International Journal of Chemistry and Pharmaceutical Sciences

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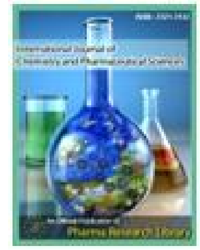

RESEARCH ARTICLE

Potability of Drinking Water

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ABSTRACT

Water is an indispensable need of life and ground water has become a global problem partly because of population explosion and partly due to phenomenal advances in industrialization. First check Ca2+ and Mg+ F-1, Cl-, Na, PH, Electronic conductivity TDS, Hardness of drinking water surrounding villages of Jhajjar District Check the Potability of Drinking Water

Keywords: *Water, alkalinity, hardness, industrialization*

ARTICLE INFO

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MS-ID: IJCPS3548

PAPER QR-CODE

Article History: Received 12 November 2017, **Accepted** 18 December 2017, **Available Online** 27 January 2018

Citation: Nidhi, Potability of Drinking Water. *Int. J. Chem, Pharm, Sci..*, 2018, 6(1): 43-48.

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1. Introduction

Water in the most abundant substance of living being. It forms 70-80% of cells and 70% of human body. In seeds and spores the content of water is as low as 10-20%. About 95% of water occurs in the free State while the remaining 5% is found in the bound and combined state. Water has maximum solvent power 10 compared to other liquids: Non-polar substance can be dispersed by water due to two reasons.

1. In the hole of lattice aggregate the small amount of water is in the ionic state.
2. In association with other polar materials.

$$H_2O \longrightarrow H^+ + OH^-$$

Water is ideal medium of chemical reaction. It is product of respiration. Water has high thermal conductivity water cycle consists of two overlapping cycles lager global and smaller global. Global water cycle consists of evaporation and precipitation of water. One estimate put the world precipitation state at 4.46×10^{20}g per year. This means that the atmosphere must be refilled with the water vapours 34 times in years. Aquatic animals absorbs water from the surroundings and excrete it after the death of organisms water returns to the surrounding medium through three process of decay. Water classified as "hard' and "Soft" water concentration of calcium and Magnesium ions is high, the capacity of lather is reduced is this is "hard water." A soft water which produce lather easily.

Table 1: Global Distribution of Fresh Water

S. No	Fresh water	Expressed in Cubic Kms.
1.	Water in ice sheets, snow cope and glaciers etc.	24,000,000
2.	Ponds, lakes and reservoirs	280,000
3.	Streams and rivers	1,200
4.	Soil moisture	85,000
5.	Ground water and well water	60,000,000
	Total amount of fresh water	84,366,200

Table 2: Potable Water

Water herd	1974	2000	2025
Irrigation	350.0	630.0	770.0
Thermal Power Generation	11.0	60.0	160.0
Industries	5.5	30.0	120.0
Domestic requirement	8.8	26.6	39.0
Lince stock management	4.7	7.4	11.0
Total	38.0	754.0	1,1000

The use of water can be considered under two categories namely.

1. Consumptive and partially consumptive
2. Non consumptive.

The first category comprises such uses as domestic water supply irrigation and requirement of industries and power generation with fossil and nuclear fuels. The second category encompasses hydropower, generation, navigation, pisciculture, recreation wild life preservation and river conservancy. Almost 76% of total used by man has to utilized to grow food following agriculture. Power generation (6.2%), industries (5.5%) domestic requirement and stock management taken together (4.67%) of total drawn. A large fraction is returned to the surface deposits or stream flows often in a polluted stated which can be reused as such or after treatment to remove impurities out of the total quantity of water drawn the amount of water irrecoverable consumed was estimated to be about 2,200 cubic kms. (L' vovich 1989) the approximate requirement of fresh water in India as estimated for the year 1974 A.D., 2000 A.D and 2025 A.D.

2. Materials and Methods

Potable Water

The water which is safe to drink is potable water. However does mean distilled or pure water. Potable water fit for human consumption, should satisfy the following essential requirement.

(1) It should be sparking clear and orderless.
(2) Pleasant in taste.
(3) Perfectly cool
(4) Turbidity should not exceed 10ppm.
(5) It should free from objectionable dissolved gases like H_2S.

Technique Employed the Analyses of Water

Polythene bottles of 2.5 litre capacity are used as sample container.

Sampling Techniques

For the analysis of ground water, two principal types of sapling procedures[13/14] are employed.

