Studies on colour removal efficiency of textile dyeing waste water using Moringo Olifera

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Abstract:

Dyes are produced naturally or artificially and give different colour to fabrics. In this paper the ability of moringo olifera in removing dyes has been studied. At various concentrations of the dye the absorbance value is noted using a double beam UV spectrophotometer and a calibration chart has been obtained. Experiments were carried out for determining the dye removal capacity using a powder derived from Moringo oleifera seed. The influences of several parameters such as pH, initial dye concentration, moringo dosage and the operating time have been tested. PH seems be an interesting variable and colour removal decreases as pH increases. The results show that the colour removal efficiency is attained maximum upto 99.9% using moringo as coagulant.

Keywords:

Moringo oleifera, Natural coagulant, colour removal.

1. INTRODUCTION:

Developing countries are facing potable water supply problems because of inadequate financial resources. The cost of water treatment is increasing, and the quality of river water is not stable due to a suspended and colloidal particle load caused by textile industries. Textile waste water include a large variety of dyes and chemicals additions that make the environmental challenge for textile industry not only for liquid waste but also its chemical composition. Main pollution in textile waste water comes from dyeing and finishing process. Major pollutants in textile waste waters are suspended solids, oxidizable matter, acidity and other soluble substances. These processes require the input of a wide range of chemicals and dye stuff Due to many problems created by using the synthetic coagulants such as aluminum sulphate which is used worldwide, . The discharge of dye containing effluents is unfavorable not just because of its colour but also due to the breakdown products from the effluents which are carcinogenic or toxic to life These dyes can remain in the environment for a long time unless treated (Suteu et al., 2009; Zaharia et al., 2009). There is a high demand to find an alternative coagulant which is preferable to be a natural coagulant. Textile dye waste water is characterized by fluctuations in many quality indicators such as COD, BOD, pH, salinity and temperature. Textile dyes are characterized mainly on the basis of its application characteristics and its chemical structure. (Zaharia Carmen, et al) Based on the general structure alone, textile dyes are also classified as anionic, nonionic and cationic dyes. Direct, acid and reactive dyes constitute the anionic dyes. (Robinson et al., 2001). Soluble reactive and acid dyes cause the most problems as they cannot be removed through conventional treatment.Before water is used, turbidity removal is an essential part of the treatment process. It is generally achieved using coagulation with metal salts followed by aggregation of particles during flocculation and separation through sedimentation and filtration (Emelie Arnoldsson et al, 2008). A number of studies have pointed out that the introduction of natural coagulants as a substitute for metal salts may ease the problems associated with chemical coagulants (Katayon et al., 2005). Presently there are several chemical and physical methods to treat textile waste water. But most of them prove to be either too expensive or harmful due to usage of chemicals. The *Moringo oleifera* tree produces a 90.00% to 99.99% bacterial reduction in previously untreated water, according to a paper published in *Current Protocols in Microbiology.* It is considered to be one of the world's most useful trees. Moringo oleifera with several health benefits, it's called the 'Miracle Tree' and the 'Tree of Life' in many cultures. It has proved its worth in health as well as in industries for the decolourization of dye water. When dried, hulled and ground, the seeds were found to have a noteworthy

ability to reduce the suspended solids in extremely turbid waters (Martin Bergstedt, 2011). Being water soluble and easily extractable it produces very less amount of sludge when compared to other natural and chemical coagulants such as neem leaf, fly ash, aluminum salts etc. Some mentionable advantages of using Moringo includes unchanged pH value, cost effectiveness, low sludge production, fit for human consumption.

1.1 CHEMICAL COAGULATION:

Coagulation is the destabilization of colloids by neutralizing the forces that keep them apart. Cationic coagulants provide positive electric charges to reduce the negative charge (zeta potential) of the colloids. As a result, the particles collide to form larger particles (flocs).Coagulation, thus, implies formation of smaller compact aggregates. Rapid mixing is required to disperse the coagulant throughout the liquid. Care must be taken not to overdose the coagulants as this can cause a complete charge reversal and destabilize the colloid complex. Effluents are heterogeneous in nature. Chemical coagulation is an important unit process in water treatment for the removal of turbidity. Its application in water treatment is followed by sedimentation and filtration. Various types of coagulants are being used to condition water before sedimentation and filtration. The most widely used coagulants are:

