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USE OF ALOE-VERA GEL AS NATURAL COAGULANT IN TREATMENT OF DRINKING WATER

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Abstract: - Now a days India is developing country in the world. Water is the most important element of among the natural resources. In many developing countries, access to clean and safe water is a big critical issue. More than millions die people because of diarrhoea which is caused by polluted water. Developing countries pay cost high to import chemical for water treatment. In our country, we need to use our surface water sources therefore save our water bodies which are contaminated due to disposal of uncontrolled domestic and industrial waste water, so water treatment is a must duty to us. Coagulation is a conventional step of water purification and bio coagulants are new horizon to go green, turbidity, Ph, hardness import a great problem in water treatment. The pH of human blood is strictly maintain the lungs and kidney spare nothing to keep the pH tightly controlled since the consequences of the blood pH changes would be life threatening.

Moringa oleifera and aloe vera where used as local locally available natural coagulant in this study to reduce turbidity, pH, hardness. Many chemicals are also associated with environmental problem and human health. So, there raised a voice to develop cost effective, easier and environmental friendly process of water clarification so, that's why natural coagulation are used such as a aloe-vera, moringa oleifera. Desirable to substitute this chemical coagulants with natural coagulant cost effective to outside the aforesaid disadvantages. So water treatment is a most used to us, aim of using all of these coagulant to make the mix proportion to treatment of the water.

Keywords: - *water treatment procedures, Aloe Vera, coagulation-flocculation.*

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I INTRODUCTION

Water is undoubtedly the most vital element among the natural resources. In many developing countries, access to clean and safe water is a crucial issue. More than 6 million people die because of diarrhea which is caused by drinking polluted water. Developing countries pay a high cost to import chemicals for water treatment. This problem is critical in Bangladesh about more than 80% of people in Bangladesh lack clean, safe water. In the case of Dhaka, the capital of city of over 10 million City dwellers, due to rapid urbanization and migration from rural areas there is a tremendous load on water consumption in city. The consumption water condition of surface water of Dhaka region has become highly polluted due to indiscriminate discharge of untreated waste from tannery, textile and other industries, municipal waste into water bodies, poor drainage system, population increasing and urban encouragement and river bank erosion. Water from all sources must have some form of purification before. Various methods are used to make water safe and attractive to the consumer. The method employed depends on the character of raw water. One of the problems with treatment of surface water is the large seasonal variation in turbidity Natural coagulants have bright future and are concerned by many researchers because of their abundant source, low price, environment friendly, multifunction and biodegradable nature in water purification.

Water is an eventful element for a human life and environment and water cannot be easily available in the right condition, right place. Today's quality of water becomes major problem and good quality of water has expensive in rural and urban areas. Artificial coagulants are mostly used in water

treatment but when it is used as a coagulant in water treatment it can caused several bad effect on human health such as intestinal constipation, loss of memory, abdominal colic's, convulsions, loss of energy and learning difficulties. So for the treatment of drinking water there are various system used.

Use of natural coagulants can be very much beneficial as compared to chemical or synthetic coagulation is the most commonly used method for purifying water. Coagulants can be used in drinking water treatment to reduce suspended solids and other Pollutants. Many synthetic coagulants like Aluminum sulphate (alum) and ferric chloride are widely used in conventional water treatment process for turbidity will removal. On the other hand effect in the functioning of living cell but presents some toxic effects in elevated concentrations. Natural coagulants work better with high turbid and the use of natural coagulants is suitable, easier and environmental friendly option for drinking water treatment.

Aelo-vera and Tamarind seed and Cicer Areitinum is grow in India and other countries and it can be great benefit for water treatment and it improve coagulant properties. Tamarind seed, Aloe-vera gel and Cicer Areitinum are organic natural polymer. The present study focus on comparison the coagulant activity and acurrency of dosage nearly IA requirement of alternative to treatment of water with environmental friendly. The objectives of the studies is to investigate assessment of two different material such as Aloe-vera gel, Tamarind seed and Cicer Areitinum. Coagulation is defined as an irreversible combination or aggreation of semi solid particles such as fats or proteins to form clot or mass. In another word, it is a process of gathering the suspended matter in untreated water for the purpose of settling and prepared the water for filtration process. Coagulation process is employed for removal of waste materials in suspended or colloidal form.

