

USE OF ALOEVERA JUICE FOR WASTE WATER TREATMENT BY COAGULATION AND FLOCCULATION

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Abstract

Safe drinking water is one of the biggest problems in front of all over the world. There are two types of coagulants inorganic coagulants and organic coagulants. Alum is used worldwide in the developing countries to treat the water in the process of coagulation and flocculation. Continuous use of Alum in the treatment of water can cause neurological diseases like Alzheimer's disease. Therefore it has become a need to treat the water by using some natural coagulants. Natural coagulants are the coagulants which extracted from natural plants or animals.

In this paper natural coagulant Aloe vera gel has been used as a coagulant to treat the water. Waste water sample collected from dairy plant is used. pH, dosage, COD and turbidity and the effect of variation of dosage and pH were studied on turbidity and COD. The optimal dosage of each coagulant was determined in the beginning and this dosage was further used to find optimal pH. Turbidity and COD of all samples are studying and the efficiency of all the coagulants are recording.

Keywords: Aloevera, coagulation, coagulant aid, Turbidity, COD

1. INTRODUCTION

Water is a precious and essential natural resource, unevenly distributed on our planet. Freshwater represents only 2.5% of global supplies of water. About 70% of this freshwater quantity are either trapped under ice caps, or disseminated in the form of humidity or steam. Less than 1% of the world's freshwater, about 0.007% of planet's waters, are easily accessible to the various uses for development.

The use of natural resources in the process of water treatment, thus constitutes a potential promising ways to reduce on one hand, the high costs and environmental impacts due to the use of synthetic products used previously, and secondly allow as many people as possible access to drinking water. This will constitute therefore a major economic issue for developing countries. In conventional method of coagulation and flocculation alum, ferric chloride, ferrous sulphate were used as coagulant for effective removal of turbidity. But in one of the research it is found that continuous use of alum has caused several problems affecting human health. It is found that aluminium is one of the causes for Alzheimer's syndrome. So this study is mainly focused on decreasing alum dose with use of *Aloe Vera* gel.

Aloe Vera specifically refers to the *Aloe barbadensis* Miller plant. *Aloe Vera* is the oldest medicinal plant ever known and the most applied medicinal plant Worldwide. This is a perennial tropical plant that can be cultivated in drought prone areas. In India, it is scattered in the wild, along the coast of southern India. It is a stem less or very short-stemmed succulent plant growing to 60–100 cm (24–39 in) tall, spreading by offsets. The leaves are thick and fleshy, green to grey-green, with some varieties showing white flecks on their upper and lower stem surfaces. *Aloe Vera* plant requires very less water for its growth as it contains 98% of water in its leaves. It contains around 75 nutrients and 200 active compounds including minerals, amino acids, enzymes and vitamins.

In this study, in order to expand the range of natural flocculants used in water clarification properties of *Aloe Vera* gel were analyzed. This study also focuses on use of *Aloe Vera* gel as coagulant aid with alum for the treatment of low and high turbid water. Initially 100ml sample was withdrawn from each dilution and analyzed for its physiochemical characteristics like colour, pH, EC, TSS, COD etc. (APHA, 1995). After the retention period (one day), 100ml of biotreated sample was withdrawn from each dilution for analysis of physicochemical parameters and the data were recorded and statistically analysed.

Aluminum sulfate (alum) has been the chemical coagulant used for drinking water treatments due to the low costs, attainability and comfortable handling. However, continuous use of alum has caused several problems affecting human health. Studies have shown that aluminum is one of the causes for Alzheimer's syndrome. In addition,

aluminum sulphate generates inconveniences because of the large amounts of sediments, which may be regarded as highly hazardous waste. Another adverse characteristic of aluminum sulfate is the permanence in the drinking water life-cycle that are present in natural water resources, animals, people and plants. Owing to various problems generated by the use of alum, new alternatives for drinking water treatments should be studied.

2. MATERIALS AND METHODS

2.1 Materials

2.1.1 Aloevera juice

Aloe vera is a stem less or very short-stemmed plant growing to 60–100 cm (24–39 in) tall, spreading by offsets. The leaves are thick and fleshy, green to grey-green, with some varieties showing white flecks on their upper and lower stem surfaces. The margin of the leaf is serrated and has small white teeth. The flowers are produced in summer on a spike up to 90 cm (35 in) tall, each flower being pendulous, with a yellow tubular corolla 2–3 cm (0.8–1.2 in) long. Like other *Aloe* species, *Aloe vera* forms arbuscular mycorrhiza, a symbiosis that allows the plant better access to mineral nutrients in soil.

