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EXPERIMENTAL STUDY ON BIO-COAGULANTS FOR TREATING THE POLLUTED GROUNDWATER BY USING JAR TEST APPARATUS IN VELLALORE DUMPING AREA

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Abstract - Groundwater, which is in aquifiers below the surface of the earth, one of the Nation's most important natural resources. Groundwater is the source of about 37% of the water that the country and city water departments supply to households and businesses. It supplies drinking water for more than 90% of the rural population. Most of the wastes from households and industries of the Coimbatore city is dumped in the Vellalore dumping yard. Due to this, the groundwater gets polluted in that area. The groundwater from that area cannot be used for domestic or drinking purposes. In order to overcome this problem, many treatment methods are available. In this present study, we have assessed the groundwater characteristics and treated it by using natural coagulants. The bio-coagulants used are Artocarpus heterophyllus (Jackfruit peel), Momordica charantia (Bitter gourd seed), Musa paradisiaca (Banana flower leaf), Cynodon dactylon (Scutch grass). These bio coagulants are effective in removing the turbidity content and maintaining the pH of the water. These natural coagulants are also found to reduce the BOD, COD, Salt content. By removing and reducing all these contaminants we can utilize the treated groundwater for domestic purposes. It is found to be a cost-effective method.

Keywords: Groundwater, Vellalore dumping yard, Jackfruit peel, Bitter gourd seed, Scutch grass, Banana flower leaf.

1.INTRODUCTION

Water is an essential material that plays an important role in human life. Without water, we cannot run our lives. In the whole world, only 3% of water is available. In that, the useable water is very low. Groundwater is the most important useful water resource which can be used for domestic and industrial purposes. Nearly 30% of freshwater originates from groundwater. Due to rapid industrialization and population explosion, the amount of waste produced and disposed of has also increased. Most of the wastes are dumped inland. The leachate formed from the wastes get infiltrated to the groundwater and pollutes it. Due to this, the quality of the groundwater gets diminished. This has led to various types of water treatment techniques for the improvement of the quality of water. In this present study, the coagulation process is used for the improvement of water quality. The commonly used coagulants are the salts of aluminum and iron.

The salts of aluminum in water have reported causing Alzheimer's, cancer, nervous disorders, etc., So it is necessary to search for natural coagulants for simple, reliable and effective treatment of wastewater.

Jackfruit is a naturally available source of starch content. Since jackfruit is a rich source of starch it can be used as an alternative for chemical coagulants. By using the jackfruit peel as a natural coagulant the treatment process can be done as an eco-friendly and cost-effective treatment. It can be used to reduce turbidity and COD.

Bitter gourd is an agricultural product that is a natural anti-oxidant. It can be used as an alternative to the chemical coagulants in the water treatment process. It makes the coagulation process cost-efficient. It also contains vitamin content. It can be used to remove turbidity from the polluted water.

Banana flower can also be used as an alternative for chemical coagulants in the water treatment process. It is a naturally available material that contains a rich amount of starch. Since it contains a rich amount of starch banana flower leaf can be used as an effective natural coagulant in the coagulation process. It can also be used to reduce the turbidity and COD from the polluted water.

Scutch grass is a naturally available material that can be found in many places easily. It is a strong antibiotic. It can also be used to reduce turbidity from polluted water. It can also be used to reduce the salt content from the polluted water.

Coagulation is the process of removing suspended and colloidal impurities present in wastewater by using natural or chemical coagulants. Coagulation is the process by which the particles become destabilized and begin to clump together. Coagulation flocculation is one of the earliest processes involved in the treatment of wastewater. Its main objective is to remove the colloidal impurities and to reduce the turbidity content of the wastewater.

The coagulant materials are collected, dried and powdered finely and sieved in 0.45mm sieve in order to provide effective coagulation. By using Jar test apparatus coagulation process is done

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2.OBJECTIVES

The main objective of the project is to assess the turbidity removal efficiency of the natural coagulants used to treat the polluted groundwater.

3.MATERIALS AND METHODS

Polluted groundwater was collected near the vellalore dumping area. The samples were collected in sterilized bottles and were preserved in the refrigerator during storage. Sufficient care was taken to obtain a sample that was a true representative of the existing condition and to handle it in such a way that it does not deteriorate or become contaminated before it reached the laboratory. Initial characterization of wastewater samples were carried out and parameters like pH, turbidity, COD, hardness, total acidity, and total alkalinity were determined.

