

Removal of Turbidity and Alkalinity from Wastewater by Using Various Natural Coagulants- A Review

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Abstract - The natural coagulants can remove the turbidity and alkalinity from the water and wastewater. This has been found from this study a lot of researches has proved that many natural coagulants have been used for the removal of turbidity and alkalinity from the wastewater such as waste tea powder ash, *Zea mays*, *Vigna mungo*, *Moringa oleifera*, *Allium Cepa*, *Hylocereus sp.*, *Phyllanthus nirur* Ash, *Albizia saman*, *Trigonous Stems* and *Phyllanthus indica* etc. This has been found from the literature reviews, that in coagulation and flocculation process the natural coagulants were widely used and found to be effective for the treatment of wastewater. The aim of this study is to trace out the different natural materials that were previously used as a natural coagulant for the treatment of alkalinity and turbidity from the wastewater and to prove them as a low-cost and ecofriendly coagulant. This is found from this review study that the different types of natural coagulants were used for the treatment of wastewater containing alkalinity and turbidity and they have been proved to be as an alternative, sustainable, ecofriendly, and low-cost coagulants compared to conventionally chemical based and other coagulants.

Keywords: Turbidity, Alkalinity, Wastewater, Natural coagulant, Flocculation

INTRODUCTION

Water is the basic requirement of all living beings but in present scenario it is not fruitful for human consumption because of pollution that is increasing continuously for different reasons like industrial raw water discharge into fresh water bodies, spiritual reasons, navigation, leakage of oil during transportation, dumping of waste directly into the water recourses that affects the aquatic life and water quality. Among all water pollutants turbidity and alkalinity are significant components of water pollution this is why the water pollution prevention and control become very necessary to decrease the level of water pollution and depletion of water. Turbidity is a visual property of the water and wastewater which is one of the most important parameter to measure its purity. It is caused by floating particles in the water that attracts and spread-out the light. These fine particles are highly inaccessible and not allowing to settle down the materials in quiet condition and are very difficult to eliminate in the sedimentation process. In water supply engineering turbidity causes problems in the treatment, processing, disinfection, and filtration process. Turbidity is analyzed by using turbidity meter for the confirmation of number of particles present in the water in the form of NTU. Turbidity is caused by the particles of soil substances, metals, algae, or related materials that are present in the wastewater. These substances spread out light and make the water dusty, cloudy, or opaque. The intensity of the turbidity is high in water affects the human health and other aquatic animals and plants. When the level of turbidity is greater than the prescribed limit of the water, it causes the growth of algae and other aquatic plants in water. Turbidity also changes the temperature of the water bodies because of the floating particles that attracts the sunlight more as compared to water. When the level of turbidity is extremely high it resists the sunlight to reach the bottom for the aquatic plants and affects the aquatic animals such as whales, starfish and eels. Alkalinity is water scalp ability to resist the acidic change in the pH, mostly alkalinity is the water capability to reduce the effect of acid. The alkalinity in ordinary water is mainly because of the presence of weak acidic salts and high level of calcium carbonate, although strong bases may also be present in large quantity in fresh water sources. The alkalinity of wastewater can also be confirmed by the type of the soil and bedrock present in river and streams. The main sources of alkalinity in wastewater are rocks that contain carbonate, bicarbonate, and hydroxide compounds. The total alkalinity is affected by ecological reasons, acidic rain and other substances that also changes the alkalinity in excess. A huge quantity of alkalinity comes in groundwater from the leaching of the rocks and calcium carbonate.

NATURAL COAGULANTS

The coagulant which is totally based on natural resources like ash, waste tea powder ash, *Vigna mungo*, *Moringa oleifera*, *Zea mays*, *Allium cepa*, *Phyllanthus niruri* ash, *Phyllanthus indica*, *Phaseolus vulgaris*, *Strychnos potatorum*, *Hylocereus sp.*, *Trigonous* stems, gum exudate of *Albiziasaman*, ground net shall, banana peel powder, *Lemna perpusilla*, *Plantago ovate* seed powder, *Tamarindus indica* seeds, pine cone powder etc. are being used in different methods like coagulation, flocculation and sedimentation for the treatment of water and wastewater. These are environmentally favorable, less chemical dependent, reliance in utilization, easily accessible and of low cost as a compared to other coagulants.

