Journal of Applied Science, Engineering, Technology and Management
Vol. 01, Issue 02, December 2023 pp. 35 - 39

Feasibility Study on Removal of Contaminants using Organic Adsorbents from Industrial Waste Water

AFNITHA M ALIYAR
Dept. of Civil Engineering,
Sree Narayana Gurukulam College of Engineering,
Kadayiruppu, Kerala, India

AKHALYA SHAJI
Dept. of Civil Engineering,
Sree Narayana Gurukulam College of Engineering,
Kadayiruppu, Kerala, India

CARMALA JOY U
Dept. of Civil Engineering,
Sree Narayana Gurukulam College of Engineering,
Kadayiruppu, Kerala, India

SHILPA M P
Dept. of Civil Engineering,
Sree Narayana Gurukulam College of Engineering,
Kadayiruppu, Kerala, India

S. Usha
Dept. of Civil Engineering,
Sree Narayana Gurukulam College of Engineering,
Kadayiruppu, Kerala, India
hodcesngce@gmail.com

***Abstract* — Water is important for the survival of human beings. If water contains undesirable particles it will become unfit for our purposes and hence it is necessary to be removed. Water purification is the process of removing physical, chemical and biological contaminants from water. There are various methods in purification of water, but may not be economically feasible. Naturally available herbs have best anti-microbial property, which may restricts the growth of microorganisms and purify water at lower cost. The type of purification can be economically done for waste water from chemical industry. In this research study, the contaminants removal from chemical industry waste water is explored using natural organic adsorbents such as Neem leaf, Curry leaf, and Banana peel powder. These adsorbents are used to reduce pollutants such as oil and grease from the waste water. The purify level of waste water can be found out by conducting various experimental tests for different parameters. The obtained test results are then compared with initial test result to find out which all waste water characteristics had been changed by the use these low cost organic adsorbents.**

Keywords - Component, Formatting, Style, Styling, Insert

I. INTRODUCTION

Among 120 crore Indians, 80% of them live in rural areas. Supplying safe drinking water economically to a large population is a daunting task. Meeting the drinking water needs of such a large population can be a daunting task. As a result, most of the rural population in India depends on local water sources such as ponds, wells, lakes, rivers etc. which may contain various microbial pathogens contamination. For the survival of human beings, water has the most important roles. It gives life to plants and animals. Being an inert liquid, it is used as universal solvent in many of the reactions.

The water gets polluted during different human activities. The Indian rivers are contaminated by the improper release of industrial effluents and untreated sewage [1]. Numerous contaminants have the potential to damage our ecosystem. One pollutant that, when found in waste water, can have a negative impact on the ecosystem is oil [2]. Special care is required to manage the quality of our resources. Different waste water types, including industrial, agricultural, and household effluent, can seriously contaminate environmental sources of surface water and other bodily fluids. Waste water disposal standards have to be considered before selecting proper treatment processes [2].

Fluorosis in the teeth, skeleton, and non-skeleton can be brought on by drinking water with excessive fluoride content. Health problems resulting from excessive daily fluoride exposure through drinking water are the main cause and have an impact on individuals in 20 Indian states. [3]. At the moment, there are DE fluoridation methods based on coagulation, chemical precipitation, absorption on solid filter media, and chemical separation. Electrodialysis, reverse osmosis, and nano-filtration are examples of physical separation techniques for DE fluoridation [4]. Numerous technologies have been unsuccessful in the field in rural areas because of their high costs, inability to find skilled operators, taste of treated water that is unappealing, and unrealistic operating requirements. Any of chemical, physical and biological treatment has its own advantage and disadvantage. Naturally available herbs have best anti-microbial property, which may restricts the growth of microorganisms and purify water at lower cost. The type of purification can be economically done for industrial waste water.

II. OBJECTIVES

The objectives of the study are to determine the waste water characteristics such as pH, Turbidity, BOD, COD, total suspended solids, sulphates etc. by conducting various parameter test.

a. To determine the waste water characteristics such as pH, Turbidity, BOD, COD, total suspended solids, sulphates, oil and grease etc. by conducting various parameter test.
b. To investigate the use of powdered neem leaves, curry leaves, and banana peel for waste water treatment by conducting various parameter test and to check the rate of purification.
c. To differentiate the various characteristics of waste water before and after the addition of mixed adsorbents

eISSN: 2584-0371

Received for review: 30-09-2023
Accepted for publication: 17-12-2023
Published: 27-12-2023

