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GROUND WATER TREATING BY USING NATURAL FRUIT WASTAGE

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ABSTRACT

Water is the major source to life. The human body weight is made up of about 75% water. The estimation done by WHO says that about 85% of the rural population lack in potable drinking water. Due to deprived hygiene, malnutrition, and polluted drinking water about 15 million infants die every year in developing countries. About 80% of diseases caused in developing countries are directly connected with polluted drinking water (WHO). If the water supply provision is made nearby for consumers in sufficient for their daily needs in turn help greatly in reducing the incidence of skin diseases, eye infections and also reduce water borne diseases, particularly if the bacteriological quality of water. However, major improvements in health conditions can be achieved by providing sufficient safe quality and quantity of water, by practicing domestic hygiene and adopting proper methods of water purification. An experimental study is done for ground water treatment by using low-cost fruit wastages such as coconut charcoal, banana and orange peels. These are used in the present Study, the effect of pH, EC, TDS, TS, Alkalinity and hardens are studied. Experiments are conducted for different detention times and 10% dosages fruit waste as treating water. The treated water shows near to drinking water standards. This process of treating water low cost and eco-friendly.

Keywords: Ground water, fruit wastage, eco-friendly.

1. INTRODUCTION

1.1 General

Water is one of the most common and the most precious resource on earth without which there would have been no life on earth. Pollution is a serious problem in India as 70% of its surface water resources and ground water reserves have been contaminated by biological, organic and inorganic pollutants (Yadav S.S 2011). Groundwater is used for agricultural, industrial, household, recreational and environmental activities all over the world (S.Devi et al., 2012). Water is the life's matter and matrix and without it, life cannot exist. The presence of safe and reliable drinking water is an essential prerequisite for a stable community. So quality of water is to be determined for a locality for various purposes. As water balances human life system in a positive way, its negative effect is attributed by consequence of various parameters beyond the permissible limits (Sujata Sen, 2011).

Wastewater disposal is the major problem being faced by us. In developing countries, like India presently, only about 10% of the generated wastewater is treated; the rest is discharged into our water bodies. Water bodies have an inherent capability to dilute the pollutants which enter the system. However, dumping of untreated sewage and chemical wastes directly into lakes and drains has made these water bodies unable to cope with the pollutant load. The steady increase in the amount of water used and waste water produced by urban communities and industries throughout the world also poses potential health and environmental problems. The contaminated waters disrupt the aquatic life and reduce their reproductive capability. The most commonly faced problem in disposal of wastewater is the colour and turbidity. Finely dispersed suspended and colloidal particles are responsible for the colour and turbidity of the waste waters. Colour in water results from the presence of natural metallic ions, humus and peat material, plankton, weeds, and industrial wastes. Suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, and plankton and other microscopic organisms are responsible for turbid waters.

1.2 Ground water pollution scenario

Studies on various aspects of chemistry of groundwater have been carried in national and international levels by several researchers: Geochemistry processes, occurring within the groundwater and their reactions with the aquifer materials, are responsible for changes in groundwater chemistry (Hem, 1991; Drever, 1997). The variations in major ion chemistry of groundwater lead to identification of geochemical processes that control the groundwater quality (Subba Rao, 2008). Weathering of minerals within the rocks is an important process, regulating the concentration of dissolved ions in groundwater (Jacks, 1973; Bartarya, 1993). Geochemical assessment of groundwater with reference to water –rock interaction and suitability of groundwater quality in respect of drinking and irrigation purposes are studied around Macherla-Karempudi area, Guntur, Andhra Pradesh (India) by Gupta et al. (2009).

2. LIETRATURE SURVEY

De Messie et al. (2015) compared the surface properties and adsorption capacity of the pyrolyzed and dried activated banana peel with commercial activated carbon (F-400) against an aqueous solution of Cu(II) ions. Pyrolytic activation of dried banana peels gives larger mesopores (49 Å) but smaller surface area (38.49 m2 /g) adsorbent with dominantly negative surface charges compared to commercial activated carbon (F-400) that have smaller mesopores (30 Å) and large surface area (819 m2 /g). The adsorption capacities of the commercial activated carbon (F-400) (2.39 mg/g) and prepared activated dried banana peel (38.4 mg/g) were compared and reported that later have better adsorption capacity. Although the dried banana peel has smaller surface area, the reason for the better adsorption capacity was the presence of opposite charge on the surface of the adsorbent. The banana peel derived adsorbents achieved a removal efficiency of 96% at lower initial concentration solutions. The isotherm data better fitted to the Langmuir isotherm. The sorption against time data fitted to a pseudo-second-order kinetic equation for both the adsorbents. The mechanism of adsorption against Cu(II) ions was explained through ion exchange and electrostatic interactions.