Coagulant is used to speed up sedimentation process The effect of coagulation depends upon several factors like the doses of coagulant, pH and initial turbidity. The coagulants used may be inorganic coagulants such as Aluminium sulphate, aluminium chloride and ferric chloride or synthetic organic polymers. There are the none the less disadvantages linked with usage of these chemical coagulant such as comparatively high cost, harmful effects on human health as well as the fact that they appreciably affect pH of treated waters. Hence it is desirable to substitute these chemical coagulants with cost effective natural coagulants to offset the oforesaid disadvantages. Examples of natural coagulants are starch,starch derivatives, proteins alge, chitosan, tannins, stychnos potatorum and moringa olefeira and tamarindies se indica seeds, Aloe-vera. Natural coagulants are preferred because of its abundance source, low price, multifunction and biodegradation while the effectiveness of these chemicals as coagulant is well recognized.

II METHODOLOGY

Initially, a water sample taken from Indrayani stream was analyzed to obtain the turbidity, alkalinity and pH values, which are fundamental for drinking water treatments. Then, flocculation-coagulation tests were carried out with alum as the coagulant. Assays allowed finding the optimal dose when varying the alum dose every 10mg/l from 20 mg/l to 90 mg/l. obtaining the optimal dose allowed the optimal concentration by applying the following solutions: 0.5%, 1.0%, 3.0%, 5.0%, 7.0% and 10.0%. Finally, both velocity gradients for rapid and slow mix were determined based on the criteria established by the Pan American Center for Sanitary Engineering and Environmental Sciences (CEPIS) shown in table 11-6 section 1.

The Aloe Vera blend was tested as a primary coagulant and coagulation-flocculation aid. For each water sample and assay, a parallel test with aluminum sulfate was carried out as the reference coagulant. The optimal dose of the Aloe Vera was determined by employing jar tests. The appropriate optimal dose was determined by testing different concentrations of aloe solution (0.5%, 1.0%, 3.0%, 5.0%, 7.0% and 10%), In the coagulation aid tests, the Aloe Vera blend was dosed with the alum simultaneously in the rapid mixing, while in the flocculation aid tests, alum was first applied in the rapid mixing. Aloe Vera was added in the slow mixing solution to find the optimal dose of Aloe Vera blend in both cases. Subsequently, a reduction the optimal alum dose was calculated 20%, 40%, 50% and60%, with simultaneous addition of the aloe blend in the process. During this stage, the optimal time and sedimentation rate offloc particles were analyzed. To determine the optimal time of sedimentation, turbidity was measured in the sample extracted at a distance of 6 comforts the upper water level. The sedimentation rate values were calculated with the formula: Vs = (h/T)

Where:

h = specific depth sampling in (cm).

T = sampling time in (s).

Finally, the sedimentation curve was plotted with sedimentation rates and remaining turbidity values for each case. Every jar test as say was performed with control raw water (without coagulant addition) in an EQ flocculator equipment ref. F6-300.

Finally, parameters of design and operation for drinking water treatment plants were calculated taking into account the efficiency of turbidity removal and the savings in the aluminum sulphate dose as a result of the addition of the natural coagulant. The procedure for coagulation-flocculation treatments was performed according to the CEPIS Manual and the Technical Regulations for the Drinking Water Sector and Basic Sanitation (RAS 2000), section 2, and title C, purification systems.

The amount of coagulant required for 1 month in a drinking water treatment plant was determined in the following way:

Incoming flow rate (l/month) x volume (l) of coagulant aid per liter of water = Total liters of coagulant aid solution required for 1 month of operation.

III RESULT AND DISCUSSIONS

3.1 Tests on a sample of raw water with medium turbidity

Initial tests on the water sample are reported in Table1.

Due to the very low values of turbidity in raw water, the results shown in table 1 for this raw water sample were considered medium turbidity.

3.1.1 Aluminum sulfate in a medium turbidity water sample

Results on the coagulation-flocculation tests using the aluminum sulfate as reference coagulant are summarized in Table 2. The table includes the optimal dose, optimum concentration and velocity gradients used in all the testing procedures applied for this water sample.