- Spot or Grab samples sport samples are discrete portions of water samples taken at a given time. A series of grab samples, collected from different depths at a given site, reflect variations in constituents are period of time.
- Composite samples when the grab samples of a particular water is collected at a regular interval for a specific period such as 12 hours or 24 hours and mixed, then the integrated sample is called composite sample.

When liquid is homogeneous, it is sufficient take the grab sample only. The sample bottle should first be rinsed with the liquid being sampled and then filled. When liquid to be sampled is heterogeneous such as sewage a composite sample is necessary of any constituent to be determined is affected by air contact take the sample out of contact with air and completely fill the container when hot sample are taken they must be cooled using cooling coils. The tap should be cleaned inside and outside then collect the sample the water being sample should then be allowed to waste for sometime so that the sample will be representatives of the whole supply.

Then water from well is collected then well has to be pumped for a sufficient time such that the sample represent the ground water that feeds the well. Samples are taken at the midpoint of livers and scheme. Collect samples at least 0.6 to 1 km. below dams or water sample keep out of light and low temperature (4°C) white. Determination like Ph, dissolved gases as O_2, CO_2, H_2S were made immediately while other constituents analyzed after sometime.

Chemical Substance Affecting Portability Colour

This test is usually applicable to drinking water and potable water. It was carried out by comparison with known colour standard[5]. Colour in water may be due to presence of fine particles in suspension or due to certain mineral matter in solution. Even pure water is not colorless and it has been found to have a pale green tint in large quantities. The three color of a water sample is due to the substances present as fine collides, color is measured with an instrument known as tinto meter. The unit of color is measured on the Platinum Cobalt scale and expressed in Hazen units. The standard colour can be produced by dissolving 1 mg. of Platinum Cobalt in one litre of double distilled water.

Turbidity

Turbidity in water is due to colloidal and extremely fine dispersions. Suspended matter such as clay, silt, finely divided organic and inorganic matter, plankton and other macro-organisms also contribute turbidity. Turbidity can be measured by visual method and instrumental methods such as absorptiometrically or nephelometically. The standard unit of turbidity is considered as that produced by one ppm of silica in the form of diatomaceous earth. Turbidity removed by setting or by centrifuging.

ODOUR

Odours in water are due to presence of microscopic organisms or delaying vegetation including algi, fungi, bacteria, actinomycetescets and weeds[16]. Sewage and industrials effluents cause offensive odours to receiving waters. The extent of odour depends upon the pH of water- lower the pH higher will be the amount of hydrogen Sulphide produced. For example, the protozoa, dinobryon imparts a fishy odour in water. The algae oscilltory and rivularia produce mouldly odour and algae anabaena a strong grassy odour. Mineral matters such as sand and clay when present in finely divided state produce a faint earthy taste and odour in water. To determine the hot odour quality take 250ml sample in a 500ml stoppered conical flask and heat to 58-60°C. Sniff the odour which may be:

(i)	Aromatic	(ii)	Chlorinous
(iii)	Chemical	(iv)	Medicinal
(v)	Sulphuretted	(vi)	Septic
(vii)	Earthy	(viii)	Peaty
(xi)	Grassy	(x)	Moldy
(xi)	Fishy	(xii)	Disagreeable
(xiii)	Vegetable	(xiv)	Putrid
(xv)	Wormy		

The intensity of odour is expressed in terms of Threshold Odour Number. For drinking water TON should not exceed three.

TASTE

Taste is always accompanied by odour. However, dissolved mineral matters produce tastes but not odour. A faint bitter taste may be due to the presence of Sulphate while soapy or inky taste may be due to excess of sodium carbonate. Water containing unusual salt content have a brackish taste. Dissolved gases, minerals, nitrates and carbonic acid make water palatable.

Temperature

Surface waters differ considerably in temperature between winter and summer. Temperature measurements are useful in detecting an unsuspected source of pollution, in calculating alkalinity and in industrial water supplies for heat transmission calculations Hydrogen Ion concentration (pH). pH, a measure of hydrogen ion activity, is used to express the intensity of acidic or alkaline condition of a solution. It is also an important factor water to 100ml in volumetric flask at 25°C.

pH 7 Buffer Solution

Dissolve 1.361g anhydrous potassium dihydrogen phosphate (KH_2PO_4) and 1.420g sodium dihydrogen phosphate (NaH_2PO_4) in distilled water and make up to 1000ml in a volumetric flask.

pH 9 Buffer Solution

Dissolve 3.81 borax ($Na_2B_4O_7.10H_2O$) in distilled water to 1000ml.

