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THE LEACHATE TREATMENT BY USING NATURAL COAGULANTS (PINE BARK AND CHITOSAN)

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Abstract- *Leachate is a concentrated liquid that originates from the solid waste at the dumping sites. Release of leachate to the environment without any treatment may pollute the soil, and both surface and ground water. Coagulation is a most common method used for the removal of soluble metals. Natural coagulants are effective in the treatment of both wastewater and Leachate. In this study, leachate collected from the waste dumped site were treated with different natural coagulants such as chitosan and pine bark in order to remove the heavy metals present and also to reduce its turbidity. The nearby pond water also collected to check whether it is contaminatedwith leachate. The Municipal Landfill Leachate and nearby Pond water was analyzed for different Physico-Chemical parameters such as pH, Temperature, TDS, BOD, COD, Total Alkalinity, Chlorides. On the basis of turbidity, the result of coagulation showed that natural coagulants was most efficient under acidic and neutral conditions. At the coagulant dosage of chitosan 0.6g/mL removal of Turbidity is 85.2% and at the optimum pH 6 the maximum removal of turbidity was 91.3% and for the pine bark dosage of 4g/mL removal of turbidity is 83.3% and at optimum pH 7 the removal of turbidity was 85.2%. The present investigation also deals with analyzed of the heavy metals concentration before and after treatment in municipal solid waste leachate. The analytical analysis revealed that the leachate showed higher concentration of heavy metals viz.,As, Cu, Cr, Pb, Hg and Ni. Treatment with the natural coagulants have shown higher removal efficiency of metals and Turbidity.*

Keywords: Coagulation, Heavy metals, Leachate, Natural Coagulants, Turbidity.

1. INTRODUCTION

The use of landfill to manage solid waste has produced a hazardous liquid named as "leachate". Leachate can be defined as a liquid that is generated when water or another liquid comes in contact with waste. Leachate is a contaminated liquid that consists of different organic and inorganic compounds that may be either dissolved or suspended. As a contaminated liquid, leachate poses potential pollution to both groundwater and surface water and also it will contaminate the soils in areas adjacent to landfill sites. There are many methods used to treat leachate from the landfill. The treatment can be carried out on or off site by physical, chemical or biological methods. For this study, it will be focus on leachate treatment by a natural polymer named "chitosan"and "pine bark". First, collected leachate will undergo screening process in purpose of removing suspended, huge and hard materials from entering the treatment plant. Then, screened leachate will undergo grit separation process before the treatment with chitosan and pine bark treatment with chitosan and pine bark will reduce heavy metal ions concentration in leachate. By reducing the concentration of heavy metal ions, leachate is safer to direct to wastewater treatment plant. In wastewater treatment plant, leachate will undergo other treatment as experienced by sewage. After undergo several treatment process in wastewater treatment plant, the leachate now becomes decontaminated and is safe to be discharge to the water works or to the rivers. Heavy metals are the metals whose density is greater than 5 g/cm3, e.g. Iron (fe), copper (cu), zinc (zn), mercury (Mg), manganese (Mn), and others. Iron concentration in leachate is normally contributed to by iron-base material waste, such as concentration materials, paints, pigments, color compounds, polishing agents and electrical materials. Different types of solid waste, will contribute to different type of metal ions. The efficient methods of heavy metal ions removal from wastewater and leachate are adsorption, chemisoption and biosorption. The most popular adsorbates, reported in the literature are gels of silicic acid, activated carbon, zeolites, tree bark, biomass, lignin, dried mushrooms and chitosan. Chitosan is a derivative of chitin. It is found in the insect's shells, fungi cell walls and in the shells of crustaceans. Commercial value of chitosan is its affinity to heavy metal. In the previous research, chitosan has been found to be effective at removing heavy metal from water sources. Most important thing is chitosan is 100% biodegradable compound. So, it doesn't bring pollution to the environment. In wastewater treatment, chitosan is used as an effective coagulant/flocculant alternative to conventional inorganic coagulants such as alum and ferric chloride. Chitosan is capable for binding the negatively charged particles, heavy metals and oils. Bark is widely used as adsorbent material for organic pollutants, and since 1980 investigated as a possible adsorbent for heavy metals. Studies covered all the heavy metals of concern and bark from different sorts of trees. Most of the papers describe batch experiments with one metal solutions and changes in pH conditions.