3.1.2 Aloe blend in a medium turbidity water sample

The Aloe blend was tested as primary coagulant and flocculation-coagulation aid as well as in the gradual reduction of the optimal dose of the reference coagulant (alum).

3.1.2.1 Estimate of aloe blend as primary coagulant

Initially, the optimal dose and concentration of aloe solution as the primary coagulant were tested. The final results of these experiments are summarized in Table 3.

Although floc formation by interaction between colloids and cations existing in the Aloe Vera solution was observed during the jar tests, high turbidity and residual color was found at the end of the process. Thus, the aloe blend was not helpful as primary coagulant.

3.1.2.2 Estimate optimal dose of aloe blend as coagulation aid.

Simultaneous amounts of aloe blend and optimal alum dose during the jar trials in the rapid mix, showed the optimal dose of aloe blend as coagulation aid.

The optimal dose for the aloe blend as coagulation aid was 5 mg / l, which left a residual turbidity of 1.87 NTU and color of 50 UPC in the water sample with mid- turbidity. The results indicate good performance of this substance as a coagulation aid in this water sample. It is probable that the metal ions present in the composition of Aloe Vera highly supported the rapid mixing phase for colloid destabilization.

3.1.2.3 Estimation of the optimal dose for aloe blend as coagulation aid simultaneous to reduction of the optimal dose of alum.

Jar tests were performed in the same water sample (45.5 NTU) to identify the optimal dose for aloe blend as coagulation aid with simultaneous reductions at 20%, 40%, 50% and 60% the optimal dose for alum respectively. (Table 4)

20% reduction of the optimal dose of alum as primary coagulant with 5mg/l of aloe optimal dose pointed better results corresponding to 96.5% turbidity removal. In general terms, aloe blend performed excellent results as coagulant aid, where turbidity removal was more than 90% even when the alum optimal dose was reduced in 60%. (Table 4)

3.1.2.4 Estimation of the optimal dose for *Aloe Vera* blend as flocculation aid.

After adding the optimum dose of alum in rapid mix in the jar test, aloe blend was added to start the slow mixing.

The optimal dose of aloe blend as flocculation aid was 12 mg / l, leaving a residual turbidity of 1.69 NTU and color of 50 UPC.

3.1.2.5 Estimate the optimal dose of *Aloe Vera* as flocculation aid simultaneous to reduction of the alum optimal dose.

Jar tests were performed in the same water sample (45.5 NTU) to identify the optimal dose for aloe blend as flocculation aid with a simultaneous reduction of the alum optimal dose at 20%, 40%, 50% and 60% (Table 5).Considering that 40% to 80% of the composition of Aloe Vera is resins, high elimination of color and turbidity can be explained by adsorption of colloids during slow mixing. The reduction on the optimal dose of alum by adding aloe blend was favorable up to 50% leaving turbidity removal more than 90%. The best result was for 20% reduction of the optimal dose of alum and 1.72 NTU of the residual turbidity and thereby, complying with current Colombian standard (2, 0 NTU) for this parameter.

Table 6 summarizes the results for optimal time of sedimentation, which highlights the performance of the Aloe Vera blend as coagulation-flocculation aid by letting low residual turbidity at an optimal time. Similar results were obtained with the primary coagulant of reference (alum).

3.2 Tests on a sample of raw water with high turbidity.

Table 7 reports the initial conditions of the water sample taken, when the turbidity of the water was high.

The sample showed high turbidity and extremely high color. The pH and alkalinity were kept in the previously analyzed range.

3.2.1. Testing for aluminum sulfate in a high turbidity water sample.

The results of the jar tests using the aluminum sulfate mas the reference coagulant are summarized in Table 8. The table includes the optimal dose, optimal concentration and velocity

gradients used in the entire testing procedures applied for this water sample.

3.2.2. **Tests on the aloe blend in high water turbidity.**

All tests performed for this sample, were developed in the same way and conditions as in the previous water sample (of medium turbidity).The Aloe blend was tested as primary coagulant and flocculation-coagulation aid as well as in the gradual reduction of the optimal dose of the reference coagulant (alum).

