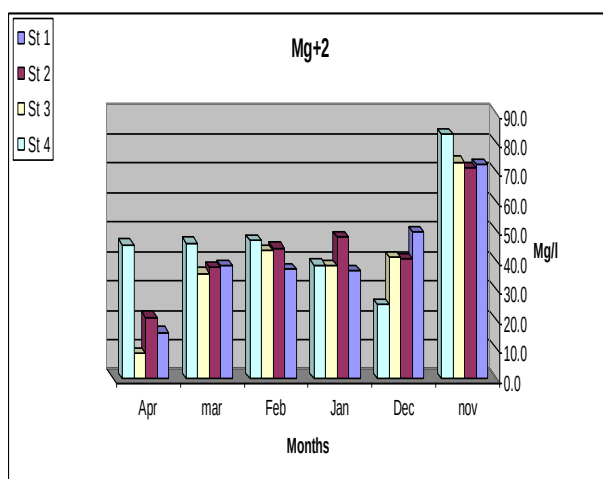


Fig. 16: Monthly magnesium variations L.S.D 0.05=11.9 (mg /l)

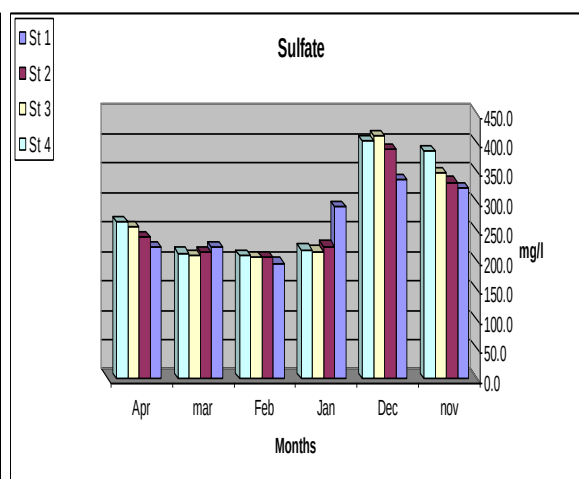


Fig. 17: Monthly Sulfate L.S.D 0.05=35.1 variations (mg /l)

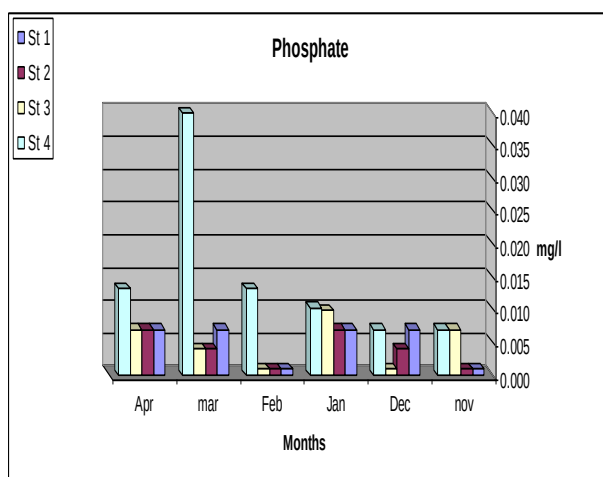


Fig. 18: Monthly Phosphate variations L.S.D 0.05=0.01 (mg /l)

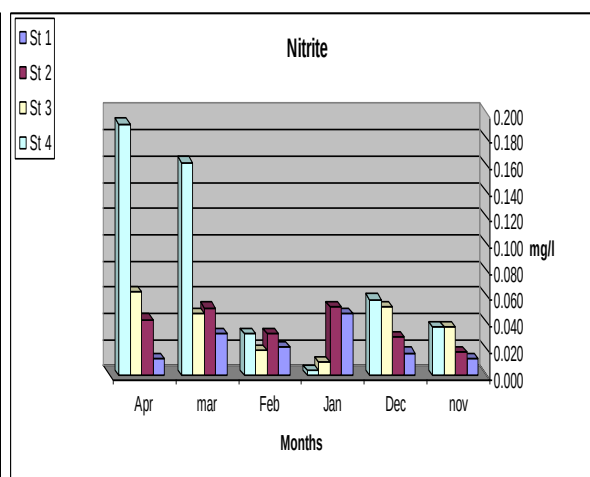


Fig. 19: Monthly nitrite variations L.S.D 0.05=0.03 (mg /l)

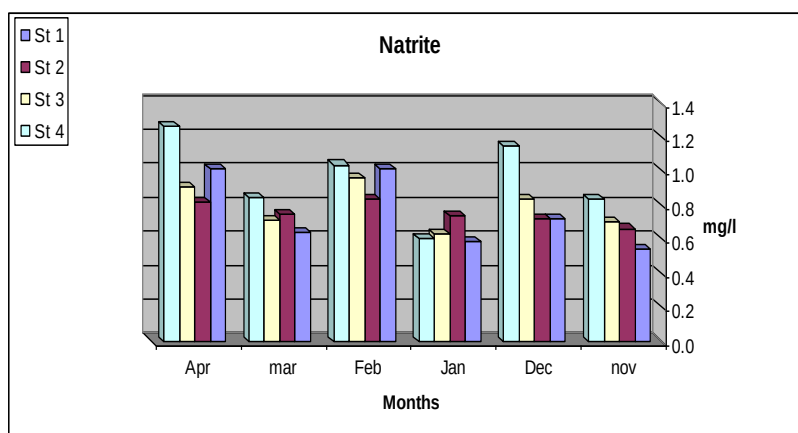


Fig. 20: Monthly nitrate variations (mg /l) L.S.D 0.05=0.2

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