Low-Cost Natural Coagulant for Water Treatment

Rajani Saranadagoudar[1], Aishwarya B Policepatil[2], Aishwarya Sugur[3], Nandini[4], Nandita[5], Dr.B.B.kori[6]
[1]*Assistant Professor Department of Civil Engineering, GND Engineering College, Bidar, India*
[2,3,4,5,6]*B.E Scholar, Department of Civil Engineering, GND Engineering College, Bidar, India*

Abstract **- Inorganic aluminium or iron salts have been used for many decades to coagulate colloidal particles in surface water prior to flocculation, sedimentation and/or filtration. Although effective, inorganic coagulants have several disadvantages including large chemical dosages required for treating eutrophic waters, large volumes of chemical sludge produced, and toxic effects of metallic coagulants on the aquatic environment. Chitosan is a natural cellulose-like copolymer of glucosamine and N-acetyl-glucosamine. Because of their biodegradability chitosan-based materials have been suggested as a more eco-friendly coagulant for water and wastewater treatment. Chitosan was an effective coagulant in several prior laboratory studies. Practical application of chitosan as a drinking water treatment coagulant is evaluated here through a series of jar tests. The Percentage removal of water treatment by using aluminium sulphate, ferric sulphate is and chitosan. From chitosan the maximum removal of results were obtained i,e turbidity removal is 86.87% pH is 7.7 and TTS is 76.37%.**

Index Terms **- surface water treatment, coagulant, Chitosan.**

I.INTRODUCTION

Water is a life sustaining drink and is essential for the survival of all living organisms. However, there are toxic contaminants present in water that cause many life-threatening health risks. So, water should be protected from contamination for public health cause and environmental reasons. The potable water obtained from raw resources requires a crucial step of removal of turbidity present in the form of suspended and colloidal materials. Along with this, removal of organic compounds, bacteria, algae and colour is also an important step in surface water treatment process. However, they do have residual impact on the environment. These polymers are synthetic in nature and are often non-biodegradable. This is the reason that a sustainable and environment friendly material for water purification purpose has become a considerable interest in the field of research.

Coagulation is used in drinking water treatment to destabilize colloidal suspensions in order to remove turbidity and natural organic matter (NOM). Inorganic coagulants are most commonly used for this purpose although synthetic polymers also have application. Although effective, inorganic coagulants such as aluminium sulfate (alum) have distinct disadvantages. These include limited availability in certain regions, large chemical dosages required for treating eutrophic waters, large quantities of chemical sludge produced, and harmful effects of residual metallic coagulants on the aquatic environment.

Chitin is a natural polymer derived primarily from two marine crustaceans, shrimp and crabs. The most important derivative of chitin is chitosan. obtained by partial de acetylation of chitin under alkaline conditions or enzymatic hydrolysis. Chitosan is a non-toxic linear high molecular weight cationic polymer exhibiting a variety of properties. It has a variety of applications in cosmetics, biomedical engineering, agriculture, nutrition and many other fields. Chitosan-based materials have also been suggested as potentially eco-friendly coagulants and flocculants for water and wastewater treatment because of their natural biological characteristics and biodegradability. To evaluate the performance of Chitosan as natural coagulant with respect to other coagulants. To study the treatment efficiency with respect solids, pH, turbidity. To find the optimum dosage of coagulant.

II.MATERIALS AND METHODOLOGY

2.1 MATERIALS:

Material used in current search work are:

1. Aluminium sulphate.
2. Ferric chloride.
3. Chitosan.

4. Surface water sample from 4 different locations of bidar district.

2.2 PREPARATION OF COAGULANTS:
Three different coagulants were prepared as per the standards methods.

2.3 WATER SAMPLING:
The surface water sample was collected from four different locations in Bidar, India
Such as,
1. Papnash lake (Bidar district)
2. Kattalli lake (Humnabad Taluka).
3. Karanja reservoir (Bhalki Taluka).
4. Aurad Lake (Aurad taluka).

(a).Papnash lake (Bidar)

(b) Karanja reservoir (Bhalki)

(c) Kattalli lake (Humnabad)

(d) Aurad lake (Aurad)

Fig-a,b,c,d are the location of selected water sample places

2.4 METHODOLOGY
Collected surface water sample were analysed for, pH, Turbidity and TTS as per the standard procedure.

III.RESULTS AND DISCUSSION

The series of jar tests evaluated the optimum dose for each coagulant. The coagulant dosages applied were based on prior published results.

