

PERFORMANCE OF NATURAL AND CHEMICAL BASED COAGULANT USED IN WATER AND WASTE WATER TREATMENT – A REVIEW

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Abstract - This review investigates and compares the practices of use of natural coagulant and chemical coagulant in water treatment. Generally, the chemical coagulant is widely used due to its high efficiency, but it causes environmental effect and consumes large dosage, also it is high in cost. However, the application of natural coagulant has less efficiency than chemical coagulant, but it is safe for human health. Natural coagulant can be used in small scale. Alternatively, the natural-based coagulant is commonly used as coagulant aids along with chemical coagulant. This review paper outlines the type of coagulant used for water and waste water treatment especially of natural based coagulants.

key words- Natural coagulant, chemical coagulant, turbidity, water and waste water.

1. INTRODUCTION

The availability of pure drinking water has been decreasing day by day. Surface water is polluted by sewage, industrial water discharge, while ground water is polluted by waste dumping site and salt water intrusion. It is therefore necessary to treat this water. In many developing countries water treatment process involves coagulation, flocculation and sedimentation, which helps to remove the turbidity from water. This process is quite expensive as it involves the use of chemical coagulants such as aluminum sulfate ($Al_2(SO_4)_3$), ferric sulfate ($Fe_2(SO_4)_3$), ferric chloride ($FeCl_3$), sodium aluminate ($NaAlO_2$), alum ($KAl(SO_4)_2 \cdot 12H_2O$), polyaluminum chloride (PAC L). PAC is generally used in water and waste water treatment plants all over the world. Though PAC and alum has a drawback it involves impurities such as epichlorohydrin tends to carcinogenic disease. Aluminum is regarded as an important poisoning factor in dialysis encephalopathy (infection of blood). Due to excess use of aluminum it leads to Alzheimer disease.

To overcome this problem, the introduction of natural coagulants and coagulant aid as an alternative to chemical coagulant has been practiced. Natural coagulant is obtained from plants that have macromolecular substances that act like coagulant. Natural coagulants like okra rice, pumpkin seeds, helps in removing the turbidity of water. Some natural coagulant works in both coagulation and disinfection process.

The extracts of seed reduce the amount of sludge and bacteria. The other natural coagulant includes, Nirmali seeds, moringa oleifera, maize etc.

2. PAST WORK REVIEW

I On basis of Natural coagulant:

S.hussian (2019), investigated the potential of pine cone extract as natural coagulant that helps in reducing the turbidity present in water. Coagulation process was carried out by jar test and synthetic turbid water was used. The dose of coagulant was 0.5mg/l for turbidity range 67 and 75NTU coagulation activity of pine cone extract is 82% removed the turbidity.

A.H.ghawi (2017), examined the study of drinking water treatment plant in Iraq. To remove the turbidity and heavy metal present in water by adding natural coagulant moringa oleifera seed and leaves instead of using alum. The samples were taken from 20 to 1000NTU were carried out coagulation process by jar tester. Result showed that moringa oleifera leaves has a high efficiency up to 99% in removal of turbidity and 98% in removal of heavy metals from surface water.

Saravanan (2017), examined natural coagulant as an alternative synthetic coagulant. Natural coagulants used are like dolichos lablab, azadirachta

indica, moringa oleifera, hibiscus rosa sinensis and synthetic coagulant like alum. The removal efficiency of turbidity observed was 37.45%, 63.01%, 31.45%, 12.95% against 75.01% obtained from alum.

Onukwuli O.D (2015), investigated the removal of colour from crystal ponceau 6R dye by using natural polymers coagulants such as, vigna uguiculata coagulant, telfaira occidentalis coagulant, vigna subterranean coagulant and moringa oleifera coagulant. The result showed that decrease of pH was highly beneficial for removal of dye. Optimal condition of pH, coagulant dosage 10mg/l and 20mg/l for time 420 min was obtained.

C.kihampa (2011), examined the performance of solanum incunum Linnaeus a natural coagulant as well as disinfectant for purifying water. The coagulation process was carried out by jar test. Result show that coagulation depend on Fe(II) content and disinfectant on bioactive natural product compounds from the plant. Turbidity ranging from 450,300,105, NTU have been removed turbidity of water by 96, 97, 75% respectively. The result suggests that solanum incunum work as an both coagulant and disinfectant.