2. MATERIALS AND METHODS

The materials used in this project are categorized according to the nature of the use, they are,

- Sample collection
- Materials required
- Physico-Chemical parameters analysis
- Treatment using natural coagulants

Fig 1: Dumping site Leachate collection

METHODOLOGY

SAMPLE COLLECTION

The municipal leachate is collected from dumping site located at sadhuperi in vellore. And to check contamination of leachate, water is collected from the pond just opposite to the dumping site. In sadhuperi both degradable, non-degradable wastes and e-waste (electronic waste) are dumped in the same place without segregation which will contain heavy metals, oils, etc., The collected municipal Leachate and water sample were taken in clean plastic containers and stored in refrigerator at -4$_0$C. The initial parameters were immediately analyzed Then, water were analyzed for the initial parameters such as pH, electrical conductivity, chlorides, total alkalinity, total hardness, and iron.

MATERIALS

The materials used in this project are categorized according to the nature of the use, they are,

- Glassware
- Chemical reagents
- Natural coagulants

CHITOSAN

Chitosan is a derivative of chitin. It is found in the insect's shells, fungi cell walls and in the shells of crustaceans. Commercial value of chitosan is its affinity to heavy metal. In the previous research, chitosan has been found to be effective at removing heavy metal from water sources. Most important thing is chitosan is 100% biodegradable compound. So, it does not bring pollution to the environment. In wastewater treatment, chitosan is used as an effective coagulant/flocculant alternative to conventional inorganic coagulants such as alum and ferric chloride. Chitosan is capable for binding the negatively charged particles, heavy metals and oils.

Fig 2: Crustaceans shells Chitosan powder

PINE BARK

Pine bark is the one of the most investigated materials and showed good adsorption properties for lead, copper, cadmium and nickel. Comparison of sorption properties of several coniferous barks has been done. Eucaliptus and Yohimbe bark were also showed to be efficient in adsorption of metal ion. Several studies were carried out with chemically pretreated pine bark , a few of these studies showed decreasing sorption capacity of pre-treated bark compared to crude bark. Adsorption capacity of bark is attributed to its high tannins content. Tannins are a group of water-soluble phenolic compounds having molecular weight between 500 and 300 giving usual phenolic reactions, and having special properties such as ability to precipitate alkaloids, gelatin, and other proteins. Molecular weights as high as 20000 have been reported. Approximately empirical formula of tannic acid, or gallotannic acid which is most often referred as "tannin" is $C_{76}H_{52}O_{46}$. The polyhydroxy polyphenol groups of tannins are thought to be the active species in the metal sorption process. Ion exchange takes place as metal cations displace phenolic hydroxyl groups, forming a chelate. Pine bark produced for adsorption of oil spills. This bark contains 90% of pine bark and 10% of wood fibre. It was additionally ground before use in the column experiments. Packed in the column, bark showed good kinetic characteristics.

Fig 3: Pine tree Pine bark powder

COAGULATION -FLOCCULATION PROCESS

Jar test is the most widely used experimental methods for coagulation-flocculation. A conventional jar test apparatus was used in the experiments to coagulate sample of turbid water using natural coagulant. It was carried out as a batch test, accommodating a series of six beakers together with six-spindle steel paddles. Before operating the jar test, the sample was mixed homogenously and the procedure is as follows:

Fig 4 :Treatment of Leachate using Coagulation process

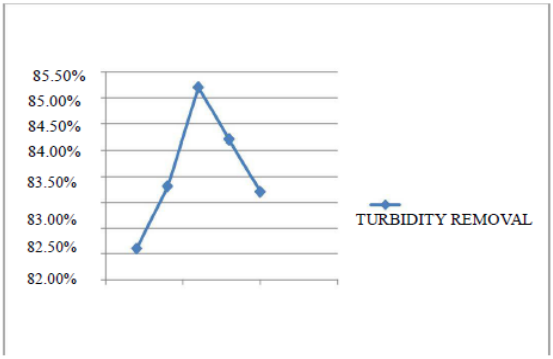

Fig 5: Chitosan Powder dosage Vs Removal of Turbidity %

Procedure of Coagulation Process:

- Take 500ml of sample in each of the 6 beakers.
- Add varying doses of coagulants (natural and chemical) of 0.05 to 5 gm/ml in different beakers simultaneously.
- Switch on the motor and adjust the speed of paddles to about 100rpm and rapid mixing is done for 1-2 minutes.
- Reduce the speed of paddles to about 30 to 40rpm and continue slow mixing for 20 minutes. This corresponds to process of flocculation.
- Switch off the motors and allow it to settle for20-60 minutes. This corresponds to sedimentation or settling of impurities.
- Collect the supernant from each beaker with the help of pipette, without disturbing the sediment and measure the percentage of turbidity removal using Turbidity meter.
- Turbidity removal corresponding to various doses of natural coagulant measured and the least dose producing maximum removal was designated as optimum coagulant dose.
- Optimum system pH was found by adding optimum coagulant dose and the pH of the sample was varied from 5 to 9 and the pH value producing maximum turbidity removal (optimum pH) was determined.

