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WATER TREATMENT BY USING NATURAL COAGULANTS

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Abstract- The use of synthetic coagulants is not regarded as suitable due to health and economic considerations. Studies will be carried out in laboratory on lake water containing high turbidity. Experiments were carried out in four turbidity ranges: 10, 50, 500, 1000 (NTU) and the pH range 5-8. The efficiency of natural coagulants and chemical coagulants was examined with jar test. The aim of this study was to compare the efficiency of two type's coagulants, chemical and natural coagulants. The results of this study give an overview that the natural coagulants will have a minimal effect on pH and a higher efficiency in removing high turbidity in comparison with chemical coagulants.

Keywords -*Natural Coagulants, Chemical Coagulants, Turbidity, Jar Test, Lake Water, pH.*

I INTRODUCTION

Water is undoubtedly the most vital element among all 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 polluted water. Due to rapid urbanization and migration from rural areas, there is a tremendous load on water consumption in all major cities. Water condition of surface water of most of the highly populated regions have become highly polluted due to indiscriminate discharge of untreated waste from tannery, textile, municipal waste into water bodies, etc. One of the problems with treatment of surface water is the large seasonal variation in 'Turbidity'.

Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air. The measurement of turbidity is a key test of water quality. Fluids can contain suspended solid matter consisting of particles of many different sizes. While some suspended material will be large enough and heavy enough to settle rapidly to the bottom of the container if a liquid sample is left to stand, very small particles will settle only very slowly or not at all if the sample is regularly agitated or the particles are colloidal. These small solid particles cause the liquid to appear turbid.

Turbidity in open water may be caused by growth of phytoplankton. Human activities that disturb land, such as construction, mining and agriculture, can lead to high sediment levels entering water bodies during rain storms due to storm water runoff. Areas prone to high bank erosion rates as well as urbanized areas also contribute large amounts of turbidity to nearby waters, through storm water pollution from paved surfaces such as roads, bridges and parking lots. In drinking water, the higher the turbidity level, the higher the risk that people may develop gastrointestinal diseases.

The units of turbidity from a calibrated Nephelometer are called 'Nephelometric Turbidity Units' (NTU). To some extent, how much light reflects for a given amount of particulates is dependent upon properties of particles like their shape, color and reflectivity. Governments have set standards on the allowable turbidity in drinking water. The 'World Health Organization' establishes that the turbidity of drinking water should not be more than 5 NTU, and should ideally be below 1 NTU. A per Indian standards (IS 10500:2012), permissible limit of Turbidity is 5 NTU and maximum limit is 10 NTU.

Turbidity is commonly treated using either a settling or filtration process. Depending on the application, chemical reagents will be dosed into the wastewater stream to increase the effectiveness of the settling or filtration process. In-situ treatment of turbidity involves the addition of a reagent, generally a flocculant, evenly dispensed over the surface of the body of water. The flocs then settle at the bottom of the water body where they remain or are removed when the water body is drained. There are a number of chemical reagents that are available for treating turbidity, which include 'Aluminium Sulfate' (Alum), 'Ferric Chloride', 'Gypsum', 'Poly-Aluminium Chloride' etc. 'Clarification' refers to the sequence of operations used to remove suspended solids (mineral and organic) from the raw water together with a proportion of the dissolved organic matter (flocculating fraction). Depending on the concentrations of the various contaminants present, there may be the need for increasingly complex operations ranging from simple filtration with or without reagents. Clarification process is applied when there is

a high degree of turbidity in the water or when solids must be separated from liquids. Clarification is highly effective at reducing turbidity and removing color, solids and colloidal material from water and wastewater when used together with chemical feed, sludge treatment and filtration of clarified elements.

