AN EXPERIMENTAL STUDY ON TREATMENT OF DAIRY EFFLUENTS USING NATURAL COAGULANTS TO REDUCE TURBIDITY

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ABSTRACT

The dairy industry is one of the most polluting of industries, not only in terms of the volume of effluent generated, but also in terms of its characteristics as well. Wastewater treatment methods include precipitation, coagulation/flotation, sedimentation, filtration, biological process, and chemical reactions. Each method has its own merits and limitations in applications because of their cost. Coagulant is one of the main components in the treatment process. The two most commonly used primary coagulants are aluminium and iron (III) salts. The recent studies have pointed out several drawbacks of using aluminium salts, such as Alzheimer's disease, Neurotoxicity, Cancer, etc. and large sludge volume. Recently uses some natural coagulant produced from plants, animals, & microorganisms. They are readily biodegradable & less volumetric sludge. Amount of sludge is 20 – 30 % that of alum treated. Some of the natural seeds used as natural coagulants are maize, grape seed, nirmali seed, pumpkin seed, Guar, common bean, etc. In this paper I studied with natural seeds such as common bean (*Pharsalus vulgaris*) and jack fruit (*Artocarpusheterophyllus*) are dried in oven and grained to 600µm powder. Coagulated in jar apparatus with dosage 0.2, 0.4, 0.6, 0.8, 1.0 gm/ 500ml of dairy wastewater sample agitated at 125 rpm for 30 minutes and after the samples were allowed to settle for 30 minutes. Characterize the treated effluent and compared and attained 99% removal efficiency.

INTRODUCTION

In Southeast Asia, approximately 60 million tonnes of dairy starch are produced annually either by mechanical or traditional methods. Plenty of average size dairy mills are found in tropical countries and a study carried out by Bujang et al. (1996) to investigate the total water consumption and wastewater effluents production by the factories reported that approximately 600 dairy logs are processed in one of the mills in Sarawak, Malaysia, daily and the water consumption during the operation is approximately 5 L/s (18 tonnes/h) whilst the wastewaters generated as the factory wastewater effluents are approximately 30 L/min (1.8 tonnes/hr). Therefore, approximately 237.6 tonnes of wastewater containing approximately 7.1 tonnes of total solids would be generated daily for an operation of 12 hours. These wastewater effluents are not suitable to be reused and recycled in the process and thus the voluminous amount of wastewater would be discharge out of the factory into nearby river. In Malaysia, it was reported that the amount of starch contained in dairy pith solid waste and wastewaters accounted for nearly half of the total annual imports of starch of the year. Again, the report stated that about the same amount of starch residues were being discharged into rivers as dairy factory wastewater effluents. However, only a few of the factories implemented wastewater treatment facilities for environment conservation purposes. This is most probably due to the economic risk and unreliable treatment efficiency although they are aware of the need for such measures. Therefore vigorous researches have been carried out to solve the predicament faced by local dairy processing industries and the environmental governing authorities.

The rapid growth in industries has resulted in increased in pollution level in all natural forms i.e. by air, water and land get polluted. The primary form pollution will be occur though the effluent (wastewater)mixing with local water bodies and nearby farms and land which results in land and water pollution.

Rasipuram is an important taluk in Namakkal district, Nearly 176 dairy factories are located in around the Rasipuram taluk. Starch produced in this area will be exported to other parts of India. This business is mostly seasonal in nature and functions only for half of the year from September to March. The dairy industries Cassava tapioca tubes are converted into commercial dairy utilizing indigenous technologies hence it requires high amount of water. The effluent contains high amount of bio oxygen demand and chemical oxygen demand, obnoxious odour irritating colour and lower p^H. The pollution affects the health of the soil, natural ecosystem, animals, plants and human agricultural field.

It is described that developing countries are paying a high cost for water treatment by importing the chemicals. There are several methods are utilized to treat the water, depends on the quality of the wastewater. Wastewater is the large seasonal variation that is associated with problems like turbidity, due to solubilize matter and results to more compactable treatment.

The physical, chemical, and biological characteristics can be altered by dissolving impurities, which is comprised of organic compounds, gases, minerals and E-coli these effect can be controlled by the concentration and composition of chemical reactions among pollutants. The proper treatment of wastewater resulted to accept that of effluents discharged. Once the effluents enters in environment such river it may health effect such as eye infections, skin diseases, as well as worm infections by hygienic practice that can result the major improvements in health conditions . These effect may be due to pollutant namely suspended solids & turbidity of the wastewater by using coagulation-flocculation.

The present study focuses on comprising the coagulant activity of alternatives to treat drinking water with environment friendly plant extract to commonly used coagulant agents. The objective of this study is to investigate the assessment of four different plant materials namely cicer aritenium, Dolicess Lablab, Tarmind seeds and moringa oleifera seeds as natural coagulants.

1.2 WASTEWATER TREATMENT

Wastewater treatment techniques that are widely used are chemical precipitation, lime coagulation, ion exchange, reverse osmosis and solvent extraction Coagulants are used that added to the water to withdraw the forces that stabilizes the colloidal particles and causing the particles to suspend in the water. Once the coagulant is introduced in the water, the individual colloids must aggregate and grow bigger so that the impurities can be settled down at the bottom of the beaker and separated from the water suspension. Various types of coagulants show potential application in treating water and wastewater. It ranges from chemical to non-chemical coagulant. The coagulant also could be synthetic and solid water material or natural coagulant with the properties of coagulant having +ve charge, these positive charge proteins would bind to the -ve charged particles in the solution that cause turbidity. water and wastewater treatment is the removal of suspended and colloidal particles, untreated matter, microbes and other substances that are deleterious to life, in search of lowest cost deployment, operation, maintenance, and reduced environmental impacts to the contiguous . Coagulants are characterized according to the wastewater properties that relates to enhance the efficiency of treatment process to achieve required quality of water on standards.

Coagulants normally in form of natural & synthetic .Both coagulants aim to remove pollutant in form of physical or chemical (BOD & COD). The coagulants also present with advantages various among them.