(i) The desirable pH range for drinking waters is 7.0 to 8.5.

(ii) pH in conjunction with total salinity and temperature is used to determine whether a water is corrosive in nature or having scale forming tendencies.

Electrometric Method for the Determination of pH

Electrometric determination of pH involves the measurement of (EME) of a cell comprising an indicator electrode (glass electrode) responsive to hydrogen ions and a reference electrode (calomel electrode)

pH 4 Buffer Solution

Dissolve 1.012 anhydrous potassium hydrogen phthalate in distilled. Its unit is micromhos/cm or micro siemns/cm^3. Conductity of water varies directly with the temperature and is proportional to its dissolved mineral matter content.

Specific Conductance

Specific conductance is the conductance of one centimeter cube of a solution of an electrolyte. It is generally denoted by k (Kappa) thus

$$k = 1/P$$

A simple conductivity meter with dip-type cell was used for the analysis of water samples. The instrument and the cell was calibrated by using 0.005M KCI solution (Conductivity = 654 mho cm^{-1}).

ACIDITY

Mineral Acidity

Took 50ml or suitable dechlorinated aliquot of the sample in a 250ml conical flask. Added 2 drops of methyl orange indicator and titrated with 0.02N-NaOH solution till faint orange color.

Calculation

$$\text{Acidity as } CaCO_3 \text{ mg/L} = \frac{mL\ titrant\ NaOH \times 1 \times 1000}{mL\ sample\ taken\ for\ titration}$$

3. Results and Discussion

Methyl orange acidity value shows mineral acidity. In absence of mineral acidity, total acidity is only the CO_2 acidity of the water sample.

Alkalinity

Alkalinity of water is due to the presence of carbonate and hydroxide ions. Determination of alkalinity by Titrimetric method principle alkalinity was determined by titration with 0.02 NH_2SO_4 using methyl orange and phenolphthalein as indicators.[20]

Reactions

$$2CaCO_3 + H_2SO_4 \longrightarrow CaSO_4 + Ca(HCO_3)_2$$
$$Ca(HCO_3) + H_2SO_4 \longrightarrow CaSO_4 + 2CO_2 + 2H_2O$$
$$Ca(OH)_2 + H_2SO_4 \longrightarrow CaSO_4 + 2H_2O$$

Total Hardness (Ca and Mg)

The hardness of water is not a pollution parameter but indicates water quality, mainly in terms of Ca^{2+} and Mg^{2+}, expressed as $CaCO_3$. The analysis is done by complex metric titration.[21,22]

Classification of Hardness

Hardness has traditionally been divided into temporary and permanent hardness.

Temporary Hardness

The portion of hardness which disappears on prolonged boiling is called temporary, hardness. It is caused by bicarbonates of Ca^{2+} and Mg^{2+}.

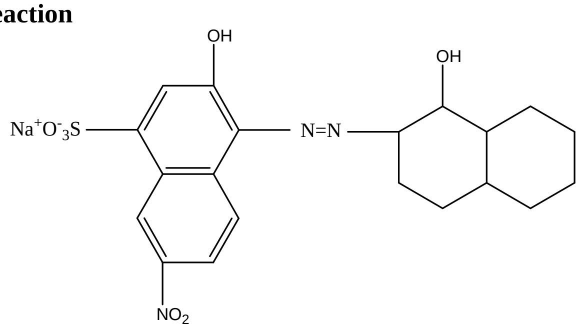
Permanent Hardness

The hardness that remains after boiling is called permanent hardness. It is caused by the presence of sulphate, chlorides, nitrates of Ca^{2+} and Mg^{2+}.

Determination of total hardness

Principle: During titration with EDTA (Na_2H_2Y), Ca^{2+} first reacts to form relatively stable CaY^{2-}, followed by Mg^{2+} to give MgY^{2-} complex (indicator/wine red) releasing the free indicator (blue). The color changes from wine-red to blue at the end point.