Syeda azeen unnisa (2018), examined the highest efficiency of turbidity removal by using natural coagulant carica papaya seed for treatment of water and waste water. In this study the carica papaya seed and alum were used as coagulant separately to find the effective coagulant and solar disinfection was used for disinfection process. Experimentally, by jar test coagulation process carried out by adding coagulants of two sets each. Dosage of c.papaya seeds about 0.2-0.6 mg/l were added in turbid water and allow to rotate for 30 min. combination of carica papaya and alum gives highest efficiency for removal of turbidity and solar disinfectant gives highest efficiency for removal of bacteria.

G.Mruthuraman(2016), investigated the performance of moringa oleifera as natural macromolecular coagulant by jar test. Initial turbidity range 100 to 500 NTU was removed by adding moringa oleifera dosage in water sample. The removal of turbidity was upto 5NTU, flocs formed using moringa was bigger as compare to the alum.

The result showed moringa removed turbidity by 2hrs of contact time and hardness was 76mg/l.

E. Christine (2019), investigated the removal of turbidity by using chitosan polymers. The result showed the highest reduction were at dose 1 and 3 mg/l on adding to 50NTU gives <5NTU. The best studied dose was 3 mg/l gives highest efficiency of turbidity removal.

J.Saravanan(2017), examined the removal of turbidity by using natural coagulant alternative to chemical coagulant for treatment of waste water. The turbidity removal efficiency for dolichos lablab (37.45%), azadiachta (31.47%), moringa oleifera (63.01%), hibiscus rosa(12.95%) and alum(75.01%). The result showed alum is most effective than moringa, but moringa can be used in rural areas at low cost.

S.maurya(2018),investigated the natural coagulant such as banana peel powder, banana stem juice, papaya seed powder and neem leaf powder for removal of turbidity, chemical oxygen demand and total suspended solids form municipal waste water. Result showed the maximum turbidity was observed by adding banana peel powder at 0.4g/l of dosage gives 59.6%, while papaya seed powder and banana stem juice were effective in removal of TSS (66.66%), COD (66.67%).

A.Hossain (2011), investigates the purification of water by moringa oleifera, cicer arietinum and dolichos lablab as natural coagulant to reduce the turbidity of synthetic water. After Coagulant dosing the turbidity reduces from 100NTU to 5NTU, 3.3NTU, 9.5NTU for moringa oleifera, cicer arietinum, dolichos lablab resp. The highest efficiency for removal of turbidity was found with cicer arietinum (95.89%) and reduction in coliform about (89 to 96%).

M. Chaudhari (2011), examined the seeds of strychnos potatorum and moringa oleifera acts as a natural coagulant containing natural polyelectrolytes which helps in removal of turbidity present in water. Surface turbid water range (15-25NTU). Result showed moringa oleifera removed 0.3NTU-1.5NTU of turbidity as compared to strychnos potatorum.

H. Beyene(2016), investigated the study of combination of natural and chemical coagulants i.e

cactus powder and alum for reduction of turbidity using jar test. Coagulant dose from 0.5g to 3.5g removed up to 23.9% to 54% and 28.46% to 58.2%.

A.Jaeel(2017), investigated the dosage of alum used in drinking water for removal of turbidity by jar test. In this study five water treatment plants water sample was taken. The initial range of turbidity were (60, 45, 80, 50, and 75) NTU respectively. Result showed that highest efficiency at optimum dosage were 93% at 20mg/l, 92% at 25mg/l, 85% at 30mg/l and 89.3% at 30mg/l respectively.

N.Zaidi(2019), observed the performance of chestnuts peels, bagasse and maize cobs. From jar test experiments, the optimum dosage of 90mg/l gives highest efficiency of bagasse (97.3%) as compared to chestnuts and maize cobs.

M.Deosarakar(2019), observed that the natural coagulants works as an alternative to chemical coagulants. In this study cicer arietinum, dolichos lablab, tamarindus indica used as natural coagulants. The result showed cicer arietinum removed (88.7%) at dose 0.6mg/l, tamarindus indica removed (80%) at 0.6mg/l.

