EXPERIMENTAL STUDY ABOUT THE VEGEITABLE WASTE WATER AND PURIFICATION OF FRESH WATER

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Abstract: Agriculture is the important process of cultivating food and some other materials. The necessity of the agriculture is more. In Tamil Nadu, large amount of agricultural lands are available. Especially in hilly region some kind of special vegetables are cultivated. It includes carrot, beet root, potato, raddish, etc,. Some of those vegetables are washed with water before it comes to the market for sale. The surrounding of Ooty contains nearly 240 washing plants. Each plants are using more than 5000 litres of water in a single day to wash carrots. This waste water is directly mixed with water bodies like river. It may cause water pollution, soil erosion, growth of micro-organisms like bacteriae. So it needs to be recycled and reused for the same or various purpose. As the advanced technologies for the recycling or treatment process are economical, an alternate change is needed. The raw sample of carrot cleaning water is collected from Ketti Palada of Nilgiri District. This water is first coagulated with some natural coagulants such as Lime Powder, Aluminium Sulphate, Ferric chloride, Industrial Grade Alum, Powdered Stone Alum (Potash Alum) and the turbidity content is tested. As the turbidity decrement is better when coagulate with the powdered stone alum (potash alum), it is chosen to use in the natural filter media set up. This natural filter media set up contains a PVC pipe having 135mm diameter and 700mm height, cotton layers, aggregate (10mm and 20mm in size) layers, river sand, filter paper and potash alum. The basic tests for both raw and treated water have done and the results are compared. These tests include pH, Turbidity, Calcium hardness, Total hardness, Total dissolved solids (TDS), Total Suspended Solids (TSS), Sulphate, Nitrate, Phosphate, Chloride and coagulation tests. Another overhead tank contains normal tap water for backwash purpose. This treatment process is effective and low cost.
Keywords- vegetable waste water, filter media, alum

INTRODUCTION

In July 2019, The Nilgris District Administration ordered people to install the treatment plant to treat the waste water obtained by washing the carrots and other vegetables like beet root, raddish, etc., before releasing it in the river or other water bodies. More than 6000 hactares of land in Nilgris are used for the agricultural purpose in which half of the quantity is used for growing carrots. The formers are using chemical fertilizers and pesticides to increase the yield and to get rid of the pests. When the carrots and other vegetables are washed in the water, these chemicals are mixed with water and pollute it.

The threat of mixing this waste water in water bodies is more. So, the method of disposing this water should be more protective one. Recycling of this waste water is the best way to this problem.

Characteristics of carrot cleaning water

The carrot cleaning water contains some bacteria, silt contents and more dissolved solids. The initial tests were done for this raw sample of carrot cleaning water and the results are tabulated below [Table 1].

Initial Test

Table 1 Initial test results of raw sample

s.no	Tests	Values	UNIT
1	pH	7.4	-
2	Turbidity	99	NTU
3	Total dissolved solids	1000	mg/l
4	Total suspended solids	1000	mg/l
5	Sulphate	78.63	mg/l
6	Phosphate	5.004	mg/l
7	Chloride	150	mg/l
8	Nitrate	57.975	mg/l
9	Total Hardness	450	mg/l
10	Calcium Hardness	250	mg/l
11	Calcium	100.2	mg/l

Materials and Methodology

The materials which are used in this experiment are, cotton, river sand, aggregate and PVC pipe of 135mm diameter and 700mm height, Lime Powder, Aluminium Sulphate, Ferric chloride, Industrial Grade Alum, Powdered Stone Alum (Potash Alum).

The raw sample of carrot cleaning water is mixed with powdered stone alum. The amount of alum used is 10 grams per litre (10g/l). After mixing of alum this water is taken in an overhead tank and filtered through the low-cost filter media set up.