The impact of p^H and coagulant doses on the coagulation procedure was contemplated in order to streamline comparing to the best evacuation of turbidity. The optimum dosage of p^H will lead to the optimum conditions of JAR test.

1.3 NEED OF COAGULATION

It is one of the important process in the waste water treatment. Chemicals used in effluent water treatment processes for solid removal, water clarification,lime softening, sludge thickening and solid dewatering. Coagulants neutralize the negative electrical charge on particles.

Coagulation is affected by the type of coagulant used, dosage and mass of the coagulant used, initial turbidity of the water that is to be treated and the properties of the pollutants present. The effectiveness of the coagulation process is also affected by the pretreatment process like oxidation.

1.4 OBJECTIVES

- To remove the turbidity in the waste water.
- To determine the effective dosage of the chemical coagulants.
- To maintain the p^H level before and after the treatment process.
- To avoid the health risk problems.
- To reduce the various parameters in the raw water such as TS, BOD, COD, sulphides, nitrates etc..,

1.5 SCOPE

- Natural coagulants derived from plants and renewable sources, contributing to a sustainable and economical water treatment.
- Natural coagulants decrease the volume of sludge and do not alter the $p^H$of the water under treatment, comparatively to conventional products based on metallic salts.
- Non- toxic and non- corrosive eco-products, thus contributing to a longer useful life of equipment and to the security of operators; not classified under the UN register of hazardous products.
- Application on a large p^H range (4 to9),without alteration of the effluents p^H. Therefore these products considerably reduce the use of acidic and alkali agents resulting in huge savings in these products and their logistics and increasing the operating security.
- Contribution to the efficiency of the posterior biological treatment due to absence of any kind of inhibitor agent while contributing with organic material for the growth of micro fauna.
- The effluents conductivity remains unchanged this is particularly important in cases followed by osmosis process and incases of closed circuit waters.

1.6TYPES OF COAGULANTS

They coagulants are classified into two types they are natural coagulants and chemical coagulants. In this chemical coagulants the chemicals used are either metallic salts or polymers.

Polymers are man-made organic compounds made up of long chain of smaller molecules, they can be either cationic, anionic or nonionic.

1.6.1 CHEMICAL COAGULANTS

The commonly used chemical coagulants fall into two categories those based on aluminium and those based on iron. The aluminium coagualnts include aluminium sulphate, aluminium chloride and sodium aluminate and in the case of iron coagulants they include ferric sulphate, ferric chloride and ferric chloride sulphate. They are great efficient one but at the same time they are costly and are harmful to the mankind due to the chemical present in them.

1.6.2 NATURAL COAGULANTS

The natural coagulants are used in water treatment include microbial polycharides, starches, cellulose and alginate. Coagulants which carry natural characteristics supposed to be harmless for human health.

1.7ADVANTAGE OF NATURAL COAGULANTS

- Eco friendly.
- Cheap and easy method for developing countries.
- The efficiency is independent to raw water p^H.
- Safe to human health.
- The low volume of sludge precipitated is biodegradable.
- The sludge can be used as good manure for crops.
- Alkalinity of the waste water can be highly reduced.

1.8EXPERIMENTAL SETUP

The coagulation-flocculation experiment was carried out using Jar Test apparatus which consists of six beakers with mixing paddle and a gauge for revolution per minutes (rpm). The experiments were performed using water samples of turbidity 100 NTU. For each water sample, six beakers were filled up to 1000 ml, placed in the jar tester, various dosage of coagulant extracts 5 mg/l, 10mg/l, 20 mg/l,30 mg/l, 40mg/l were added and then agitated further for 5 min at different speed of 100 rpm, 200rpm, 300rpm. The mixing speed was then reduced to 30 rpm and maintained at slow mixing for 15 min, followed by sedimentation for 20min after which supernatant was collected at approximately 5 cm from the top of water surface for further analysis.

1.9ANALYSIS OF SAMPLES

The samples were analyzed before and after treatment using jar test apparatus for various parameters such as Turbidity, Electrical conductivity, Total dissolved solids by using water analyzer kit and p^H using Ion analyser.

Fig 1 After 30 minutes coagulation

Fig 1.1After settling & filtration

Fig 2 Waste Dairy Water Taken Area

LITERATURE REVIEW

M. Narmatha, S. Kamali Sangavi & G. Sripavithra "Effluent Treatment of Dairy Waste Water by Using Natural Coagulants" One of the most important treatment processes in raw water treatment plant is coagulation. Waste water contains suspended solids and turbidity. With the help of coagulants, and by flocculation process, followed by sedimentation and filtration, these impurities can be removed from raw water, besides conventional chemicals such as Alum, Ferric chloride and Poly Aluminum Chloride. These chemicals are used for the purpose of pretreatment of water. There are some disadvantages related to the use of such chemicals as their residues present in the waste water may cause the health hazards. In this research, the preliminary investigation was carried out for the possible use of oil cakes as natural coagulants for the treatment of dairy effluent. The quality of the treated raw water were analyzed and compared with each other. The experiments were conducted for various dosages of the crude extracts of the cotton seed and castor oil cakes using flocculate. The optimum dosage of these natural coagulants was identified. Various parameters of quality of the waste water were measured before and after the treatment to evaluate the removal efficiency on the major pollutants of concern in waste water treatment such as pH, Total Solids (TS), Total Dissolved Solids (TDS), sulphates, chlorides, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD) etc., Results showed that the use of cotton seed oil cake was more efficient for the treatment of the dairy effluent when compared to the castor oil cake. The alkalinity, sulphates and Total Suspended Solids of dairy effluent after treated with the cotton seed oil cake were highly reduced. Hence, the use of cotton seed oil cake can be adopted as a natural coagulant for purification of the dairy effluent.