- Aluminum sulphate{Alum }
- Poly aluminum chloride {PAC}
- Ferrous sulphate
- Sodium Aluminates
- Silicon Derivatives
- Lime
- Synthetic Organic Polymers

Currently Alum and PAC are most extensively used in water treatment .When brought in contact with water, they form positively charged aluminum hydroxide floc which agglomerates the negatively charged clays, slit, bacteria, algae organic matters etc causing them to settle down. The sludge formation in alum and PAC is very high. Also it suffers from high disposal cost making the treatment non user friendly. Without getting enmeshed in details of polymer-surface interactions, the gross effects of Ph on effective cationicity can be obtained from colloid titration behavior of the polymer at fixed levels of pH.

The coagulation mechanism of the M. oleifera coagulant protein has been explained in different ways in the previous studies. It has been described as adsorption and charge neutralization and interparticle bridging. Flocculation by inter-particle bridging is mainly characteristic of high molecular weight polyelectrolytes. Due to the small size of the M. oleifera coagulant protein, a ridging effect may not be considered as the likely coagulation mechanism. (Mangale Sapana M. et al).

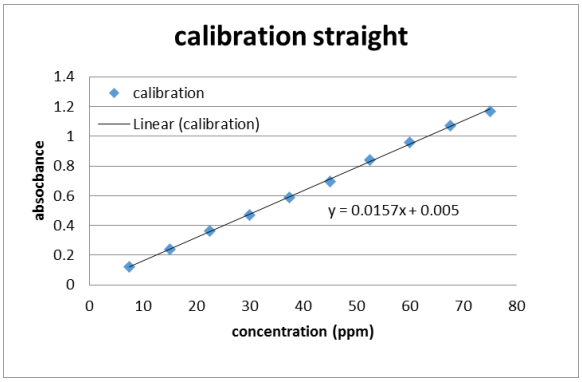
2. EXPERIMENTAL PROCEDURE:

Synthetic Blue CA dye was prepared at various concentrations and 250ml of the sample was taken in a beaker. Moringo powder was added to the dye and the reaction was allowed along with stirring using electrical stirrers. After the reaction time it was allowed to settle and the supernatant was tested for various parameters. The colour removal was observed using a double beam UV spectrophotometer and the efficiency of removal was calculated using the absorbance value before and after treatment. All the experiments were carried out at room temperature.

Fig1. Experimental Setup

3. RESULTS AND DISCUSSION:

A calibration curve was obtained using various concentration of the dye and determining the absorbance value.



3.1. VARYING DYE CONCENTRATION AND CONSTANT MORINGO CONCENTRATION:

An attempt was made to find out the efficiency of colour removal for different concentrations of the dye. The coagulant dosage was constant throughout.

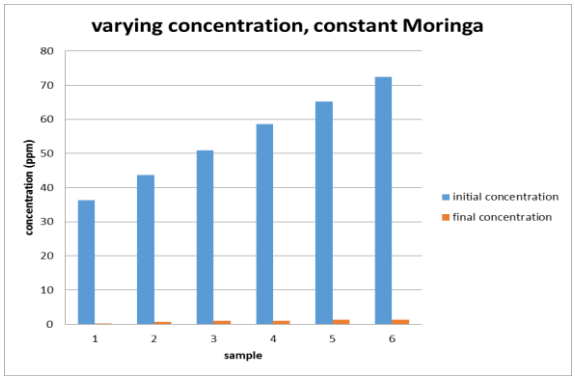


Fig2. Varying Dye Concentration before and after treatment

The result shows that the concentration of the dye before and after treatment has large difference. This is because after the addition of the moringo the dye molecules imparting colour has been removed through adsorption. More than 99% of the colour removal is attained.

