

A STUDY ON PHYSICO-CHEMICAL ANALYSIS OF WATER SAMPLES FROM DIFFERENT PRIVATE SCHOOLS IN KALKULAM TALUK, KANNIYAKUMARI DISTRICT

¹M.P. Jeyasekhar, ²J. Jaslin Edward

¹Associate Professor, ²Associate Professor,

¹Department of Zoology and Research Centre

Scott Christian College (Autonomous), Nagercoil – 629 003, India.

²Cape Lab and Research Centre, Marthandam – 629 165, India.

ABSTRACT

Water is essential for the survival of all living organisms. The quality of drinking water and their associated health problems varies throughout the world. The Physico-Chemical parameters of the drinking water sample taken from different schools in Kalkulam Taluk, Kanniyakumai, District, were assessed. The physical characters like appearance colour, odour, turbidity, dissolved solids and electrical conductivity were evaluated using experimental method. And it was found that the appearance was almost clear in four samples (A, B, C & E) except in sample D it was turbid. While evaluating the chemical parameters for various samples (A, B, C, D and E) it was found that almost agreeable with the permitted limit in all the samples except in sample B. Hence concerned authorities must follow WHO standards for providing healthy and hygienic drinking water in their school premises.

Keywords: contamination, electrical conductivity, hardness, pollution, turbidity.

1. INTRODUCTION

Water is one of the most important resources especially for humans. Over one billion people of the world's more than six billion people do not have available sources of clean water for drinking. Due to lack of safe water over two million people die every year. In some third world countries, over 50% of the population does not proper access to safe drinking water, 50 to 60% of human body is made up of water and it plays a vital process in our body (Kawther et al., 2007).

Water facilities in schools include water fountains and taps and which are currently the most common drinking facility in schools, and both are frequently found in the toilet area. Different mineral nutrients available in drinking water include magnesium, chloride, sulphate, calcium, sodium, potassium, nitrate fluoride and even bicarbonates. Calcium and magnesium content are the major drinking water mineral nutrients (Rylander, 1996). The basis on which drinking water safety is judged in national standards or international guidelines. The most important of these are the WHO Guidelines. The Guidelines are now based on Water Safety plants that encompass a much more proactive approach to safety from source- to – tap.

Today there is contamination not only of surface water but also ground water bodies, which are susceptible to leaching from waste dumps, mine tailings and industrial production sites. Organic manure, municipal waste and some fungicides often contain high concentration of heavy metals. Soils receiving repeated applications of organic manures, fungicides and pesticides have exhibited high concentration of

extractable. The impurities may give water a bad taste, colour, odour, turbidity, hardness, corrosiveness, staining and frothing.

The use of the physico-chemical properties of water to assess water quality gives a good impression of the status productivity and sustainability of such water body. The changes in physical characteristics like temperature, transparency and chemical elements of water such as dissolved oxygen, chemical oxygen demand, nitrate and phosphate provide valuable information on the quality of the water, the sources of the variations (Djukie et al., 1994).

OBJECTIVES

- ❖ To study the physico- chemical components in water of different private schools.
- ❖ To estimate the level of calcium, magnesium, sulphate, sodium, phosphate, potassium and nitrate in drinking water from the study area.
- ❖ To understand the water pollution in the study area.

The rest of the paper is organized as follows: Section 2 describes related study, Section 3 deals with materials and methods, Section 4 describes results, Section 5 discusses the performance evaluation and Section 6 concludes the paper.

2. LITERATURE SURVEY

A recent study found that over half the schools studied forbade children to take drinks to school to consume at break time (Emma, 2007). The hardness of the water is determined by calcium and magnesium (Abed & Alwakeel, 2007). Studies which measured the hygiene of water fountains in 29 schools found that most were sited in toilets areas and were dirty badly maintained and highly contaminated (Walters & Cram, 2002). Fresh water is finite resources, essential for agriculture, industry and even human existence, without fresh water of adequate quantity and quality, sustainable development will not be possible. The addition of various kinds of pollutants and nutrients through the agency sewage, industrial effluents, agricultural runoff etc. into the water bodies brings about a series of changes in the physico-chemical characteristics of water. Fresh water resource is becoming day by day at the faster rate of deterioration of the water quality is now a global problem (Mahananda & Mohanty, 2010).

The physicochemical tests include the determination of appearance, colour, turbidity, total dissolved solids, P^H , electrical conductivity, chloride, iron, total alkalinity, free ammonia, oxygen, calcium, magnesium, sulphate. Sodium, phosphate, CO_2 , total hardness, nitrate, potassium (APHA, 1985). Increase in human population has exerted an enormous pressure on the provision of safe drinking water especially in developing countries (Abu and Egenonu, 2008; Okonko et al., 2008). The quality of water is an important aspect as the poor quality of water will adversely influence the normal functions in all the systems. Both surface and ground water contain a lot of dissolved impurities and suspended materials. Therefore it becomes imperative to evaluate the physical, chemical qualities of these sachet water sold in the market to ascertain whether they conform to recommended standards for portable water (Taiwo et al., 2012)..