3.2.2.1 Estimate of the aloe blend as primary coagulant. Originally, the optimal dose and optimal concentration of aloe blend were assessed as primary coagulant. The final results of these experiments are summarized in Table 9**.**

The use of Aloe Vera as primary coagulant blend was not efficient, due to the low percentage of turbidity and color removal.

3.2.2.2. Evaluation of the aloe blend as coagulation aid.

The optimal dose of Aloe Vera blend applied as coagulation assistant was 10 mg/l, which left a residual turbidity of 1.89 NTU. This represents 98.1% of removal and gives compliance to the existing Colombian standard in turbidity data. Although the residual color was high, (50 UPC), removal exceeded 90%.These results confirm the good performance of Aloe Vera as coagulation aid.

3.2.2.3 Optimal dose identification for aloe blend as coagulation aid simultaneous reduction of the optimum dose of alum.

The results of the optimal dose of Aloe Vera blend applied as coagulation aid simultaneous reduction of the optimal dose of alum in 20%, 40%, 50% and 60% are in the table 10.

The table 10 shows that high efficiency in removing turbidity by the primary coagulant of reference (alum) can be overcome by using only 40% of the optimal dose and applying the solution of Aloe Vera as aid for coagulation process.

3.2.2.4. Identification of the optimal dose of aloe blend as flocculation aid.

In this jar tests, Aloe Vera was added at the beginning of the slow mix after adding the optimal dose of alum at the beginning of the process. The optimal dose of aloe blend as flocculation aid in high turbidity water was 11 mg / l, leaving a residual turbidity of 1.52 NTU and color corresponding to 40 UPC. In this way, the good performance of this natural substance as aid for flocculation in high turbidity water becomes evident.

3.2.2.5 Identification of the optimal dose of aloe blend as flocculation aid simultaneous reduction of the alum optimal dose.

Subsequent jar tests allowed determining the optimal dose of solution of Aloe Vera as flocculation aid with a simultaneous reduction of the dose of alum in 20%, 40%, 50% and 60%. (See table 11).

The use of solution of Aloe as flocculation aid allows the reduction in the optimal dose of alum up to 20%, complying with the residual turbidity of 1.52 NTU and the current standard in Colombia, which is 2,0 NTU. Additionally, achieving a removal of 98.5% compared to the initial water turbidity.

The same results for sedimentation optimal time, emphasizes the performance of Aloe Vera as flocculation aid for its low residual turbidity and a similar time to the primary coagulant of reference (alum), summarized in table 12.

Table 1. Initial conditions of raw water

PARAMETERS	**VALUES**
Turbidity(NTU)	45.5
Alkalinity(mg./l)	70
pH	7.78

Table 2. Optimal values for aluminum sulfate as a primary coagulant in medium turbidity water.

PARAMETERS		**RESULTS**
Optimal Dose		70 mg/l
Optimal Concentration		5%
	Rapid mix	150 rpm for 35 s.
	Slow mix	30 rpm for 25 min.

Table 3. Optimal dose and concentration for the aloe blend used as primary coagulant.

Parameters	**Results**	**Residual Turbidity (NTU)**
Optimal Dose	140 mg/l	32.8
Optimal concentration	10 %	31.6

Table 4. Aloe Vera blend as coagulation aid with simultaneous reduction in the optimal dose.

Aluminum sulphate dose (mg/l)	Optimal dose of aloe blend (mg/l)	Residual Turbidity (NTU)	Turbidity removal %
70 (primary coagulant)	-----	6.25	86.3
------	140 (primary coagulant)	32.8	27.9
70 (100%optimal dose)	5	1.87	95.9
56 (*20% optimal dose)	5	1.59	96.5
42 (*40% optimal dose)	5	2.7	94.1
35 (*50% optimal dose)	7	3.93	91.4
28 (*60% optimal dose)	6	4.22	90.7

* Reduction in percentages on the alum optimal dose

Table 5. Trials overview with Alum and Aloe Vera as flocculation aids in medium turbidity water samples