The adsorbents from the banana peel and stem by direct sunlight drying and then activated with sodium hydroxide and formalin solutions (Hasanah et al., 2012). The prepared adsorbent was tested against Cu(II) ion present in textile industry effluent. The batch adsorption experiment was run to identify the suitable type of activating agent, adsorbent particle size, pH of the adsorbate solution, and contact time. The results implied that the optimum conditions for maximum adsorption of Cu(II) ion (adsorption capacity, 19.70 mg/g, removal efficiency, 89.01%) were formalin treated banana stem, with particle size 30 mesh, pH of Cu(II) ions solution 4.0, and contact time 12 h. The NaOH-treated banana peel adsorbent has adsorption capacity 13.24 mg/g and removal efficiency 59.81%, at particle size 20 mesh, pH of the Cu(II) ions solution 5.0, and contact time 24 h. The copper metal ions adsorption onto dried banana peel was experimentally tested by varying the independent parameters such as particle size, adsorbent dosage, solution pH, contact time, agitation speed, and temperature (Hossain et al., 2012). It was found that the low acidic solution (pH ¼ 6) favored the Cu(II) ion removal through the dried banana peel. The isotherm data were followed monolayer model; the adsorption capacity was calculated to be 27.78 mg/g. The pseudosecond-order kinetic model was followed by the Cu (II) ions adsorption onto the dried banana peel. For the recovery of the Cu(II) metal ions from the surface of the adsorbent, 0.10 N sulfuric acid solution was found to be effective for desorption. Around 94% of the adsorbed Cu(II) ions can be recovered through 0.1 N sulfuric acids washing.

In recent years the use of adsorption technique for the removal of heavy metals has received global attention (Raji et al., 1998). Several researchers have been working on the heavy metals removal. However, most of them have used commercially available activated carbon in their studies. The high cost of activated carbon and its loss during the regeneration restricts its application. Thus there is need to undertake studies to substitute the costlier commercial activated carbon with the unconventional, low cost and locally available agricultural waste adsorbents (Bailey et al., 1999, Brown et al., 2000). India is an agricultural country and generates considerable amount of agricultural wastes such as sugar cane bagassess, coconut jute, nut shell, rice straw, rice husk, waste tea leaves, ground nut husk, crop wastes, peanut hulls, fertilizer wastes etc. Successful studies on these materials could be beneficial to the developing countries and could be easily incorporated in development of appropriate technologies. The successful utilization of agricultural waste in the treatment of wastewater would be quite economical due to its high adsorption capacity (Drake et al., 1996, Shukhla and Sakhardane, 1992, Weber 1996, Chand et al., 1994, Laszlo 1996, Siddiqui et al., 1994, Ayub, et al., 1998, 1999, 2001, 2002, 2003, 2006, 2012, 2013).

Around 71 million tons of oranges are produced annually around the world. Approximately 73% of these are consumed as fresh fruit, while 26% of the oranges are used for secondary products, primarily juice. Enormous quantities of agrifood waste are generated as a consequence of this large-scale production. In Iraq, the cultivation of oranges is one of the agro-economic activities that result in large quantities of bio-waste (orange peels). Therefore, orange peels are widely available as low-cost bio-waste. Making use of this waste for remediation would have both economic and environmental benefits. Widmer et al. (2010) indicated that a large portion of the global orange production results in waste that must be disposed of, creating environmental and economic burdens. Several researchers have utilized orange peels (OP) as economical, readily biodegradable sorbents due to their physio-chemical features. The OP consists of chlorophyll, lignin, pectin, cellulose, pigments, amid, carboxyl, and hydroxyl surface functional groups, and other lowmolecular-weight compounds. It is an abundant waste product that can be used for the adsorption of heavy metals (Pandiarajan et al., 2018).