III. Sample Collection and Initial tests

A. Collection of sample

The sample was collected from a nearby chemical factory. The sample was stored in an airtight bottle as shown in figure 1. The collected waste water is stored in refrigerator. When it comes to its effects on the environment, the chemical sector is significant. In chemical industrial wastes, organic and inorganic materials are typically present in different proportions. It has a low concentration of suspended particulates, high biological oxygen requirement, color, oil, and grease content, as well as bases, acids, and hazardous compounds. In general, treating severely contaminated and hazardous industrial wastewater at the source is the recommended course of action. However, occasionally onsite treatment within the production lines combined with treated effluent recycling is also necessary.

Fig 1: Chemical waste water

Chemical industry waste water contains pollutant COD, organic chemicals, heavy metals, suspended solids, oil, grease and cyanide. Here a cost effective method was explored to reduce the contaminants before treatment of waste water in industry. Organic adsorbents like neem leaf, curry leaf and banana peels were used as pretreatment agents. These adsorbents are cost effective in treatment of chemical industry waste water. The waste water characteristics such as pH, Turbidity, BOD, COD, total suspended solids, sulphates, oil and grease etc. of the collected sample were analyzed by conducting various parameter test.

B. pH Test

Using a logarithmic scale to express a solution's acidity or alkalinity, where 7 is neutral and lower numbers indicate greater acidity and higher ones indicate greater alkalinity.

- The sample waste water containing beaker is placed in the pH meter.
- Dip the pH electrode in the beaker containing waste water to be tested. Note the pH.
- Replace the electrodes in the storage solution.

C. Turbidity

The presence of suspended materials, such as silt, clay, finely divided organic material, plankton, and other inorganic material, is indicated by turbidity, a measure of light transmission. Keep an eye out for potential bacterial contamination if the turbidity is excessive. Turbidity greater than 5 NTU is typically considered visually unappealing.

Determination of turbidity of sample water:

Remove the air bubbles by thoroughly shaking the sample. Pour it into meter cell and then place it in the compartment cell of the instrument and take the reading from the digital display.

D. Total dissolved solids and Total suspended solids

The waste water sample is taken in a weighted vessel and mixed thoroughly. It is dried in an oven at 103 - 105°C. During drying, sample gets evaporated. After cooling, the dish with dry material is weighed. The increase in weight over that of the empty dish represents the total solids. The portion of solids that retained on filter paper is taken as suspended solids and remaining as total dissolved solids. After the total solids and total dissolved solids tests are finished, the dishes with the residue left over are heated for an hour in a muffle furnace maintained at 550°C. The increase in weight over that of the empty vessel represents fixed solids in each case. The difference between the total dissolved or total suspended solids and the corresponding fixed solids is the volatile solids in each instance. Using Imhoff cone, settleable solids are obtained.

E. Chlorides

Waste water is titrated with silver nitrate solution to find the presence of chlorides. If chlorides are present, white silver chloride will be precipitated. Chlorides also interfere in the determination of chemical oxygen demand.

F. Total Solids

Five ml (V) of the waste water sample is taken in the dish having weight W1. Evaporate the contents in the dish using steam bath/ iron plate. After cooling the dish weight is noted as W2 mg. Then weight of the total solid residue can be calculated using the formula,

$$\text{Total solid} = (W_2 - W_1)/ V \text{ mg/L}.$$

G. Sulphates

The water with appreciable amount of sulphates has a tendency to form scales in boilers and heat exchangers. Standard solutions of sulphate by mixing sodium sulphate salt in distilled water. 100 ml waste water sample and five ml conditioning reagent are mixed thoroughly at a uniform rate of 1 minute by placing the conical flask in the magnetic stirrer apparatus. Add 15gm of $BaCl_2$ crystal after one minute and stir at constant speed for 60 seconds by placing the residual solution in nephelo turbidimeter to find turbidity. The sulphate concentration corresponding to the obtained turbidity is determined from the calibration graph.

H. Biological oxygen demand

Biochemical oxygen demand (BOD) is defined as the amount of oxygen required by bacteria while stabilizing biodegradable organic matter under aerobic conditions. Prepare three different percentage mixture of sample by mixing glucose, seeding and tap water to have 1000ml sample. Find the initial Dissolved Oxygen (DO) value of each sample. Place each percentage mixture in a BOD incubator at 20 ^{o}C

for 5 days. After 5 days, DO readings are again taken for each percentage sample mixture. The calculations are performed based on the difference between these readings and readings taken before incubation.