Doses of aluminum sulfate (mg/l)	Dose of Aloe Vera blend (mg/l)	Residual turbidity (NTU)	Turbidity removal %
70 (primary coagulant)	-----	3.61	92
------	140 (primary coagulant)	32.8	27.9
70 (100% optimal dose)	12	1.69	96.3
56 (*20% optimal dose)	10	1.72	96.2
42 (*40% optimal dose)	12	3.87	91.5
35 (*50% optimal dose)	12	3.16	93.1
28 (*60% optimal dose)	11	5.57	87.8

* Reduction in percentages on the alum optimal dose

Table 6. Optimal time of sedimentation and the respective residual turbidity

Method	Optimal time [min.]	Final residual turbidity [NTU]
Alum as primary coagulant	25	3.11
Aloe blend as primary coagulant	25	31.5
Aloe blend as coagulant helper	30	1.34
Aloe blend as flocculation helper	30	2.82

Table 7. Initial conditions of raw water

PARAMETERS	VALUES
Residual turbidity (NTU)	101
Alkalinity (mg./l)	65
pH	7.1

Table 8. Optimal parameters of aluminum sulfate as primary Coagulant

PARAMETERS		RESULTS
Optimal dose		40 mg/l
Optimal concentration		5%
	Rapid mix	150 rpm during 35 s.
	Slow mix	30 rpm during 25 min.

Table 9. Optimal parameters using Aloe Vera as primary coagulant blend.

Parameters	Results	Residual Turbidity (NTU)
Optimal dose	130 mg/l	52.1
Optimal concentration	10%	55.5

Table 10. The Aloe Vera as coagulation helper in turbidity water sample

Aluminum Sulfate dose (mg/l)	Aloe Vera dose (mg/l)	Residual turbidity (NTU)	Turbidity r emoval %
40 (primary coagulant)	-----	1.89	98.1
------	130 (primary coagulant)	52.1	48.4
40 (100% optimal dose)	10	1.89	98.1
32 (*20% optimal dose)	13	1.33	98.7
24 (*40% optimal dose)	14	1.55	98.5
20 (*50% optimal dose)	17	21.8	78.4
16 (*60% optimal dose)	8	27.7	72.6

* Reduction in percentages on the alum optimal dose

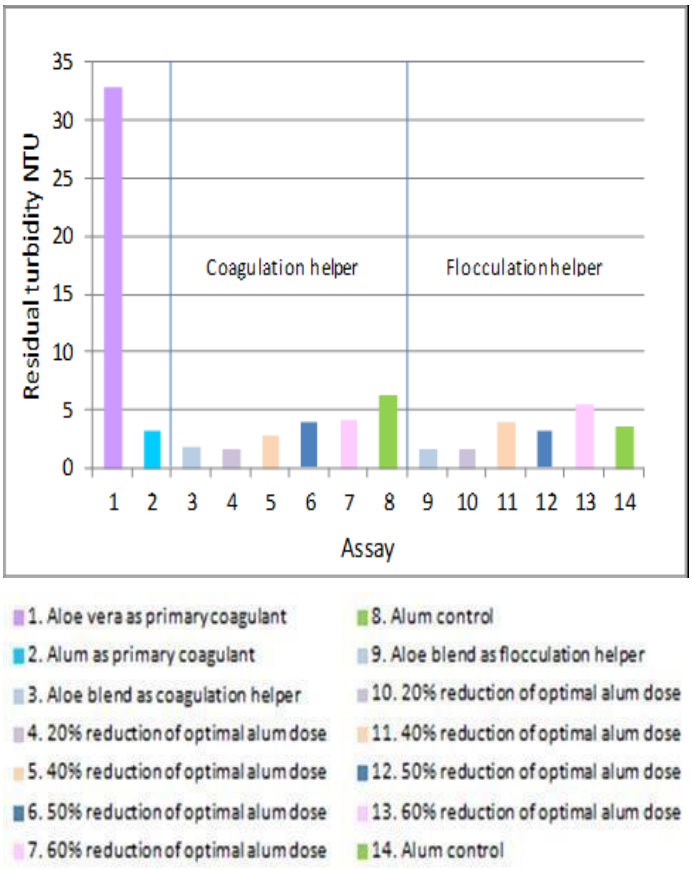
Table 11. Alum and Aloe Vera as flocculation helper in high turbidity water sample.