3. MATERIALS AND METHODS

Study area

Kanyakumari is the southernmost district of Tamil Nadu. Kalkulam Taluk is situated in Kanyakumari district. The total geographical area of Kalkulam Taluk is 229.39 square miles. The Private schools (A, B, C, D and E) are located in Kalkulam Taluk.

Collection of water samples

A total different school was analyzed for their physico- chemical analysis of water samples. The water samples were collected from each school. The method used is experimental method.

Physical Examination

Colour

Compare with known colour standards and record the colour value in Pt/ Co scale.

Estimation of Turbidity

Set the meter to 'O' using turbidity free Determination H₂O. Set the meter to '100' using 100 NTU standard. Measure the turbidity for the sample (if the sample turbidity is high, dilute and measure the turbidity).

Electrical Conductivity

Set the meter to 1412 standard. Measure the EC for sample. Measure the values for other known Standards (Use the 'rinse' and 'test' for each standard and sample). A_o = Observed EC for next lower std; B_o = Observed EC for next higher std; C_o = observed EC for sample; A_T = Theoretical EC for next lower std; B_T = Theoretical EC for next higher std.

Calculation

$$EC = A_T + [((C_o - A_o) / (B_o - A_o)) \times (B_T - A_T)]$$

Total Dissolved Solids

The weight an empty dish (W₁ in g). Take 100ml or known volume of sample (V). Dry in a water bath. Dry in an oven at 170°C. Cool in desiccators. Take the final weight (W₂ in g).

Calculation

$$(W_2 - W_1) \times (1000/V) \times 1000$$

Estimation of P^H

Using 7.0 buffer, set the meter to 7.0 reading. Note the P^H for the buffers 9.2 and 4.0. Measure the p^H for sample. (Use the 'rinse' and 'test' for each buffer and sample). Let A = p^H for 4.00 buffer; B = p^H for 7.00 buffer; C = p^H for 9.2 buffer; D = p^H for sample.

Calculation

$$P^H = (D > B, (7 + ((D - B) / (C - B) * 2.2)), (7 - ((B - D) / (B - A) * 3))$$

Estimation of Alkalinity

1. Sample: Take 25/50ml, sample (V). Add 2-3 drops of phenolphthalein indicator, if the p^H is equal to or greater than 8.3, a pink color develops. Titrate with N/ 50 H₂SO₄. The end point is the disappearance of pink color. Note the initial and intermediate titre values (T₁ & T₂). Continue the titration with mixed indicator. (If no pink color develops in the first stage, add mixed indicator to the same flask and continue the titration; in this case both T₁ and the T₂ will be same). With mixed indicator, the second end point is change of color from blue to greenish yellow. Note the final titre value (T₃).

2. Control-standard (1ml=1mg): For each batch of samples, take 20 ml 20 ml, control-standard (1 ml = 1 mg), titrate with n/50 H₂SO₄ using only mixed indicator for the final end point. Note the titre values (Initial - T₄ and final - T₅).

Calculation

- (1) Alkalinity- Phenolphthalein= $(T_2 - T_1) \times (20 / (T_5 - T_4)) \times (1000 / V)$
 (2) Alkalinity- Total= $(T_3 - T_1) \times (20 / (T_5 - T_4)) \times (1000 / V)$

Total amount of Hardness

1. Sample: Take 50 ml or an aliquot diluted to 50 ml of sample (If hardness is low, take 100 ml sample for titration) (V). Add ml buffer +1ml sodium sulphide inhibitor +1ml Calmagite indicator. Titrate against standard EDTA. The end point is change of colour from pinkish red to blue. Note the initial and final titre readings (T1 and T2)

2. Control- standard (1ml = 1mg): take 20 ml, control-standard (Calcium 1ml=1mg); Add 1ml sodium sulphide inhibitor +1 ml. Calmagite indicator. Titrate against standard EDTA. The end point is change of colour from pinkish red to blue. Note the initial and final titre readings (T3 and T4).

Calculation

$$(T_2 - T_1) \times (20 / (T_4 - T_3)) \times (1000 / V)$$

Estimation of Calcium

Sample: Take 50 ml or an aliquot diluted to 50 ml of sample (If Calcium Hardness is low, take 100 ml sample for titration) (V). Add 1 ml 1 N HCl. Heat and boil for one minute. Cool and add 2ml 1 N NaOH. Add 1g eriochrome blue black-R indicator. Mix and titrate with standard EDTA. The end point is change of colour from red to blue. Note the initial and final titre readings (T1 and T2).

Calculation

$$(T_2 - T_1) \times 920 / (T_4 - T_3) \times (1000 / V)$$

Note: T4 & T3 are the readings obtained for Control-standard in TH test.

Estimation of Sodium & Potassium

1. Sample: Set the meter for '0' reading with double distilled water. Set the meter for '100' with Na/ K standard (Na= 10mg/L and K=5mg/L). Inject the sample and note simultaneously the readings for Na and K.