Aloe Vera was diluted to various percentage (1%,4%,5%,7% up to 20%) and then suitable *Aloe Vera* dose was given.1% *Aloe Vera* solution was prepared by diluting 1ml of *Aloe Vera* gel in 100ml of distilled water. The coagulation and flocculation processes were performed using the jar test apparatus. Initially jar tests were carried out by using alum as a coagulant for high and low turbid water. Then by using *Aloe Vera* gel as coagulant aid with alum was used for the turbidity removal. Along with turbidity pH, electrical conductivity,

hardness these water parameters were also analyzed.

2.1.2 Alum solution

Aluminium sulfate is a chemical compound with the formula $Al_2(SO_4)_3$. It is soluble in water and is mainly used as a coagulating agent (promoting particle collision by neutralizing charge) in the purification of drinking water and waste water treatment plants, and also in paper manufacturing.

The anhydrous form occurs naturally as a rare mineral millosevichite, found eg in volcanic environments and on burning coal-mining waste dumps. Aluminium sulfate is rarely, if ever, encountered as the anhydrous salt. It forms a number of different hydrates, of which the hexadecahydrate $Al_2(SO_4)_3 \cdot 16H_2O$ and octadecahydrate $Al_2(SO_4)_3 \cdot 18H_2O$ are the most common. The heptadecahydrate, whose formula can be written as $[Al(H_2O)_6]_2(SO_4)_3 \cdot 5H_2O$, occurs naturally as the mineral alunogen.

The alum used for experiment was aluminium sulphate $Al_2(SO_4)_3 \cdot 18H_2O$. 5% strength alum in liquid form was used. It was prepared by dissolving 50gm of alum in 500 ml of dairy waste water.

2.2 Methods

2.2.1 Experimental Setup

. Preparation of Aloe Vera gel

The leaves were washed under the tap water to remove the dirt. Thick green cover or epidermis was carefully separated from the gel part. Then the gel part was blended in mixer to form liquid and preserved in glass bottles in refrigerator. 1% dilution of aloe vera was made by using 1ml aloe vera gel in 100 ml distilled water similarly

different percentage of aloe vera solutions were made.



2.2.2 Preparation of Aloe vera gel aqueous solution:

50 mL of gel were introduced into 500 mL of distilled water and stirred using a magnetic stirrer, then strained through a sieve of 25 mm mesh. The filtrate collected was stored in refrigerator until the use which not exceeding one week.

2.2.3 Jar test Experiments (test of coagulation-flocculation):

The coagulation-flocculation was performed according to the protocol of "Jar Test". Increasing doses of *Aloe vera* were introduced in 500 mL of dairy waste water. After settling time, 100 mL of the supernatant were collected in the average of 2 and 3cm from the surface using a pipette and subjected to the same physico-chemical analyzes of the dairy raw water. The removal efficiency of the analyzed parameters was determined by the formula below

$$\text{Removal parameter in percentage} = 100 * (C_i - C_f) / C_i$$

Where: C_i represents the concentration of the parameter in the

raw water. Cf represents the concentration of the same parameter in the treated water.

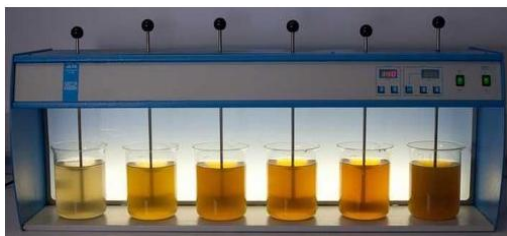


Fig 2.2.3 jar test apparatus

3. RESULTS AND DISCUSSIONS

Table3.1: Effect of alum as a coagulant in turbidity removal

Residual Turbidity(NTU)	Alum dose (mg/l)
5	11.02
10	9.07
20	7.32
30	5.31
40	8.32
50	10.31
60	13.01