Doses of aluminum sulfate (mg/l)	Aloe Vera dose (mg/l)	Residual turbidity (NTU)	Turbidity removal %
70 (primary coagulant)	-----	3.61	92
------	140 (primary coagulant)	32.8	27.9
70 (100% optimal dose)	12	1.69	96.3
56 (*20% optimal dose)	10	1.72	96.2
42 (*40% optimal dose)	12	3.87	91.5
35 (*50% optimal dose)	12	3.16	93.1
28 (*60% optimal dose)	11	5.57	87.8

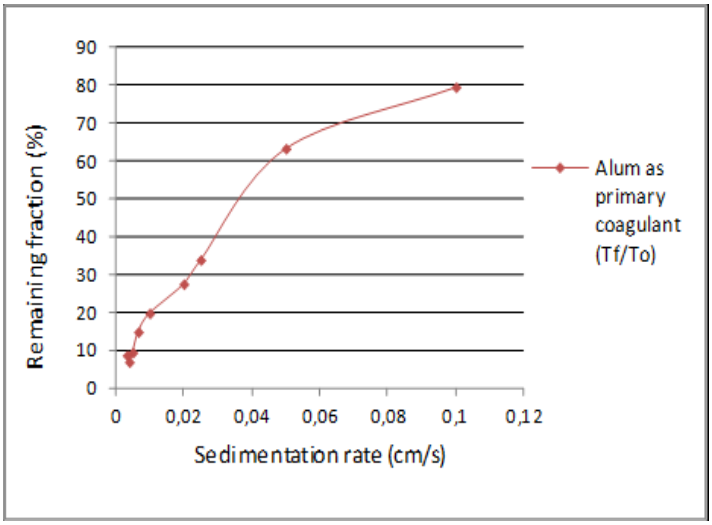
Table 12. Optimal timing of sedimentation and respective residual turbidity

METHOD	Optimal time [min.]	Final residual turbidity [NTU]
Alum as primary coagulant	30	2.28
Aloe Solution as primary coagulant	10	85.1
Aloe solution as coagulant helper	25	6.47
Aloe solution as flocculation helper	30	2.64

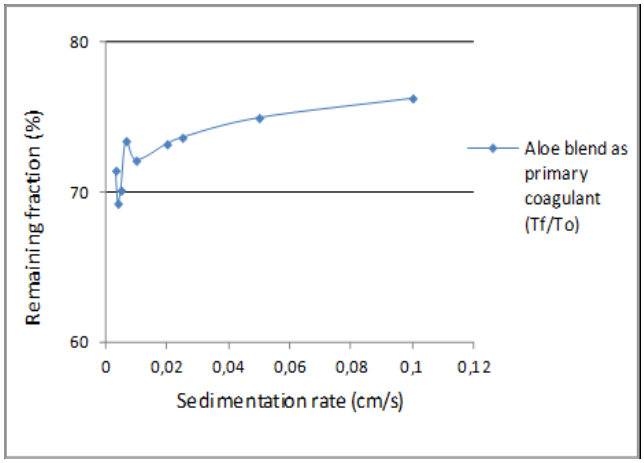
Graph 1. Summary for aloe blend testing in water of medium turbidity



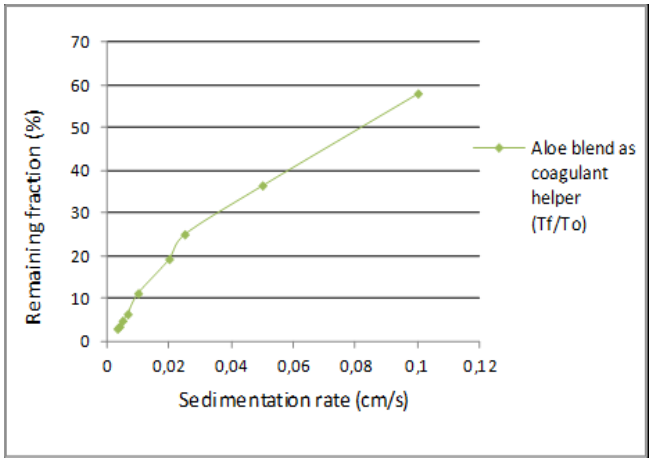
Graph 2. Floc sedimentation formed with alum as primary coagulant