Sedimentation and Decantation are done to get rid of the heavier suspended particles. Clarification which is the next step consists of 4 distinctive processes namely:

a) Coagulation
b) Flash mixing
c) Flocculation
d) Settling

The variables that affect how these processes are carried out are water velocity, time, and pH. Sufficient time and velocity are necessary to maximize the probability that particles will come together. The pH level is an important determinant of how thoroughly colloids are removed.

a) Coagulation: During this process, as per the conventional method, chemical coagulants are added to water to destabilize colloidal and finely divided materials and to cause them to begin aggregating. The most commonly employed metal coagulants fall into 2 groups – Aluminium-based, such as Aluminium sulfate, Aluminium chloride and Sodium Aluminate; and Iron- based, such as Ferric sulfate, Ferric chloride, and Ferric chloride sulfate. Other chemicals sometimes used in the water treatment process are magnesium carbonate and hydrated lime, among others. Aluminium and Iron coagulants work by forming highly adsorptive multi-charged polynuclear complexes. The pH of the system can be manipulated to control the characteristics of the complexes and their effectiveness.

b) Flash mixing: After chemical coagulants are introduced, the water is mixed quickly and forcefully by the flash mixer so that the chemicals are evenly distributed throughout the water. This step is very important to create the conditions for efficient, effective water treatment. Flash mixing must last at least 30 seconds, or else the chemicals will not be properly distributed. When water is flash mixed for a longer period, the mixer blades will tend to chop or shear the aggregating material back into small particles. Coagulation actually begins during flash mixing as the coagulants neutralize the electrical charge of the fine particles. This stops the repulsion of like-charged particles and allows the particles to begin bonding and forming larger clumps. Coagulation affects the performance of other stages of treatment, favoring microbiological quality of the final product thereby increasing the lifetime of Filters and reducing the final cost of treated water.

c) Flocculation: After flash mixing, flocculation begins with a slower gentler mixing that brings the fine particles produced during the coagulation step into contact with each other. The flocculation phase usually goes on for 30-45 minutes in a flocculation basin that may have multiple compartments. Each compartment has a different mixing speed, and these speeds randomly decrease as water flows from top of the basin to its bottom. This approach allows increasingly large clumps of matter to form without being broken apart by the mixing blades. At the end of this process, most of the turbidity and particulate matter in the water should be formed into a material called 'floc', which consists of relatively large clumps of impurities and bacteria bound together in clusters of about 0.1 to 3.0 mm in size. A larger floc is more likely to break apart in the flocculation basin.

The coagulation-flocculation process is necessary in water treatment primarily because of non-settleable solids, particles too small to be removed effectively by other treatment processes such as Sedimentation and Filtration. These non-settleable solids can be changed into larger and heavier settleable solids by physical and chemical changes brought about by adding and mixing chemical coagulants in raw water. Colloidal particles consist of particles with an electric charge, usually negative. This characteristic prevents the collision and aggregation of particles. Addition of certain chemicals to colloidal suspension can enhance destabilization and segregation of particles, leading to formation of flocs of considerable dimensions. These flocs can then be further removed by Sedimentation and Filtration.

d) Settling: This process takes place in a 'Clarifier' which consists of tanks or basins which hold water or wastewater for a period sufficient to allow the floc and other suspended materials to settle to the bottom. This process makes the water clear by removing all kinds of particles, sediments, oil, natural organic matter and color. Floc which collects on the bottom of the basin is called sludge, and is piped to drying lagoons. The purpose of a clarifier is to remove solids, produce a cleaner effluent and concentrate solids. Concentration of solids removed from the wastewater reduces the volume of sludge for dewatering and/or disposal.

II LITERATURE STUDY

1. M. Yaramadi, M. Hossieni 2009 - The use of synthetic coagulants is not regarded as suitable due to health and economic considerations. Studies were carried out in laboratory scale on deionized water containing synthetic turbidity of kaolinite. Experiments were carried out in four turbidity ranges: 10, 50, 500, 1000 (NTU) and the pH range 5-8. The efficiency of moringa oleifera seed extract and polyaluminum chloride was examined with jar test. Extract of moringa oleifera seed could respectively remove turbidity of 98, 97, 89 and 55 percent in optimum concentration 10-30 (mg/l) and the optimum pH of 6-8. Poly aluminum chloride

could remove 99, 98, 95 and 89 percent of the above-mentioned turbidity ranges in optimum concentration of 20-30 (mg/l) with the optimum pH of 8.