3.1 Papnash lake bidar:
Table-1 tabulated result of papnash lake

Coagulants	pH	Turbidity (NTU)	TSS in ml	Dosages in ml	% Removal turbidity	% Removal of TSS
Aluminium sulphate	6.7	5	215	6	62.50	41.73
				8	50.00	
				10	37.50	
Chitosan	7.6	2	100	2	87.50	72.89
				4	75.00	
Ferric chloride	6.8	4.6	176	8	52.03	52.30
				10	43.69	

3.2 Karanja reservoir:

Table -2 Tabulated result of Karanja reservoir

Coagulants	pH	Turbidity (NTU)	TSS in ml	Dosages in ml	% removal turbidity	% removal of TSS
Aluminium sulphate	8.4	9	130	6	57.14	69.41
				8	42.85	
				10	28.57	
Chitosan	8.7	3.5	85	2	85.71	80.00
				4	71.42	
Ferric chloride	8.1	6	154	8	45.02	63.76
				10	37.45	

3.3 Kattalli lake:

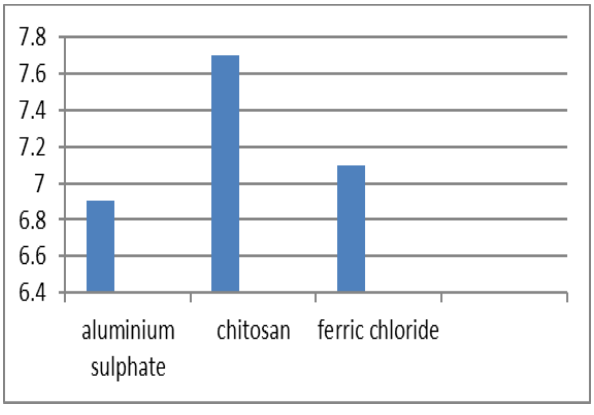
Table -3 tabulated result of Kattalli lake

Coagulants	pH	Turbidity (NTU)	TSS in ml	Dosages in ml	% removal turbidity	% removal of TSS
Aluminium sulphate	6.6	5.4	112	6	57.14	66.06
				8	42.85	
				10	28.57	
Chitosan	7.2	2.9	84	2	85.97	74.54
				4	71.42	
Ferric chloride	6.9	5.1	120	8	49.45	63.63
				10	37.45	

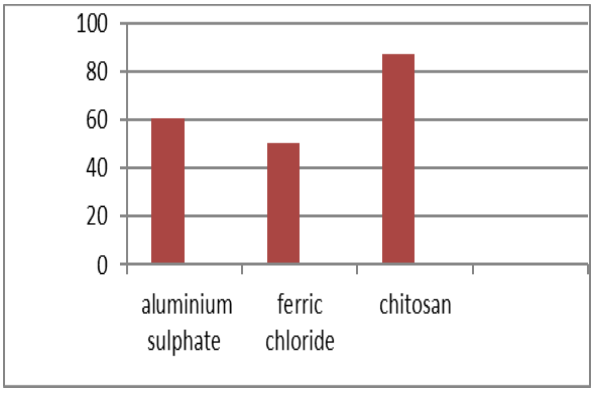
3.4 Aurad lake

Table-4 tabulated result of Aurad lake

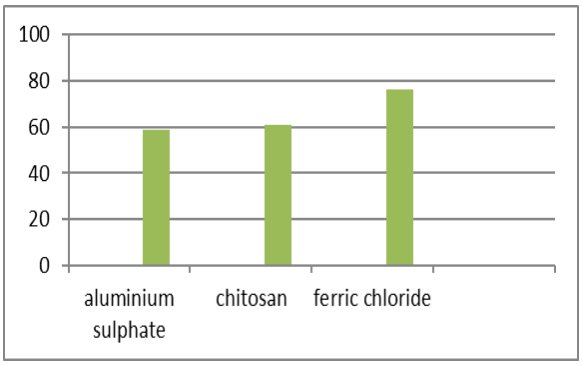
Coagulants	pH	Turbidity (NTU)	TSS in ml	Dosages in ml	% removal turbidity	% removal of TSS
Aluminium sulphate	6.2	8	150	6	64.70	58.33
				8	52.29	
				10	41.17	
Chitosan	7.3	3.0	80	2	88.23	77.78
				4	76.47	
Ferric chloride	6.8	5	130.21	8	55.98	63.83
				10	48.33	