3. OBJECTIVE AND METHODOLOGY

3.1 Objective of the study

In this work, it is proposed to evaluate and compare the fruit wastage based water treatment. The following objective is:

- To find out the optimum detention period for treating of ground water by fruit wastage.
- To compare the all three different fruit wastage based water treatment and to find out which one gives better water quality standards.
- To compare with raw ground water with treated water.

3.2 Methodology

1. The collected Ground water test initially (i.e: pH, EC, Alkalinity, Hardness, TDS, TSS, TS)

2. The Banana peels, orange peels, coconut shells collected from local market.

3. The banana peels and orange peels oven dried at 103^{0}C for 10mints.

4. Coconut shells burned upto 75%. The burned coconut shells called as "coconut charcoal"

5. Collect the Ground water in beakers and soak these three natural waste into the water. The ratio mentioned water : natural waste is 1:0.1.

6. The soaking period mentioned as 24hrs and 48hrs.

7. Compare the test results and conclude the project.

4. EXPERIMENTAL WORK

4.1 General

The College Ground water collected from outlet, the water quality parameter was determined. The test procedure mentioned in this chapter. Initially Ground water tested after that 3different natural wastage mix with Ground water (as per methodology) test individual to find out the water quality properties and compare each other's.

4.2 Water quality testing Procedures

4.2.1 pH

pH of the water was recorded by an Elico digital pH meter. Carbon dioxide free distilled water was used for pH measurements. The pH meter was standardized against standard buffer solutions (4.00, 6.85, and 9.18). The combined electrode was kept immersed in the sample in a beaker and the pH of the sample was recorded.

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4.2.2 Electrical conductivity

Principle: Electrical Conductivity is a measure of water's capacity of conveys electric current. Electrical Conductivity of water is directly proportional to its dissolved mineral matter content. The unit of Conductivity is mmhos/cm. Since Electrical Conductivity varies directly with the Temperature of the sample, the result is, usually reported at 25°C. Specific Conductivity of water sample was determined by Conductivity Meter calibrating the instrument by standard Potassium Chloride solution.

Reagent: 0.1 N KCl solution -Take 0.7g of KCl in 100ml volumetric flask and made up to the mark with distilled water.

Procedure: The cell was calibrated with standard 0.1N KCl solution of conductivity 14.12mmhos/cm at 300C. The cell was rinsed thoroughly with deionized distilled water and carefully wiped with tissue paper. The cell was dipped into the sample solution, swirled and waited up to 1 minute for steady reading. The reading was taken after the indicated value remained constant for about a minute.

4.2.3 Total Dissolved Solids (TDS) and Suspended solids (SS)

TDS of the water sample was measured by filtering 50 ml of the waste water through Whattman 44 filter paper into a clean, dry and weighed platinum dish (W_1g). The contents of the platinum dish and filter paper were evaporated on a water bath and the residue was dried at 103^0C in a hot air oven to a constant weight (W_2g).TDS was calculated using the formula

Total dissolved solids = TDS (mg/l) = (W2-W1) x 1000/V

Where, W1= weight of the platinum dish.

W2= weight of the platinum dish with residue.

V= volume of sample

Suspended solids = SS (mg/l) = (W2-W1) / volume of water filtered

Where, W1= empty dry filter paper

W2= Final weight of filter paper after oven dried @ 103^0C

Total solids = (W2-W1) / V

Where, W1= Initial weight of empty container

W2= Final weight after oven drying

V= volume of sample

4.2.4 Alkalinity

Principe: Alkalinity is the quantitative capacity of aqueous media to react with Hydrogen ions. The Alkalinity of natural or treated water is normally due to the presence of Bicarbonate, Carbonate - and Hydroxide compounds of Calcium, Magnesium, Sodium and

Potassium. Alkalinity can be determined by titrating the strong alkali (such as Carbonate, free NaOH) to pH 8.3. At this pH all the free CO2 is converted into Bicarbonates.

Reagents:

a). Sodium thiosulphate solution (0.1N) – Dissolve 25g of sodium thiosulphate in distilled water and make volume to 1 litre.

b). Standard sulphuric acid (0.02N) – Prepare 0.1N H2SO4 solution by diluting 3ml of concentrated sulphuric acid to 1000ml.Standardise it against standard Na_2CO_3 (0.1N). Take approximate volume of H2SO4(approximately 0.1N) and dilute with distilled water and make up to 1 litre to obtain standard 0.02N H_2SO_4.

c). Phenolphthalein indicator.

d). Methyl Orange indicator.