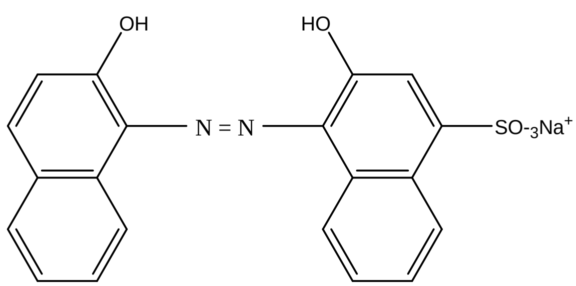
Reaction



Eriochrome Black T {1-(1-Hydroxy-2-naphthylzao-6-nitro-2-naphthol-4-sulphonate)}

This gives total Ca^{2+} and Mg^{2+} Next from a aliquot of the sample, Ca^{2+} is estimated selectivity at pH 12.3 (Mg^{2+} gets precipitated as $Mg(OH)_2$ in presence of cation indicator. The color change is from pink to blue.

$$Ca^{2+}\ H_2Y_2 \rightleftharpoons CaY^{2-} + 2H^+$$
$$Mg^{2+}\ H_2Y_2 \rightleftharpoons MgY^{2-} + 2H^+$$
$$Mg^{-}D + H_2Y_2 \rightleftharpoons MgY^{2-} + HD^{-}\ H^+$$



Calcon [1-2 (Hydroxy-1-naphthylzao)-2-naphthol-4-sulphonate]

Total Hardness (Ca and Mg)

Total hardness of water is not pollution parameter but indicates water quality in term of Ca^{2+} and Mg^{2+} expressed as $CaCO_3$. The total hardness is also expressed in ppm. The analyses is done by complexometric titration using EDTA. The hardness of water reflects the nature of geological formation with which the water is in contract. Ground water[30] may be hard due to the natural accumulation of salts from contract with the soil. Generally surface water are softer than ground well waters. Total hardness is calculated by adding the multi equivalents of Ca and Mg per litre and multiplying the sum by 50. According to the degree of hardness the waters are commonly classfied[31] as per U.S. Geological survey as illustrated in table.

Table 3: Classification of Hardness

Total hardness as $CaCO_3$ in mgk	**Classification**
0-55	Soft
50-100	Slightly hard
101-200	Moderately hard
201-500	Very hard

On examining the table total hardness value ranges in between 100 to 4300ppm. These results indicate that the ground water of this region in very hard in nature. Hard water of these wells are reported to cause no harmful effect upon the health of consumers. The use of hard waters however is limited because of excessive soap consumption in homes. Hard water form incrustation untensils and the vegetables cooked in it get toughened.

TOTAL DISSOLVED SOLIDS

In natural waters, the dissolved Solids consist mainly of bicarbonates, carbonates, chlorides, sulphate, nitrate and possibly phosphates of calcium, magnesium, sodium and potassium with traces of iron and other substances. In the percent study the total dissolved solids range between 120 to 40,700 ppm in the water samples. The WHO International[32] standards set the permissible[33] limit for total dissolved solids as 1000 ppm and excessive limit as 3000ppm. Thus water for domestic and industrial uses should have TDS value of less than 1000ppm. And for agriculture utility the optimum range should be below 3000ppm. In the percent investigation the TDS value lies between 175 to 4300 ppm.

SODIUM

Sodium is a major component of potable waters. Most of the sodium compounds are water soluble and do not play any role in the incrustation of wells. The primary sauce of sodium in natural water is from the release of soluble products – All natural waters contain meouble[34] amount of sodium.

CALCIUM

Calcium is an essential element and human body requires approximately 0.7 to 2.0g of calcium per day as a food element. However waters with high calcium content are undesirable for washing, bathing and laundering because of the consumption of more soap and other clearing gents sub surface waters in contact with sedimentary[35] rocks of marine origin drive most of their Calcium for the solution of dolomite, anhydrite and gypsum. Surface water in equilibrium with atmospheric carbon dioxide can contain as much as 20ppm to 30ppm of calcium at saturation. In the present in investigation the calcium concentration lies between 24 to 1544 ppm.

MAGNESIUM

Magnesium is an essential element for human beings. Magnesium is relatively non-toxic to man. However, a higher concentration causes unpleasant taste to water. At high concentrations, magnesium salts have a laxative effect particularly when present as magnesium sulphate. Despite higher solublities of most of the magnesium compounds, magnesium is generally found in lesser amount in natural than is calcium. In contrast with most natural water, sea water contains above five times as much magnesium as calcium. The deficiency of calcium in sea water is undoubtedly due to the preferential abstraction of calcium by plants and animals. Common concentration of magnesium range from about 1 to 40 ppm, water from rocks rich in magnesium may have as much as 100ppm, but concentrations more than 100 ppm rarely encountered except in sea water and brines. Exceptionally low values of calcium and magnesium are found in some waters which have undergone natural softening by cation exchange.