Graph-1 comparison of pH of surface water sample with 3 coagulants (Alum, ferric and chitosan)



Graph -2 comparison of turbidity of surface water sample with three coagulants such as aluminium sulphate, ferric and chitosan



Graph -3 comparison of TSS of surface water sample with three coagulants such as aluminium sulphate, ferric and chitosan

IV.CONCLUSION

Chitosan reduces turbidity and removes unwanted contaminants. Chitosan improve water quality. Chitosan is easy filtration. Chitosan is a low-cost natural coagulant.

The optimum coagulant dose for the surface water tested in this study based on settled water turbidity was 6, mg/L for aluminium sulphate, 2 mg/L for chitosan, and 8 mg/L for ferric chloride, respectively.

The optimum pH found for coagulation to remove settled water turbidity was 6.8, 7.3, and 6.2 for aluminium sulphate, chitosan, and ferric chloride respectively. compare to aluminium sulphate, ferric chloride and chitosan, chitosan shows highest turbidity and TSS i,e 86.87%, 76.37%.

REFERENCES

[1] Sacher, F.; Gerstner, P.; Merklinger, M.; Thoma, A.; Kinani, A.; Roumiguières, A.; Bouchonnet, S.; Richard-Tanaka, B.; Layousse, S.; Ata, R.; et al. Determination of monochloramine dissipation kinetics in various surface water qualities under relevant environmental conditions-Consequences regarding environmental risk assessment. Sci. Total Environ. 2019, 685, 542–554. [CrossRef] [PubMed]

[2] Hernández-Martínez, R.; Valdivia-Rivera, S.; Betto-Sagahon, J.; Coreño-Alonso, A.; Tzintzun-Camacho, O.; Lizardi-Jiménez, M.A. Solubilization and removal of petroleum hydrocarbons by a native microbial biomass in a bubble column reactor. Rev. Mex. Ing. Quím. 2019, 18, 181–189. [CrossRef]

[3] Carvajal, A.; Akmirza, I.; Navia, D.; Pérez, R.; Muñoz, R.; Lebrero, R. Anoxic denitrification of BTEX: Biodegradation kinetics and pollutant interactions. J. Environ. Manag. 2018, 214, 125–136. [CrossRef]

[4] Chen, X.; Ren, P.; Li, T.; Trembly, J.P.; Liu, X. Zinc removal from model wastewater by electrocoagulation: Processing, kinetics and mechanism. Chem. Eng. J. 2018, 349, 358–367. [CrossRef]

[5] Villaseñor-Basulto, D.L.; Astudillo-Sánchez, P.D.; del Real-Olvera, J.; Bandala, E.R. Wastewater treatment using Moringa oleifera Lam seeds: A review. J. Water Process Eng. 2018, 23, 151–164. [CrossRef]

[6] Bello, O.S.; Lasisi, B.M.; Adigun, O.J.; Ephraim, V. Scavenging Rhodamine B dye using moringa b oleifera seed pod. Chem. Speciat. Bioavailab. 2017, 29, 120–134. [CrossRef]

[7] Camacho, F.P.; Sousa, V.S.; Bergamasco, R.; Ribau Teixeira, M. The use of Moringa oleifera as a natural coagulant in surface water treatment. Chem. Eng. J. 2017, 313, 226–237. [CrossRef]

[8] Camacho, F.P.; Sousa, V.S.; Bergamasco, R.; Ribau Teixeira, M. The use of Moringa oleifera as a natural coagulant in surface water treatment. Chem. Eng. J. 2017, 313, 226–237. [CrossRef]

[9] R. Yang, H. Li, M. Huang, H. Yang, A. Li. “A review on Chitosan-based flocculants and their applications in water treatment.” Water Research, vol. 95, 2016, pp. 59-89.

[10] NSF Standard 60-2015. Drinking Water Treatment Chemicals – Health Effects. Ann Arbor, MI: NSF International.

[11] S. A. Fast, B. Kokabian and V. G. Gude. “Chitosan enhanced coagulation of algal turbid waters – Comparison between rapid mix and ultrasound coagulation methods.” Chemical Engineering Journal, vol. 244, 2014, pp. 403-410.