LITERATURE REVIEW

Turbidity in water and wastewater is mainly due to the colloidal particles, generally that comes in water from the land and are very fine in nature. Turbidity can be removed from the water and wastewater by various methods, some of them are using various varieties of natural coagulants. Many studies have been done in the recent past on the removal of Alkalinity and Turbidity by using different natural coagulants such as Sasikala and Muthuraman (2017) removed the turbidity from outdoor H₂O through ordinary coagulants. Furthermore, it has been found that the waste tea powder ash, *Vigna mungo*, *Phyllanthus niruri* ash, *Zea mays* and *Allium cepa* ash were used for the removal of turbidity, V-mungo seed removal capacity has been found to be maximum 90% as compared to 76% in *Zea mays*. The ultrasonic and microwave removal capacity were in the equal proportion (87%), *Vigna mungo* and *Zea mays* (70%) removed turbidity, tea powder ash, *Allium cepa* peel ash waste and *Phyllanthus niruri* ash removed more than 95% of the turbidity. Keogh et.al (2017) used natural coagulants *Moringa oleifera* seeds powder for the treatment of solids in low strength wastewater having turbidity less than 30 NTU, the best result was found in 24 hours. Sasikala (2013) studied on reduction of turbidity from the drinking water using natural coagulants like *Phaseolus vulgaris*, *Moringa oleifera*, *Strychnos potatorum* etc. Cheng (2008) studied on removal of organic substances from the less strength turbidity wastewater by using metal polysilicate coagulant. Marina (2009) removed turbidity from the water by using natural coagulants that is obtained from chestnut and acorn. Qinget et. al (2009) worked on natural coagulants like Mercaptoacetyl chitosan to remove the turbidity from wastewater. The efficiency of turbidity removal by using Mercaptoacetyl chitosan with hydrolyzed polyacrylamides was found to be superior as compared to Mercaptoacetyl chitosan and the reduction of turbidity was reached near to 3 NTU. Hussain (2019) studied on purification of wastewater by using pine cone powder as a natural material to remove the turbidity. The efficiency for the removal of turbidity was found to be maximum (82%) at density 1.8g/cm. Senthil et. al (2016) worked on reduction of turbidity from discharged water of washing machine by using *Strychnos potatorum* seeds powder as a natural coagulant. The result was found that the percentage removal of turbidity was 68–89% and 65–84% at pH value 6 to 7 respectively. Keith (2015) used ground net shall and fine sand as a natural filter media, and rice husk as natural coagulant for the reduction of turbidity from the wastewater and found 60% turbidity removal. Sciban et. al (2009) worked on the removal of turbidity from the wastewater by using natural materials that are obtained from oak acorn and chest nut and found the coagulation behavior was maximum up to 70% and 80% turbidity removal efficiency were obtained from the of wastewater. Ndabigengesere and Narasiah (2010) worked on the removal of turbidity by natural *Moringa oleifera* seeds and the study were conducted at different concentration and period of time for quick and slow mixing of turbidity. Asrafuzzaman, et. al (2011) worked on the removal of turbidity from the wastewater by using *Cicer arietinum* as a natural coagulant and found most of the turbidity was effectively removed by 95.89% and the coliform were also reduced to 89-96% from the wastewater. Prihatinningtyas (2019) worked on removal of turbidity from the wastewater by using *Lemna perpusilla* and found the turbidity removal at pH 11 and 30 ppm coagulants concentration was 82.02%, 88.98% and 92.48% for 50, 150 and 300 NTU concentration respectively. Priyatharishini (2019) worked on removal of turbidity from synthetic wastewater by using banana peel powder as natural coagulant and found 88% removal efficiency. Badrus zaman (2018) removed turbidity from the wastewater by using *Plantago ovate* seed powder as a natural coagulant through coagulation and flocculation process. It has been found that more than 90% of the turbidity removal efficiency was achieved at 6-8 pH values. The flour of *Moringa oleifera* seed has been previously used for the treatment of many types of impurities from the wastewater and found that it has more than 90% ability to remove the turbidity and color. *Tamarindus indica* pod seeds were also found to be capable for the reduction of golden and yellow dye by 60% and 25% for quick crimson dye removal. Ramavandi (2014) worked on removal of turbidity from wastewater by using *Plantago ovata* as a coagulant and found 95.6% removal efficiency of turbidity for (50NTU-300NTU) concentrations. Alkalinity is the chemical property of the water and can neutralize the acid due to the presence of carbonates, bicarbonates and hydroxide compounds such as calcium, sodium and magnesium. Amarasooriya (2019) studied on removal of alkalinity from the ground water by electrolysis method and found 82% of removal efficiency. Diaz (2016) worked on removal of alkalinity from Sinu River wastewater using *Trigonous* stems in saline *Hylocereus sp.* and gum exudate of *Albizia saman* bark, seed of *Moringa oleifera* and the barks of the *Guazumaulmi folia* and found 50%, 70% and up to 75% alkalinity removal. Kannan (2014) worked on removal of alkalinity from groundwater by using *Phyllanthus*