Procedure: 25ml of the given sample was taken in a conical flask and one drop of 0.1N Sodium thiosulfate solution was added to remove the residual chlorine (if present). 2 drops of phenolphthalein indicator was added and the solution turns pink. This solution was titrated against 0.02N standard Sulfuric acid until the solution turns colorless. The volume of H_2SO_4 run down was noted (V1). Then, 2 drops of Methyl Orange indicator was added and the sample turns yellow. The titration was resumed until the solution turns to pink. The total volume of H2SO4 rundown was noted (V2). Phenolphthalein alkalinity and Total alkalinity were calculated.

Calculation:

Phenolphthalein alk. (p) mg/l as $CaCO_3$ = (V1 x Normality of H_2So_4 x 1000x 50) / (Volume of sample taken)

Total alkalinity (T) mg/l as $CaCO_3$ = (V2 x Normality of H_2So_4 x 1000x 50) / (Volume of sample taken)

4.2.5 Total Hardness:

Total Hardness represents the concentration of Ca^{++} and Mg^{++} present in the water and was determined by Ethylene Diamine Tetra Acetic acid (EDTA) complexometric titration. EDTA solution was standardized against standard calcium chloride using NH_4Cl + NH_4OH buffer and Eriochrome Black -T indicator. The standardized EDTA solution was used for the determination of Total Hardness of wastewater.

Reagents:

a) EBT(Eriochrome Black T) - Dissolve 1pinth of EBT in distilled water.

b) Buffer solution

c) EDTA solution (0.01M)

Procedure: 25ml of the given sample was taken in a conical flask and one drop of 0.01M EDTA solution was added to remove the residual Ca^{2+} (if present). 2 drops of EBT indicator

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was added and the solution turns wine red colour. This solution was titrated against 0.01M standard EDTA until the solution turns blue. The volume of $CaCO_3$ run down was noted (V1).

Total Hardness as $CaCO_3$ in (mg/l) = Titrant in ml (A) x 1000 /volume Sample (ml)

5. RESULTS AND DISCUSSIONS

5.1 Ground water quality parameters

Calculation:

5.1.1 Total solids (TS):

Total Solids (TS) = (W2-W1)/V

W1= weight of china dish = 67.074g

W2= weight of china dish after oven drying = 67.056g

TS= (67.074-67.044)/50

TS= 600 mg/l

5.1.2 Total suspended solids (TSS)

Calculations:

W1 = Initial weight of filter paper =1.030

W2 = weight of filter paper after oven drying for 24hrs = 1.43

Volume of sample = 50ml

TSS = (W1-W2)/V = (1.43-1.030)/50

TSS = 800 mg/l

5.1.3 Alkalinity test:

It is defined as the quantity of ions in the water that will react to neutralize the hydrogen ions.

Calculation:

Table. 1: Alkalinity test results with phenolphthalein.

S.No	Volume of sample	Initial reading	Final reading	Volume of H_2SO_4
1	50ml	0	0.9	0.9
2	50ml	0	1.4	1.4
3	50ml	25.2	26.1	0.9

A = (0.9+1.4+0.9)/3 = 1.0266

Table. 2: Alkalinity test results with methyl orange.

S.NO	Volume of sample	Initial reading	Final reading	Volume of H_2SO_4
1	50ml	0.9	12.6	11.7
2	50ml	14	25.2	11.2
3	50ml	26.1	37.6	11.5

B = (11.7+11.2+11.5) = 11.4663

Total Alkalinity = ((A+B)*N*50000)/volume of sample

= ((1.0666+11.4667)*0.02*50000)/50

= 250 mg of CaCo3/lit

5.1.4 Hardness

Hardness of water is due to presence of certain salts such as carbonates, bicarbonates, chlorides and sulphates of calcium and magnesium dissolved in it.

Table. 3: Hardness of water.

