UTILIZATION OF MORINGA OLIEFERA LEAVES COAGULANT FOR LEACHATE TREATMENT : CASE STUDY OF PASURUHAN LANDFILL, MAGELANG REGENCY

Rizqa Puspitarini[1*], **Riva Ismawati**[2], **Adi Iriyanto**[1]
[1]Environmental Engineering Departement , Polytecnic of Muhammadiyah Magelang
Jl. Tentara Pelajar No. 12 Muntilan, Magelang, 56413
[2]Natural Science Education Departement, Universitas Tidar
Jl. Kapten Suparman 39 Potrobangsan, Magelang Utara, Magelang, 56116
[*]Email: rizqapuspitarini13@gmail.com

Abstract

Waste has caused environmental problems, especially waste processing that is not yet optimal. Open dumping waste processing is still used in waste processing. Open dumping waste processing will produce leachate pollution. The research aims to test the quality of leachate by utilizing the natural coagulant of Moringa leaves to reduce the total dissolved solids (TDS) and conductivity of the leachate. The coagulant was made by macerating Moringa leaves using 70% ethanol and leaving it for 72 hours. Moringa leaf coagulant was contacted with leachate samples from the Pasuruhan Magelang landfill using variations in coagulant mass and contact time. Treatment with a coagulant mass of 1 gram and a contact time of 10 minutes was able to reduce leachate TDS levels by 1020 mg/L with an effectiveness of 55.98%. Treatment with a coagulant mass of 1 gram and a contact time of 15 minutes can reduce the leachate conductivity by 2333 cm/s with 79.38%. The use of natural coagulants from Moringa oliefera leaves can be used as an alternative treatment method for handling leachate.

Keyword:*: Leachate, Moringa Oliefera*

1. INTRODUCTION

Landfill is a method commonly used for the systematic and safe disposal of solid waste such as rubbish from hazardous waste (Osra et al., 2021).Most developing countries use sanitary landfills for waste processing. However, open dumping waste processing is still used in waste processing. In Indonesia, open dumping waste processing is still used, which has caused environmental problems. Open dumping waste processing will produce leachate water pollution. Waste in final landfills (TPA) will experience a complex degradation process due to chemical, physical and biological waste processes (Lindamulla et al., 2022). This waste will produce leachate produced by percolation of rainwater through the waste which is disposed of in landfills. The quantity of leachate is determined by rainfall, evaporation, transpiration and soil infiltration (Kamaruddin et al., 2017).

Leachate consists of four types of pollutants: dissolved organic materials (organic carbon, fatty acids), inorganic compounds (chloride, ammonium, phosphate, nitrate), heavy metals (copper, zinc, lead, mercury), and xenobiotic organic compounds (XOCs) (benzene, phenol, phthalate) (Kumari et al., 2016). If leachate enters the aquatic environment, it will cause surface water pollution. The leachate will seep and enter the ground, resulting in pollution of ground water and soil around the final waste disposal site. Groundwater pollution by leachate occurs because the leachate seeps and spreads along the ground flow so that the leachate pollutants enter the soil.

Waste processing technologies that are often used include physical, chemical and biological processing. Physical waste treatment can be carried out using several methods including settling, media and membrane filtration (Obotey Ezugbe & Rathilal, 2020), adsorption and UV processes (Nimesha et al., 2022). Coagulation (Alibeigi-Beni et al., 2021), disinfection (Collivignarelli et al., 2017), ion exchange (Ergunova, 2017), catalytic reduction (Guo et al., 2020), oxidation and the softening process is chemical waste processing(Nimesha et al., 2022). Biological methods include microbial biodegradation (Huang et al., 2018), phytoremediation, process bioreactors (Nimesha et al., 2022), often used waste treatment using coagulation techniques. Coagulation is considered one of the simple methods to remove suspended solids and pollutants in water efficiently.

Natural coagulants have been widely used because they are natural, sustainable, environmentally friendly and non-toxic

compared to chemical coagulants.. Natural coagulants can be produced by extracting plants, microorganisms or animals (Teh et al., 2014). Some common ones include Moringa oliefera (Nonfodji et al., 2020), Nirmali seed (Prabhakaran et al., 2020), watermelon seeds (Bhattacharjee et al., 2020) and cactus species (Rebah & Siddeeg, 2017). Natural coagulants have a number of advantages over chemical coagulants such as cost-effectiveness and minimal side effects. Many parts of the Moringa oleifera plant (Nouhi et al., 2019) have been widely used for water treatment processes (Okuda & Ali, 2019) because of the presence of water-soluble (low molecular weight) proteins [19]. Several coagulants have been widely reported in conventional process water purification.