KEYWORDS: Coagulant, Ferric Chloride, Poly Aluminum Chloride, Alkalinity

Saravanan, Priyadharshini, Soundammal, Sudha, Suriyakala "Wastewater Treatment using Natural Coagulants" Natural coagulant is a naturally occurred; plants based coagulant that can be used in coagulation-flocculation process of wastewater treatment for reducing turbidity. The objectives of this study were to assess the possibility of using natural coagulants as an alternative to the current commercial synthetic coagulant such as aluminium sulphate and to optimize the coagulation process. Based on the experimental results, it was concluded that natural coagulants which have been obtained from Dolichas lablab, Azadirachta Indica, Moringa Oleifera, Hibiscus Rosa Sinensis have showed an merely equalant coagulation comparing to commercial alum. The turbidity removal efficiency for Dolichas lablab, Azadirachta Indica, Moringa Oleifera, Hibiscus Rosa Sinensis respectively were 37.45%, 63.01%, 31.47%, 12.95% against 75.01% obtained from alum.

Keywords — Jar Test, Coagulation, Flocculation, Natural Coagulants, Turbidity. NTU.

Aweng E.R, et al., "Cassia alata as a Potential Coagulant in Water Treatment" have concluded that the widely available legume plant Cassia alata, as natural coagulant can treat low turbidity surface water. The result of this study showed that the extract of Cassia alata leaves is able to remove turbidity of river water by up to 93.33% a level almost similar to that obtained by Opuntia spp.16, which gave a reduction percentage of 95%. The ability to remove suspended solids by 56.4% is another remarkable feature. It had some effect in lowering the pH level by 1% and raised the iron and manganese concentrations by 15.7% and 78.6% respectively.

Sachin M.Kanawade and R.W.Gaikwad, "Removal of turbidity in dairy Effluent by Using Natural coagulants as an Adsorbent" has concluded that the Sugar cane be gases ash, an agricultural by-product, acts as an effective adsorbent for the removal of dyes from aqueous solution. Batch adsorption study was investigated for the removal of Acid Orange-II from aqueous solution. Adsorbents are very efficient in decolorized diluted solution. The effects of bed depth on breakthrough curve, effects of flow rate on breakthrough curve were investigated. The removal of dyes at different flow rate (contact time), bed height, initial dye concentration, column diameter, p^H& temperature by Sugarcane Biogases Ash as an adsorbent has been studied. It is found that percent adsorption of dyes increases by decreasing flow rate from 2 lit/hr to 1 lit/hr, by increasing bed height from 15cm to 45cm, by decreasing initial conc.150mg/lit to 100mg/lit, by increasing column diameter from 2.54cm to 3.5cm, by maintaining neutral pH & at temperature 450ºC than 25ºC & 35ºC.The result shows that, bagasse ash is a good adsorbent for dye effluent treatment.

Marina B. Šćiban, et al., "The Investigation of Coagulation Activity of Natural Coagulants Extracted from Different Strains of Common Bean" have concluded that all investigated strains of bean showed potential to be used for preparing coagulants for water clarification. Turbidity of model water was decreased by 5 – 50 % by using natural coagulants obtained from different strains of bean. Samples 1, 2 and 4 showed maximum of coagulation activity (about 45%) in the range of applied doses of coagulants from 3.5 mg/l to 4.5 mg/l. Sample 3 showed a lower coagulation activity (maximum about 33%) in comparison with other samples, but at a significantly lower dose of coagulant – 1.5 mg/l. Content of organic matter in the water after coagulation tests performed with all samples was high, twice higher than it was in the blank.

Kalyani Ladole, "Rajma Powder as a Natural Coagulant in Turbidity Removal from Raw Water" have concluded that the dosage of Rajma powder in this research was Moderate than other traditional chemicals application in turbidity removal with dosage of up to 10 mg/l in a water treatment plant, the efficiency in turbidity removal was also lower. With many advantages of Rajma Powder that is a natural coagulant for water treatment.

Yin Chun Yang, et al., "A Study on Cactus Opuntia as Natural Coagulant in Turbid Water Treatment" have concluded that the powdered and dried cactus opuntia was very effective in removing turbidity from both estuarine and river waters as evident by the high removal efficiencies. It was also proven that the cactus powder did not have a significant effect on final p^H of the waters as compared to chemical-based coagulants. Increased cactus dosages correlated with decreased p^H of surface water. It can be concluded that cactus opuntia has the potential to be utilized for surface water treatment applications.

Venkata Maruti Prasad S, H. Ramamohan, B. Srinivasa Rao "Assessment of Coagulation Potential of Three Different Natural Coagulants in Water Treatment" In addition to food, shelter and clothing, water is one of our basic human needs and lack of potable water is a major cause of death and disease in our world. Now a days due to rapid industrialization even in rural areas, water become contaminated. Suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, plankton and other microscopic organisms are responsible for turbid water. Aluminum and iron salts are commonly used as chemical coagulants. There are a variety of purification methods of drinking water which are very costly and those methods cannot serve a common man effectively. The purpose of this study is to provide information on low cost household water treatment using Moringa Oleifera, Arachis Hypogaea (Peanuts), Zea mays (Corn). Natural coagulants show bright future and are concerned by many researchers because of their abundant source, low price, multifunction and biodegradation. In the present investigation, assessment of three different natural coagulants namely seeds of Moringa Oleifera, Arachis Hypogaea (Peanut), Zea mays (Corn)has been carried out. After treatment the water samples were analyzed for different parameters like pH, Turbidity, TDS and Electrical conductivity. Turbidity removal efficiency was 86%, 83%, 21%, after the treatment at optimum dosage of 20mg/l and speed of mixing of 200rpm respectively for synthetic water of 100 NTU. Finally, it can be concluded that Moringa Oleifera and Arachis Hypogaea (Peanuts) are the most efficient natural coagulants.

Jisha.T.J, M.A.Chinnamma "Effect of Natural Coagulants on the Treatment of Automobile Service Station Waste Water"In This paper the effects of natural coagulants on the treatment of automobile service station waste water has been investigated. Moringa oleifera, Jackfruit lablab and cicer arietinum are the natural coagulants used for the study. The treatment system was designed in four stages included, skimming tank with aeration, coagulation and flocculation, sedimentation and filtration unit to produce high quality of treated waste water. The treated waste water obtained after all the process have a considerable decrease in BOD, COD, TSS, Turbidity, Oil & grease etc... Among the natural coagulants used in this study, Cicer arietinum was found most effective. The results show that it was possible to reclaim almost 90% of clear water after treatment and can be effectively reuse for vehicle washing.