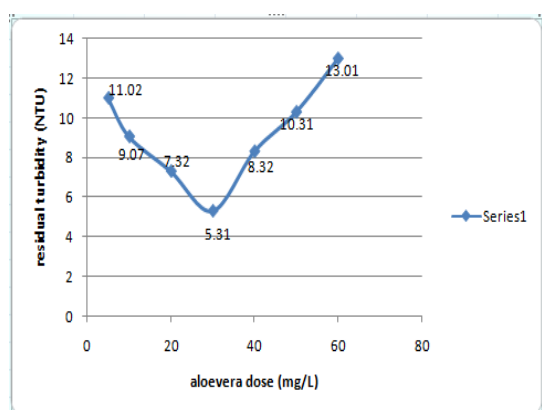


Fig 3.1 effect of alum on turbidity

Experiments were carried out using alum as coagulant for dairy waste water. Alum dose was varied in the range of 5- 60mg/l. In results it was found that for effective turbidity

removal alum dose required was high. The maximum removal efficiency was found 91% for dairy waste water for alum dose of 30 mg/l . Fig 4 shows the effect of alum dose on turbid water.

Table 3.2 Effect of different percentage of aloe vera gel on turbidity

Residual turbidity (NTU)	Aloe vera dose (%)
0	12.08
5	8.15
10	9.01
20	9.04
30	9.08
40	10.08
50	11.09

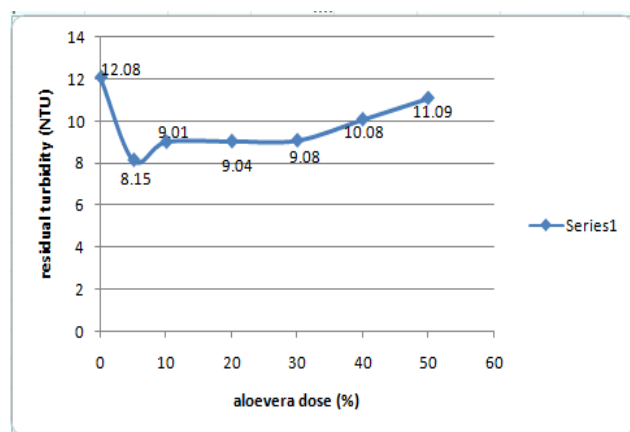


Fig 3.2 effect of aloe vera dose on turbidity

Jar tests were carried out for different percentage of dilution of Aloe Vera gel such as 1%, 4%, 5%, 7%,10%,15% . For dairy turbid water the alum dose was kept constant of 10mg/l, 40ml/l of Aloe Vera dose was given from each of diluted solution made. For dairy waste water 5% dilution of Aloe Vera gel was found to be effective. For dairy waste water removal efficiency found

was between 75-80% . Following graph shows the variation of different percentage of Aloe Vera gel on dairy waste turbid water.

Table 3.3 Effect of Aloe Vera gel as coagulant aid with alum for turbidity removal

Residual Turbidity (NTU)	Aloe vera dose (ml/l)
0	12.01
5	10.02
10	9.02
20	8.98
30	7.09
40	8.32
50	10.02

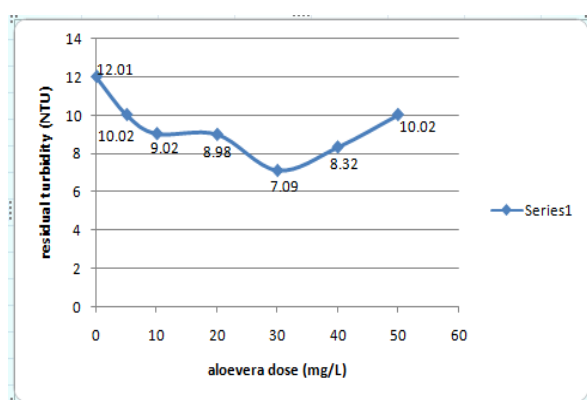


Fig 3.2 effect of aloevera dose with 10mg/l constant alum dose

From the above results it was shown that 7% dilution of Aloe Vera gel was found to be effective. Jar tests were performed for the 10 mg/l of constant alum dose and various doses of Aloe

Vera gel for turbid water. In results it was found that for 10mg/l of alum dose and 30ml/l of Aloe Vera dose maximum turbidity removal efficiency was achieved. For dairy waste turbid water it varied between range of 76-81% . In fig the effect of Aloe Vera gel on turbid water was given below.

4. CONCLUSIONS

At the end of our study, Aloe vera can be used as natural flocculant for water treatment. It was also found that the use of this plant even in low doses can rid the highly charged water of their suspended materials therefore their turbidity. For optimal doses, the percentages of reduction are high, 75% for turbidity and 91% but this reduction is low for the apparent color. The use of Aloevera, whose pharmacological properties have already been demonstrated, would be a possible alternative to chemical flocculants for the same treatment of drinking water in rural areas, only that it could increase the organic matter in the water account given its high levels in this element (approximately 81.05% organic matter).

