

Comparison between Alum, Poly Aluminum Chloride , Ferric Chloride with Aloe vera as a Coagulants

Estabraq Ali Hameed

estabraq_ali@ntu.edu.iq

Raed Mejbil Abdullah

raed.m.abdullah@ntu.edu.iq

College of Health and Medical Techniques /Kirkuk

Abstract

Coagulants of all kind are very important in the process of purifying water from turbidity and pollutants, so comparisons are made between four types of a coagulants used during the chlorinated drinking water purification process are alum, iron chloride, aluminum chloride polymer and a mixture of alum (5mg/l) with three concentrations of aloe vera, solution which is (5%,10%,20%) .The results showed that the 20% concentrated aloe vera with 5mg/l alum gives a high removal of the turbidity by up to 90% compared to other coagulants.

Key words:Alum, Aloe vera , Coagulant, Turbidity

1. Introduction

two main problems appear in the water purification process , which are quantity and quality. the water treatment process in poor and developing countries is very expensive, so researcher and specialists sought to search for natural materials that are available ,safe, cheap and serve the desired purpose(1).

Water is the backbone of life, so it is necessary to pay attention to its quality in all sides and one of the determinants and specifications of water, is turbidity, which was formed by particles suspended in the water(2), since the presence of a high rate of turbidity is not accepted by the consumer in terms of health and environmental (3). Because it causes many diseases of the digestive system because it is possible that viruses and bacteria are suspended in these plankton such as (clay, organic matter, silt,.....)(4). The particles with density close to water density such as bacteria and silt do not settle and remain stuck in the water so the process of collecting them and converting them into large particles needs to be more tease particularly and then removed by the sedimentation process.

The permissible value of the turbidity according to international specifications is five

units and should not exceed the number (5 NTU). Fermentation is one of the necessary and important processes in water purification because through it it is removed the substances causing the turbidity (6). One of the common chemicals used in the process of fermentation is water Aluminum Sulfate (alum) and iron chloride as well as polymer Long-chain (7). The coagulant process is an important stage in the water purification process, through which negative electrical charges on particles are neutralized by the addition of positive-charge coagulant to encourage the initial collection of suspended materials (8).

There are many studies that have dealt with the subject of coagulation and the comparison between chemical coagulants in terms of efficiency in the removal of suspended substances and the extent to which they affect other water specifications. It is an inexpensive clot that does not cause serious health effects in addition to maintaining other water specifications. With little effect, it reduces the coagulation and suspended substances, but it has little effect on the insolvent, electrical and electrical function, as well as the acid function.

Aloe vera is an antibacterial and inflammatory medical plant that produces at least six microbiological and Aloe vera-resistant

substances, a tropical plant that can always be grown in drought-prone areas and spread frequently in the wild, which explains why it is of acceptable cost compared to other types of coagulant (10).

The reason why research is geared towards finding a safe and healthy alternative to the chemical-formulated alum is (Hydrated aluminum Sulfate) and the presence of aluminum in alum is one of the causes of Alzheimer's disease so it is good to reduce its percentage by mixing it or replacing it with another clot. The removal process occurs in the coagulants by tugging between the folds and the minutes with the negative charge and the aluminum ion found in the alum with the positive charge (11). In the polymeric-type coagulant, the multiple ionic positions of aluminum attract negative minutes made up of large, undissolved pads and are subsequently removed by deposition (12).

The importance of this research is to encourage the use of natural substances as well as to indicate the percentage of removal efficiency of suspended substances harmful to different types of clots and to compare them with natural substances..

2. Experimental work

2.1. Materials

2.1.1 Raw water

to prepare turbid raw water , take 5 liters of tap water and add 0.5mg of kaolin on it.

2.1.2. Coagulants

Alum which is (hydrated aluminum sulfate), iron chloride, aluminum chloride polymer, a mixture of alum and natural Aloe vera solution, is used in different proportions.