Chidanand Patil1, Ms. Manika Hugar "Treatment of dairy wastewater by natural

coagulants"The dairy industry is generally considered to be largest source of food processing. These industries wastewater is characterized by high COD, BOD, nutrients etc. Such wastewater is to be treated natural coagulants and then tests are to be carried to check the water characteristics like BOD, COD, pH and turbidity, etc. The initial pH, Turbidity, COD are 7.41. 289.5 NTU, 10000 mg/l respectively. Natural coagulants to be used are Moringa Oleifera seeds, Trigonella foenum-graecum, Jackfruit lablab and Cicer arietinum. The efficiency of reduction of turbidity by M.oleifera, Jackfruit lablab, T.foenum-graecum and Cicer arietinum are 61.60%, 71.74%, 58.20% and 78.33% respectively. The efficiency of reduction of COD from M.oleifera, Jackfruit lablab, T.foenum-graecum and Cicer arietinum are 65.0%, 75%, 62.5% and 83% respectively. For variation of doses of these natural coagulants the reduction of solids takes place. There is not much change in pH and conductivity due to natural coagulants. The efficiency of Cicer arietinum is more compared to other three; this depends on the protein content which is present in the natural coagulant. The increase of dosage causes the increase of turbidity

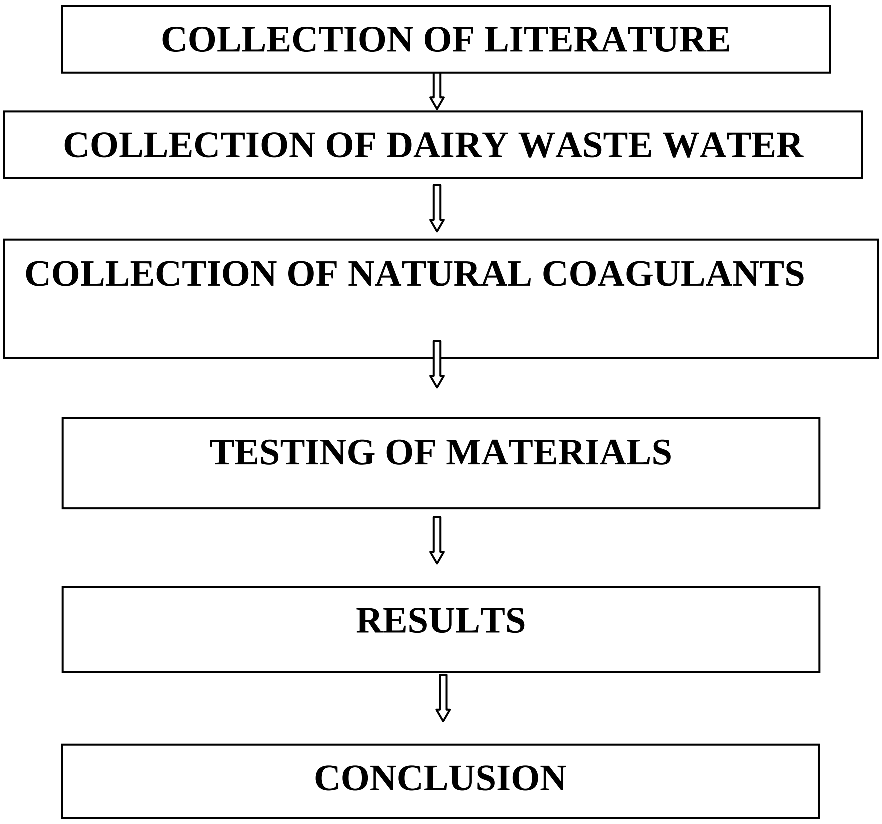
VickyKumar, NorzilaOthman and Syazwani Asharuddin "Applications of Natural Coagulants to Treat Wastewater"The natural water falls from the mountain is merging into the oceans. This water is preserved by humans that are consumed for agriculture, industrial, and municipal use. This water become wastewater after different usage, and finally, completes the hydrological cycle. The water becomes wastewater due to population growth, urbanization, industrialization, sewage from household, institutions, hospitals, industries and etc. Wastewater can be destructive for the public because it contains a variety of organic and inorganic substances, biological substances, toxic inorganic compounds and the presence of toxic materials. The coagulant chemicals and its associated products are resourceful but these may change the characteristics of water in terms of physical and chemical characteristics, this make matters worse in the disposal of sludge. An option of natural polymer can be used in water and wastewater in this review. The natural polymers are most efficient that provide several benefits such as; prolific, exempt from physical and chemical changes from the treated water**.**

SY Quek, DAJ Wase and CF Forster "The use of dairy waste for the sorption of lead and copper"Dairy processing waste, which is both a waste and a pollutant, was used to adsorb lead and copper ions from solution. The sorption process was examined in terms of its equilibria and its kinetics. The effect of pH, contact time, sorbate concentration, particle size and sorbent mass were also studied. The most effective pH range was found to be 4 to 5.5 for both metals. The equilibrium data for both metals fitted both the Langmuir and the Freundlich models and, based on the Langmuir constants, the dairy waste had a greater sorption capacity for lead (46.6 mg/g) than for copper (12.4 mg/g). The kinetic studies showed that the sorption rates could be described better by a second-order expression than by the more commonly applied Lager green equation.