This article aims to test the quality of leachate water using natural coagulant Moringa leaves based on total dissolved solid (TDS) and conductivity. The research results obtained can be used as a basis for the use of Moringa leaf coagulant as a leachate treatment technique in final waste disposal sites.

2. METHODS

2.1. Materials and Tools

The chemicals used in this research were ethanol 70%, distilled water. The raw material of Leaves Moringa Oliefera.The sampel analysis of leachate in Pasuruhan Landfill, Magelang Regency. The tools used in this reseach include analytical balance, blender, oven, mohr pipettes, beaker glass, spatula, filter paper, separating funnels, TDS meter, EC meter,spray bottle, alumunium foil.

2.2. Synthesis of Moringa Oliefera Leaves Coagulant

Moringa leaves are cleaned with clean water until they are free of dirt, baked in the oven until dry, cut into small pieces, blended until smooth and sifted using a sieve. Moringa leaves powder 50 grams was weighed, macerated with 1 liter of ethanol 70% for 72 hours, placed in a beaker covered with aluminum foil, filtered using filter paper. The precipitate was dried using an oven until dry.

2.3. Performance Test of Moringa Oliefera Leaves Coagulant in Leachate

The coagulant test was carried out by directly contacting the Moringa leaf coagulant and leachate using varying coagulant doses (0.5 grams and 1 gram) and coagulant contact variations (5 minutes, 10 minutes and 15 minutes). Moringa leaf coagulant (0.5 gram and 1 gram) was added to 50 mL of leachate in a 50 mL Erlenmeyer flask. Stirring was carried out for 10 minutes, 20 minutes and 30 minutes. Moringa leaf leachate and coagulant are separated by filtration. The filtrate was measured for total dissolved solids (TDS) and conductivity.

3. RESULT AND DISCUSSION

3.1. Moringa Oliefera Coagulant

Coagulation and flocculation processes are often used in wastewater treatment. The aim of processing waste with this technique is to remove suspended colloidal particles. Environmental coagulants used in waste processing are chemical-based coagulants and natural-based coagulants. Chemical coagulants can use alum and iron salts. However, the use of chemical-based coagulants results in the production of sludge in large quantities and dangerous. Currently, much research has been developed on natural-based coagulants. Natural coagulants were chosen for waste treatment because they are safe and environmentally friendly. A part from that, natural coagulants can be extracted from plants, microorganisms and animals (Hariz Amran et al., 2018). Some plants can be used as natural coagulants because plants are able to become coagulants and carry out several coagulation mechanisms by neutralizing the charge in colloidal particles and linking polymers (Kristianto, 2017).

The potential of Moringa leaves as a natural coagulant in water purification (Pandey, Khan, Ahmad, et al., 2020).Moringa leaf extract is soluble in various organic solvents showing that the potential of Moringa leaves can reduce biological impacts, chemical and physiological impurities in groundwater thus adding to the strong beneficial role of moringa oleifera plants in the water purification process (Pandey, Khan, Mishra, et al., 2020). Research investigated the efficacy of Moringa leaves in having better coagulant potential (Alam et al., 2020). With the above considerations, this research ses Moringa leaves to reduce levels of total dissolved solids (TDS), conductivity and pH in leachate water (Pandey & Khan, 2022).

The coagulation process occurs between the coagulant added with dirt and the alkalinity of the water in the formation of insoluble floc. Floc is an agglomeration of particulate suspended matter in raw water, reaction products of chemical additives, colloids and

dissolved substances from adsorbed water by the products of this reaction. Untreated waste contains organic and inorganic impurities such as sludge, putrefactive substances, algae, bacteria, etc. Therefore, the coagulation process is an important step in waste processing. The coagulation process with natural coagulants will be successful depending on the characteristics of the coagulant used, characteristics of the water to be treated, characteristics mixing process (Kumar et al., 2017).

The coagulation mechanism consists of double layer compression, polymer bridging, charge neutralization and sweep coagulation. However, only polymers bridge and This charge neutralization is a coagulation mechanism that occurs in natural vegetable coagulant. The polymer bridging process is preceded by polymer adsorption is a process where polymers are long chains stick to the surface of colloidal particles due to the affinity between them. Only part of the polymer sticks on the particles while the unbound parts will form circles and tails . These loops and tails are the main structural links of polymers because they allow attachment to other colloidal particles and thus forming larger flocs. Therefore, in the coagulation process, sufficient empty particle surfaces are required to obtain an effective polymer bridging and the bridging must reach far enough to overcome interparticle repulsion(Hariz Amran et al., 2018).