2. Control-standard (5ppm Na and 2.5 ppm K): Inject the control- standard (Na=5 mg/L and K=2.5 mg/L); Note the meter readings for both Na and K standards.

Calculation

- (1) Sodium : Reading from graph (for sodium reading) mg/ L x Dilution factor
 (2) Potassium: Reading for potassium slope x Dilution factor.

Estimation of iron

1. Sample: Take 50 ml or an aliquot diluted to 50 ml sample (V). Add 2ml 1+ 1 HNO₃. Heat, boil and reduce the volume to about 20 ml., Continue boiling and add N/8 K MnO₄ till a permanent pink color is formed. Cool and make up to 50 ml, with double distilled water. Add 1 ml ammonium thio cyanate reagent. If iron is present a red colour develops. Stir and measure the O.D at 470 nm (OD₁)

2. (Control- standard (1 ml= 0.1) mg): For each set of samples, take 5ml of Control-standard (Iron 1 ml=0.01mg). Make up to 50 ml with double distilled water. Continue the process as above. Measure the O.D at 470 nm (OD₂).

3. Blank: For each set of samples conduct a blank with 50 ml distilled water. Note: Use Distilled water blank for '0' setting.

Calculation

$$(\text{OD}_1 \times (1/\text{OD}_2) \times (50/V))$$

Estimation of Manganese

1. Sample: Take 50 ml or an aliquot diluted to 50 ml of sample (V). Add 2.5 ml special Reagent. Add a drop of H₂O₂. Boil and reduce the volume to about 30-40 ml. Add 1g Ammonium per sulphate and continue boiling for exactly one minute. Remove from the heat source and suddenly cool under a tap. Dilute to 50 ml with double D.H₂O. Stir and measure the O.D at 525nm (OD₁).

2. Control- standard (1ml=0.01 mg): Take 5 ml special reagent. Add a drop of H₂O₂. Boil and reduce the volume to about 30-40ml. Add 1g ammonium per sulphate and continue boiling for exactly one minute. Remove from the heat source and suddenly cool under a tap. Dilute to 50 ml with double D.H₂O. Stir and measure the O.D at 55nm (OD₂).

3. Blank: For each of the samples conduct a blank with 50 ml distilled water. Note: Use distilled water blank for '0' setting.

Calculation

$$[\text{OD} \times (1/\text{OD}_2) \times (50/V)]$$

Estimation of Ammonia

1. Sample: Take 100ml of sample in a beaker. Add 1.0ml Zinc sulphate solution. Add 0.4ml 6N NaOH. Mix and allow to stand for a few minutes. Filter, discard the first 25 ml and collect the balance filtrate take 50 ml or a portion diluted to 50ml (V). Add 2 drops of Rochelle salt solution. Mix and add 1 ml nessler reagent. Mix and allow to stand for 10 minutes. Measure the O.D at 420 nm (OD₁).

2. Control- standard (1ml=0.01 mg): Take 20ml control-standard (1ml=0.01 mg) and make up to 100ml. Add 1.0 ml Zinc sulphate solution. Add 0.4ml 6 N NaOH. Mix and allow to stand for a few minutes. Filter; discard the first 25 ml and collect the balance filtrate. From the filtrate take 50 ml. Add 2 drops of Rochelle salt solution. Mix and add 1 ml. Nessler's reagent. Mix and allow to stand for 10 minutes. Measure the O.D at 0 nm (OD₂).

3. Blank: Take 100 ml D.H₂O. Add 1.0 ml zinc sulphate solution. Add 0.4 ml. 6 N NaOH. Mix and allow to stand for a few minutes. Filter, discard the first 25 ml and collect the balance filtrate from the filtrate take 50 ml or a portion diluted to 50 ml. Add 2 drops of Rochelle salt solution. Mix and add 1 ml. Nessler's reagent mix and allow to stand for 10 minutes. Measure the O.D at 420 nm (OD₃)

4. Use pure D. H₂O for 'zero' setting.

Calculation

$$[\text{OD}_1 - (\text{OD}_3 \times (50-V)/50) \times (50/V) \times (2/(\text{OD}_2 - (\text{OD}_3 \times (8/10))))]$$

Estimation of Nitrite

Sample: Take 25 ml or a portion diluted to 25 ml of sample (V). Add 1 ml colour reagent. Stir and measure O.D at 540 nm after 10 minutes but before 2 hours (OD₁).

Blank: Take 25 ml double D.H₂O. Add ml colour reagent use this as blank for 'zero' setting.