Table-1: Characteristics of polluted waste water

PRARAMETERS	VALUE
pH	8.9
Turbidity(NTU)	7
COD(mg/lit)	696
Total Hardness(mg/lit)	420
Total Dissolved Solids(mg/lit)	780
Calcium(mg/lit)	120
Sodium(mg/lit)	280
Total Alkalinity(mg/lit)	250
DO(mg/lit)	
Magnesium(mg/lit)	50

3.1 COAGULANT POWDER PREPARATION

Jackfruit peel, Bitter gourd seed, Scutch grass, and Banana flower leaf are collected from households and were boiled and Sun-dried for 48 hours. Then the dried coagulants were ground to a fine powder in grinding mills. The powder was sieved by using 0.45mm mesh and was stored in an air-tight container to prevent the entry of moisture into it and to avoid loss of its activity. The fine powder was used as a coagulant for analysis.

Fig-1: Banana flower leaf

Fig 2: Jackfruit peel powder

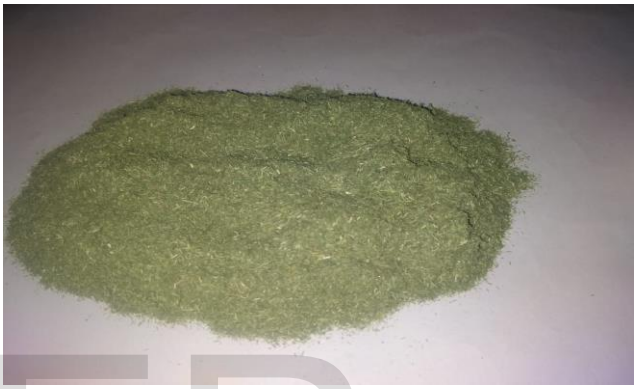

Fig 3: Scutch grass powder

3.2 JAR TEST APPARATUS

Coagulation and flocculation are the most common method used for the removal of turbidity, color, suspended matters, microorganisms, and other odor-producing substances. Coagulation can be done by using the Jar test apparatus.The portion of the coagulant to be utilized can be calculated by means of the Jar test.The Jar test involves the determination of different doses of the natural coagulant for the same volume of the samples to be treated and then simultaneously mixing the samples at a constant rapid mixing time. The micro floc formed after coagulation further undergoes flocculation and it is allowed to settle. Then the turbidity of the samples is measured and the dose with the lowest turbidity can be said to be the optimum dosage of the coagulant. The natural coagulant was fed to the respective samples in varying dosages. Initially, rapid mixing was carried out for two minutes at 100 rpm and followed by slow mixing for 35 minutes at 20 rpm. The mixing speed was reduced to 25-20 and mixing was continued for another 10 minutes. The sample after coagulation was allowed to settle down for 30 minutes. The supernatant obtained was filtered and its characteristics were determined.

Fig 4: Jar test Apparatus

4.RESULTS AND DISCUSSIONS

The optimum coagulant dosage was found by varying the coagulant dosage as 0.4, 0.8, 1.20, 1.60, 1.80 and 2.00g/lit for the polluted groundwater. The turbidity of the sample was measured by using Nephelometric turbidity meter and pH using pH meter.

Table 2: Final test results

Characteristics	Jackfruit peel	Bitter gourd seed	Banana flower leaf	Scutch grass
pH	7.3	8	7.9	7.4
Turbidity(NTU)	4.5	5	5.2	4.75
COD(mg/lit)	620	615	600	625
Total Hardness(mg/lit)	300	300	320	360
Total Dissolved Solids(mg/lit)	620	700	720	650
Calcium(mg/lit)	95	100	96	98
Sodium(mg/lit)	200	280	256	210
Total Alkalinity(mg/lit)	190	200	260	215
DO(mg/lit)	6.5	7	7.2	6.7

Upon treating with jackfruit peel powder, optimum coagulant dosage was obtained at 1600 mg/l for polluted groundwater. Turbidity reduction was 82% and the optimum pH range can be found to be between 7.7-7.9.

Upon treating with Bitter gourd seed powder, optimum coagulant dosage was obtained at 1200 mg/l for polluted groundwater. Turbidity reduction was 76% and the optimum pH range can be found to be between 7.5-8.

Upon treating with Banana flower leaf powder, optimum coagulant dosage was obtained at 2000 mg/l for polluted groundwater. Turbidity reduction was 58% and the optimum pH range can be found to be between 7.9-8.3.

Upon treating with Scutch grass powder, optimum coagulant dosage was obtained at 1400 mg/l for polluted groundwater. Turbidity reduction was 80% and the optimum pH range can be found to be between 7.8-8.

From this test, it is found that among the four natural coagulants jackfruit peel and Scutch grass are the most useful natural coagulants for treating the polluted groundwater.

5.CONCLUSION

In this study, we mainly analyzed the turbidity removal from the polluted groundwater by using natural coagulants such as Jackfruit peel, Scutch grass, Bitter gourd seed, and Banana flower leaf powder. Among the four natural coagulants, Jackfruit peel is found to be an efficient coagulant in reducing the turbidity of the polluted water samples from the vellalore dumping site.

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