3.2. Effect Coagulant Mass on TDS Leachate

Optimizing the performance of Moringa leaves by combining coagulant mass and its effect on Total Dissolved Solid (TDS) parameters is presented in Figure 1. Figure 1 shows that the treatment of adding 0.5 gram and 1 gram of Moringa leaf coagulant mass can reduce TDS levels in leachate water. The addition of coagulant mass can reduce TDS levels for all contact times. Treatment of 0.5 gram coagulant mass with a contact time of 5 minutes can reduce TDS levels by 989 mg/L. Treatment of 0.5 gram coagulant mass with a contact time of 10 minutes can reduce TDS levels by 742 mg/L. Treatment of 0.5 gram coagulant mass with a contact time of 15 minutes can reduce TDS levels by 721 mg/L. Treatment with a coagulant mass of 1 gram with a contact time of 5 minutes can reduce TDS levels by 835 mg/L. Treatment with a coagulant mass of 1 gram with a contact time of 5 minutes can reduce TDS levels by 1020 mg/L. Treatment of 1 gram of coagulant mass with a contact time of 5 minutes can reduce TDS levels by 839 mg/L. The optimum TDS level of leachate with the addition of Moringa Oliefera leaves decreased when the coagulant mass was treated with 1 gram at a contact time of 10 minutes with an effectiveness of 55.98%.

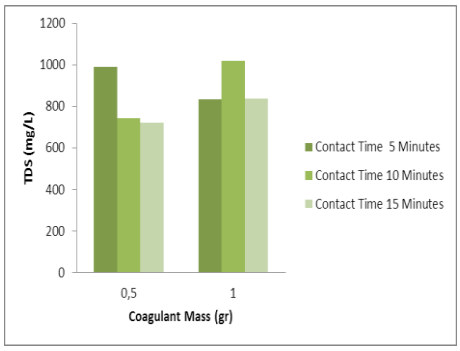

Figure 1. Effect Coagulant Mass Moringa Leaves on TDS

The decrease in TDS levels by Moringa Oliefera leaves is caused by the fact that they consist of polypeptide molecules with varying molecular weights from 6000 to 16000 acts as a thinning flocculant dissolved solids (Rahmadyanti et al., 2018). Moringa Oliefera leaves dissolve easily with organic solvents and can reduce TDS levels. The mechanism of Moringa Oliefera leaves is through the process of adsorption and neutralization of the positive charge of colloids which attracts negative charges in water (Dehghani & Alizadeh, 2016). There is neutralization between particles bridge between the negatively charged proteins in the seed causes floc formation in the flocculation process (Rahmadyanti et al., 2018).

Coagulant mass is one of the important parameters that must be considered in determining optimal conditions for the coagulation process to remove pollutants because coagulants change the negative charge of particulate, dissolved and colloidal contaminants. Determination of optimal coagulant mass in the coagulation process by increasing the coagulant mass. An increase in coagulant mass will occur Charged coagulants are adsorbed on the surface of negatively charged colloidal particles with charge neutralization due to increasing the dose will result in more coagulant coming into contact with the colloid particles to form aggregates, resulting in higher floc formation. The results showed that Moringa oleifera leaves extracts had significantly reduced TDS content in a

coagulant dose dependent manner (Pandey, Khan, Mishra, et al., 2020).

3.3. Effect Coagulant Mass on Conductivity

The addition of coagulant mass and its effect on conductivity is shown in Figure 2. Figure 2 shows that adding Moringa leaf coagulant mass can reduce the conductivity of leachate water. Treatment of a coagulant mass of 0.5 grams with a contact time of 5 minutes, a conductivity of 2087 µs/cm. Treatment of a coagulant mass of 0.5 grams with a contact time of 10 minutes resulted in a conductivity of 1863 µs/cm. Treatment a coagulant mass of 0.5 gram with a contact time of 15 minutes reduces conductivity by 2185 µs/cm. Treatment of a coagulant mass of 1 gram with a contact time of 5 minutes produces a conductivity of 2030 µs/cm. Treatment of a coagulant mass of 1 gram with a contact time of 10 minutes with a conductivity of 2302 µs/cm. Treatment a coagulant mass of 1 gram with a contact time of 15 minutes reduced the conductivity by 2333. The optimum conductivity of leachate with the addition of Moringa leaves decreased in the coagulant mass was treated with 1 gram at a contact time of 15 minutes treatment with an effectiveness of 79,38%. The increasing coagulant mass of Moringa oliefera causes a decrease in conductivity, characterized by maximum effectiveness when treating a coagulant mass of 1 gram with a contact time of 15 minutes.