TREATMENT USING NATURAL COAGULANTS

CHITOSAN POWDER

From this, volume of sample 500ml taken at different dosage 0.2, 0.4, 0.6, 0.8,1 gm/ml using, the percentage of turbidity removal was found to be increased with increase in the dosage level. The maximum amount of removal percentage obtained was 85.2% at 0.6g/mL

Determination of optimum pH

The optimum pH was determined at a pH of 6 and the turbidity removal was 91.3%. It was found that the percentage of turbidity removal was suddenly increased from pH 5 to 6 and the percentage of turbidity removal was gradually decrease with decrease respect to the pH.

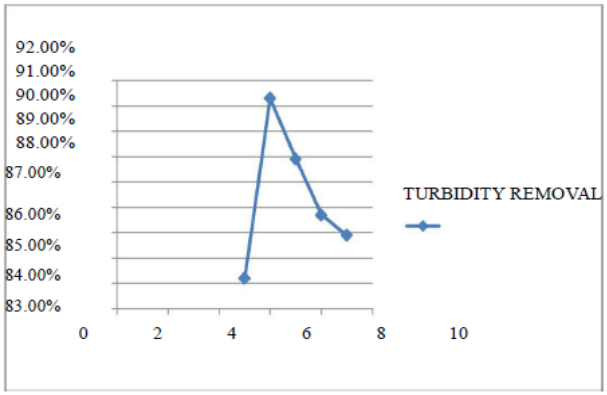

Fig 6: pH Vs Removal of turbidity (%) of Chitosan PINE BARK

The volume of sample 500ml taken at different dosage 2,4,6,8,10 gm/ml using pine bark as natural coagulant in jar test apparatus, the maximum amount of removal percentage obtained was 83.3% at 4gm/ml.

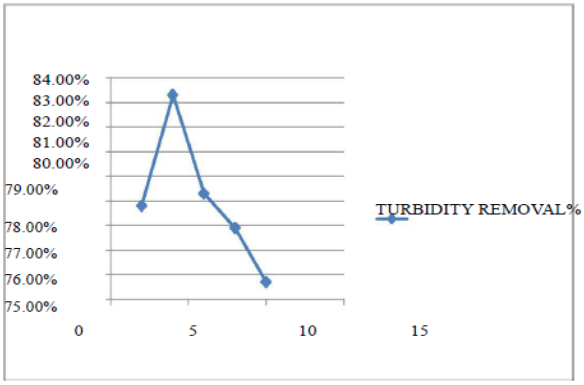

Fig 7 :Pine bark dosage Vs Removal of Turbidity %

Determination of optimum pH

The optimum pH was determined at a pH of 7 and the turbidity removal was 85.2%. It was found that the percentage of turbidity removal was gradually increased from pH 5 to 9 and then the % of turbidity removal was gradually declined.

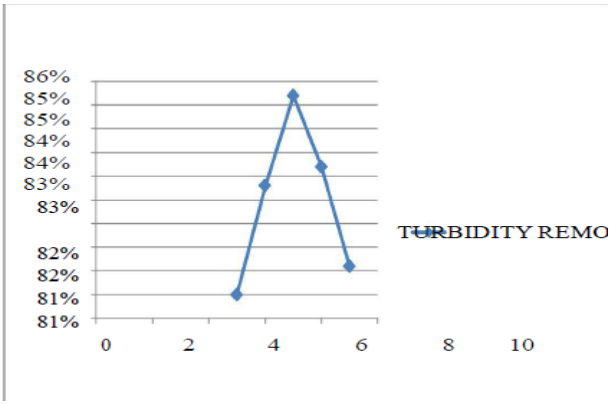

Fig 8 : pH Vs Removal of turbidity (%) of pine bark

3. CONCLUSION

The conclusions were drawn from the present studies on the removal of turbidity of the natural coagulant. From the study, it clearly shows that the natural coagulant (Chitosan powder and pine bark) are effective in the removal of turbidity .Therefore, the need for economical, effective and safe method for disposal of pollutant in leachate has resulted in coagulation process. Thus, the environmental pollutions can be reduced by adapting coagulation all over. The absence of proper management system and lack of adequate capacity for final deposition of solid waste has been a serious problem in urban areas. Developing countries like India have not been able to adequately address these problems due to high cost involved. This seems to be one of the reasons why contaminated dumpsites are often shut down for natural recovery of the site. Though there is a scarcity of data on physicochemical status of shut down dumpsites. The data recorded in this study support the assertion that most shut down dumpsites in heavily urbanized society may have been contaminated significantly due to on going human activities. This underlines the need for appropriate authority to further monitor shut down dumpsites alongside remediation process that may be initiated.

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