Calculation

$$[\text{OD}_1 \times \text{Slope} \times (50/V)]$$

Estimation of Nitrate

1. Sample: Take 10ml or a portion of sample diluted to 10 ml in a boiling tube (V). Place in an ice cool water bath. Add 2 ml NaCl reagent and 10mlH₂SO₄ reagent. Mix and allow to cool. Add 0.5ml Brucine sulphanilic acid. Stir and mix. Keep in a water bath at 95⁰C for 20 minutes, immediately immerse in an ice cool water bath. A yellow colour is developed. Measure the O.D at 410 nm (OD₁).
2. Control- standard (20 ppm) : Take 1 ml control- standard (20mg/ L)and make up to 10 ml in a boiling tube. Place in an ice cool water bath. Add 2 ml NaCl reagent and 10 ml H₂SO₄ reagent. Mix and allow to cool. Add 0.5 ml Brucine sulphanilic acid. Stir and mi. keep it in a water bath at 95⁰ C for 20 minutes. After 20 minutes, immediately immerse in an cool water bath. A yellow colour is developed. Measure the (OD₂).
3. Blank: Take 10ml D.H₂O in a boiling tube. Place in a cool water bath. Add 2 ml NaCl reagent and 10 ml H₂SO₄ reagent. Mix and allow to cool. Add 0.5 ml. Brucine sulphanilic acid. Stir and mix. Keep it in a water bath at 95⁰ C for 20 minutes. After 20 minutes, immediately immerse in an ice cool water bath. Measure the O.D at 410 nm (OD₃)
4. Zero-setting: Use pure D.H₂O for zero setting.

Note :(i) The NaCl and HSO₄ should be of good quality chemicals.

(ii) Cooling in both stages should done only with ice cool water.

(iii)The boiling tubes should be kept in water bath containing the water, bath for exactly 20 minutes.

(iv) Use double d.H₂O for dilutions.

Calculation

$$[\text{OD}_1 - (\text{OD}_3 \times (10 - V) \times /10))] \times (10/V) \times (20 / ((\text{OD}_2 - (\text{OD}_3 \times (9/10))))]$$

Estimation of Chloride

1. Sample: Take 50 ml or a suitable portion diluted to 50ml(for less chloride content water take 100ml) (V). Add 1 ml. Potassium Chromate (in 1 ml volumetric pipette). Titrate against standard (1 ml=0.5 mg) Silver nitrate. At the end point, the yellow colour changes to light pinkish red. Note the initial and final titre values (T1 and T2).

2.Control- standard (1 ml= 1 mg): Take 1o ml Control –Standard (1 ml= 1 mg) . Make up to 50 ml with D. H₂O.Add 1 ml Potassium chromate, Titrate with Standard Silver nitrate. At the end point, the yellow colour changes to light pinkish red. Note the titre values (Initial- T3 and final T4).

3. Blank: With 50 ml D.H₂O, conduct a blank. Note the titre values (Initial- T5 and final – T6).

Calculation

$$\{(T2 - T1) - (T6 - T5)\} \times \{20 / ((T4 - T3) - (T6 - T5))\} \times (1000 / 2V)$$

Estimation of Fluoride

1. Sample: Take 10 ml or a portion of sample diluted to 10 ml (V). Add 2ml Spadns. Measure the Transmittance (T1)

2. Control-standard (1ppm):Take 10 ml fluoride standard(1 ml=0.001 mg).Add 2ml spands. Measure the Transmittance (T2).

3. Blank: Take 10 ml D.H₂O. Add 2 ml Spands. Use this as blank for ‘100’% Transmittance’ setting.

Calculation

$$[(100- T_1) \times (1/ (100- T_2)) \times (10/ V)]$$

Estimation of Sulphate

1. Sample: Take 25 ml or a portion of sample diluted to 25 ml (V). Add 25 ml buffer. Add a pinch of $BaCl_2$. Mix and stir for 1 minute. measure the turbidity using a nephelometer (N_1). The 'zero' and '100' setting for the nephelometer are carried out with D.H₂O and 100 NTU standard respectively.

2. Control-standard (1ml= 0.1mg): Take 5 ml control- standard 91 ml=0.1 mg) and dilute to 25ml. add 5ml buffer. Add a pinch of $BaCl_2$. Mix and stir for 1 minute. Measure the turbidity using a Nephelometer (N_2). The 'zero' and '100' settings for the nephelometer are carried out with D. H₂O and 100 NTU standard respectively.

3. Blank: Take 25 ml D.H₂O. Add 5ml buffer. Add a pinch of $BaCl_2$. Mix and stir for minute . Measure the turbidity using a Nephelometer (N_3). (The'zero' and '100' settings for the nephelometer are carried out with D.H₂O and 100 NTU standard respectively).

Calculation

$$[N_1-(N_3 \times (25- V)/ 25))] \times (25/V) \times (20/ (N_2-(N_3 \times (4/5))))$$

Estimation of Phosphate

1. Sample: Take 25 ml or a portion of sample diluted to 25 ml (V). Add 25 ml Conc H₂SO₄ and 2.5ml Conc. HNO₃. Digest to 1 ml and continue heating until the solution becomes colourless so that the HNO₃ is completely removed. Cool and add 10ml double D.H₂O. Neutralise with 6 NaOH(to pale pink end point with phenolphthalein) and filter and make up to 25 ml. Add 1ml molybdate Reagent and exactly 2drops of stannous chloride. After 10 minutes but before 12 minutes measure O.D at 690 nm (OD_1).