S.NO	Volume of sample	Initial reading	Final reading	Difference
1	50ml	14.5	28	13.5
2	50ml	29	41.2	12.2

A = (13.5+12.2)/2 = 12.85

Ca Hardness = $\frac{100\ x\ 1000000\ x\ ml\ of\ EDTA\ X\ Molarity\ of\ EDTA}{1000\ X\ ml\ of\ water\ sample}$

Where, Morality of EDTA = 0.01M

Ca Hardness = $\frac{100\ x\ 1000000\ X\ 12.85\ \ X\ 0.01}{1000\ X\ 50}$ = 257 mg of $CaCo_3$/lit

Table. 4: Ground water quality parameters.

Test	Result
pH	8.8
EC (micro siemens)	650
TDS (mg/l)	800
TS (mg/l)	600
Alkalinity (mg of CaCo3/lit)	250

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Hardness (mg of $CaCo_3$/lit)	257

5.2 Treated Ground water quality parameters

Table. 5: Treated ground water quality parameters (24hrs detention period).

Test	Result			
	Raw water	**Orange peels**	**Banana peels**	**Coconut charcoal**
pH	8.8	7.8	7.5	7.3
EC (micro siemens)	650	502	560	489
TDS (mg/l)	800	560	600	620
TS (mg/l)	600	274	276	286
Alkalinity (mg of CaCo3/lit)	250	152	204	163
Hardness (mg of $CaCo_3$/lit)	257	112	129	120

Table. 6: Treated ground water quality parameters (48hrs detention period).

Test	Result			
	Raw water	**Orange peels**	**Banana peels**	**Coconut charcoal**
pH	8.8	7.5	7.2	7.0
EC (micro siemens)	650	498	548	465
TDS (mg/l)	800	510	540	580
TS (mg/l)	600	260	273	279
Alkalinity (mg of CaCo3/lit)	250	148	196	152
Hardness (mg of $CaCo_3$/lit)	257	107	123	115

5.3 Summary

The water quality properties are changed with treating with natural waste like banana peels, orange peels and coconut charcoal. By treating Ground water with waste, pH values within the drinking water ranges, Ec more than drinking water range, TDS near to drinking water range, TS lesser than drinking water range, Alkalinity near to drinking water range and

Hardness lesser than drinking water ranges as per ICMR (Indian Council of Medical Research) The observation of test results mentioned below:

- pH test result: Coconut charcoal < banana peels < orange peels
- EC test results: Coconut charcoal < orange peels < banana peels
- TDS test results: Orange peels < banana peels < coconut charcoal
- TS test results: Orange peels < banana peels < coconut charcoal
- Alkalinity test results : Orange peels < Coconut charcoal < Banana peels

Table. 7: Summary of treated water test results.

Property	**Drinking water standards**	**Recommended agency**	**Raw water**	**Orange peels**		**Banana peels**		**Coconut charcoal**	
				24hrs	**48hrs**	**24hrs**	**48hrs**	**24hrs**	**48hrs**
pH	6.5 –8.5	ICMR/BIS	8.8	7.8	7.5	7.5	7.2	7.3	7.0
EC (micro siemens)	300	ICMR	650	502	498	560	548	489	465
TDS (mg/l)	500	ICMR/BIS	800	560	510	600	540	620	580
TS (mg/l)	500	ICMR	600	274	260	276	273	286	279
Alkalinity (mg of CaCo3/lit)	120	ICMR	250	152	148	204	196	163	152
Hardness (mg of $CaCo_3$/lit)	300	ICMR	257	112	107	129	123	120	115

6. CONCLUSIONS

In this Study, filtration processes the waste materials are used to purify the water without disturbing ecosystem. Experiments were carried out for the treatment of ground water by the addition of Natural fruit wastage. The Performance characteristics such as Detention time removal efficiency of physical parameters of coconut charcoal, banana and orange peels were investigated. This study following conclusions is:

- The detention time plays major role in this process of treating water. For 48hours soaking of fruit waste play major change in water quality properties like pH, EC, TDS, TS, Alkalinity and Hardness.
- The pH values are within drinking standard after treating of Ground water
- The EC values are least obtained for coconut charcoal based treating of water and it's near to drinking water standards.
- The TDS values are least obtained for Orange peels based treating of water and it's very near to drinking water standards.
- The TS values are lesser than the drinking water standards for all 3 different fruit waste based treated Ground water.
- The Alkalinity values are least obtained for Orange peels and coconut charcoal based treating of water and it's near to drinking water standards.
- The Hardness values are lesser than the drinking water standards for all 3 different fruit waste based treated Ground water.

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