Hussein Janna "Effectiveness of Using Natural Materials as a Coagulant for Reduction of Water Turbidity in Water Treatment"Coagulation-Flocculation plays a significant role in drinking water treatment. Laboratory experiments were carried out in order to assess the effectiveness of using Co nocarpus Leaves Solution (CLS) as a natural coagulant in conjunction with the synthetic chemical represented by Alum in the water purification. Biological test was carried out to confirm that these leaves are not toxic, followed by optimizing the dosage of alum and then Alum and CLS were applied to the turbid water whose turbidity level has two ranges, (20 - 35) NTU and (90 - 120) NTU, using the JAR Test. The parameters determined before and after coagulation were turbidity, pH and temperature. The experiments showed that the optimum dose of alum coagulant (individually) for high turbid water is about 18 mg/l with PH = 7 and 24 mg/l f with PH = 5 and 9. In addition, for the low turbidity water, the optimum dose of alum was lower than in the high turbid water. In terms of using Alum in conjunction with CLS, at high range of turbidity, the results show that at 33% ratio of leaves solution to alum coagulant, there are 50% and 75% turbidity reduction performed for the PH equal to 5 and 9 respectively. Although about 62% and 65% turbidity reduction were achieved at PH = 7 and PH = 9 in the low range level. However, low reduction in turbidity has occurred when the water PH =

5. The amount of leaves solution added to the water in the water treatment plant is highly important, hence it decreases the amount of using the synthetic chemicals by about 33% of the quantity that required for water treatment and that will help both, the water industry and the human health. More studies need to be achieved in particular different concentration of the Conocarpus leaves solution in order to improve the percentage of using the natural material as a coagulant**.**

METHODOLOGY



MATERIALS

The coagulants which are used in our process are Cicer aritenium, Dolicess Labab, Tarmind seeds and moringa oleifera. The natural coagulants which are used in the experiment are collected from the local market and nearby farms in Rasipuram.

PREPRATION OF NATURAL COAGULANTS:

The Seedpods of cicer aritenium, Dolicess Lablab, Tarmind seeds and moringa oleifera seeds are collected, dried seeds were ground to fine powder and they was sieved through 240µm sieved.

COMMON BEANS SEED POWDER

JACK FRUIT SEED POWDER


MORINGA OLIFERA **CICER ARTENIUM**

TESTING OF MATERIALS
5.1 COAGULATION AND PRECIPITATION PROCESS FOR TREATING DAIRY WASTEWATER (JAR TEST)

PRINCIPLE

Metal salts hydrolysis in presence of the natural alkalinity to form metal hydroxides. The divalent cations can reduce the zeta-potential, while the metal hydroxides are good absorbents and hence remove the suspended particles by enmeshing them.

APPARATUS REQURIED

1. Jars mixer
2. Turbid water
3. Beakers
4. Pipettes
5. Turbidity meter
6. p^H meter

REAGENTS

Dairy waste water

PROCEDURE

1.200ml of water sample is taken in each jar. Increasing dose of alum (1%) i.e. 1gm/100ml of distilled water added to supply for 15min allowed to stand for 15min.

2. The jars are observed and the settling of sediments are noted. The quality of alum added to the jar containing the clearest solution is noted.

3. Take the sample out of beaker and test for turbidity in each trial plot the curve on x and y of the graph sheet. Take the alum dosage in ml along x axis and turbidity along –y-axis.

