Hydro chemical Analysisand Purification of Domestic Waste Water by Using clay filter of Kathora region, Amravati district. India

W.K.POKALE[1],N.A.KALAMBE[2], S.V.AGARKAR[3], H.R.DHANBHAR[4]

[1] Principal, Saraswati College of social work, Washim
[2,4] Asstt. Prof. P. R. Patil College of Engg. & Tech, Amravati
[3] Prof.&Dean, Anuradha College of Engineering, Chikhli
Corresponding author: hemantdhanbhar@rediffmail.com

Abstract

Quality of water is an important criterion for evaluating the suitability of water for drinking and agricultural purposes.A study was carried out to assess the extent of domestic waste water pollution in and around Kathora area, Amravati district, Maharashtra. Water samples were collected and were analyzed for the concentrations of physico-chemical parameters. Waste water in this area is unsuiTable for drinking as well as agricultural as it contains higher concentrations of calcium, magnesium, hardness, sodium, chloride,sulphate and potassium are found in water and compared with BIS guidelines level for drinking water and are health hazards especially for the people residing in this areas. This is due to the recharge of effluent discharged by homes into open drains and lakes.
Work presented is a preliminary investigation of water purification by using clay filters.This research was carried out to determine the efficiency of clay pots (as a filter) in removing water impurities. Pilot and the related clay parts were fabricated and its efficiency in removing EC, TDS, TSS, hardness, BOD, COD, and some ions like Ca, Mg, Na, K, chloride, sulphate, Oil and grease was measured by passing water through the clay filters. The results showed that the clay filters had not the potential to remove hardness, EC, TDS, chloride and sulphate of water. However, they showed excellent efficiency in TSS, BOD,COD, Oil and grease, sodium and potassium.

Keywords:-Hydro geochemistry, Surface water, domestic purpose, Kathora region

Introduction :-

Groundwater is the primary source of water for human consumption, and industrial uses in many regions all over the world. In India, most of the population is dependent on groundwater as the only source of drinking water supply. The groundwater consumption rate is increasingly day by day in the areas where surface water sources are not enough to meet the demands. The quality of world water resources is being increasingly degraded as a consequence of its intensified anthropogenic exploitation. The resources in several locations become contaminated from numerous human activities or natural source. Industrial, residential, municipal and agricultural activities affect groundwater quality. Contaminations of the groundwater result in the poor quality of drinking water, loss of water supply and potential health problems.

Water is a precious natural resource used for domestic, industrial and agricultural purposes. The availability of good quality water is an indispensable feature for preventing diseases and improving

quality of life . Natural water contains some types of impurities whose nature and amount vary with source of water. Metals for example, are introduced in to aquatic system through several ways which include, weathering of rocks and leaching of soils, dissolution of aerosol particles from the atmosphere and from several human activities, including mining, processing and the use of metal based materials .

Surface water sources like shallow wells, rivers, lakes are potential sources of contaminations due to discharge of domestic and other waste. In contrast, contaminants is less likely to occur in deeper ground water reservoirs because contaminants get filtered while travelling greater depths to reach the water (Mueller et al,1995) Contaminated water sources affect the health and economic status of the populations (Jafar et al,2008) Even if no sources of anthropogenic contamination exist, there is potential for natural levels of heavy metals and chemicals to be harmful to human health. Based on the reports of World Health Organization (WHO), nearly 85 percent out of 1.5 billion population of the world has no access to healthy and uncontaminated water and live in small communities who need safe drinking water. Inexpensiveand appropriate technologies including Point of Use (POU) and Point of Entry (POE) are more considered (Cortruvo et al., 1999).Application of appropriate technology in the consumption and the entry points may significantly help water provision for small communities through considering a suiTable and healthy quality for drinking water (USEPA,1997). One of the methods of water purification in this category is the use of ceramic filters (Rob et al., 2003). These filters may be produced with different materials and in various forms; however, the most common ceramic filters in the world are diatomaceous filters, which are supplied in candle, plate and vase forms. These ceramic filters have become conventional in some parts of the world, such as India and Nepal (Mintz et al., 1995; NRC, 1997). In this research, the efficiency of water impurities removal by ceramic filters (made of ceramic soil) was studied.