Lime Powder

Calcium hydroxide is known as lime. It can be obtained in the form of colourless crystal or white powder. It is used as a flocculant and coagulant in waste water treatment. It forms a fluffy charged solid. It can be settled down and the turbidity of the water can be removed. (Fig.1)

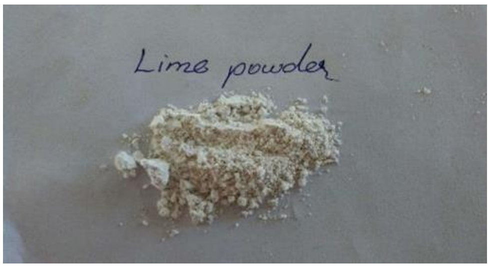


Fig.1 Lime powder

Aluminium Sulphate

Aluminium sulphate is mostly used in the drinking and the waste water treatment process. It coagulates the suspended impurities in the water and allows them to settle down. It is the most common coagulant used in the water treatment
methods. (Fig.2)

Industrial Grade Alum

Ammonium iron (III) sulphate is known as industrial grade alum. It is also known as ferric ammonium sulphate. It is the weakly violet crystals in octahedral shape. It is a good coagulant used in industries. (Fig.3)

Powdered Stone Alum

Potassium alum is manufactured in the industries by adding potassium sulphate with aluminium sulphate solution. Potassium alum is used in the water purification process, in the dyeing process, in fire proof textiles, in the food industries and in leather tanning. It used as deodorant for aftershave treatment, to stop bleeding. (Fig.4)

Natural filter media set up and process

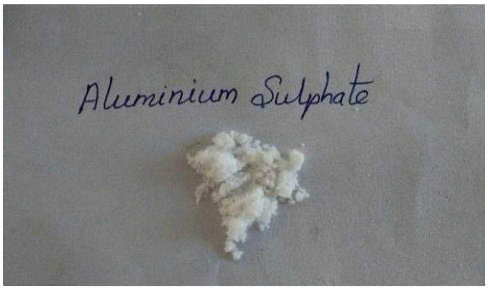


Fig.2 Aluminium sulphate

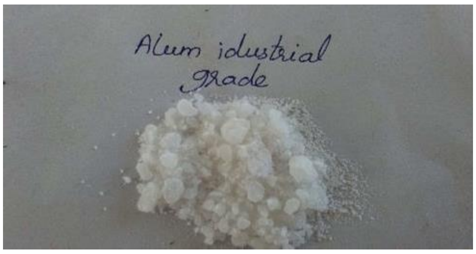


Fig.3 Industrial Grade Alum

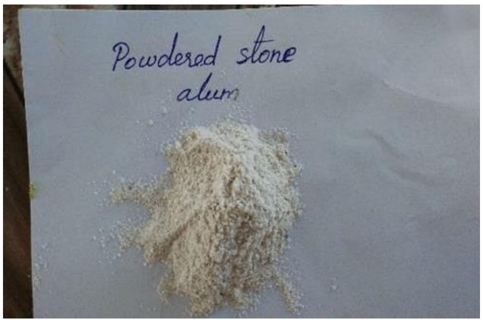


Fig.4 Powdered stone alum

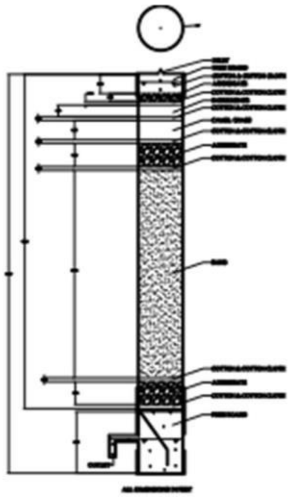


Fig.5 Layout of filter media Fig.6 Filter media set up

A PVC pipe of 135mm diameter and 700mm height is fixed on an even surface. At the bottom, 20mm space is provided for the collection and settlement of water. Above that, a layer of filter paper is placed. Above that, a 100mm layer of coarse aggregate size of 20mm, 10mm layer of cotton, 400mm thick layer of river sand, again a 10mm cotton layer and 100mm thick layer of mixer of 10mm and 20mm aggregates are placed from bottom to top. Above that a 10mm cotton layer is provided. Above all 70mm freeboard is provided to avoid the overflow of water from the filter set up. This filter media is connected with two overhead tanks and required inlet and outlet pipes. One tank is carrying the waste water to be treated in which the coagulant is added in the amount of 10g/l to what the inlet pipe is connected. The outlet pipe is connected with collection tank. The second overhead tank is used for the back-wash purpose. This experiment set up is shown in Fig.5 and Fig.6.

The back wash in this set up is provided as per the principle of hydrostatic equilibrium. The water for backwash is allowed through the filter from bottom to top without using any electrical or mechanical energy. As the level of water in the tube connecting backwash tank and filter set up is increased, the water level inside the filter media set up is automatically raised according to the principle of hydrostatic equilibrium. After the backwash, the treatment process can be repeated.