2.2 The method of work

2.2.1. Measuring raw water specifications

is calculated (16) to see how much it removes the den by using the following equation:

Both the sour function the acid function and the total suspended salts of the laboratory prepared raw water and measured ,table (1)explains these value before adding the coagulant,where the turbidity meter is measured the acid function is measured by PH meter and the total suspended salt are measured in the weighty way (13)

2.2.2. Jar test

We bring three concentrations (5mg\l,10mg/l,15mg\l) of each of the following types of clots (alum, iron chloride and aluminum chloride polymer) and take 10 ml of them and put these concentrations in separate bakeries and put on each of them 1 liters of raw water prepared laboratory and conduct the test of the jar according to the U.S. standard specification 80 ASTM (D2035-ASTM) The operation is at three different speeds, the first speed (100 cycles /per minute) and for two minutes and then (60 rounds /per minute) for ten minutes and the third speed is (20 cycles/per minute) For 20 minutes, then leave the model to settle for 20 minutes, then we pull 100ml of each concentration and measure the turbidity (14) , the acid function and the total suspended salts. For turks (5mg\l, 10mg/l ,15mg/l).

2.2.3. Test the jar for the a coagulants material made up of (alum and aloe vera solution)

We bring three solutions for the substance Aloe vera, where the leaves of the Aloe vera are collected and washed well with water and dried, and then remove the thick green outer shell and separate the gel to prepare three different concentrations(15) which are (5%,10%,20%). The concentrations are placed in clean and dried glass containers and then kept in the refrigerator until use. Table 5 shows these values

2.2.4. Calculating the percentage efficiency of the removal

The percentage efficiency of the previously recorded density percentage and for all types

$$\%E = C_0 - C / C_0$$

%E = percentage removal

C_0 = primary concentration of raw water before putting the acogulant

C= Final focus of the solution after the placement of the acogulant

2.2.5. A comparison of the three types of coagulants

(Alum, Iron chloride and Aluminum Polymer Chloride at concentration (5mg/l,10mg/l,15mg/l) with turbidity.

2.2.6. Make a comparison between the values of the alum alone and the mixture of aloe vera

that contains the alum with different concentrations of aloe vera (20,10,5%).

2.2.7. Study of the relationship between the acid function and the three compositions of the three types of a coagulants

(alum, iron chloride and aluminum chloride polymer PAC)

3. Results and discussion

3.1. explain the data for raw water

Table (1) explains the values of laboratory-prepared raw water as well as the acid function and total suspended salts. These values must be measured because they are the basis for determining the effectiveness of acogulants of different types.

Table 1: Shows the values of turbidity, acid function and total suspended salts of raw water

Model type	Turbidity(NTU)	PH	Total suspended salt (T.S.S)mg/l
Raw water	50	7.9	133

-2- The results of the alum for three different concentrations

show that the more concentrated the substance is, the more effective the removal, as well as the percentage of salts stuck in the

water, which is a good indicator where plankton are carrying different types of bacteria and viruses in addition to their health effect as they may contain folds, silt, organic salts, etc. and table (2) explains this.

Table (2): Shows the values of turbidity, total suspended salts for three concentrations (5,10, 15 mg/l) of (alum)

TEST	Concentrations		
	20mg/l	10mg/l	5mg/l
Turbidity(NTU)	20.5	18.3	11.5
T.S.S(mg/l)	75	33	17

As for the results of iron chloride, we note that with the increased concentration of the clotting material, the percentage of turbidity and salts stuck in the water is lower, in addition to the fact that this a coagulant contains the element of iron positive charge, which attracts plankton negative charge and the effect of iron on the health side of the consumer is less dangerous than the aluminum

found in the material of the alum. The third clot, aluminum chloride polymer (17), is excellent in removal, as well as due to the presence of multiple ion sites, we use less concentration but has a high impact in removing harmful substances and reducing turbidity, folds, viruses and bacteria, as well as its ability to form bridges with negative ions.

Table 3: Shows the values of Turbidity, total suspended salt for three concentrations (5,10,15 mg/l) of ferric chloride.

Concentrations			test
15mg/l	10mg/l	5mg/l	
9.3	12.1	14.2	turbidity
10	15	25	T.S.S

Table 4 : shows the values of Turbidity, total suspended salt for three concentrations (5,10,15mg/l) of aluminium chloride polymer .

Table 4 : shows the values of Turbidity, total suspended salt for three concentrations (5,10,15mg/l) of aluminium chloride polymer . test	Concentrations		
	5mg/l	10mg/l	15mg/l
Turbidity(NTU)	8.3	7.5	6.0
T.S.S(mg/l)	13	11.2	6.8

3.3 The relationship of the acid function

the work of the three chemical acogulants (alum, iron chloride, and aluminum chloride polymer).

We note from the values in table 5 that the alum works in a specific area of acidity degree ranging from (6.8-7.6). It should be noted that this substance is relatively low cost and easy to deal with as well as effective in removing negative-charge colloids.