Materials and Methods:-

The soil sample is collected from Nandura Village of Amravati district(India) from sampling sites , Samples were powdered using pestle and morter and sieve analysis was carried out using AIMIL Sieve shaker. Soil sample having particle size in the range of 2.36- 2.00 mm,2.00-1.00mm,and 1.00mm-600µ, 600µ-425 µ and ingredients like saw dust ,rice husk and wheat husk were used for making round shape pellets, Pellets were dried & Baked in muffle furnace at 750^{O}C for 30 minute to form clay filter.

The waste water sample was collected in prewashed (with detergent,dil HNO3 and doubly deionized distilled water,respectively) polythene bottle.Before filling the water samples the bottle was rinsed with the water sample.

In the present work, waste water sample and water samples after filtering through baked filter were studied as a part of treatment of waste water with respect to pH , Electrical conductivity, TSS, BOD, COD, Oil and grease, Total hardness, TDS, and metal ions like Ca, Mg, Na, K, etc Chloride, and Sulphate content. Standard (APHA1995) methods were used for the analysis of samples.Chemicals used were of

AR/GR grade and obtained from Qualigen/E-Merck/Hi-media.For pH and conductivity measurement digital pH Meter(ModelEQ-610)and digital conductivity Meter(Model Eq-660A)Equiptronics make were used.

Results and Discussion

Drinking water quality:-Groundwater used for domestic purposes, such as drinking and cooking should be free from toxic elements and pathogens. Domestic water quality indicates that a particular parameter at a given concentration may be suiTable for the human body beyond which it is unsuiTable. The concentration of various ions in the groundwater samples was compared with Bureau of Indian standards (BIS., IS 10500, New Delhi, **(1991)**, which are given in Table1,2,3,4 where as some samples were exceed the suiTable limit. The groundwater in this area was thus seen to be unfit for domestic consumption.

Hydrogen Ion Concentration (pH): The pH value of water indicates whether the water is acidic or alkaline. The pH of water provides vital information in many types of geochemical equilibrium or solubility calculations (Hem et al **1985)**It controls by carbon-dioxide, carbonate and bicarbonate equilibrium. The combination of CO_2 with water form carbonic acid, which affects the pH of the water. Drinking water with a pH range 6.5 to 8.5 is generally satisfactory. If the pH is not within the prescribed limit of 6.5 to 8.5, it damages mucous membrane present in eyes, nose, mouth, abdomen, anus etc. The pH value of water samples in the study area is within the safe limit ranged from 7.35 to 7.42 characterized by slightly alkaline.

Electrical Conductivity (EC): Electrical conductivity is a measure of water capacity to convey electric current. It is used to estimate the amount of dissolved solids. It increases as the amount of dissolved mineral (ions) increases. The most desirable limit of EC in drinking water is prescribed as 1500 μScm−1 and permissible limit 3000 μScm−1. In this study, the value of conductivity ranged between 960 μScm−1 to 994 μScm−1. Lower EC in the study area indicates that salts less than desired in the water. The value of electrical conductivity may be an approximate index of the total content of dissolved substances. It depends upon the temperature, concentration and types of ions present (Hem .et al **1985)**