3.1 Coagulation test procedure

Jar test apparatus is used for the coagulation test. The coagulants are added in the dosages of 0.5gm,1gm,1.5gm,2gm,2.5gm and 3gm in the different six beakers. The beaker contains the same amount of sample water(300ml). This apparatus is having six steel paddles which ensures the good mixing of coagulant with sample water. Initially, the speed of the paddles is 100rpm. In this speed mixing is allowed for 2 minutes. Then this speed is reduced to 40 rpm and allowed to agitate for 30 minutes. Then the process is stopped and a 60minutes is given for the settlement of particles without any disturbance. The turbidity and coagulation test apparatus are shown in Fig.7 and Fig.8.

Fig.7 Turbidity meter Fig.8 Jar test apparatus

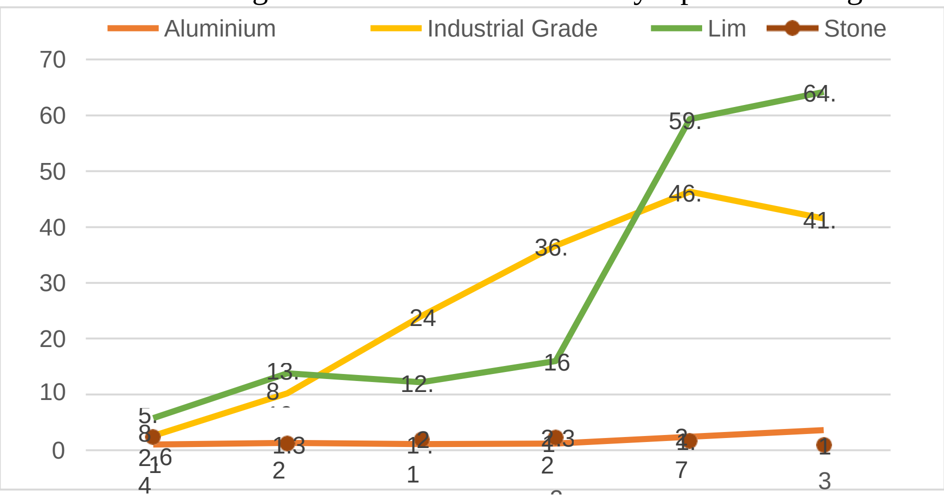
Results and discussion

The results obtained from the various physical and chemical tests are tabulated and given below.

Table 2 Determination of Turbidity

S.No	Coagulants	Turbidity Values					
		0.5 g	1g	1.5g	2g	2.5g	3g
1	Aluminium sulphate	1.1	1.3	1.1	1.2	2.4	3.6
2	Industrial Grade alum	2.6	10.2	24	36.6	46.3	41.5
3	Lime	5.8	13.8	12.2	18	59.3	64.2
4	Stone alum (Potash alum)	2.4	1.2	2	2.3	1.7	1

Fig:3 Determination of Turbidity Optimum dosage



According to the above results, while adding 3g of the stone alum in, it 300ml of sample gives the better results than others. So, it is chosen as the optimum dosage. The dosage is selected as 10g/l to treat the water.

Comparison of results on Carrot cleaning water and treated water

Table 3 Comparison between waste water and treated water

s.no	Tests	Carrot cleaning water	Treated water	Permissible limits	Desirable limits	Units
1	pH	7.36	7.26	6.5 to 8.5	-	-
2	Turbidity	81.48	0.03	5	10	NTU
3	Total dissolved solids	1000	500	500	2000	mg/l
4	Total suspended solids	500	200			mg/l
5	Sulphate	58.7	48.7	200	400	mg/l

6	Phosphate	120	2.428			mg/l
7	Chloride	250	145	250	1000	mg/l
8	Nitrate	3.41	0.0038	45	-	mg/l
9	Total Hardness	300	250	200	600	mg/l
10	Calcium Hardness	150	145			mg/l
11	Calcium	60.11	58.11			mg/l

Desirable limit is the limit above which the water cannot be used for the drinking or any other purposes. But when there is no alternate source, this limit may be tolerated. Permissible limit is the limit beyond which the water cannot be used even there is no other alternate sources.

