

# Treatment of Refinery and Petrochemical Wastewater Using Banana Peel as A Natural Coagulant



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## Abstract

The investigation into the ability of a natural coagulant banana peel to treat refinery and petrochemical waste water has been studied. The waste generated from various activities in these industries is usually disposed and promotes environmental degradation. Coagulation method was used in the treatment of the wastewater. Results reveal that turbidity of the waste water was 39.3%. The banana peel had a turbidity removal efficiency of 71.9% at pH of 8.0.

**Keywords:** Natural Coagulant; Turbidity Removal Efficiency; Banana peels

## Introduction

Coagulation and flocculation processes are physical-chemical methods that are widely used in the treatment of wastewater [1]. In the treatment of wastewater, coagulation has been used in the past with the aim of removing colloidal impurities. It has been noted that in the developing countries more than 1.6 million people are using the unhygienic water & among them most of the people suffers from diarrhea and other water related diseases [2]. Wastewater treatment techniques that are widely used are chemical precipitation, lime coagulation, ion exchange, reverse osmosis and solvent extraction [3]. Other bio adsorbent prepared from banana peels has been reported for the removal of chromium, cadmium and copper ions from aqueous solution [4]. Today, the prime concern of the environmental engineers is how to lower the coagulants and flocculants cost and to improve the characteristics of the produced sludge for safe utilization [5]. Coagulants play a major role in the treatment of water, wastewater and in the treatment and disposal of sludge [6]. Although many water treatment methods have been utilized, most of them are expensive [7]. The aim of this research is to investigate the ability of low cost banana peel to extract contaminants and heavy metals off refinery and petrochemical waste water.

## Materials and Methods

The waste water was collected from Warri refining and Nigeria National Petroleum Co-operation (NNPC) petrochemical company in Warri, Delta State of Nigeria and were characterized at thermocouple temperature. Matured banana bunch containing

63 seeds were purchased from Agbani market, Enugu State, Nigeria. The peeled banana was cut into tiny bits and then washed with distilled water. This was sundried for 20days. The dried peels were pulverized and sieved with a mesh size of 0.85mm to obtain a uniform particle size.

## Extraction of Active Components in the Coagulant

The peels were grounded and sieved with a 0.85mm mesh size to make the particles finer for better extraction purposes. 2g of the coagulant precursor was weighed and added to 100ml of distilled water to make 2% suspension. The suspension was stirred using a magnetic stirrer for 20minutes at room temperature (29°C) before filtration. This experiment was repeated three times.

## Coagulation Experiment

**Optimum pH:** Place 10ml of the active component, 10ml of buffer 2 and 20ml of wastewater into a beaker. Using a turbidity meter, record your initial value. Stir rapidly at 150rpm for 4minutes and slowly stir at 50 rpm for 20minutes at room temperature (29°C). Pour the mixture into a sample bottle and allow settling for 30minutes. Place the supernatant portion into a turbid meter and record your final value. Calculate the turbidity efficiency using equation 1 [8]. Repeat the following procedure using buffers 4, 6, 8, 10 keeping the other parameters constant.

$$\frac{NTU_0 - NTU_F}{NTU_0} \times 100 \quad (1)$$

**Suitable Coagulant Dosage:** Place 5ml of the active component, 10ml of buffer 8 and 20ml of waste water in a beaker, using a turbid meter, record your initial value. Stir rapidly for 4minutes, slowly stir for 20minutes at room temperature (29°C). Pour the mixture into a sample bottle and allow settling for 30minutes. Place the supernatant portion into a turbid meter and record your final value. Calculate the turbidity efficiency using equation 1. Repeat the following procedure using 10ml-25ml in 5.0 steps of the coagulant dosage respectively while keeping other parameters constant.

**Best Settling Time:** Place 20ml of the coagulant dosage, 10ml of buffer 8 and 20ml of waste water into a beaker, using a turbid meter record your initial value. Stir rapidly for 4minutes, slowly stir for 20minutes at room temperature (29°C). Pour the mixture into a sample bottle and allow settling for 30minutes. Place the supernatant portion into a turbid meter and record **Table 2:** Metal Content of the Wastewater.

Sample ID	Iron	S.D ±	Lead	S.D ±	Cadmium	S.D ±	Nickel	S.D ±	Chromium	S.D ±
Treatment Trains	2.932	0.014	0.342	0.038	<0.001	0.00	<0.00	0.00	0.001	0.00
Pretreated Control	0.967	0.028	1.170	0.00	1.055	0.005	0.940	0.015	0.907	0.055

The proximate analysis of Banana peels has been studied [9]. The results of the characterization of the collected waste water are presented in (Tables 1 & 2). The pH of waste water was found to be 7.043 before treatment. This is similar to a reported work [10]. Also, the turbidity of the wastewater was found to be 38% with total dissolved solid of 38. Conductivity and TDS values were high in the water samples. This is possibly because the ions from the dissolved solids in the water samples created an ability of water to conduct an electrical current [10]. The metal content of the waste water was investigated using an (FAAS) atomic absorption spectrometer (Table 2). Result shows that there are high levels of metal content of lead, cadmium, chromium. The presence of these metals poses harmful effect to the aquatic environment.

**Table 3:** Determination of suitable pH on coagulation.

pH	Turbidity Removal Efficiency (%)
2	54.8
4	25.6
6	45.0
8	67.1
10	51.8

**Table 4:** Determination of Coagulant dosage.

Coagulant (mg/L)	Turbidity Removal Efficiency (%)
5	71.5
10	64.7
15	69.7
20	71.9
25	50.0

The highest turbidity removal efficiency was at pH 8 (Table 3). pH has a very important role to play on the ionic reactions too. This means that at pH 8, the coagulants cationic charged

your final value. Calculate the turbidity efficiency using equation 1. Repeat the following procedure using the settling time of 10-30 minutes in 5.0 steps while keeping the other parameters constant.

## Results and Discussions

**Table 1:** Characterization of the collected waste water.

Parameters	(Pre-Treatment)	S.D ±
Temperature	29.7	
Ph	7.043	
Turbidity (%)	39.3	
Conductivity	78.2	0.00
Tds	38	0.00
Tss	0.148	0.00
Colour	>0.5<1.0	

particles were equal to the contaminants or anionic suspension charged particles and thus destabilized them all by attracting them to coagulate or settle in the solution as suspension (Table 4).

**Table 5:** Settling time on coagulation.

Settling Time	Turbidity Removal Efficiency (%)
5	39.1
10	66.8
15	69.6
20	70.8
25	71.8
30	71.9

Table 4 represents the actual coagulant dosage that was needed. 20mg/L of the coagulant dosage gave the highest turbidity removal efficiency. The turbidity removal efficiency increased from 5 minutes to 30 minutes. However, the maximum was seen at 30 minutes (Table 5) with a turbidity removal efficiency of 71.9%. This contrasts with a reported work [11].

## Conclusion

The use of eco-friendly coagulant is really needed in the treatment of wastewater and paramount for the sustenance of human health, plant and aquatic life. Banana peel flocculants acts as a polymer body which continuously traps the dirt, forming more networks of monomer chains and causing itself and the dirt to fall to the bottom of the wastewater. It yielded a turbidity removal efficiency of 71.9%.

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