2. Control- standard(1ml =0.005 mg): Take 5 ml control standard(1 ml= 0.005 mg)and make up to 25 ml. Add Conc H₂SO₄ and 2.5 ml Conc. HNO₃ .digest to 1 ml and continue until the solution becomes colour less so that the HNO₃ is completely removed. Cool and add 10 ml double D.H₂O. Neutralise with 6 N NaOH (to pale pink end point with phenolphthalein) and filter and make up to 25 ml . Add 1 ml molybdate reagent and exactly 2 drops of stannous chloride. after 0 minutes but before 2 minutes, measure O.D at 690 nm (OD_2).

3. Blank: Take 25 ml D.H₂O. Add 0.5 ml Conc H₂SO₄and 2.5 ml Conc. HNO₃. Digest to 1 ml and continue heating until the solution becomes colourless so that the HNO₃ is completely removed. Cool and add 10 ml doubled.H₂O. Neutralize with 6 N NaOH(to pale pink end point with phenolphthalein) and filter and make up to 25 ml. Add 1 ml, molybdate reagent and exactly 2 drops of stannous chloride. After 10 minutes but before 12 minutes, measure O.D at 690 nm (OD_3). (The blank should not show blue colour).

4. Zero-setting: Use pure D.H₂O for 'zero' setting of the meter.

Calculation

$$\{OD_1- (OD_3 \times ((25- V)/ 25))\} \times (25/V) \times (1/ (OD_2- (OD_3 \times (4/ 5))))$$

Estimation of Silica

(1)Sample : Take 25 ml or a portion diluted to 25 ml of sample (V) . Add 0.5 ml (1+1) HCl and 1ml. ammonium molybdate reagent. Mix and allow to stand for 5 to10 minutes. Add 1 ml oxalic acid solution. Mix thoroughly and stand for 2 to 15 minutes. Add 1 ml reducing agent. Mix thoroughly. After 5 minutes measure the O.D ($O.D_1$) for blue colour at 815 nm (or less preferably at 650 nm).

(Control-standard (1ml=0.005mg): Take 5 ml of control-standard(1ml=0.005 mg)and make up to 25 ml. Add 0.5 ml(1+1)HCl and1ml Ammonium molybdate reagent. Mix and allow to stand for 5to 10 minutes.Add1ml oxalic acid solution. Mix thoroughly. Let stand for 2 to 15minutes. Add 1 ml. Reducing agent. Mix thoroughly. After 5 minutes measure the O.D (OD₂) for blue colour at 815 nm (or less preferably at 650 nm).

(3)Blank: Take 25 ml D.H₂O. Add 0.5 ml (1+1) HCL and1ml Ammonium molybdate reagent. Mix and allow to stand for 5 to 10 minutes. Add 1ml oxalic acid solution. Mix thoroughly. Let stand for 2 to 15minutes. Add 1ml Reducing agent. Mix thoroughly. Wait for 5minutes. Measure the O.D for blank (OD₃)at 815 nm(650nm).

(4)For zero setting of the meter, use pure D.H₂O.

Calculation

$$\{OD_1 - (OD_3 \times ((25 - V)/25))\} \times (25/V) \times (1 / (OD_2 - (OD_3 \times (4/5))))$$

Estimation of Tidy's

(1) Sample: Take 250ml or a portion of sample diluted to 250 ml 9v). Add 10 ml 25% H₂SO₄. A 10 ml n/80 KMnO₄ (for higher organic content water use N/8 KMnO₄). If the colour of KMnO₄ disappears, add more KMnO₄ (Total volume of KMnO₄ added= V₁); keep in the dark for 4 hours. Add 2 ml 10% KI solution. The Iodine liberated is titrated with N/ 80 Thio (or N/8 KMnO₄ used) using starch as indicator. The end point is the disappearance of blue colour . Note the initial and final titre readings (T₁ and T₂).

(2) Blank:Conduct a blank with 50 ml D.H₂O. Proceed as above and note the initial and final titre readings (T₃ and T₄).

Calculation

$$(1) \text{ If N/ 80 KMnO}_4 \text{ used Tidy's} = [((T_3 - T_4)(V_1/ 10)) - (T_2 - T_1)] \times (100/V)$$

$$(2) \text{ If N/ 8 KMnO}_4 \text{ used Tidy's} = [((T_3 - T_4)(V_1/ 10)) - (T_2 - T_1)] \times (1000/V)$$

4.RESULTS

The results of the physical and chemical analyses were presented in Tables 1 and 2. The temperature ranged between 26.50 C and 29.5⁰ C. The samples in drinking water sample A, B, C, and E were colourless, sample D Brownish in the colour (Figure 1). The total dissolved solids ranged from 156 mg/L to 615 mg/L.

The P^H of the water sample ranged from 5.81(mg/L) to 6.62 (mg/L). The total conductivity of the sample E was 931 mg/L is high value sample B as 236 mg/L is Low value respectively. The amount of total hardness of water samples ranged from 84 mg/L to 256 mg/L respectively. The total alkalinity ranged from 28 mg/L to 64 mg/L samples acceptable. The Potassium in water sample showed a of high value 24 mg/L and low value of 4 mg/L. The Sodium of the water sample ranged from 17 mg/L and 96 mg/L. The Fluoride of the water sample ranged from 0.2 mg/L to 0.4 mg/L respectively.