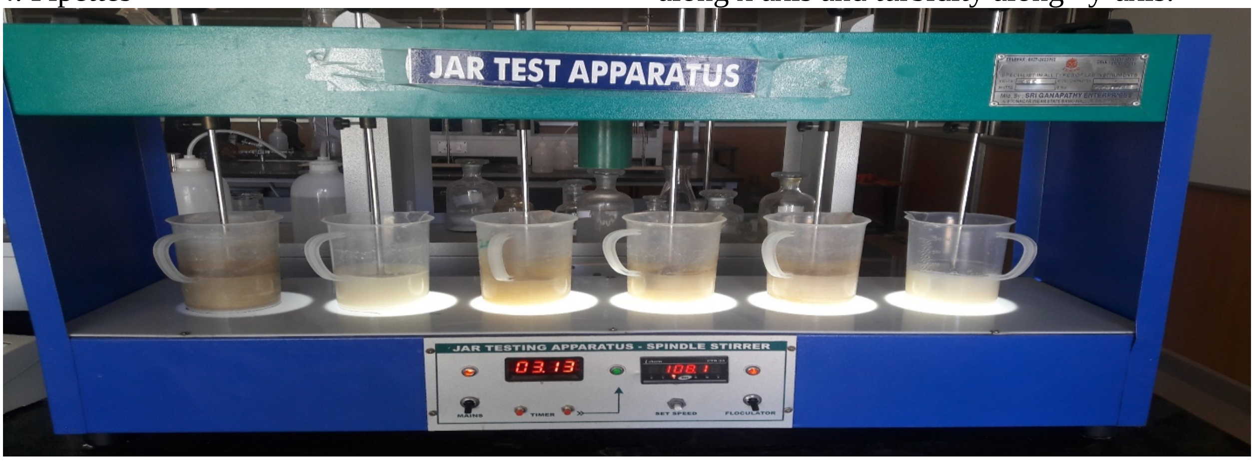


Fig 5.1 Jar test of moringa olifera seed

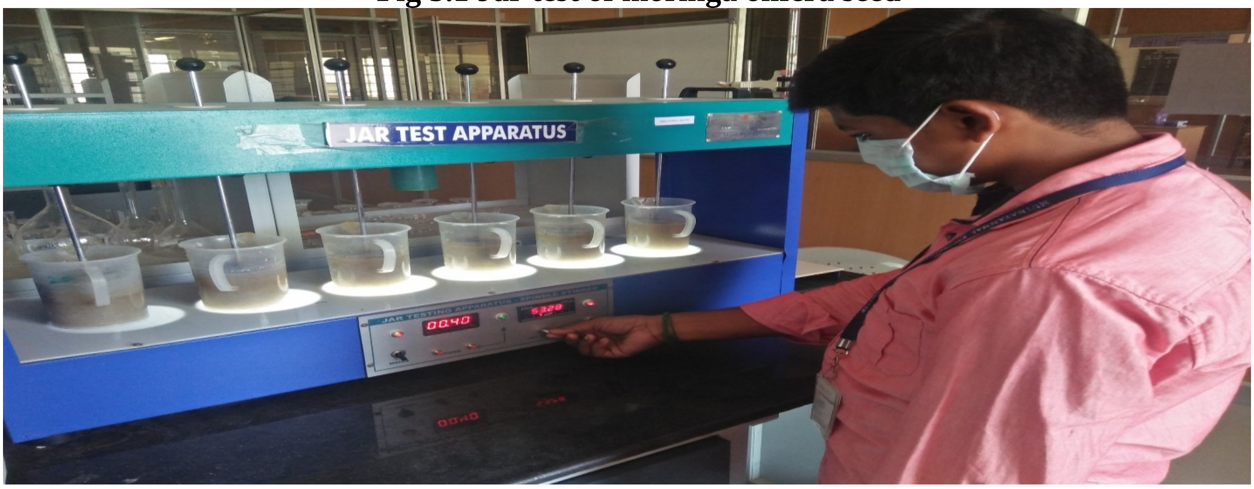


Fig 5.2 Jar test of Jack fruit seed

Fig 5.3 Jar test ofjackfruit labab

5.2 DETERMINATION OF p^H:

P^H can be viewed as an abbreviation for power of hydrogen or more completely, power of the concentration of hydrogen ion. It says that the pH is equal to the negative log of the hydrogen ion concentration, or pH = -log $[H^+]$.

$$P^H = -\log [H_3O^+].$$

P^H values are calculated in powers of 10. The hydrogen ion concentration of a solution with p^H 1.0 is 10 times larger than the hydrogen concentration in a solution with p^H 2.0. The larger the hydrogen ion concentration, the smaller the p^H.

- when the p^H is above 7 the solution is basic (alkaline)
- when the p^H is below 7 the solution is acidic
- when the p^H is equal to 7 the solution is neutral

APPARATUS REQUIRED:

- p^H meter: p^H of the solution was monitored by using a digital desktop, and p^H was adjusted with the help of NaOH and HCL
- Beakers
- Reagents
- Buffer solution of 4.0 p^H (Thallate buffer): 10.2 grams of potassium hydrogen
- Thallate was dissolved in one litter double distilled water.
- Bufer solution of 7.0 p^H (Phosphate buffer): 3.4 gram of borax was dissolved in one liter double distilled water.
- Buffer solution of 9.2 p^H(Borax Buffer): 3.81 gram of borax was dissolved in one liter of double distilled water.

PROCEDURE:

- After calibration with buffer solution, rinse the electrode with DDW and wipe gently.
- Take the sample in a beaker. Bring the temperature of the sample to room temperature.
- Deep the electrode in the beaker in such a way that bulb of the electrode deep in to sample. Bring the temperature to homogeneity by stirring.
- Record the reading from display, which will give the p^H value of the sample.
- Temperature rod is inserted to find temperature of the waste water.

Fig 5.4 p^HAPPARTUS

5.3 DETERMINATION OF BOD:

Biochemical oxygen demand or BOD is a chemical procedure for determining the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at certain temperature over a specific time period.

USES OF BOD INCUBATOR:

HEATING:

Indirect heating system is provided in our units, comprising of air heaters made of high grade Kanthal A-1 wires of suitable voltage. The warm air is evenly distributed throughout the chamber through efficient motor fans ensuring a very good temperature sensitivity.

COOLING:

An energy efficient cooling unit is installed in our bod incubators to enable bio chemical demand studies at lower room temperatures. We use ISI marked high end CFC free compressors of Kirloskar/Tecumseh make, conforming to latest international standards and guidelines.

PRINCIPLE:

BOD is measure of biodegradable organic material present in wastewater and can be defined as the amount of oxygen required by the microorganisms in stabilizing the biologically degradable organic matter under aerobic conditions. The principle of the method involves, measuring the difference of the dissolved oxygen concentration of the sample and after incubation it for 5 days at 200 ºC.

APPARATUS AND REAGENTS:

- BOD bottles
- BOD incubator

PREPARATION OF NUTRIENTS:

- Phosphate buffer: 8.5 g KH_2PO_4, 21.75 g K_2HPO_4, 33.4 g $Na_2H.\ PO_4.7H_20$ and 1.7 g NH_4Cl was dissolved in 500 ml distilled water and diluted to 1 liter.
- Magnesium sulphate solution: 82.2 g $MgSO_4$. $7H_2O$ was dissolved in distilled water and diluted to 1 liter
- Calcium chloride solution: 27.5 g of anhydrous $CaCl_2$ was dissolved in distilled water and dilute to 1 liter
- Ferric chloride solution: 0.25 g $FeCl_3$. $6H_2O$ was dissolved in distilled water and diluted to 1 liter.

PREPARATION OF DILUTION WATER (AERATED WATER):

About 2ml/ 5 liter seed was added to a required volume of dilution water (distillation water) and aerated about on night to have the sufficient dissolved oxygen in it. After aeration 1 ml each of phosphate buffer, $MgSO_4$, $CaCl_2$, and $FeCl_3$ solution each was added per liter of water.

PROCEDURE:

Two bottles for sample and two bottles for blank were filled up by the dilution water to get the required dilution factor. One set of dilution sample and blank was kept in BOD incubator at 250C for 5 days, and DO contend in another set was estimated on the same day. After 5 days DO was also estimated from the second set of the sample and blank from the incubator.

REAGENTS:

- Manganese sulfate solution: 100 mg of $MnSO_4$. H_2O was dissolved in boiled distilled water, filter and diluted to 1 liter.
- Alkali-iodide-aside reagent: Dissolve 500 g of NaOH and 135 g NaCl in distilled water and dilute to 1 liter. Add 10 g $NaNO_3$ dissolved in 40 ml of distilled water.
- Starch Solution: 1 g of starch was added in 100 ml of warm (800C-900C) distilled water and a few drop of formaldehyde solution were added.
- Sulphuric acid: H_2SO_4, concentration (sp gr. 1.84) Standard Sodium Thiosulfate solution (0.025N): 24.82 g of NaS_2O_3. $5H_2O$ was dissolved in boiled distilled water and made volume to 1 liter and 0.4 g of NaOH pallet added as stabilizer. Then the solution was diluted to 4 times with boiled distilled water to prepare 0.025 N solutions.