3.2 CONSTANT DYE CONCENTRATION AND VARYING MORINGO CONCENTRATION:

Further experiments were carried out to determine the optimum dosage of moringo. Hence moringo powder at various concentrations (0.03g, 0.05g, 0.07, 0.1g and 0.15g) was added. The observations made experimentally and the result is as follows:

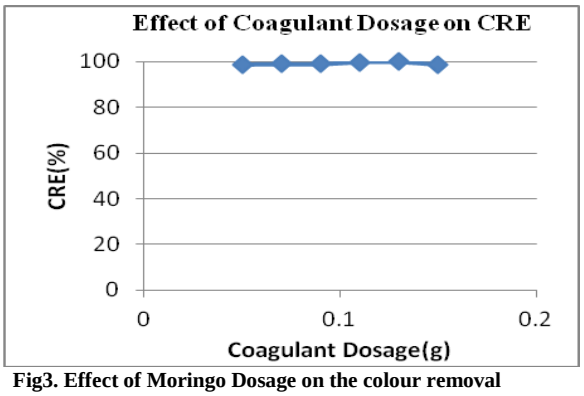


Fig3. Effect of Moringo Dosage on the colour removal

From the results it is clear that moringo acts as a good coagulant for colour removal. At the addition of 0.05g of moringo itself the efficiency was very high upto 98% and it attained maximum upon further concentrations of the coagulant.

3.3 VARYING PH, CONSTANT DYE CONCENTRATION AND CONSTANT MORINGO CONCENTRATION:

As stated in the previous studies pH had a greater influence on the colour removal efficiency. Experiments were carried out at different ranges of pH maintaining the dye concentration and coagulant dosage constant throughout. The observations made experimentally and the results are shown in the graph.

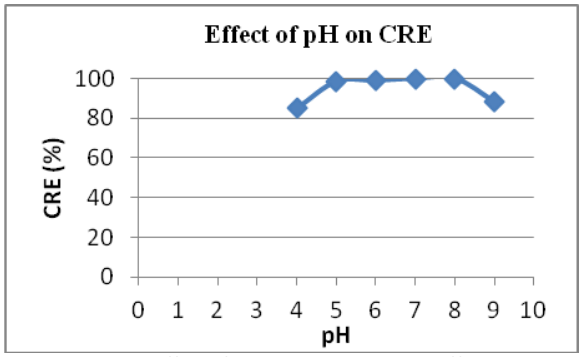


Fig4. Effect of pH on colour removal efficiency

At the initial stage when the pH was low at a range of 4 – 5.5 the removal efficiency was lesser than the efficiency attained when the pH was maintained between 6-8. Similar was the case when the pH was increased and ranged between 8-9.

3.4 VARYING CONTACT TIME, CONSTANT DYE CONCENTRATION AND CONSTANT MORINGO CONCENTRATION:

Studies were made to find out the effect of variation of the reaction time on the colour removal efficieny. Various contact time ranging from 10 minutes to 50 minutes were maintained and the results were observed.

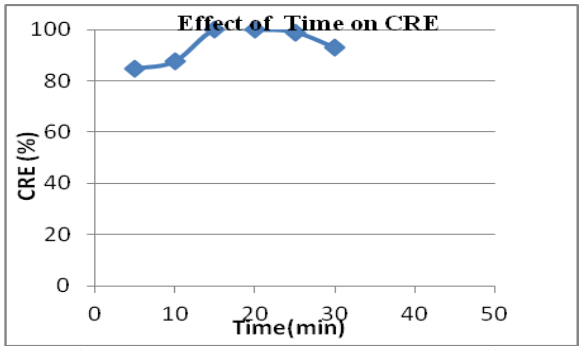


Fig5. Effect of Reaction time on the colour removal efficiency

Initially at less contact time the colour removal efficiency was achieved to only 85%. But results

show when the reaction time was increased and when time was maintained 20 minutes the efficiency was nearly100%.This may be due to the increasd formation of flocs when there was increase in the time.But again the efficiency started decreasing when the time was further increased to 30 minutes and more.

4.CONCLUSION:

The treatment of textile dyeing waste water before disposal into the environment is important and ensures safety to the environment without affecting the quality of lakes, rivers etc. Use of an economic method also plays an important role. Thus natural product moringo olifera powder seems to be more promising in the treatment of coloured waste water. The efficiency of treating the dye waste water using Moringo olifera was also found to be more effective. The colour removal percentage is more than about 99%. Operating parameters such as the coagulant dosage, reaction time, pH and the initial dye concentarion has major role on the efficiency of removal.

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