FLUORIDE

Source of fluoride in ground water are minerals like calcium fluoride, apatite cryohite and fluorspar in sedentary rocks. Presence of fluoride in drinking water in beneficial[36] because it reduces tooth decay. At higher levels, however mettling of the teeth occurs. For this reason maximum fluoride concentrations recommended for drinking water as per WHO or ICMR standards range from 1.4 to 2.4ppm depending on how much water is ingested. In the present investigation the fluoride concentration ranges in between 0.1 to 1.85 ppm.

CHLORIDE

Chloride is a major dissolved constituents of most natural water. The concentration of C1 ions varies team sample to sample under investigation. Chloride produces a salty taste to all well waters, but the salty taste is variable. Reasonable amounts of chloride are tolerable in many water supplies. Chloride salts are highly soluble in water so they can not be removed simply by precipitation. Chloride is also free from the effects of exchange, adsorption and biological activity. Chloride concentration found in natural water vary between 0.1ppm in arctic snow to 150,000ppm in brines. Continental[37] rain and snow may contain from 1.0 to 3.0 ppm of chloride.

VILLAGE – DIGHAL

pH	7.9
E.C (µmhos/cm)	1500
TDS	380ppm
Hardness	280ppm
Ca^{2+}	52.0ppm
Mg^{2+}	36.0ppm
Cl^-	90ppm
Na^+	6.8ppm

Result – Water is potable here. All constituents present within the limit.

VILLAGE – GUDDA

pH	8.4
E.C	3700
TDS	90
Total Hardness	460
Ca^{2+}	96.0
Mg^{2+}	50.8
Cl^-	150
Na^+	17.8

Result: water is potable here.

VILLAGE - SHERIA

pH	8.0
E.C	1000
TDS	640
Total Hardness	400
Ca^{2+}	76.0
Mg^{2+}	38.0
Cl^-	240
Na^+	4.4

Result: As all the value lies within the limit. Thus sample is potable.

4. Conclusion

Water is an indispensable need[39-41] of life. We are now near the stage when surface and ground water has become a global problem partly because of the population explosion and partly due to phenomenal advances in industrialization. Now there is the need to prevent water borne diseases such as typhoid, chlorea, diarrhea and dysentery etc. The water quality of wells needs a betterment in which can be achieved by considering the following suggestions:

- The contaminant sources near the wells should be carefully surveyed so that there is no seepage of toxic constituents.
- Location of wells for drinking water supplies should be decided with utmost caution.
- Surrounding contaminant's sources and flow direction of effluents should be considered. It is not advisable to tap the uppermost acquifer in case of drinking wells.
- Location of industrial and municipal disposal sites should be decided keeping in view the ground (well) water levels and flow patter in the area.
- In case of toxic industrial effluents, steps should be taken for predisposal treatment by the industry itself. Industries must also learn to do a better job of controlling the release of its pollutants or thermal discharges.
- The 4R concept i.e., recycling, renovation, recharge and reuse should be employed in the modern technology of waste water treatment.
- All disposal of solid wastes near the well waters or the various channels need to be curtailed.
- Most of the municipalities still use the inadequate primary treatment. So there is an urgent need to design sewage treatment facilities so that BOD load on receiving water is reduced.
- Water quality of the wells rivers need to be monitored and controlled in a sustained manner for human use and sustenance of the ecosystem.
- More treatment plants should be created for treatment of effluents. Discharge of raw sewage, sullage and sludge should not be allowed in the water bodies.