Total Dissolved Solids (TDS):-Total dissolved solids (TDS) generally reflect the amount of mineral content that dissolved in the water and this controls its suitability for use. Higher concentration of total dissolved solids may cause adverse taste effects. Highly mineralized water may also deteriorate domestic plumbing and appliance. Based on the TDS content allowed for drinking water, all the groundwater of the study area exceeds the desirable limit of 500 mg/l and up to 1500 mg/l is maximum permissible limit. As per the TDS classification (Fetter, 1990) . In the study area the TDS value varies between 657 mg/l to 682 mg/l in water , the higher TDS decrease palatability and causes gastrointestinal irritation in the human beings. It has also laxative effect, especially upon transits. But, the prolonged intake of water with the

higher TDS can cause kidney stones, which are widely reported from different parts of the country(Garg et al,**2009)** . High concentration of TDS in the groundwater sample is due to leaching of salts from soils and industrial and municipal waste disposal may percolate into the groundwater, which may cause a huge increase in dissolved solids. The TDS value of water samples in the study area is within the safe limit ranged from 657 mg/l to 682 mg/l

Total Hardness (TH):-Hardness is an important criterion in determining the suitability of water samples for domestic and industrial purposes as it involved in the water hard. Total hardness was found in the sample was ranges from 346 mg/l to 352 mg/l in water that water is safe for drinking purpose after filtering through clay filter. The hardness of the water is due to the presence of alkaline earths such as calcium and magnesium. High levels of hardness may affected water supply system, excessive soap consumption, calcification of arteries and cause urinary concentrations, diseases of kidney of bladder and stomach disorders (CPCB.**2008)**

Calcium (Ca^{2+}) and Magnesium (Mg^{2+}):-Calcium (Ca^{2+}) and magnesium (Mg^{2+}) are the most abundant elements in the natural surface and groundwater and exist mainly as bicarbonates and to a lesser degree in the form of sulphate and chloride. The Ca^{2+} is an important element to develop proper bone growth. Ca^{2+}concentrations are varying from 58.6 to 63Mg/l. The desirable limit of Ca^{2+} concentration for drinking water is specified as 75 mg/l (. APHA.,**1995)** which shows that all the groundwater samples. It is undesirable for domestic uses . Mg^{2+} content is varying from 46.8 to 48.4 mg/l in water . Although, Mg^{2+} is an essential ion for functioning of cells in enzyme activation, but at higher concentration, it is considered as laxative agent (Garg ,et al**2009)**. The maximum permissible limit of Mg^{2+} concentration of drinking water is specified as 100 mg/l (BIS 2003), all samples are within the limit.

Sodium (Na^{+}):-Among the cations, sodium (Na^{+}) was the most dominant in groundwater and its concentration (>50 mg/l) make the water unsuiTable for domestic use. Higher concentrations of Na^{+} and Ca^{2+} in the groundwater were attributed to the cation exchange among minerals (Tijani J.**1994)** and to the sewage concentration, in addition to the pollutants from effluents. Sodium is generally found in lower concentration than Ca^{2+} and Mg^{2+} in fresh water. The observed concentration of Na^{+} is varied from 42.1 to 42.6 mg/l in water , lower than the recommended limit of 200 mg/l for safe, . Groundwater in most of the study area comes under the safe zone for drinking with reference to the concentration of Na^{+}, which is less than 200 mg/l (APHA.,**1995).** Therefore, Na^{+} enriched diet is suggested to the patients, who suffer from the heart diseases and also from the kidney problems.

Chloride (Cl^{-}):-Chloride (Cl^{-}) ion induces a salty taste to water, which deteriorate the quality of drinking water at large extent. Cl^{-} is present in all natural water, usually in relatively small amounts, however, Cl^{-} also can be derived from human sources. Abnormal concentrations of Cl^{-} were found in groundwater and one possible source might be the tannery, where common salt was used as a raw material (Peace Trust,

