Removal of Turbidity and TDS from Wastewater by Using Natural Coagulants — A Review

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Abstract: The highest quantity of wastewater is produced from lather industries that is mixed with oil and other pollutants and under goes to the drains from sinks, toilets, laundries, showers, etc. The waste water is usually classified as industrial wastewater or municipal wastewater. As the population of the earth is very huge there is a requirement that the treatment of wastewater become necessary by using different techniques. The removal of TDS and Turbidity are here done by natural coagulants such as Strychnospotatorum, Passion fruit, Phaseolus Vulgaris, Chitosan, Cicer Arietinum, Cactus, Nirmali seeds, Vingna Mungo, Ripe Okra, Surjana seed powder (SSP), Orange peel, Moringa Oleifera, and Maize seed powder. This is found from the literature review that; Jar tests were prominently used in the coagulation-flocculation process for the removal TDS and Turbidity from wastewater. The objective of this review is to find out the scope of different natural coagulants as an alternative compared to other commercial chemical-based coagulants. It has been found from the literature review that these natural coagulants are alternative, cheaper, eco-friendly, and easy to use in wastewater treatment.

Keywords: Wastewater, Natural Coagulant, TDS, Turbidity, Jar Test
1. Introduction

Clearwater is a basic need of the human beings but unfortunately, it is not available to a large segment of the human population because the treatment of effluent coming from domestic and industrial uses are done at the small scale. Turbidity and TDS are part of wastewater treatment hence, it is necessary to make the water clear for drinking purposes or any other uses [1–3].

1.1 Turbidity

The scattering properties of light is due to the suspended particles is known as turbidity. Turbidity makes the water cloudy. The main impact of turbidity is esthetic [4–7]. If the value of scattered light intensity is high, then the turbidity value will also high. SI unit of Turbidity is NTU (Nephelometric Turbidity Units).

1.2 Effects of Turbidity

Turbidity can affect aquatic life as well as human life. Turbidity helps in increasing the growth rate of algae and some aquatic plants because it does not allow the sunlight to penetrate deeper in the water [8–12]. Turbidity also increases the temperature of water because the suspended particles present in water absorbs the heat.

1.3 Total Dissolved Solid (TDS)

TDS include both volatile and non-volatile solids. Volatile solids are those solids that can convert from solid to liquid state and nonvolatile solids are those solids that cannot be converted to gases directly. Therefore, TDS concentration is the sum of the cations (+vely charged) and the anions (-vely charged) ions present in the water. The SI unit is parts per million (ppm).

Total solids = Dissolved solids (DS) + Suspended solids (SS)

1.4 Effects of TDS

The level of TDS in drinking water affects the taste of the water. The levels of TDS affect the animals much more than humans [13–15].
1.5 **Natural Coagulants**

The natural coagulants are plant-based coagulants that can be used for both Turbidity and TDS removal by the coagulation-flocculation process from wastewater. Natural coagulants were used in different industries like a dairy, tannery, textile etc. for wastewater treatment [16–19]. The natural coagulants can be used as an alternative cost-effective, environment-friendly and sustainable coagulants in water and wastewater treatment.