As for iron chloride, it is acidic in all its conditions and its characteristics is wet and

has the smell of hydrogen chloride. The addition of iron chloride ($FeCl_3$) to water works large blocks of insoluble iron hydroxide and can be separated by sedimentation.

PACL is effective in the base center(18), a long-chain polymer that acts as a multi-parity ion, and the fermentation process is conducted by equivalent to charges and electrostatic conduction works to connect the chain and achieves good removal of the knots, suspended salts and other determinants.

Table 5: Shows the values of the acid function (PH) of the three coagulants with three different concentrations (5,10,15 mg/l)

PH	Alum			Ferric chloride			Aluminum chloride polymer		
	5mg/l	10mg/l	15mg/l	5mg/l	10mg/l	15mg/l	5mg/l	10mg/l	15mg/l
	7.6	7.3	6.8	7.1	6.8	6.1	7.2	7.7	8.1

3.4. Results of the addition of natural aloe vera powder to the alum substance (5mg/l)

The practical results show in table (6) that the addition of Aloe vera solution (5,10,20%) to the alum material achieves a good removal of the total suspended salts compared to the alum material alone and for the same focus as well as works in the near center of the equalizer as

well as note that the effects on electrical conductivity and difficulty are almost few so this natural clot contributes to reducing the percentage of alum and thus stay away from the seriousness of the element of aluminum present in it, It is also a natural substance with many benefits, available, easy to use and of little risk.(19)

Table 6: Shows values (PH,Trbidity, T.S,S,E.C,Hardness) for alum material alone and then mixed with aloe vera solutions

TEST	Concentrations			
	Alum with concentration 5mg/l)	Alum 5mg/l) +5% aloe vera solution	Alum (5mg/l) 10%+ Aloe vera Solution	Alum 5mg/l) +20% aloe vera solution
PH	7.8	7.3	7.2	7.2
Trbidity	24	17	12.0	5
T.S.S	65	40	28	15
E.C	2.3	2.1	2.1	2.0
Hardness	480	475	470	471

3.5. Calculating the efficiency rate of the percentage removal of the turbidity for all types of A coagulants

In table (7) appears that the removal rate of the three coagulants mentioned in the nose has achieved the removal rates of the dendritic well.

Table 7: Shows the percentage removal of the three chemical types of coagulants (alum, ferric chloride and aluminum chloride polymer).

Removal % of turbidity of alum (5mg/l)	Removal % of the alum at a concentration of 10mg/l)	Removal % of the alum with concentration (15mg/l)	Removal % of ferric chloride at a concentration of 5mg/l)	Removal % of ferric chloride with concentration (10mg/l)	Removal % of ferric chloride with concentration (15mg/l)	Removal % of aluminum polymer chloride with concentration (5mg/l)	Removal % of aluminum chloride polymer with concentration (10mg/l)	Removal % of aluminum chloride polymer with concentration (15mg/l)
59%	63%	77%	71%	75%	81%	83%	85%	88%

3.6- Calculating the percentage removal rate of the alum (5mg/l) and then mixed with the aloe vera solutions

Table (8) shows the percentage removal of the alum (5mg/l) with aloe vera solutions where

Table (8): Shows the percentage removal of the turbidity using the alum alone or with different solutions of aloe vera

Type of a coagulant	Alum 5mg/l	Alum 5mg/l with aloe vera solution 5%	Alum 5mg/l with aloe vera solution 10%	Alum 5mg/l with aloe vera solution 20%
% for removal	59%	66%	76%	90%

we note that mixing 5mg/l of alum with 20% of the aloe vera solution achieves an alum in drinking water purification plants

4-Conclusions

- 1- The alum material with the solution of aloe vera is the best in terms of removal as well as in terms of health
- 2- It is better to go towards the use of natural materials that are available cheap and safe in the industrial fields. This is one of the goals of sustainable environment.
- 3- Removal efficiency increases as the added dose of the coagulant increases
- 4- Avoid using alum alone in the coagulation process when sterilizing water because it contains aluminum, which studies and researcher have shown to be the main cause of (Alzheimer's disease) if its concentration in drinking water more than 0.2mg/l
- 5- It is preferable to use aluminum chloride polymer compared to the alum and Ferric chloride because it is highly effective in removing turbidity, clay, silt and less toxic and better for health.

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