PROCEDURE:

2 ml manganese sulfate solution followed by 2 ml alkali-iodide-aside reagent were added to the sample collected in 300 ml BOD bottle and mixed by inverting the bottle for complete fixation of DO as brown color manganese hydroxide precipitation. Then 2 ml conc. H_2SO_4 was added and dissolved the precipitation by gentle inversion. This solution was titrated with 0.025 N sodium sulphate solution using starch indicator and end point was blue to colorless.

5.4 DETERMINATION OF COD:

The COD is considered mainly the representation of pollution level of domestic and industrial wastewater or contamination level of surface, ground and potable water. This is determined in terms of total oxygen required to oxidize the organic matter to CO_2 and water. The COD values include the oxygen demand created by biodegradable as well as non-biodegradable substances because it involves oxidation of organic matter with strong oxidizing chemicals. As a result, COD values are greater than BOD and may be much greater when significant amounts of biologically resistant organic matter is present.

APPARATUS REQUIRED:

- Close refluxing unit.
- Titration assembly

PROCEDURE:

- Mercuric Sulphate, $HgSO_4$
- Ferroin Indicator: Weigh 1.485g of 1, 10-phenanthroline monohydrate and 0.695g $FeSO_4.7H_2O$. Transfer both the chemicals to a 100 ml volumetric flask. Dissolve in DDW. Dilute up to the mark with DDW.
- Potassium dichromate solution, , 0.25N: Dry an adequate quantity of analar K2Cr2O7 in an oven set at 103 C for 2 hours. Cool to room temperature. Accurately weigh 12.259g dry and cool $K_2Cr_2O_7$ and transfer to a 1 liter volumetric flask. Dissolve in DDW. Add 0.12g of sulfamic acid to the concentrated dichromate solution. Dilute up to the mark concentrated sulphuric acid, H_2SO_4.
- Sulphuric acid concentrated with silver sulphate, $H_2SO_4 – Ag_2SO_4$ catalyst: Weigh 22g of silver sulphate (Ag_2SO_4) and add to a 2.5 liter concentrated H_2SO_4 bottle. Keep this solution on magnetic stirrer. Stir for 1-2 days for complete dissolution of Ag_2SO_4.
- Ferrous ammonium sulphate (FAS) solution, $Fe(NH_4)_2(SO_4)_2.6H_2O$, approx. 0.25N: Weigh 98g FAS and transfer to a 1 liter volumetric flask. Dissolve in about 500 ml DDW. Add 20 ml conc. H_2SO_4. Dilute to 1 liter with DDW and cool it.
- Ferrous ammonium sulphate (FAS)titrant, 0.10 N: Measure 400 ml of the 0.25 N FAS solution in a 1 L volumetric flask. Dilute to 1 L with DDW. Standardize this solution daily before estimation.

STANDARDIZATION:

FAS titrant, 0.10 N:

- Fill the burette with 0.10 N FAS titrant.
- Accurately measure 10 ml of 0.25 N $K_2Cr_2O_7$ solutions into a clean Erlenmeyer flask and add 90 ml DDW into the flask.
- Dispense 30 ml concentrated H_2SO_4 with constant stirring and cool the solution.
- Add 0.5 ml ferroin indicator.
- Titrate with FAS titrant till the endpoint is achieved. First the solution turns bluish green and then attains a reddish brown color at endpoint.

Fig 5.5 COD TITRATION

5.5 DETERMINATION OF AMMONIA NITROGEN INDAIRY WASTEWATER

PRINCIPLE

Ammonia ion reacts with Nessler's reagent (k_2HgI_4) to form a brown colour substance and can be determined calorimetrical. Most of the natural water and wastewater have interfering substances, therefore, the stream distillation of ammonia becomes essential.

APPARTUS REQUIED

1. Measuring Jar
2. Conical flask
3. Burette
4. Pipette

REAGENTS

1.Phosphate Buffer Solution
2.Boric Acid
3.Methyl Orange Indicator
4.Sulphuric Acid 0.02N (1ml contains 0.28mg of nitrogen)

PROCEDURE

1. Take 50ml of the sample in a conical flask.
2. Add 5ml of phosphate buffer solution and 10ml of boric acid solution.
3. Add 3-5 drops of methyl orange indicator.
4. Titrate against 0.02N of sulphuric acid till end point is changes from orange to yellow.

5.6 DETERMINATION OF CALCIUM IN THE DAIRY WASTE WATER BY EDTA METHOD

PRINCIPLE

When EDTA (Ethylene-demine tetra acetic acid) is added to the water containing calcium and magnesium it combines first with calcium. Calcium can be determined directly with EDTA when p^H is made sufficiently high such that the magnesium is largely precipitated as hydroxyl compound (by adding NaOH and isopropyl alcohol). When murex idee indicator is added to the solution containing calcium all the calcium gets completed by the EDTA at p^H 12-13.The end point is indicated from a colour change from pink to purple.

APPARATUS REQUIRED

1. Burette
2. Pipette
3. Conical flask
4. Beakers
5. Droppers

REAGENTS

1.**Sodium hydroxide (8%):** 8g of sodium hydroxide is dissolved in 100ml of distilled water.
2.**Murex idee indicator (ammonium purports):** 0.2g of murex idee is ground well with 100g of sodium chloride thoroughly.
3.**Standard EDTA titrant,0.01M:**3.723g of EDTA (disodium salt) is dissolved in distilled water and made up to100ml with the same.

PROCEDURE

1.A known volume (50ml) of the sample is pipette into a clean conical flask, to which 1ml of sodium hydroxide and 1ml of isopropyl alcohol is added.
2. A pinch of murex idee indicator is added to this mixure and titrated against EDTA until the pink colour turns to purple.