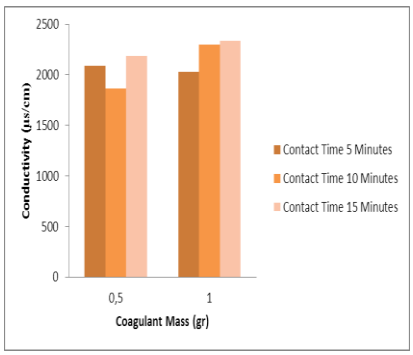

Figure 2. Effect Coagulant Mass Moringa Leaves on Conductivity

3.4. Effect Contact Time on TDS

The performance of Moringa leaves by combining contact time and its influence on the Total Dissolved Solid parameters is presented in Figure 3. Figure 3 shows that treatment with contact times of 5 minutes, 10 minutes and 15 minutes can reduce the TDS levels of leachate water. The optimum TDS level of leachate with the addition of Moringa leaves decreased the contact time by 10 minutes.

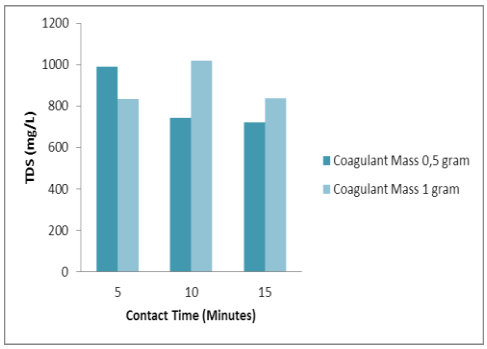

Figure 3. Effect Contact Time Moringa Leaves on TDS

The main factor that influences wastewater treatment using Moringa Oleifera is contact time (Gali Aba Lulesa et al., 2022).Moringa leaf coagulant reacts with leachate, there will be an interaction between the coagulant and pollutants in the leachate. The effect of contact time on reducing TDS can be seen in Figure 3. Increasing the contact time of Moringa leaf coagulant can reduce TDS levels in leachate water. This is because the particles formed react with leachate pollutants as the contact time increases.

3.5. Effect Contact Time on Conductivity Leachate

The performance of Moringa leaves by looking at the effect of contact time on conductivity parameters is presented in Figure 4. Figure 4 shows that treatment with contact times of 5 minutes, 10 minutes and 15 minutes can reduce the conductivity of leachate water. The optimum conductivity of leachate with the addition of Moringa leaves reduces the contact time by 15 minutes.

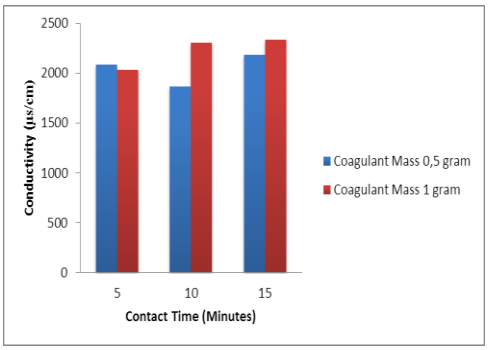

Figure 4. Effect Contact Time Moringa Leaves on Conductivity

The effect of contact time on reducing conductivity can be seen in Figure 3. Increasing the contact time of Moringa leaf coagulant can reduce the conductivity of leachate water. The optimum contact time of 15 minutes reduces the conductivity of leachate water. The decrease in leachate conductivity can be caused by a decrease in TDS levels (Olanrewaju & Jeged, 2018).

4. CONCLUSION

Natural coagulants based on Moringa Oliefera can reduce Total Dissolved Solid (TDS) levels and conductivity in leachate water. Treatment with a coagulant mass of 1 gram and a contact time of 10 minutes was able to reduce the TDS levels of leachate water. Treatment with a coagulant mass of 1 gram and a contact time of 15 minutes can reduce the conductivity of leachate water. The use of natural coagulant from Moringa oliefera leaves can be used as an environmentally friendly alternative method for treatment in reducing TDS pollutant levels and conductivity.

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