2. **Literature Review**

Sasikala and Muthuraman (2014) used Strychnos Potatorum, Phaseolus vulgaris, and Moringa Oleifera to remove turbidity from potable water. In this experiment, NaCl and NaOH solvents were used to extract the natural coagulants from the seeds. The removal of Turbidity was found to be 99% with Moringa Oleifera as compared to other coagulants. Coagulants like Chitosan, Drumstick seed powder and Corn seed powder to eliminate the Congo red dye from synthetic solution. The percentage removals were found to be 89.4, 98.0 and 94.5 for Chitosan, SSP and MSP respectively. The elimination of COD and Turbidity by using natural coagulants like Cicer Arietinum and Moringa Oleifera from effluent coming from tannery industry and found (90%) COD removal and (82.02%) Turbidity removal respectively. 50% removal among the coagulants i.e., Cactus, Nirmali seeds and Tannin to treat wastewater. Experimented to determine the emerging use of natural coagulants (Tannin, Moringa Oleifera, Cactus and Nirmali seeds) to treat both supply water and industrial wastewater. Choy et.al, (2014) worked on the application of natural coagulants like Vingna mungo and found (90%) turbidity removal, and with Zea maze (76%) turbidity removal. Kumar et.al, (2017) found COD and turbidity curtailment with Moringa Oleifera by 83.33%, and 82.02% with Cicer Arietinum. The 90% (COD) and 81.8% (Turbidity) removal were obtained from Cactus respectively for treating wastewater biogenic iron oxide as iron plaque of Typha latifolia and banded iron formation for removal of Cr$^{6+}$ and Cu$^{2+}$ ion. The result was obtained as 91.6% and 96.2% removal for Cr$^{6+}$ and Cu$^{2+}$ ion respectively with iron plaque of Typha latifolia and 88.65% for Cu$^{2+}$ ion with banded iron formation. reviewed on removal of color, dye and heavy metal with different natural materials and advance nano-materials respectively. the synthetic dairy industry and agricultural-industry wastewater. The result was observed as 50.3% (COD) and 91.5% (Turbidity) removal with passion fruit seeds whereas 48.3% (COD) and 91.8% (Turbidity) with Okra. both chemical coagulant (Alum), and natural coagulant (Moringa Oleifera) for wastewater treatment coming from textile industry. coagulants like Clearing Nut and Moringa Oleifera and artificial coagulants like iron coagulants (FeSO₄) and sodium coagulants (alum) for wastewater treatment from the vehicle industry. The results were obtained 81% and 65% removal for turbidity, 87% and
77% for COD respectively. worked on sewage wastewater treatment using natural coagulants like cantaloupe and watermelon seeds powder. The percentage removal was obtained 92.1 (BOD) and 92.8 (TSS) respectively Dolichos lablab, Cicer Arietinum, and Moringa Oleifera for reducing turbidity. In this study, the reduction of coliform was found from 89 to 96 Lilva beans and Cactus as natural coagulants and aluminium and iron salts as chemical coagulants. The obtained result was found to be 89.03% and 77.10% removal of turbidity and 20.15% and 11.52% removal for bacteria. experiments on natural coagulants to eliminate the turbidity from non-toxic water. coagulants like Moringa Oleifera and Al2(SO4)3 for treating the effluent from the textile industry. The removal of COD and colour were obtained 83.05% and 82.2% from this experiment. Okra (natural coagulants) to treat textile industry effluent through the coagulation- flocculation process. The percentage of removals was obtained 85.69% (COD), 93.57% (colour) and 97.24% (turbidity). chitosan for the removal of turbidity and colour from industrial wastewater. The percentage removal of turbidity and color was 90.14 and 76.2 respectively. wastewater treatment using natural coagulants. The turbidity removal efficiency was found to be 75.01%. coagulants (Orange peel powder) in coagulation-flocculation process and found that the initial Turbidity 260 NTU reduced to 8 NTU. Al2(SO4)3.18H2O (Alum), Cactus and PAC (Poly Aluminium Chloride) for sustainable treatment of potable water. The obtained results were found that on increasing the pH from 7.2, 7.4 and 8.1 the turbidity was reducing to 510NTU, 415NTU and 150NTU respectively. the Acorn and Chestnut (natural coagulants) to remove the turbidity. The result was obtained as 70% and 80% turbidity removal respectively. turbidity removal efficiency using Jatropha Curcas seeds and found 99.4% turbidity removal. the Turbidity and COD were reduced to 39.76% and 62.4% at optimum condition by using plant-based natural coagulant i.e., S the turbidity removal from wastewater by using a natural coagulant and 78% highest turbidity reduction efficiency was found. experiments on coagulation-flocculation process to treat the tannery industry wastewater. The maximum efficiency of turbidity and conductivity removal was found to be 87% and 55% respectively. natural coagulants i.e., Moringa Oleifera and Strychnos Potatorum in wastewater treatment by filtration method. The result shows the reduction from 5-10 MPN for fecal coliforms, 5-20 Cfu/ml for heterotrophic bacteria and 0.3-1.5 NTU for turbidity respectively. Chitra and Muruganandam (2020) worked on greywater treatment by natural coagulants. They determined the coagulation efficiencies of various coagulants like Banana peels. Moringa Oleifera, Fly ash and Tamarind seeds. It was found that the percentage removal of turbidity was 94.27% for Banana peels, 90.42% for Moringa Oleifera, 96.49% for Fly ash and 61.39% for Tamarind seeds under identical conditions. graphene oxide in coagulation process from open water to check the turbidity removal and found more than 95% of turbidity removal under optimum conditions. plant-based coagulant (Carica papaya seeds) to remove the coliforms and turbidity. It was found that the percentage removals of turbidity and coliforms was 97.1% and 95.7% at pH 6 respectively.
Moringa Oleifera, Chitosan and Cactus as plant-based coagulants for the reduction of turbidity in coagulation process removal of heavy metals and turbidity from wastewater by using Moringa Oleifera seed powder and found (85-94%) turbidity removal, (2.58-4 mg/l) dissolved oxygen (DO) and (98%) heavy metal removal like Cu and Cd. Prasad and Rao (2016) studied on removal of turbidity and heavy metal from wastewater by plant-based coagulants such as Moringa Oleifera and Tamarindus Indica seeds and found 1.8 NTU and 3 NTU turbidity, 70% and 73% heavy metals and 34% and 10% hardness removal respectively turbidity and COD removal by using natural coagulants (potato flour and Sago) and chemical coagulants (Al2(SO4)3 and PAC) in semiconductor wastewater treatment and found 1.5g/l reduced turbidity and COD removal.

3. Conclusion

It is concluded from the literature review that; the natural coagulants were proved to be the best alternative coagulants to eliminate the TDS and Turbidity from wastewater. The water treated with these natural coagulants were found to be useful because it is cost-effectiveness, environment-friendly, social acceptability and sustainability. Since chemical coagulants involves higher cost in procuring chemicals hence, the natural coagulants are cost-effective, as they are abundantly available. It is also concluded that lesser dosages of natural coagulants are required against artificial coagulants to treat the wastewater coming from various sources. Natural coagulants were proved to be better than conventional one because of the commercialization of plant-based coagulants. Some of these coagulants are also used as disinfection for bacteria removal presents in surface water. Since millions of tons of chemicals are used for treating the effluents of industries; hence the utilization of natural coagulants will be a great success for the elimination of chemicals. The scope of natural coagulants is increasing day by day as compared to other chemicals-based coagulants for treating the wastewater.

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