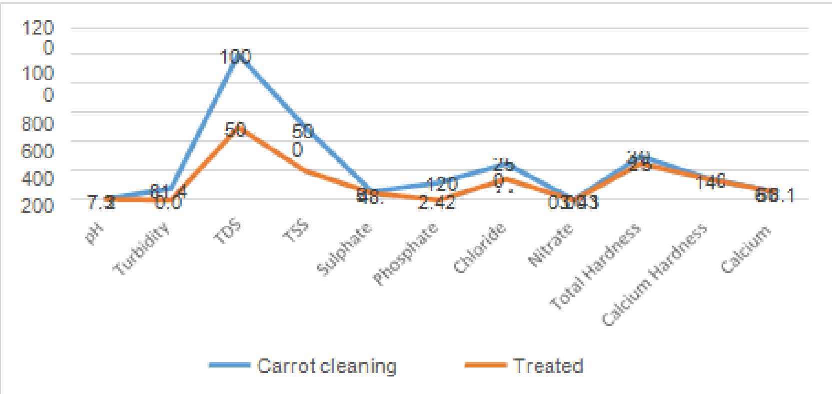


Fig.10 Comparison between waste water and treated water

Fig.11 Waste water and treated water

The Fig.9 shows the raw and treated water. According to the test results obtained, it is clear that the turbidity of sample water is reduced in a huge level after treatment. The other test results are also modified within the permissible limits by treatment. It shows the treatment process gives the effective results.

Conclusion

In this experimental study, it is found that the results were obtained are satisfactory. This method is more effective for decreasing the high turbidity. Very low amount of coagulant is used in the treatment process. So, there won't be any health issues for people. The vegetable cleaning water is treated in a good way. The treated water can be used for drinking or any other purpose. The filter set up gives good performance and also it is a simple and economical process. The village farmers can also use this treatment method easily.

References

Abidin ZZ, Ismail N, Yunus R, Ahamad I, Idris A (2011) A preliminary study on Jatropha curcas as coagulant in waste water treatment. Environ Technol 32(9):971–977

Anandkumar, j., & mandal, b. (2009). Removal of Cr (vi) from aqueous solution using bael fruit (aegle marmelos correa) shell as an adsorbent. 168, 633–640.

Anderson, m. A., & berkowitz, j. (2010). Chemosphere aluminum polymers formed following alum treatment of lake water. Chemosphere, 81(7), 832–836.

Audu SS, Aremu MO (2011) Effect of processing on chemical composition of red kidney bean (Phaseolus vulgaris L.) flour.Pak J Nutr 10(11):1069–1075

Beyene, h. D., hailegebrial, t. D., & dirersa, w. B. (2016). Investigation of coagulation activity of cactus powder in water treatment. 2016.

Binayke, m. S. R. A., & jadhav, p. M. V. (2013). Application of natural coagulants in water purification. 1, 118–123.

Bodrezov S.V., Gamov V.E., and Morozova K.M., Wastewater Sludge Treatment, Water Supply and Sanitary Technology, No.3, pp. 12-14, 1993r.

Chakravarty, s., mohanty, a., sudha, t. N., upadhyay, a. K., konar, j., sircar, j. K., madhukar, a., & gupta, k. K. (2010). Removal of pb (ii) ions from aqueous solution by adsorption using bael leaves (aegle marmelos). 173, 502–509.

Chandrasekar, D., Sathanandham, T., Pravin Kumar, R., Punithavalli, R., Gokila, G., & Kamali,

G. (2020). Study of Ground Water (Bore Well) by Using Clearing Nut as Natural Filter Media. 3(1), 1–5.

Choy, S. Y., Prasad, K. M. N., Wu, T. Y., & Ramanan, R. N. “A review on common vegetables and legumes as promising plant-based natural coagulants in water clarification”, International journal of environmental science and technology, 2015, vol.12(1), pp.367390.

Feofanov U.A, Smernova L.F., New Forms of Flocculants, Water Supply and Sanitary Technology, No.7, pp,5-6, 1995.

Ferraro, a., methods, p., & application, n. (2017). Treatment of waste water by coagulation and flocculation using biomaterials treatment of waste water by coagulation and flocculation using biomaterials. Https://doi.org/10.1088/1757-899x/263/3/032006

Hamid, N. S. A. A., Malek, N. A. C., Mokhtar, H., Mazlan, W. S., & Tajuddin, R. M., “Removal of oil and grease from wastewater using natural adsorbents” Journal Teknologi,2016,pp.5-8.