2000). The origin of Cl^- in groundwater may be from anthropogenic sources such are industrial waste discharges, municipal effluents, domestic waste discharges, weathering, leaching of soil and rocks, etc (Loizidou and Kapetanios1993). In the study area the concentration of Cl^- is between 61 mg/l to 67 mg/l in water, . A limit of 250 mg/l chloride has been recommended as desirable limit and 1000 mg/l as the permissible limit for drinking water (APHA,1995). Chloride content of the water samples was high, and its possible source is tanneries where sodium chloride is used as a raw material. The safe limit of Cl^- for drinking water is specified as 250 mg/l (APHA,1995). In fact, the Cl^- is derived mainly from the non-lithological source and its solubility is generally high. The excess of Cl^- in the water is usually taken as an index of pollution from industries and tracer from groundwater contamination (McCarthy,**2004)**. In natural waters, the concentration of Cl^- bears strong correlation with the Na^+ content and specific conductance. High concentration of Cl^- may be injurious to some people suffering from diseases of the heart and kidney, taste, indigestion, corrosion and palatability are affected (Sawyer and McCarthy **1967)** Cl^- plays an important role in balancing level of electrolytes in blood plasma, but higher concentration can develop hypertension risk of stroke, left ventricular hypertrophy, osteoporosis, rental stones and asthma(Garg ,et al**1998)**

Sulphate ($SO4^{2-}$):-Sulphate ($SO4^{2-}$) is one of the major anion occurring in natural water. Bureau of Indian standard has prescribed 200 mg/l as the desirable limit and 400 mg/l as the permissible limit for $SO4^{2-}$ in drinking water. The source is from natural and the waste sludge in the dump may be contributing as chromium sulphate. The concentration of $SO4^{2-}$ is likely to react with human organs if the value exceeds the maximum allowable limit of 400 mg/l will cause a laxative effect on human system with the excess Mg^{2+} in groundwater. The diarrhea, catharsis, dehydration and gastrointestinal irritation may due to ingestion of water contain sulphate(Sreeram and Ramasami,**2003)**

The $SO4^{2-}$ concentration in the study area ranges between 40.5 mg/l to44.5 mg/l in groundwater, indicting that all samples below the desirable limit.

Table No.1

SN	PARAMETER	BEFORE FILTRATION	Domestic Sewage water filtered through (Black soil < 2.36 mm sieve)				BIS (IS 10500: 1991)
			Original sieved soil	Sieved soil+ Saw	Sieved soil+ Rice	Sieved Soil+ Wheat husk	
1	**pH**	7.35	7.37	7.35	7.35	7.35	6.5-8.5
2	**TSS (mg/l)**	138	Nil	Nil	12	20	100-200
3	**BOD(at 27°C)**	37	12	16.0	18.4	20.2	30-100
4	**COD (mg/l)**	172	90	96	104.5	108.7	250
5	**OIL & GREASE**	8	Nil	Nil	5	Nil	10-20
6	**EC (µS/cm)**	960	972	968	965	962	1500-3000
7	**TotalHardness**	346	350	348	348	347	300-600
8	**TDS (mg/l)**	657	668	664	660	659	500-2000

9	**Calcium (mg/l)**	58.6	61	60.0	59.3	59.0	75-200
10	**Magnesium (mg/l)**	48.4	48.0	48.1	48.5	48.48	30-100
11	**Chloride (mg/l)**	167	165	165	165	161	250-1000
12	**Sulphate (mg/l)**	141	140	141	141	140	200-400
13	**Sodium (mg/l)**	42.6	42.3	42.4	42.4	42.5	50-200
14	**Potassium (mg/l)**	9.5	9.0	9.0	9.2	9.2	

Table No.2

SN	PARAMETER	BEFORE FILTRATION	Domestic Sewage water filtered through (Black soil ≤ 2.00 mm sieve)				BIS (IS 10500: 1991)
			Original sieved soil	Sieved soil+ Saw dust	Sieved soil+Rice husk	Sieved Soil+Wheat husk	
1	**pH**	7.35	7.37	7.35	7.35	7.35	6.5-8.5
2	**TSS (mg/l)**	138	Nil	Nil	Nil	10	100-200
3	**BOD (27°C at**	37	8.7	10.5	10.7	12.0	30-100
4	**COD (mg/l)**	172	84	88	99.5	102.0	250
5	**OIL & GREASE**	8	Nil	Nil	Nil	4	10-20
6	**EC (µS/cm)**	960	984	976	970	966	1500-3000
7	**Total Hardness**	346	352	350	348	347	300-600
8	**TDS (mg/l)**	657	672	670	668	660	500-2000
9	**Calcium (mg/l)**	58.6	60.7	59.7	59	58.8	75-200
10	**Magnesium (mg/l)**	48.4	48.7	48.8	48.7	48.6	30-100
11	**Chloride (mg/l)**	167	165	165	165	160	250-1000
12	**Sulphate (mg/l)**	141	140	141	141	141	200-400
13	**Sodium (mg/l)**	42.6	42.4	42.5	42.5	42.3	50-200
14	**Potassium (mg/l)**	9.5	8.6	8.8	8.8	9.0	