indica wood and found 89.78% removal efficiency. Kankeu (2017) removed alkalinity from wastewater by using RO–rejected water and found 67% removal efficiency. Kispergher (2017) worked on removal of alkalinity from the dairy wastewater by bio methanation process and found 46.7% removal efficiency with a maximum of 55.5%. Ozkok (2015) worked on removal of high alkalinity wastewater or leachate generated wastewater from the old steel slag and found 71% of the alkalinity was reduced. Segura et.al (2011) studied on removal of alkalinity from the wastewater by using corn grain stover and cobs. Singh and Kishor (2020) studied a review on removal of turbidity and TDS from the water and wastewater by using natural coagulants. Ramal et.al (2022) worked on removal of Euphrates River water turbidity by using new natural coagulant aids and found maximum 97.72% turbidity removal. Getahun et.al (2024) removed the color and turbidity through coagulation process by using bio-coagulant from the wastewater of wet coffee processing industry. The color and turbidity removal efficiency were found to be about 99.99% and 98.7% respectively. Ozun (2024) studied on Enhanced implications on removal of turbidity from the wastewater released from natural stone by using binary mixtures. The turbidity removal efficiency was found to be $\leq 98\%$ at pH 4 and $\geq 99\%$ at pH 2. Mahanna et al (2024) treated the turbid wastewater by using oat and onion seeds based derived natural, eco-friendly coagulants. The result was found that 99% removal efficiency was reported by using oat extract and 98.9% by onion extract. Amin et al (2025) done a comparative study on use of lupin beans and rice straw extract for the removal of turbidity from the water and achieved 86.4% turbidity removal by lupin bean extract and 98.7% by combing both natural coagulants.

CONCLUSIONS

This is concluded from the literature and assessment that the various types of natural coagulants were previously used in recent past for the removal of turbidity and alkalinity from the water and wastewater. Some of the natural materials were found to be extremely capable for the removal of turbidity and alkalinity. It has been found that these natural materials are more successful over the chemical and conventional based coagulants. This has been found and observed after an extensive review from various literatures and reports that the natural coagulants can be proved to be an excellent natural substrate for the removal of turbidity and alkalinity from the water and wastewater. The water and wastewater treatment with naturally available coagulants are valuable, since it is a cost-efficient, environment friendly, sustainable and are alternative option for the treatment of water and wastewater on real ground. The natural coagulants are emerging as an alternative and eco-friendly coagulants day by day as compared to chemical-based coagulants for the treatment of water and wastewater.

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