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***Short Communication***

# Treatment of textile wastewater with banana stem pith juice as natural coagulants

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## Abstract

*In India, textile industry is the eldest and major manufacturing industry in the country. Gradually increasing demand of products causes increase in wastewater generation. Textile wastewater is a combination of types of dyes used and additives such as oxidizing agents, surfactants, salts, heavy metals, dispersing agents and finishing agents comprising compounds that are persistent and lethal. Physico-chemical treatment processes of textile wastewater such as chemical coagulation processes are cost effective but lead in significant sludge volume generation. Such sludge production requires appropriate treatment and disposal. Natural coagulants be naturally occurring low cost products, biodegradable and so environment friendly. This study is based on the relevance of Banana Stem Pith Juice as an organic coagulant for textile wastewater treatment and their comparison for treatment efficiency. Jar tests were conducted using varying dosages and pH adjustment of raw wastewater. Appropriate pH and dosage of the natural coagulant was observed to be 4 and 1000mg/L respectively. Coagulant Banana Pith Juice showed results of treatment efficiency for parameters COD, BOD, TS and TSS as 14.04%, 13.12%, 18.52% and 40.37% respectively.*

**Keywords:** Textile industry, textile wastewater, Banana Pith Juice, COD, BOD, TS, TSS, natural coagulant.

## Introduction

Textile industry sector is expanding day by day with the increasing demand of products. Textile industry is one of the vast and imperative and it utilize textile auxiliaries, dyes and chemicals in its processes. Textile industries generate bulk of wastewater due to use of dyes, chemicals and other additives in its manufacturing processing. These processes require abundant quantity of water leading to generation of wastewater in high volume. An estimation from World Bank states that textile industry contributes 17–20% of industrial water pollution. In general, textile wastewater is fairly a complex mixture that contains many polluting substances and is highly varying in its characteristics. Textile wastewater is a combination of types of dyes used and additives such as oxidizing agents, surfactants, salts, heavy metals, dispersing agents and finishing agents having compounds that are persistent and lethal. Disposal of such heavily polluted wastewater into water bodies result in contamination of soil and water. It effects the environment adversely.

The methods of treatment of wastewater that have been developed are physical or physico-chemical, chemical, biological, electrochemical methods and membrane techniques. Primary treatment processes are used to reduce load on secondary and tertiary treatment. The chemical coagulation process leads to significant sludge production, which requires suitable treatment and disposal. Biological treatments are insufficient in removal of color of the wastewater. Use of natural organic material like seeds, leaves and other parts of plants has been found effective in water and wastewater treatment. Natural coagulants have advantages against chemical coagulants due to their biodegradability, low toxicity and they generate less residual sludge after treatment.

Banana is a vital fruit crop of various states in India. It is nurtured in an expanse of 830500 ha and overall yield is around 29779910 ton. Main banana cultivating states are Andhra Pradesh followed by Maharashtra, Gujarat, Tamil Nadu, and Karnataka. As fruits grow for single time only on the stem of banana tree, banana stems are cut off. After taking out the fruits production, these numerous quantity of stems is left in the plantation to decompose or to be used as fertilizers. Gopika G. L. et.al reported the reduction of suspended solids and turbidity from textile wastewater in their study. In the proposed study, the efficiency of banana stem pith juice as a natural coagulant for the treatment of textile wastewater was analyzed. Jar test along with a flocculation was operated and the effect of pH of textile wastewater on coagulation was examined.

## Materials and methods

Textile wastewater was collected from Tessitura Monti India pvt ltd, at Kolhapur, Maharashtra. Samples were carried in 5L container with airtight closed lid to avoid any contamination.

**Natural Coagulant Preparations:** Pith of the Banana Stem was separated carefully from its foliage. Pith of stem was cut into small pieces. A solution of 100gm of small pith parts in 10 ml of distilled water was prepared providing stirring for 45min using magnetic stirrer. The juice was collected by filtering the mixed pith solution.

**Coagulant Application to Wastewater:** In order to determine and compare the performance of the natural coagulants, jar test was experimented. Batch experiments were conducted providing rapid mixing, slow mixing and settling.