The water sample Phosphate sample A 0.03mg/L to sample D.0.05 mg/L is acceptable. The Sulphate of the water sample ranged from 11 mg/L 33 mg/L. The Chloride of the sample E was 228 mg/L is high value sample B was 48 mg/L is low value respectively. The water sample A, C and E is increased an value of iron. The Nitrite of the water sample ranged from 0.01 mg/L to 0.95 mg/L. The Tidys Test for 4 hours of the sample D was 0.36 mg/L is high value sample B was 0.2 is low value respectively (Figure 2). Nitrate content sample B is 3 mg/L and sample E is acceptable.

PHYSICAL EXAMINATION

Table: 1. Physical examination of the water sample in different private schools

Sl.No.	Physical Examination	A	B	C	D	E
1	Appearance	Clear	Clear	Clear	Turbid	Clear
2	Colour	Colourless	Colourless	Colourless	Brownish	Colourless
3	Turbidity Units	1	0	2	0	2
4	Total dissolved Solids Mg/L	263	156	301	294	615
5	Electrical conductivity mho/cm	399	236	456	446	931

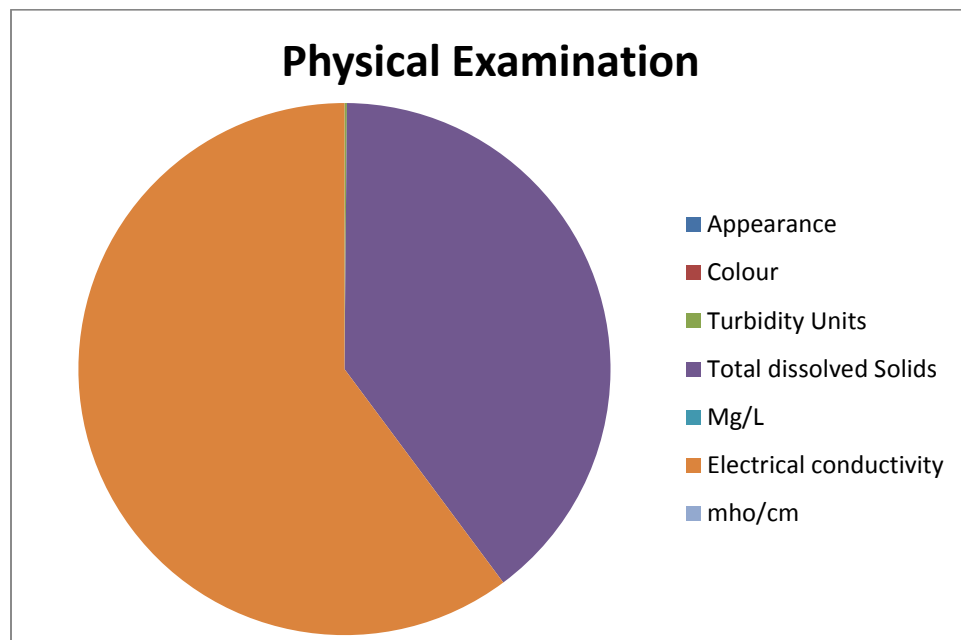


Figure 1: The level of Physical Examination value of water samples collected from various private schools.

CHEMICAL EXAMINATION

Table: 2. Chemical examination of the water sample in different private schools

Sl.NO	CHEMICAL EXAMINATION	A	B	C	D	E
1	pH	6.14	5.98	5.81	6.52	6.62
2	Total alkalinity mg/L	28	28	36	44	64
3	Total Hardness mg/L	136	84	144	128	256
4	Calcium mg/L	30	19	42	29	77
5	Magnesium mg/L	14	9	10	13	15
6	Sodium mg/L	30	17	35	33	96
7	Potassium mg/L	8	4	6	6	24
8	Iron mg/L	0.06	0.00	0.24	0	0.24
9	Nitrite mg/L	0.01	0.04	0.03	0.01	0.95
10	Nitrate mg/L	5	3	5	6	8
11	Chloride mg/L	88	48	108	94	228
12	Fluoride mg/L	0.2	0.4	0.4	0.4	0.4