Hand Book of Public water supplies, American Water Werks Association, Inc., 3rd eds. McGraw Hill Book, 1971, pp. (66-111)

J, a. C., & george, d. (2018). Use of papaya seed as a natural coagulant for water purification. 6(3), 41–46.

L. Mihaly-Cozmuta, A. Mihaly-Cozmuta, A. Peter, C. Nicula, H. Tutu, D. Silipas, and E. Indrea, “Adsorption of heavy metal cations by Na-clinoptilolite: Equilibrium and selectivity studies”, J. Env. Manag., vol. 137, pp. 69-80, May 2014.

Leila Gorgani. Maedeh Mohammadi, Ghasem D. Najafpour, Maryam Nikzad., Piprine- The bioactive component of Black pepper: From isolation to medicinal formulations.

Li, j., liu, l., liu, j., ma, t., yan, a., & ni, y. (2015). Effect of adding alum sludge from water treatment plant on sewage sludge dewatering. Elsevier b.v.

M. Delkash, B. E. Bakhshayesh, and H. Kazemian, “Using zeolitic adsorbents to cleanup special wastewater streams: A review", Micropor. Mesopor. Mat., vol. 214, pp. 224-241, September 2015.

Mark Aaron Gerrard., The ability of vetiver grass as to act as a primary purifier of waste water; an answer to low cost sanitation and fresh water pollution, 2008.

Mizuno, t., & kani, k. (2001). Research note use of some natural and waste materials for waste water treatment. 35(15), 3738–3742.

Muhammad, i. M., abdulsalam, s., abdulkarim, a., & bello, a. A. (2015). Water melon seed as a potential coagulant for water treatment. 15(1).

Raghuwanshi, P. K., Mandloi, M., Sharma, A. J., Malviya, H. S., & Chaudhari, S., "Improving filtrate quality using agro based materials as coagulant aid" Water Quality Research Journal, 2002, vol.37, pp.745-756.

S, r. M., & s, s. C. (2018). Science direct. Waste water treatment using economically viable natural adsorbent materials. Materials today: proceedings, 5(9), 17699–17703. Https://doi.org/10.1016/j.matpr.2018.06.091

S. B. Wang, and H. W. Wu, "Environmental-benign utilization of fly ash as low-cost adsorbents", J. Hazard. Mat., vol. 136. pp. 482-501, August 2006.

S. J. T. Pollard, G. D. Fowler, C. J. Sollars, and R. Perry, "Low-cost adsorbents for waste and waste-water treatment – a review", Sci. Tot. Environ, vol. 116, pp. 31-52, May 1992.

Saleem, m., & bachmann, r. T. (2018). A contemporary review on plant-based coagulants for applications in water treatment. Journal of industrial and engineering chemistry. Https://doi.org/10.1016/j.jiec.2018.12.029

Saravanan, j., priyadharshini, d., soundammal, a., sudha, g., & suriyakala, k. (2017). Wastewater treatment using natural coagulants. 4(3), 37–39.

Vaughn, J. C., Turre, G.J. and Grimes, B.L.: Chemical and Chemical Handling. In: Water Quality and Treatment, a Handbook of Public Water Supplies, Prepared by the American Water Works Association, Inc., Third Edition, McGraw-Hill Book Company. 1971.

Venkata maruthi prasad, s., ramamohan, h., & srinivasa rao, b. (2017). Assessment of coagulation potential of three different natural coagulants in water treatment. International journal of reaseach and scientific innovation(ursi), iv, 3.

Vuppaladadiyam, a. K., sowmya, v., & dasgupta, p. (2013). Comparative study on coagulation process for vellore municipal drinking water using various coagulants abstract:

2. Materials and methods: 2. 2 preparation of reagent: reagent. 3(1), 119–126.

Xie, s., ren, w., qiao, c., tong, k., sun, j., zhang, m., liu, x., & zhang, z. (2018). Science direct an electrochemical adsorption method for the reuse of waste water-based. Natural gas industry b, 5(5), 508–512. Https://doi.org/10.1016/j.ngib.2018.03