



## An Experimental Study on Usage of Cactus and Hyacinth Bean Peels as Natural Coagulants to Treat Lake Water

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### ABSTRACT

Reusing wastewater by effective treatment can contribute to counter the water scarcity. Growing population, increased economic activity and industrialization has not only created an increased demand for fresh water but also resulted in severe misuse of this natural resource. Natural macromolecular coagulants show bright future and are concerned by many researchers because of their abundant source, low price, multifunction and biodegradation. In this study *Opuntia ficusindica*, a species of the cactus and the Hyacinth Bean peels are used as natural coagulants. The optimum dosage of cactus and the Hyacinth Bean peels was indicated 90 mg/L, respectively for kothacheruvu lake water. The Turbidity removal efficiency was 70% to 99% after treatment with NC1 and NC2 for dosage 70 to 100 mg/L, respectively. Effect of treatment on parameters pH, TSS, TDS and COD also studied. From this study, high turbidity removal indicates that cactus and Hyacinth Bean Peel powders has the potential for wastewater treatment application.

**Keywords:** Natural macromolecular coagulants, cactus, Hyacinth Bean peels, water treatment

### 1. Introduction

Almost fifty per cent of the developing world's population over 884 million people still uses unsafe drinking water sources. Inadequate access to safe water services, coupled with poor hygiene practices, kills and sickens thousands of children every day, and leads to impoverishment and diminished opportunities for thousands more. Women are forced to spend large parts of their day fetching water. Poor farmers and wage earners are less productive due to illness, health systems are overwhelmed and national economies suffer. Without safe water sustainable development is impossible.

For instance, in India, rapid population growth and other factors such as industrial discharge, agricultural run-off and poor sanitation practices put the long-term availability and quality of the potable water at stake. Water from boreholes is often too hard and although most people in the urban area have access to water treated by the municipality through tap or protected pumps; this water is rarely fit for drinking unless treated first. Microbial contamination through faecal contamination in water is the major reason for the poor water quality, transmitting a large number of diseases. The pathogens present in the drinking water include: *Shigella* species, *Salmonella* species, *Klebsiella* species, *Escherichia coli*, *Enterobacter* species, and parasites such as *Giardia lamblia* and *Entamoeba histolytica*. Drinking water treatment involves a number of combined processes based on the quality of the water source such as turbidity, amount of microbial load present in water and the others include cost and availability of chemicals in achieving desired level of treatment.

The rapid increase of industrialization and urbanization in the last few decades had caused a dramatic increase in the demanded water, as well as significant deteriorations in water quality throughout the world. Suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter and other microscopic organisms are responsible for turbid waters. The most used chemical coagulants to treat wastewater are aluminum and iron salts. Research works carried out by many researchers also proven that natural coagulants have brilliant potential due to their abundant availability, less price, innocuity, multifunctional, and biodegradation.

The present study focuses on the coagulant activity of *Opuntia ficusindica*, a species of the cactus and the Hyacinth Bean peels for physico – chemical and biological parameters removal from lake water.

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## 2. LITERATURE REVIEW

### NATURAL COAGULANTION PRACTICES IN INDIA

In view of growing awareness of pollution problems, dispersal of organic contamination in the environment is becoming a matter of concern. Ever increasing use of chemical and related compounds in each and every field of industry and ever agriculture summons an urgent need of method for their effective removal from water and wastewater. Increased population and modernized civilization trend gave rise to blooming of textile sectors in India. An estimate shows that textiles account for 14% of India's industrial production and around 27% of its export earnings. India is the second largest producer of cotton yarn and silk and third largest producer of cotton and cellulose fiber. The total production of yarn during the year 2003–2004 was 3051 kt. There are about 10,000 garment manufacturers and 2100 bleaching and dyeing industries in India (Ranganathan et al., 2007). However, the textile industry is facing major problems in the disposal of wastewater generated from textile dye and finishing processes. Textile dye wastewater contains strong color, high Chemical Oxygen Demand (COD), high total dissolved solids and is also bio-refractory in nature. The mostly polluted and large amounts of wastewaters are generated from the dye-houses of the textile industry (Muthukumar et al., 2004).

### NEED FOR NATURAL COAGULANTS

Chemical coagulant used has raised controversial issues due to its toxic nature for living organisms and can be categorized into three types: hydrolyzing metallic salts, pre-hydrolyzing metallic salts, and synthetic cationic polymers (Freitas et al., 2018; Verma et al., 2012). Due to the low cost, easy handling, storage, and high availability, chemical coagulants are more prevalent in wastewater treatment processes.  $Al_2(SO_4)_3$ ,  $Fe_2(SO_4)_3$ ,  $AlCl_3$ , and  $FeCl_3$  are the most commonly used coagulant salts (Freitas et al., 2018; Matilainen et al., 2010; Sher et al., 2013). Despite the availability, low cost etc.; chemical coagulants are far behind in green chemistry due to high residual concentrations of aluminum found in treated wastewater (Freitas et al., 2018; Matilainen et al., 2010). According to Freitas et al., 2018; McLachlan 1995; Polizzi et al. 2002, Alzheimer's disease is linked with the neurotoxicity of aluminum. Synthetic polymer coagulants form hazardous secondary products such as acrylamide which is carcinogenic and neurotoxic, and also synthetic polymers have low biodegradability (Freitas et al., 2018; Kurniawan et al., 2020). Excessive concentrations of chemical coagulants such as aluminum reduce the pH of water tends and also, they can be accumulated to food chains (Kurniawan et al., 2020). Improper disposal of toxic sludge pollutes the groundwater and soil. Accumulation of toxic sludge, such as aluminum, iron etc., in natural water bodies causes adverse effects on aquatic organisms and plant species (Kurniawan et al., 2020). Hence there is a need for the efficient utilization of natural coagulants for water and wastewater treatment.