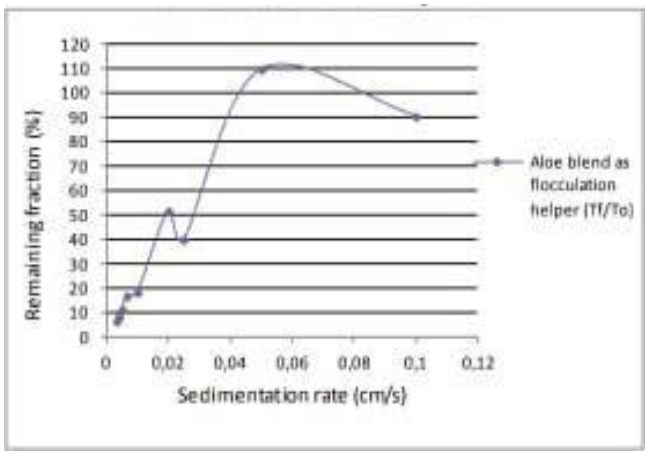
Graph 3. Floc sedimentation formed with aloe blend as primary coagulant



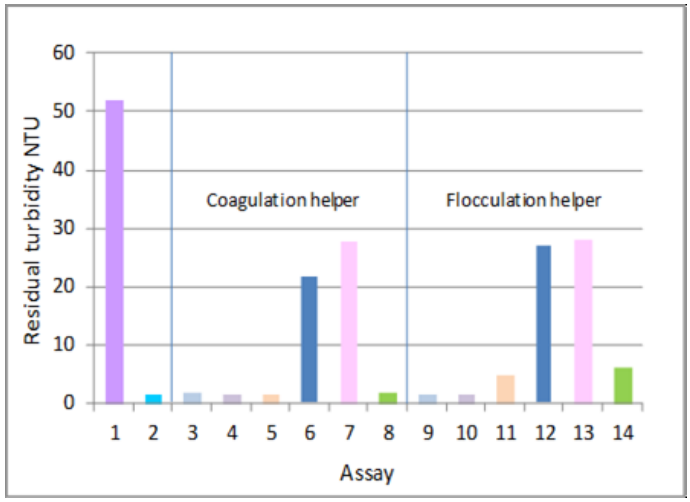
Graph 4. Floc sedimentation formed with aloe bend as

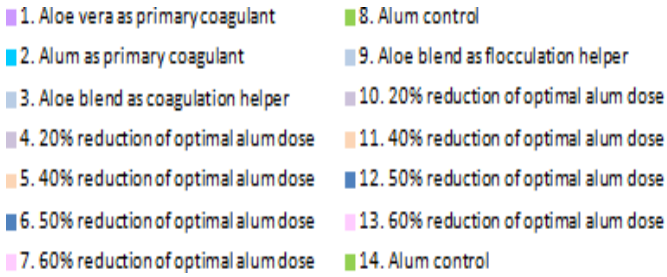


Graph 5. Floc Sedimentation formed with aloe blend as flocculation aid



Graph 6. Assays overview with blend of Aloe Vera in high turbidity water.





IV CONCLUSIONS

The parameters found for the design and operation were: 56 mg/l of alum with 5 mg/l of liquid Aloe Vera as a coagulation aid in medium turbidity water and 24 mg/l of alum with 14 mg/l of liquid Aloe Vera as a coagulation aid in high turbidity raw water. The raw water used in this project was characterized by turbidity associated with the climatic conditions present at the time of sample collection, reaching up to 101 NTU.

Regardless of the turbidity of the water sample analyzed, Aloe Vera solution proved to be a poor primary coagulant in comparison with the aluminum sulfate applied as a reference in the same jar tests.

The solution of Aloe Vera as coagulation aid achieved a decrease up to 20% of the optimal dose of aluminum sulfate in Water samples in medium turbidity and up to 40% of the optimal dose of alum in high turbidity samples.

Aloe Vera solution applied as flocculation aid, presented turbidity removal exceeding 95% in medium and high turbidity samples and allowing a reduction of the optimal dose of the chemical up to 20% on both tests.

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