Table No.3

Sn	Parameter	Before Filtration	Domestic Sewage Water Filtered Through (Black Soil ≤ 1.00 Mm Sieve)				Bis (Is 10500: 1991)
			Original	**Sieved**	**Sieved**	**Sieved**	
1	**pH**	7.35	7.40	7.40	7.40	7.38	6.5-8.5
2	**TSS (mg/l)**	138	Nil	Nil	Nil	8	100-200
3	**BOD (27°C at**	37	9.5	10.0	10.6	11.8	30-100
4	**COD (mg/l)**	172	78.5	79.6	81.3	88.3	250
5	**OIL & GREASE**	8	Nil	Nil	Nil	Nil	10-20
6	**EC (µS/cm)**	960	988	982	986	986	1500-303000
7	**Total Hardness**	346	352	350	349	348.5	300-600
8	**TDS (mg/l)**	657	676	672	674	673.6	500-2000
9	**Calcium (mg/l)**	58.6	63	62.7	62.4	62.2	75-200
10	**Magnesium**	48.4	47.3	47	46.9	46.9	30-100
11	**Chloride (mg/l)**	167	166	167	167	167	250-1000
12	**Sulphate (mg/l)**	141	143	142	141	140	200-400
13	**Sodium (mg/l)**	42.6	42.1	42.2	42.2	42.4	50-200
14	**Potassium (mg/l)**	9.5	8.6	8.9	8.9	9.0	

Table No.4

SN	PARAMETER	BEFORE FILTRATION	Domestic Sewage water filtered through (Black soil ≤ 600µ sieve)				BIS (IS 10500: 1991)
			Original sieved soil	Sieved soil+ Saw dust	Sieved soil+Rice husk	Sieved Soil+Wheat husk	
1	pH	7.35	7.42	7.40	7.40	7.40	6.5-8.5
2	TSS (mg/l)	138	Nil	Nil	Nil	Nil	100-200
3	BOD (27°C at	37	7.5	8.0	8.6	10.4	30-100
4	COD (mg/l)	172	68.6	72.4	74.5	81.0	250
5	OIL & GREASE	8	Nil	Nil	Nil	Nil	10-20
6	EC (µS/cm)	960	994	988	988	982	1500-3000
7	Total Hardness	346	356	352	350	348	300-600
8	TDS (mg/l)	657	682	675	674.4	670.8	500-2000
9	Calcium (mg/l)	58.6	64.5	63.3	62.9	62.0	75-200
10	Magnesium (mg/l)	48.4	47.3	47.1	46.8	46.9	30-100
11	Chloride (mg/l)	167	167	167	167	167	250-1000
12	Sulphate (mg/l)	141	144	142	142	141	200-400
13	Sodium (mg/l)	42.6	42.0	42.0	42.2	42.1	50-200
14	Potassium (mg/l)	9.5	8.4	8.6	8.6	8.9	

Conclusion:-

The results of the study shows that the water in and around Kathora area is not significantly contaminated. The type of water that predominates is Na-Cl type based on hydrochemicalfacies. The parameters EC, Ca, TH, Na, Cl, in majority of the samples within the drinking level standards of BIS.This indicates that water is suiTable for domestic purpose. Various parameters not exceeding drinking water criteria indicating that the contamination is only localized. Hence proper water treatment is required in terms of community health.