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## 3. OBJECTIVES

- To collect the water samples from the surface water source ( Kothacheruvu Lake).
- To analyze physico-chemical and biological parameters (Turbidity, pH, TSS, TDS, COD and Colour) of lake water samples using standard procedure.
- Collection and preparation of natural coagulants for experimental study
- To determine the optimum dosage of natural coagulants
- To assess the efficiency of natural coagulants for treating surface water ( lake water).

### MATERIALS & APPARATUS :

- Cactus seeds
- Hyacinth bean peels
- Lake water samples
- pH meter
- Turbidity
- Jar test apparatus
- Whatman Filter paper
- Digital balance
- Oven
- Evaporating dishes
- Water bath

#### 4. RESULT AND DISCUSSION

Table 4.1

S.NO	PARAMETERS	BEFORE TREATMENT	NATURAL COAGULANTS ADDED	DOSAGE OF (NC-1 & 2)	RESULTS AFTER TREATMENT	STANDARD VALUES
1	pH	8.94	Cactus powder	70 mg/l 80 mg/l 90 mg/l 100 mg/l	8.54 8.42 8.36 8.52	6.5 – 8.5
2	TURBIDITY	263 NTU	Cactus powder	70 mg/l 80 mg/l 90 mg/l 100 mg/l	15.83 NTU 9.9 NTU 4.08 NTU 7.93 NTU	5 NTU
3	pH	8.94	Hyacinth Bean Peel powder	70 mg/l 80 mg/l 90 mg/l 100 mg/l	8.59 8.45 8.39 8.59	6.5 – 8.5
4	TURBIDITY	263 NTU	Hyacinth Bean peel Power	70 mg/l 80 mg/l 90 mg/l 100 mg/l	18.67 NTU 12.93 NTU 7.98 NTU 9.63 NTU	5 NTU
5	TSS	147 mg/L	Cactus powder	70 mg/l 80 mg/l 90 mg/l 100 mg/l	67 mg/L 52mg/L 44mg/L 49mg/L	75 mg/L
6	TDS	783 mg/L	Cactus powder	70 mg/l 80 mg/l 90 mg/l 100 mg/l	385 mg/L 357 mg/L 329 mg/L 354 mg/L	500 mg/L
7	TSS	147 mg/L	Hyacinth Bean Peel powder	70 mg/l 80 mg/l 90 mg/l 100 mg/l	72mg/L 61mg/L 56mg/L 62mg/L	75 mg/L
8	TDS	783 mg/L	Hyacinth Bean Peel powder	70 mg/l 80 mg/l 90 mg/l 100 mg/l	489 mg/L 465 mg/L 433 mg/L 459 mg/L	500 mg/L
9	Colour	Dark Black	Cactus powder	70 mg/l 80 mg/l 90 mg/l 100 mg/l	Colourless	-
10	COD	440 mg/L	Cactus powder	70 mg/l 80 mg/l 90 mg/l 100 mg/l	185 mg/l 177 mg/l 149 mg/l 154 mg/l	250 mg/L
11	Colour	Dark Black	Hyacinth Bean Peel powder	70 mg/l 80 mg/l 90 mg/l 100 mg/l	Colourless	-
12	COD	440 mg/L	Hyacinth Bean Peel powder	70 mg/l 80 mg/l 90 mg/l 100 mg/l	189 mg/l 175 mg/l 153 mg/l 159 mg/l	250 mg/L

## 5. CONCLUSION

The main conclusions that can be withdrawn from this study are as follows:

- More efficient treatment was achieved in Turbidity, COD, TDS and TSS removal from highly turbid lake water.
- Based on laboratory experiments it was found that natural coagulants was effective in reducing turbidity by 70 to 98% in surface lake water samples.
- High turbid water can be treated by adding natural coagulants, where the values that were recorded when using Cactus (NC-1) and Hyacinth Bean Peels (NC-2) were: effective turbidity 4.08 NTU and 7.98 NTU, removal turbidity efficiency of 98 % and 93% respectively.
- COD removal efficiency was found to be 72.73% and 65 %, after treatment with Cactus (NC-1) and Hyacinth Bean Peels (NC-2), Respectively.
- TSS removal efficiency was found to be 70 % and 61 %, after treatment with Cactus (NC-1) and Hyacinth Bean Peels (NC-2), Respectively.
- TDS removal efficiency was found to be 57 % and 44 %, after treatment with Cactus (NC-1) and Hyacinth Bean Peels (NC-2), Respectively.
- Increasing the concentration of the coagulants has an efficient effect in increasing the turbidity removal efficiency and reducing the residual turbidity.
- As the settling time increases the residual turbidity get decreased at certain time limit above that period slight increase in the turbidity was determined.
- It is concluded that the natural coagulants gives better results for turbidity, COD, TDS, and TSS removal.
- The scope of natural coagulants in water treating increasing day by day as compared to other chemicals.
- The water treated with natural coagulants is much useful for further uses like irrigation, public uses parks, cleaning of roads etc.
- The scope of natural coagulants in water treating increasing day by day as compared to other chemicals.

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