I. Chemical Oxygen Demand

A measure of the oxygen equivalent of the portion of organic matter in a sample that is oxidable by a powerful chemical oxidant is provided by the chemical oxygen demand (COD) determination. Industrial waste pollution intensity is commonly measured using the chemical oxygen demand. Regardless of the materials' biological assimilation, organic matter is transformed to CO_2 and water during the COD measurement process. After mixing, fifty ml of waste water sample with six ml of potassium dichromate digestion solution, add 20 ml concentrated sulphuric acid carefully to solution. Cooled solution with two drops of ferroin indicator solution are stirred well and titrated with standard 0.1 M ferrous ammonium sulphate. The termination point is shown by the color transition from blue green to reddish brown. Repeat the same procedure with distilled water of equal volume as that of waste water sample.

J. Total hardness

The overall concentration of calcium and magnesium ions in a water sample is known as water hardness, and it is represented by the concentration of calcium carbonate. To remove the last trace of reddish color, titrate 100 milliliters of the sample, two milliliters of buffer solution, two to three drops of Black T. titrate, and standard EDTA solution. At the end point the solution turns blue. Note down the volume used.

If V = volume of titrant (mL),
N = normality of EDTA and
SV = sample volume (mL), then

Hardness (in mg/L as $CaCO_3$) = (V× N × 50 ×1000)/(SV).

K. Nitrate

A nitrate meter is used to measure the concentration of nitrate in waste water. The natural level of ammonia or nitrate in the effluent of wastewater treatment plants is safe up to a range of 30 mg/L.

L. Fluoride

Four ml waste water sample and one ml zirconium xylenol orange reagent are mixed. Depends upon the fluoride concentration, the colour vary from pink to yellow. The colour produced is compared with the colour chart and the fluoride content is quantified.

M. Oil and Grease Test

Any item recovered as a substance soluble in the solvent is referred to as oil and grease. Therefore, in addition to oil and grease, substances with comparable physical properties will also be identified.

IV. Final Test Using Organic Absorbants

A. Preparation of organic adsorbents

Neem leaf, curry leaf and banana peel are collected from the surroundings. These are dried under sunlight for three days. After it has been completely dried, it was made to fine powder by using grinding tool to get fine particles. Figures 2 – 4 shows the various leaves and their powder which was used in this study. Then it sieved to get it as fine powder. The fine powder was stored in airtight container to keep away from moisture in it. Finally, the powder is used as a natural coagulant in waste water treatment. The mainly used organic adsorbents are, Neem leaf, Curry leaf and Banana peel

Indian lilac and neem are two of the most well-known flowering plant species in the meliaceae family, Azadirachta indica. It grows in tropical, subtropical, and mild climate zones all throughout the world. It has therapeutic use, particularly in the treatment of diabetes [5]. The neem tree has an amazing array of health benefits. Every section of the tree has some amount of active substances that are valuable in organic and natural cosmetics, natural medicine, and agricultural practices. It is an age-old form of Ayurvedic therapy. Neem oil and Neem leaves are the most common forms [6]. It has properties like anti-bacterial and antifungal effects. The Neem leaf powder is good in removal of oil and grease from waste water.

Fig 2: Neem leaf to Neem leaf powder

The gathered neem leaves for this investigation were dried for two or three days. To obtain fine particles, the dried leaves were then ground with the aid of a grinding tool. Next, the powder was put through a 90 micron standard IS sieve. The powdered Neem leaves is used in the treatment of oily waste water.

Fig 3: curry leaves to curry leaf powder

Curry leaves were harvested from a little tree that reaches a height of six meters. It is a blood purifier, stomachic, tonic, and flavoring for chutneys and curries. The leaves have a

slightly pungent and bitter taste. They keep their flavor and other attributes even after drying. Many Indian ayurveda and unani remedies also contain curry leaf. Curry leaves have the property to remove odour and deflouridation [7]. In this study, the fresh leaf powder extract of Murraya koenigii was used for the reduction of t chemicals present in effluent.

Banana peel is an agricultural waste that is being discarded all over the world as a useless material. The adsorbent potentiality of Banana peels is utilized for purification and refining process of wastewater. It has adsorption capacities to remove chromium, copper and also some dyes from wastewater. Numerous pollutants, including oil spills, biological waste, carcinogenic components, heavy metals, and different pigments found in water from diverse sources, can be eliminated from waste water by using banana peels [8]. Pollutants in waste water were extracted using powdered dried banana peel.