References

[1] Mondal N. C., Singh V. S., Puranik S.C. and Singh V. P., Trace elements concentration in groundwater of Pesarlanka Island, Krishna Delta, India, Environ. Monit Assess., 163 (1-4), 215-227, (2009)

[2] WHO, Guidelines for drinking water quality recommendations, World Health Organization, Geneva, (1984)

[3] Govil P. K., Reddy G. L. N., Krishna A. K., Seshu C. L. V., SatyaPriya V. and Sujatha D., Inventorization of contaminated sites in India, NGRI technical report, 54-66, (2004)

[4] APHA., Standard methods for the examination of water and wastewater, 21st Edn, Washington D.C. (1995)

[5] BIS., Indian standard specification for drinking water, IS 10500, New Delhi, (1991)

[6] Hem J. D., Study and interpretation of the chemical characteristics of natural waters, 3rd edn, USGS Water Suppy Paper, 2254, 117-120, (1985)

[7] Garg V.K., Suthar S., Singh and Jali S., Drinking water quality in villages of southwestern Haryana, India, assessing human health risks associated with hydrochemistry, EnvirGeol, 58, 1329-1340. (2009)

[8] Sawyer C. and McCarthy P., Chemical and Sanitary Engineering, 2nd edn, McGraw-Hill, New York, (1967)

[9] CPCB., Guidelimes for water quality management, Central Pollution Control Board, PariveshBhawan, East Arjun Nagar, Delhi, (2008)

[10] Tijani J., Hydrochemical assessment of groundwater in Moro area, Kwara State, Nigeria, Env. Geology, 24(12), 194-202, (1994)

[11] Peace Trust, Dossier on Tannery Pollution in Tamil Nadu, Peace Trust Pub., Dindigul, India, (2000)

[12] Loizidou M and Kapetanios E.G., Effect of Leachate from landfills on underground quality, Sci.total Environ, 128, 69-81 (1993)

[13] McCarthy M.E., Should we strict chloride rather than sodium? Medical Hypothesis, 2004, 63, 138-148, (2004)

[14] Garg V. K., SharmaI.S. and Bishnoi M. S., Fluoride in under groundwater of Uklana town, District Husar, Haryana, Pollut. Res., 17, 149-152, (1998)

[15] Sreeram K. J. and Ramasami T., Sustaining tanning process through conservation, recovery and better utilization of chromium, ResoConserRecyling, 186-212 (2003)

[16] Environmental Protection Agency, 2000. Trickling filters. Office of Water Washington, D.C, wastewater Technology Fact Sheet. United States Environmental Protection- EPA 832-F-00-014,(Sept. 2000).

[17] APHA(American Public Health Association).Standard methods for the examination of water and waste water.17 thed, American Public Health Association,Washington DC(1995)

[18] .G.J.Houben,Iron oxides in wells. Part1.Genesis, mineralogy & geochemistry, Appl. Geochem.18(2003)PP 927-939

[19] .G.J.Houben, Iron oxide incrustation in wells.part2. Chemical dissolution & modeling, Appl.Geochem.18 (2003)PP 941-954

[20] B. Das, P. Hazarika, G. Saikia, H. Kalita, D. C. Goswami, H. B. Das, S. M. Dube& R. K. Datta, Removal of iron from ground water by ash: A systematic study of traditional method, Elsevier B V (2006)

[21] K. Kowalski (2003). Investigation of the turbidity and TOC concentration on the filtration rate of the filtrón ceramic filter. University of Colorado, School of Civil and Environmental Engineering.

[22] American Institute of Industrial Technology-AIIT (2002). Identification and evaluationof design alternatives for a low cost domestic filter for drinking water. Center for the Research of Aquatic Resources of Nicaragua, The national University of Nicaragua

[23] Cortruvo JA, Graun GF, Hearne N (1999). Providing safe drinking water in small systems.NSF. WHO