13	Sulphate mg/L	24	11	21	23	33
14	Phosphate mg/L	0.03	0.00	0.00	0.05	0.00
15	Tidys Test mg/L	0.28	0.2	0.24	0.36	0.32

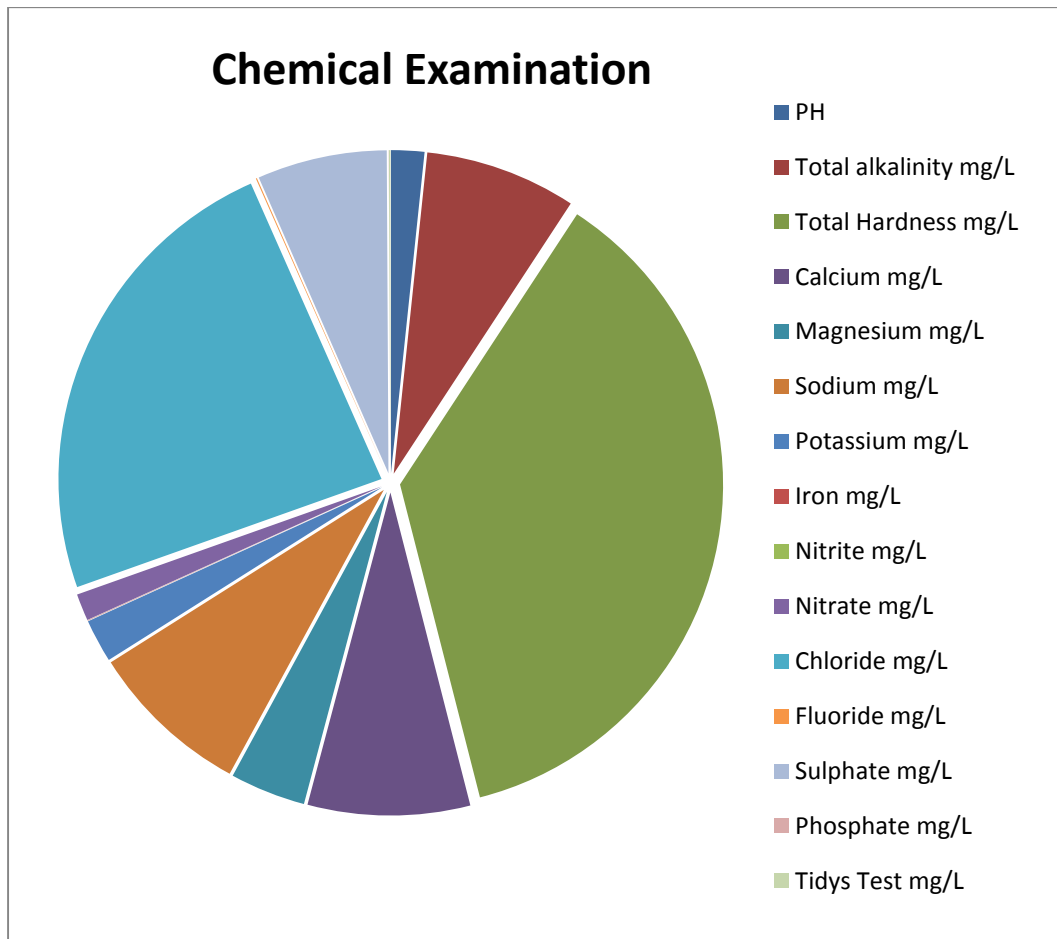


Figure 2: The level of Chemical Examination value of water samples collected from various private schools.

5. DISCUSSION

The physical and chemical water analysis such as color, appearance, p^H , turbidity, total electrical conductivity, alkalinity CO_2 , O_2 , hardness, calcium, magnesium, sodium, potassium, manganese, nitrate, chloride, sulphate and phosphate were analyzed

The temperature ranged between 26.5^0 C and 29.5^0 C. This parameter is one of the most important parameters for aquatic environment because almost all the physical chemical and biochemical parameter of water are temperature depended (Vutthichai et al., 2006). The presence of solid particles in water indicate the level of contamination P^H used to express the intensity of acidic or alkaline condition of a solution. The P^H values observed for the water samples were between 5.98 - 6.62. P^H of the sample B and C have below the range of 6.5 - 8.5 specified by WHO (6.5 to 8.5).

Electrical conductivity is the measure of the capacity of water to conduct electric current (Budhahoki, 2010). In the present study for conductivity sample E has the maximum value of 931 micro mho/ cm. High values of conductance indicate high dissolved gases and other chemical in water (Boominathan & Khan, 1994). The calcium and magnesium are the most abundant elements in the ground water. Calcium is an essential nutritional element for human being and aids in maintaining the structure of plant cells and soils. Mg^{2+} is a constituent of bones and is essential for normal metabolism of Ca^{2+} . Its deficiency may lead to protein energy

malnutrition. The acceptable Limits of Ca^{2+} and Mg^{2+} are 75 mg/L and 30 mg/L respectively Lower concentration of Ca^{2+} and Mg^{2+} were observed in certain locations.

The hardness is mainly contributed by bicarbonates, carbonates, sulphates and chlorides of calcium and magnesium (Chadetrikt Rout & Arabinda Sharma, 2011). The highest value of total hardness was water sample E 256 mg/L as $CaCO_3$. If these components are present in high concentration than this leads to encrustation in water supply structure and adversely affect use of water. The higher concentration of Na^+ ion in drinking may cause heart problems. The permissible limit of sodium in drinking water as prescribed by BIS is 50 mg/L. The range of Na^+ ions in water sample E 96 mg/L.