2. Md. Asrafuzzaman, A. N. M. Fakhruddin and Md. AlamgirHossain2011 - This Work Presented Reduction of Turbidity of Water Using Locally Available Natural Coagulants. Moringa oleifera, Cicer arietinum, and Dolichos lablab were used as locally available natural coagulants in this study to reduce turbidity of synthetic water. The tests were carried out, using artificial turbid water with conventional jar test apparatus. Optimum mixing intensity and duration were determined. After dosing water-soluble extracts of Moringa oleifera, Cicer arietinum, and Dolichos lablab reduced turbidity to 5.9, 3.9, and 11.1 nephelometric turbidity unit (NTU), respectively, from 100 NTU and 5, 3.3, and 9.5, NTU, respectively, after dosing and filtration. Natural coagulants worked better with high, turbid, water compare to medium, or low, turbid, water. Highest turbidity reduction efficiency (95.89%) was found with Cicer arietinum. About 89 to 96% total coliform reductions were also found with natural coagulant treatment of turbid water. Using locally available natural coagulants, suitable, easier, and environment friendly options for water treatment were observed.

3. Vicky Kumar, Syzwanr Ashrudin 2016 - The natural water falls from the mountain is merging into the oceans. This water is preserved by humans that are consumed for agriculture, industrial, and municipal use. This water become wastewater after different usage, and finally, completes the hydrological cycle. The water becomes wastewater due to population growth, urbanization, industrialization, sewage from household, institutions, hospitals, industries and etc. Wastewater can be destructive for the public because it contains a variety of organic and inorganic substances, biological substances, toxic inorganic compounds and the presence of toxic materials. The coagulant chemicals and its associated products are resourceful but these may change the characteristics of water in terms of physical and chemical characteristics, this make matters worse in the disposal of sludge. An option of natural polymer can be used in water and wastewater in this review. The natural polymers are most efficient that provide several benefits such as; prolific, exempt from physical and chemical changes from treated water.

4. Saravanan J., Priyadharshini D.2017 - In this study using natural coagulants as an alternative to the current commercial synthetic coagulant such as aluminium sulphate and to optimize the coagulation process. Based on the experimental results, it was concluded that natural coagulants which have been obtained from Dolichos Lablab, Azadirachta Indica, Moringa Oleifera, Hibiscus Rosa Sinensis have showed a merely equalling coagulation comparing to commercial alum. The turbidity removal efficiency for Dolichos Lablab, Azadirachta Indica, Moringa Oleifera, Hibiscus Rosa Sinensis respectively were 37.45%, 63.01%, 31.47%, 12.95% against 75.01% obtained from alum.

5. R. Shree Vidhya, S. Mahendran 2018 - In this study, attempts have been made to study the comparative effectiveness of chemical coagulants like alum and ferric chloride with less known natural coagulants such as Maize seed, Cicer arietinum (Bengal gram) and Trigonellafoenum (Graecum) for turbidity reduction in domestic sewage. The coagulants were tested at different dosages and two combinations of coagulants were also investigated for increase in removal efficiency of TDS. The maximum reduction of alum, ferric chloride, Maize seed, Cicer arietinum and Trigonellafoenum were found to be 44.11%, 61.75%, 35.2%, 50%, 55.8%, 52.9% and 47.08% respectively. Maximum TDS removal was obtained at 19.5% at 6gm/l in Cicer arietinum and at 8gm/l in Trigonellafoenum with Ferric chloride.

III METHODOLOGY

By study of above literature research papers, we found different tests to be carried out such as;

1. pH Test
2. Temperature Test
3. Turbidity (NTU) Test
4. Jar Test

The methodology to be used is;

1. Study area analysis
2. Collection of water sample
3. Collection of seeds
4. Drying and powdering of seeds
5. Analysis of raw water sample
6. Determination of correct proportion
7. Treatment of sample with powdered seeds, PAC and Alum
8. Testing
9. Comparison of results
10. Comparative analysis
11. Conclusion

Name of coagulants to be used:

Natural Coagulants –

1. Cicer Arietinum
2. Dolichos Lablab
3. Moringa Olifiera
4. Glycine Max

Chemical Coagulants –

1. Alum
2. Poly-Aluminium Chloride

IV CONCLUSION

Through above studies we conclude that; Natural coagulants show better coagulation and turbidity removal for given well water. Natural coagulants to replace chemical coagulant in removing suspended solids in water and it is effective in eliminating heavy metals for water treatment.

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