Application of natural coagulants was carried out in two phases:

**Phase-1: Appropriate pH Determination:** pH of raw wastewater was adjusted to 4, 5, 6, 7, 8. pH of wastewater was adjusted using diluted $H_2SO_4$ and NaOH.

**Phase-2: Optimum Dosage Determination:** Dosage range of 750-1500mg/L was applied for appropriate pH determination.

Physiochemical analysis of wastewater was carried out for COD, BOD, TS and TSS.

## Results and discussion

**Characteristics of raw textile wastewater:** Preliminary analysis of raw textile effluent was carried out to examine the effectiveness of Banana Pith Juice.

**Effects of pH on treatment potential of coagulant:** Collected samples were tested for varying pH range from 4 to 8 under dosage of 1000mg/L. COD, BOD, TS and TSS removal was noted.

**Table-1:** Characteristics of raw textile wastewater.

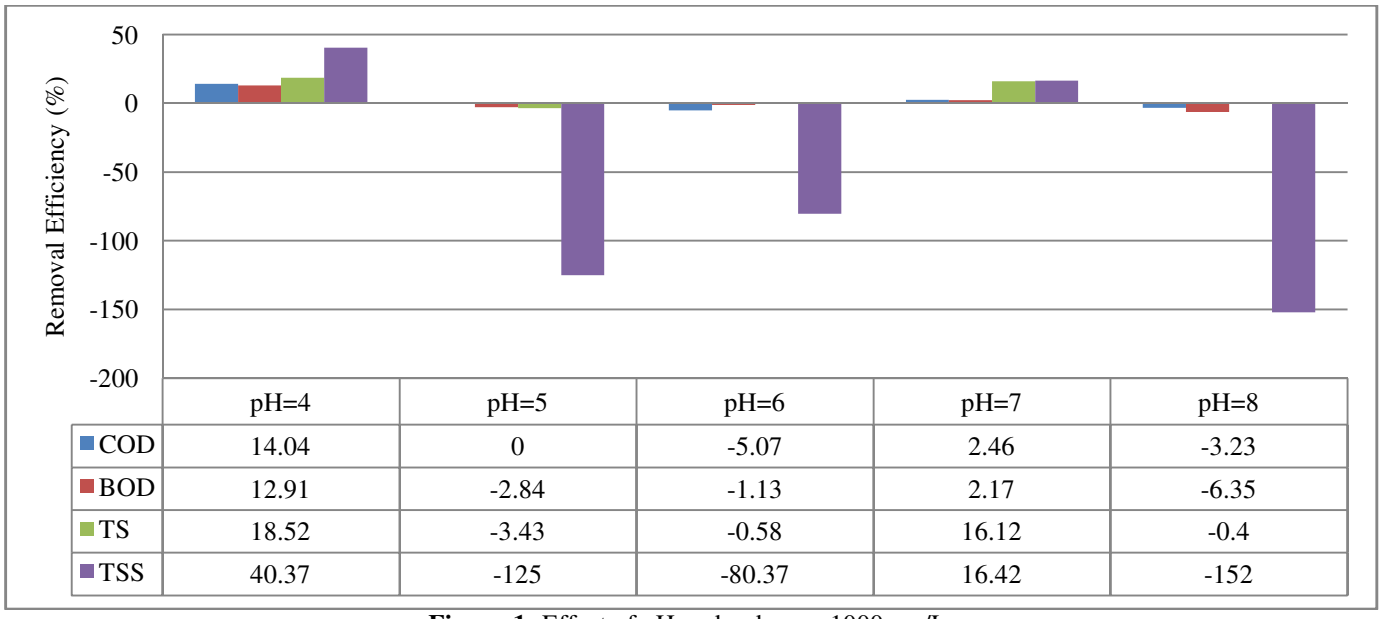
| Parameter | Raw Textile Wastewater |
|---|---|
| pH | 6.55-11.55 |
| COD (mg/L) | 420-760 |
| BOD (mg/L) | 165-300 |
| TS (mg/L) | 990-5038 |
| TSS (mg/L) | 118-858 |

At pH 5, 6 and 8, 1000mg/L dose of pith juice of banana coagulant showed negative removal efficiencies for all selected parameters. At pH 4 and 7, positive removal efficiencies were noted. Out of which, pith juice of banana stem was most effective in removing COD, BOD and TS at pH 4. Banana pith juice was observed to be more efficient in acidic condition of wastewater.