Fig 4: banana peel to banana peel powder

B. Treatment of waste water with the addition of organic adsorbents

One litre of waste water, 10gm of powdered neem leaves, 10gm of powdered curry leaves and 10gm of powdered banana peel were mixed. After mixing, the sample was kept for 24 hrs. After 24hrs the water sample was filtered with a cotton cloth. The filtered water sample was then tested to find different parameters.

V. Results and Discussion

Water is very important for a living organism but today the water is contaminated by different pollutants. Table 1 gives the cconsolidated test results along with a list of pollutants.

Table 1: Consolidated Test Results

Sl. no	Parameter	Initial test results	Final test results
1	pH	7.34	6.57
2	Turbidity (NTU)	25.4	70
3	TDS (mg/l)	1434	1780
4	TSS (mg/l)	120	230
5	Total chloride (mg/l)	39.7	51.4
6	Total hardness(mg/l)	124	264
7	Sulphate (mg/l)	182	980
8	Nitrate (mg/l)	5.01	28
9	Flouride (mg/l)	<LOQ	<LOQ
10	BOD (mg/l)	61.5	162
11	COD (mg/l)	246	567
12	Oil and grease (mg/l)	27.5	6.00

VI. Conclusion

Water is very important for a living organism but today the water is contaminated by different pollutants. Approximately 880 million people globally lack access to safe drinking water, according to estimates from the World Health Organization. The world health organization estimates that 884 million people worldwide do not have access to clean drinking water. Over one half of these individuals living in developing countries are affected by water bone disease. There are several methods for purification of waste water treatment. But due to high cost of running it becomes a daunting task. Considering the economy of treatment purification, usage of naturally available organic adsorbents are explored in the waste water treatment.

In the present study, locally available organic substance like banana peel, neem and curry leaves etc. had been used in powdered form for treatment of waste water. The various tests were conducted to find the characteristics such as pH, Turbidity, BOD, COD, total suspended solids, sulphates etc., present in the waste water before and after treatment. On comparison of the results, it reveals that characteristics of waste water such as pH, oil and grease removal are reduced by the treatment with neem leaves powder, curry leaves powder and banana peel powder. Odour and fluoride content had remained unchanged, whereas all other parameter values are increased. The change in dosage/ retention time of the organic adsorbents may reduce the contaminants and hence further study is required in future for better results. It is advised to treat industrial waste water initially with powdered neem, curry leaves, and banana peel to reduce the amount of oil and grease present and facilitate subsequent treatment.

References

[1] A.K Bajaj and H Amarnath (2018), "Removal of oil and grease from waste water using natural adsorbent", International Journal of Applied Engineering Research, Vol 13, Issue 10, page no: 7246-7248.

[2] Divya k S, Dr. Syed Ariff, V Vaishnavi and G. Swetha (2019), "Experimental study on the treatment of diary waste water using low cost natural adsorbents", International of current Engineering and Scientific Research, Vol 6, Issue 6, page no 231-234.

[3] B G Mahindra and Ms. Firdous Sultana (2020), "Treatment of waste water using lemon and banana peel as natural coagulant", International Research Journal of Engineering and Technology, Vol 7, Issue 8, page no 4688-4690.

[4] Gimba Casmir, Emmanuel and Hajara omenesa (2015), "Removal of Microbes from Hospital Waste water Using Neem Husk and Cake Activated Carbon", Modern Chemistry and Applications, Vol 3, Issue4.

[5] Raka Bhattacharje and Reshma Patel (2017), "Adsorption of chromium using neem leaves and pomegranate peels", Journal of Emerging Technology and Innovative Research, Vol 4, Issue 5, page no 64-69.

[6] Rubini S and Balamurugan (2019), "Exploring the use of cactus and neem leaf powder as coagulant in treatment of waste water", International Journal of Recent Technology and Engineering, Vol 8, Issue 2, page no 1561-1564.

[7] R. Subasree, N. Surya Prabha and G. Anusha (2017), "Treatment of waste water using banana and lemon peels as adsorbent", International Journal of Engineering Technology Science and Research, Vol 4, Issue 9, page no 1289-1291.

[8] S. Mohan, K. Vidhya & C.T. Sivakumar (2019), "Textile waste water treatment by using natural coagulant", International Research Journal of Multidisciplinary, Vol 3, page no 636-642.