5. References

[1] Nag B.S. and Kathapalia G.N., Water resources of India. Second World congress of water resources. Report of the irrigation Commission, Ministry of Irrigation and Power, New Delhi Vol. 3, 1975.
[2] Vaidyanthan A., Water Resources, what we do not now. The Hindu survey of environment, Madras, 1994.
[3] Vohra B.B., Managing India's water resources INTACH Environmental Series-II, New Delhi, 1990.
[4] Rogers P.P., Freshwater. In the Global possible: Resource, development and the new century. Ed. Repetto R., App. E.W. Press, New Delhi, 1991.
[5] Lvovitch M.J., World water resources and their future. English translation. Ed. R.L. Nace, American Geophysical Union, Washington D.C., 1979.
[6] Peixoto J.P., Kettani M.A., The control of water cycle. Scientific American, 228(4), 46, 1973.
[7] Kathpalia G., Water budgeting and Planning. In water pollution and management Ed. Varshney C.K., Wiley Eastern Ltd., New Delhi, 1985.
[8] Desarda H.M., Irrigation planning, water its economic and politics. In the Hindu survey of Environment, Madras, 1994.
[9] Sandra Postel, Manageing fresh-water supplies. In state of the world, Eds. Brown LR., et al., Prentice Hall, New Delhi, 1985.
[10] Vohra B.B., Agenda for water, Myth and reality. The Hindu survey of environment, 1998.
[11] Stumn W. and Morgan J.J., Aquatic Chemistry, Wiley inter science, New York, 1977.
[12] Suffer I., Mcguire M., Josephson, J. and Ember L., Env. Sci. Tech., 12, 1138, 1978.
[13] American Society for sampling and testing manual on water, 3rd edition, Philadelphia, 1979.
[14] Black H.H., Procedures for sampling and measuring industrials wastes, SIWAA, 24, 45, 1972.
[15] Aboo K.M., Shastry C.A. and Alex P.G., A study of well water in Bhopal city, Indian J. Environ. Health, 1978.
[16] British standards Institutions, Specification for pH scale, BS-1647, 1971.
[17] Robinson R.A. and Stokes R.H., Electrolytic solutions, Second edition, Academic Press, New York, 1979.
[18] Dickinson D., The chemical analysis of waters, boilers and feed waters, sewage and effluents, Blackie and Son, London, 1980.
[19] Marr I.L. and Gesser M.S., Environmental Chemical analysis, International Text Book Co., Glasgow, 1983.
[20] Natusch D.F.S. and Hopke P.K. Analytical aspects of environmental Chemistry, John Wiley and Sons, New York, 1983.
[21] Vogel A.I., A text book of quantitative inorganic analysis including elementary analysis LBS Longman, Green and Co. Ltd. London, 1984.
[22] Dean J.A., Flame Photometry, McGraw Hill publishing Co., New York, 1980.
[23] Kolthoff I.M. and Sandell E.B., Text Book of quantitative inorganic analysis, McMillan Co., New York, 1992.
[24] Hillebrand W.F., Applied inorganic analysis, John Wiley and Sons, New York, 1983.
[25] Her Majestry's stationary office. Analysis of raw, potable and waste waters, HMSO, London, 1972.
[26] Bis, Drinking water specifications, Business of India Standard, New Delhi, UDC, 15, 00315, 621, 1991.
[27] American Public Health Association AWWA, water pollution control federation. Standard methods for the examination of water and waste water, 19th APHA, Washington, 1995.
[28] Stanely N. Davis, Roger J.M., Hydrogeology, John Wiley and Sons, New York, 96-125, 1990.
[29] Todd David Ceith, Ground water hydrology, John Wiley and Sons. Inc. New York, 191, 1959.
[30] Goetx C.A. Loomis T.C. and Delhi H., Total Hardness in water, Anal. Chem., 22, 798, 1980.
[31] Babbit H.E. and Donald J.J., Water supply engineering, 5th Ed, McGraw Hill and Co. London, 1955.
[32] Manahan S.E., Environmental Chemistry, Willard Grant Press, Boston USA, 3rd Ed. 1989.
[33] Edwin Windle Taylor, The examination of water and water supplies, 6th Ed., Churchill Ltd., London, 1989.
[34] Dean J.A., Flame Photometry, McGraw Hill Publishing Co. New York, 1980.
[35] Marr I.L. and Cresser M.S. Environmental Chemical analysis, International text book Co. Glasgow, 1983.
[36] Samant H.S., Methods for chemical analysis of water and waste, Surveillance report EPSS-AR 73-12, Canada, 1983.
[37] Home R.A., Chemistry of aquatic environment, Wiley Inter science, 1978.
[38] Ciacci L.L., Water and water pollution handbook, Marcell Dekker, New York, 1982.
[39] Jackson D.V., et a;., Recovery from Industrial and domestic wastes in centralized treatment plant. In: Chem. Engg. In a changing world, edited by Koester W.T. (EISEVIEW scientific Pub. Co. Amsterdam), 1986.
[40] CS Sharma, RK Nema, SN Meyyanathan. Floating Drug Delivery System an Overview. World Journal of Pharmacy and Biotechnology, 2009, 2(1):2019-224.
[41] RK Nema, SN Meyyanthan, CS Sharma. A Practical Approach to Pharmaceutical Analysis, 1st Edition, CBS Publishers & Distributors, New Delhi, 2008 pp.89-90.