N.Zaidi(2019), investigated the efficiency of fruits peels as natural coagulants as an alternative to the chemical coagulant. Waste materials like banana peels, orange peels and mango peels with coagulant dose 110mg/l gives (92,7%) of highest efficiency in reduction of turbidity. Mango peels have great potential replacing to chemical coagulant for treatment of water.

M.Shafad(2013), investigated the study of dragon fruit as natural coagulant. The fruit was dried at 50°C. the optimum dosage for 100NTU, 200NTU and 400NTU found were 5mg/l, 10mg/l, 20mg/l. the contact time of sedimentation was very fast (10min). The coagulant dose of dragon fruit was 1.5 times lower than alum. Hence dragon fruit has higher efficiency to remove turbidity.

II On Basis Of Chemical Coagulant:

Davoud Khodadadi dehkordi (2017), investigate the efficiency of coagulants by comparing three various inorganic polymers such as poly aluminum chloride(PACL), aluminum sulfate(alum), ferric

chloride. These were added to turbid water which was collected from karoun river and jar test was carried out for every turbidity range. Coagulant aid besfloc was added when sample were above 300NTU range. Result showed Poly aluminum chloride and ferric chloride gives more efficiency and turbidity removal in comparison with alum, but ferric chloride is cheaper than poly aluminum chloride, so as considering economic analysis ferric chloride shows more turbidity removal than PACL.

S.Kalavathy (2017), studied the removal of turbidity present in water by adding alum dose. The water impurities like silt, clay, finely inorganic and organic matter were extinct by using process of coagulation and flocculation. The alum was used as chemical coagulant, synthetic turbid water was prepared in range (90-140) NTU. Two coagulant dose 10mg/l and 20 mg/l in 250 ml synthetic turbid water with help of jar test. Result showed that highest turbidity removal efficiency was 46.15% over the applied range of turbidity. By this study proved that by using alum water can be treated and provided as drinking water.

A.wambuli mumbi(2018), aimed to study the clean drinking water for rural area in cheaper ways. In this experiment poly aluminum chloride (PAC), aluminum sulfate (alum), and cactus is used for coagulation process to reduce the turbidity from surface water, with range of 150, 415 and 510 NTU by using jar test method. Result showed combination of PAC and cactus highest performance in reduction compared to PAC and Alum.

M.pritchard(2010), examined the performance of moringa oleifera compared with aluminum sulfate and ferric sulfate. The synthetic turbid water created by kaolin was range into 146NTU and spiked the *E. coli* at 10^4 per 100ml. this water sample was taken under jar test by adding above coagulant. Results showed that moringa oleifera removed turbidity 84% and *E. coli* 88%, while alum removed 99% turbidity and *E. coli*. whereas ferric sulfate removed 94% turbidity and *E. coli*. moringa oleifera is not effective as alum and ferric but showed sufficient removal capability for treatment of turbid and contaminated water.

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M.Mbaeze(2017), examined the reduction in turbidity by using chemical coagulant alum and ferrous sulfate. After coagulation process carried out by jar test at certain turbidity range, removal efficiency of turbidity for alum (98.70%) and for ferrous sulfate (96.77%). Result showed that alum is more effective chemical coagulant than ferrous sulfate.

H.Hoveidi(2015), examined the effective coagulant among aluminum sulfate and poly-aluminum

chloride evaluated at different pH values and different coagulant dose. Initial turbidity range was 500NTU and 100NTU and coagulant dosage used 10mg/l to 20mg/l. result showed turbidity removal of alum (82.9-99.01%) and poly aluminum chloride(PACL) (93.8-99.6%). Although PACL showed highest removal efficiency compared to alum.

3. CONCLUSIONS

The application of natural and chemical coagulants in water and waste water has been presented. Although all coagulants show satisfactory result for removal of turbidity and bacteria present in water. Chemical coagulant shows highest removal efficiency than natural coagulant, but higher dose of chemical contributed to environmental pollution. So, for turbidity removal natural coagulants would be best as compared to chemical coagulant.

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