The results showed that the amount of alum required was high for effective removal of turbidity. Aloe Vera can be used as natural flocculant for water treatment. Use of Aloe Vera gel as coagulant aid with alum can effectively reduce the amount of alum required. Owing to various problems associated to alum, use of Aloe Vera gel with alum as a coagulant aid can be new alternative for drinking water treatment. For dairy waste water removal efficiency was found to be 76-80%. For 7% dilution of Aloe Vera gel optimum 40ml/l of Aloe Vera dose was found more effective. Also it was

found that Aloe Vera have less effect on other water quality parameters like pH, EC, hardness, COD. As a conclusion, Aloe Vera gel is proven to be effective coagulant aid which can be used in rural areas where Aloe Vera plant availability is more.

REFERENCES

- 1 E.N.Ali, S.A.Muyibi, H.M. Salleh, M. Z. Alam and M.R.M. Salleh. "Production of Natural Coagulant from Moringa Oleifera Seed for Application in Treatment of Low Turbidity Water. Journal Water Resource and Protection, 2, 259-266, 2010
- 2 S.Rai, R.Sharma, S. S.Arora, M. Sharma and A.K. Chopra. "Concentration of the heavy metals in Aloe VeraL. (Aloe barbadensis Miller) Leaves collected from different geographical locations of India." Annals of Biological Research,2011.
- 3 M.I.Kopytko, E.P. Villamizar, and Y.R.Picon. "Application of Natural Product (Aloe Vera) in Coagulation-Flocculation Procedures, for Water Treatability Study." International Journal of Engineering Science and Innovative Technology (IJESIT), 2014.
- 4 V. Rondeau, D.Commenges, H.Gadda, J. Dartigues. "Relation between Aluminium Concentrations in drinking water and Alzheimer's Disease, An 8
- 5 V. Rondeau,D.Commenges,H.Gadda, J. Dartigues, "Relation between Aluminum Concentrations in drinking water and Alzheimer's Disease, An 8 year follow-up Study", Oxford Journals Vol. 152,pp. 59-66,1999.
- 6 A.Panizza,A. Aldama, A.Chacalo,M. Vaca, J. Grabinsky, C. Márquez, C. Durán, "Evaluación del compost elaborado a partir de lodos con alto contenido de sulfato de aluminio",Revista Latinoamericana de Recursos Naturales, 4 (3), p. 342-348, 2008.
- 7 D.B. George, S.G. Beck, V.D. Adams, E.L. Morgan, R.O. Roberts, C.Holloway,R.C. Lott, L.K. Holt, "Alum sludge in the Aquatic Environment",AWWA Research Foundation and the American Water works Association. 1991.
- 8 S. Hall, W. Hall, N.Lenwood, "Toxicity of alum sludge to Ceriodaphniadubia and Pimephalespromelas," Bulletin of Environmental Contamination& Toxicology; Vol. 42 Issue 5 p.791,1989.
- 9 J.D. Birchall, C.Exley, J.S.Chappell, M.J.Phillips, "Acute toxicity of aluminum to fish eliminated in silicon-rich acid water", Nature, 338 (9), pp. 146-148, 1989. [6] S.Syafalni,I. Abustan, Zakaria, Siti Nor Farhana, Z. M. Hafiz, R. R.Abd,"Raw water treatment using bentonite-chitosan as a coagulant", Water Science & Technology: Water Supply, Vol. 12 Issue 4, p.480, 2012.
- 10 L.G. Romero, "Aprovechamiento de algunos materiales en el desarrollo de coagulantes y floculantes para el tratamiento de aguas en Costa Rica". Tecnología en Marcha Vol. 19-4. [8] G. Folkard, J. Sutherland &Reya Al-Khalili, "Natural Coagulants - A sustainable Approach", 21st WEDC Conference, UK.1995.
- 11 N. Almendarez,"Comprobación de la efectividad del coagulante (Cochifloc) en aguas del lago de

- Managua Piedras Azules”, Revista Iberoamericana de Polímeros. Volumen 5(1), 2004.
- 12 T.Okuda, A. Baes, W.Nishijima, M. Okada, “Isolation and Characterization of Coagulant Extracted from Moringa Oleifera Seed by Salt Solution”, Water Research 35 (2) p5, 2001