Potassium is an important cation and plays a vital role in intermediate metabolism. K^+ is an essential nutrient for both plant and human life. However ingestion of excessive amounts may prove detrimental to human beings. Alkalinity of water is its acid neutralizing capacity. The acceptable limit of alkalinity is 200 mg/L and in the absence of alkalinity up to 600 mg/L is acceptable for drinking. Total alkalinity of all samples was below the permissible limit.

The maximum permissible limit of chloride in potable water is 250 mg/L (WHO). In the analyzed water samples, the concentration of chloride varied from 48 to 228 mg/L. The chloride content of water sample when compared with in BIS standard then it was found that all samples showed concentration with the permissible limit. Fluoride concentration in all these samples found to be well within permissible limit. The acceptable limit of sulphate is 200 mg/L. The sulphate content in analyzed water samples varied from 11 mg/L to 33 mg/L. The iron content of water samples A, D and E showed high value but in water samples B and C it was low value.

6. CONCLUSION

The physico-chemical characteristics of drinking water samples from five different private schools located in Kalkulam Taluk of Kanniyakumari district were analysed. The physico-chemical characteristics include the appearance, colour, turbidity, total dissolved solids, pH , electrical conductivity, chloride, iron, total alkalinity, calcium, magnesium, sulphate, sodium, phosphate, CO_2 , total hardness, nitrate, potassium were analysed following standard method of APHA. The most of the physico-chemical characteristics were well within the permissible allowed limits. The availability of quality water supply is a primary consideration for schools.

REFERENCES

1. Abed, K., F. & Alwakeel, S.S, 2007, Mineral and Microbial Contents Of Bottled and Tap Water in Riyadh, Saudi Arabia, *Journal of Scientific Research*, 2(3), pp. 151- 156.
2. Abu, G.O. & C. Egenonu, 2008, The current pollution status of new Calabar River in the Niger Delta Region of Southern Nigeria: A Survey of AntibioGram Profile of Its Bacterial Isolates. *African Journal of Environmental Science and Technology*, 2, pp. 134-141.
3. APHA, 1985, Standard Method For The Examination of Waste Water, American Public Health Association, 16th edition.
4. Boominathan, R. & Khan, S.M., 1994, Effect of Distillery Effluents on pH, Dissolved Oxygen and Phosphate Content in Uyyakundan Channel Water, *Environmental Ecology*, 12(4), pp. 850-853.
5. Budhahoki, 2010, Analysis of the Physico-Chemical And Bacteriological Parameters of Bottled Water Available in Kathmandu Valley, Thesis.
6. Chadetrikt Rout & Arabinda Sharma, 2011, Assessment of Drinking Water Quality: A Case Study of Ambala Cantonment Area, Haryana, India, *International Journal of Environmental Sciences*, 2 (2).
7. Djukic, N., Maletin, S., Pujin, W., Ivanc, A. & Milajonovic, B. 1994. Ecological Assessment of Water Quality of Tisza By Physic-Chemical and Biological Parameters. *Tisza Szeged*, 28(1), pp. 37-40.
8. Emma Croghan, 2007, Promoting Health in Schools: A Practical Guide for Teachers and School Nurses Working with Children Aged 3 to 11

9. Kawther F. Abed and Suaad S. Alwakeel, 2007, Mineral and Microbial Contents of Bottled and Tap Water in Riyadh, Saudi Arabia, Middle-East Journal of Scientific Research, 2 (3-4), pp. 151-156.
10. Mahananda, M., & Mohanty B, 2010, Physico-Chemical Analysis of Surface and Ground Water of Bargarh District, Orissa. Department of Environmental Sciences, Sambalpur University, International Journal of Recent Research and Applied Studies 2(3).
11. Okonko, I.O., O.D. Adejaye, T.A. Ogunnusi, E.A. Fajobi & O.B. Shittu, 2008, Microbiological and Physicochemical Analysis Of Different Water Samples Used for Domestic Purposes In Abeokuta And Ojota, Lagos Nigeria. African Journal of Biotechnology, 7, pp. 617-621.
12. Rylander, R, 1996. Environmental Magnesium Deficiency as Cardiovascular Risk Factor, Journal of Cardiovascular Risk (3), pp. 4- 10.
13. Taiwo, A.A, Ijaola, O. Oluadare, I & Onkiyesi, 2012, Physico-Chemical and Bacteriological Analysis of Well Water in Abeokuta A Metropolis, Ogun-State Nigeria, IOSR-Journal of Applied Chemistry; 2(6), pp. 29 -35.
14. Vutthichai Oniam R, Likhit Chuchit & Wasana Arkronrat Klongwan, 2012, Reproductive Performance and Larval Quality of Blue Swimming Crab (*Portunus Pelagicus*) Broodstock, Fed with Different Feeds, Fisheries Research Station, Academic Supporting Division, Songklanakarinn Journal of Science and Technology.
15. Walters & Cram, 2002, Drinking Water In Schools: Hygiene Standards At Fountains, Nutrition & Food Science, 32 (1), pp. 9-12.