Therefore, due to better overall treatment efficiency, pH 4 was considered as appropriate pH for further dosage optimization.

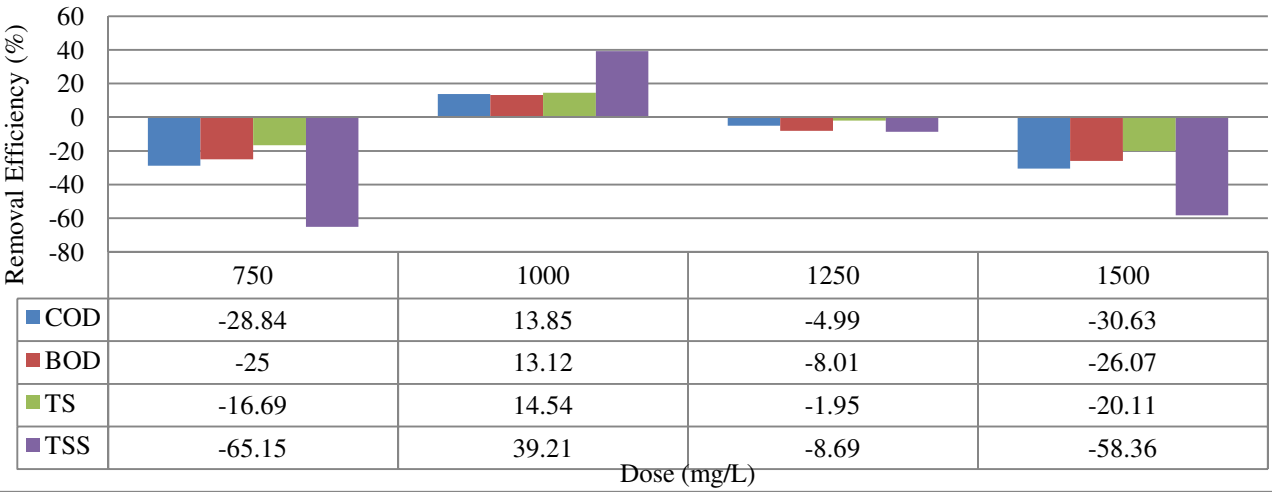
**Effects of coagulant dose on treatment potential of coagulant:** Dose range 750-1500mg/L was applied to wastewater sample with pH 4.

At appropriate pH 4, maximum removal of COD, BOD, TS and TSS was noted under 1000mg/L of banana pith juice coagulant. Except 1000mg/L dosage, each dosage within selected dosage range was found to be ineffective. Negative removal efficiency was observed under 750, 1250 and 1500mg/L dosage.




| | pH=4 | pH=5 | pH=6 | pH=7 | pH=8 |
|---|---|---|---|---|---|
| COD | 14.04 | 0 | -5.07 | 2.46 | -3.23 |
| BOD | 12.91 | -2.84 | -1.13 | 2.17 | -6.35 |
| TS | 18.52 | -3.43 | -0.58 | 16.12 | -0.4 |
| TSS | 40.37 | -125 | -80.37 | 16.42 | -152 |

**Figure-1:** Effect of pH under dosage 1000 mg/L.




| | 750 | 1000 | 1250 | 1500 |
|---|---|---|---|---|
| COD | -28.84 | 13.85 | -4.99 | -30.63 |
| BOD | -25 | 13.12 | -8.01 | -26.07 |
| TS | -16.69 | 14.54 | -1.95 | -20.11 |
| TSS | -65.15 | 39.21 | -8.69 | -58.36 |

**Figure-2:** Effect of dose at pH 4.

## Conclusion

After comparing the removal efficiencies of natural coagulant, Banana Pith Juice, for the treatment of textile wastewater following conclusions are made: i. At optimum pH of 4 and 1000mg/L dose of Banana Pith Juice coagulant the maximum reduction efficiencies were noted as 14.04%, 13.12%, 18.52% and 40.37% for COD, BOD, TS and TSS respectively. ii. Treated wastewater pH was observed to be in the range of 4 to 5. Hence, for further secondary treatment by biological process, pH of treated wastewater needs to be adjusted in acceptable range.

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