RESULT

JAR TEST

Table 6.1 CICER ARTENIUM

S.NO	DOSAGE (g)	TURBIDITY(NTU)
1	5	614
2	10	558
3	15	690
4	20	730
5	25	800
6	30	820

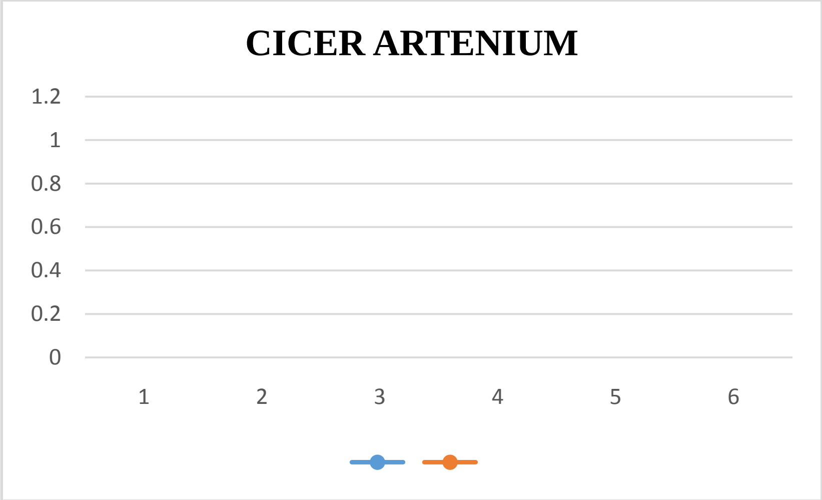


Table 6.2JACKFRUIT

S.NO	DOSAGE (g)	TURBIDITY(NTU)
1	O	10
2	0.2	27
3	0.4	27
4	0.6	26
5	0.8	26
6	1.0	27

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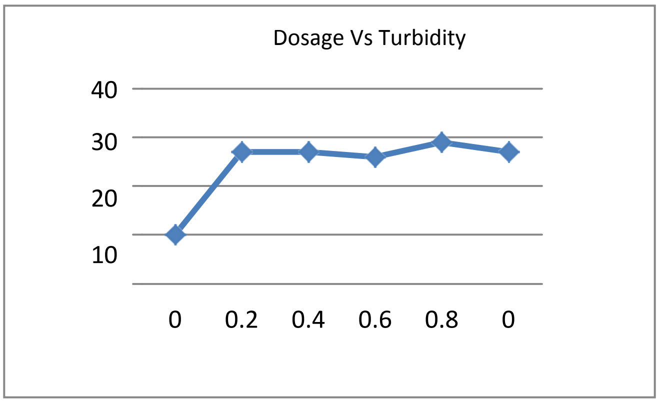

Table 6.3 COMMON BEANS

S.NO	DOSAGE(g)	TURBIDITY(NTU)
1	0	10
2	0.2	5
3	0.4	5
4	0.6	5
5	0.8	5
6	1.0	4.9

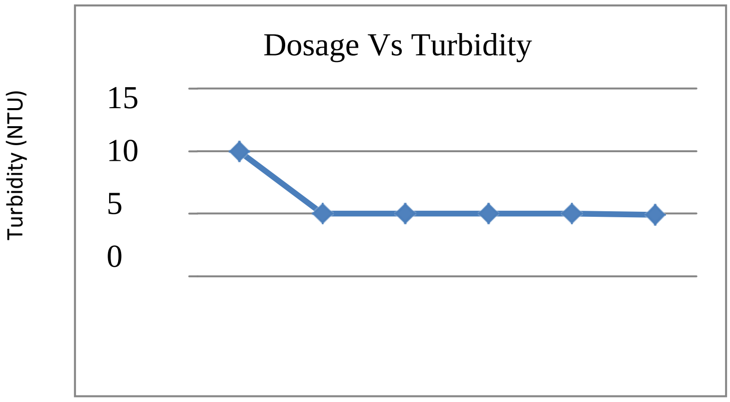

Table 6.4 MORINGA OLIFERA

S.NO	DOSAGE(g)	TURBIDITY(NTU)
1	5	996
2	10	1288
3	15	1265
4	20	928
5	25	1007
6	30	1125

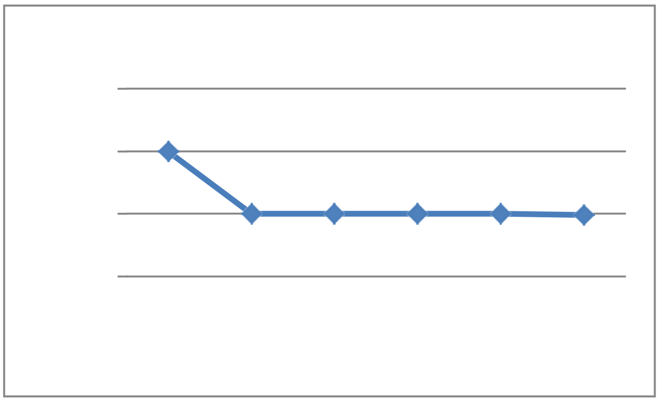

Table 6.5 CHARACTERISTICS OF DAIRY WASTEWATER

S.NO	PARAMETERS	VALUE
1	P^H	5.98
2	COD(mg/l)	57000
3	BOD(mg/l)	32300
4	CALCIUM(ml)	20
5	AMMONIA NITROGEN(ml)	2.9

CONCLUSION

Using some locally available natural coagulants for example moringa oleifera, cicer arietinum , jackfruit labab and common beans seeds significant improvement in removing turbidity and turbidity from wastewater was found .maximum turbidity reduction was found for highly turbidity water. After dosing , water soluble extract of moringa oleifera, cicer arietinum, Jackfruit labab and common beans seed reduced turbidity to 928 in 20g, 558 in 10g, 756 in 25g, 60in 20g.it was also found that thus natural coagulants reduced about 89-95% of turbidity.Among the natural coagulants used in the study for turbidity reduction, common beans seed was found most effective.

The dairy industry is the one of the leading industry in the world. But the effluent content leads to the some problems such as turbidity, oil and grease, organic content etc. If treating this effluent with some chemicals leads some health problems. So these can be overcome by using some natural materials. In this study using the two seeds an effective removal of turbidity is obtained. Coagulating with Artocarpusheterophylius (jack fruit) seed attained 94% removal efficiency, while with the Phaseolus vulgaris (Common Beans) seed obtain a highly removal efficiency upto99%.

Phaseolus vulgaris (Common Beans) seed can use as an effective coagulant in the dairy wastewater treatment mainly for the turbidityremoval.

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