



Laboratory Study on Turbidity Reduction in Sugar Industry Wastewater Using Rice Husk and Water Hyacinth

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ABSTRACT:

Sugar industry wastewater contains high turbidity and suspended solids which can cause environmental pollution if discharged untreated. This study investigates the laboratory-scale treatment of sugar industry wastewater using rice husk powder and water hyacinth powder as natural adsorbents for turbidity reduction. Wastewater samples collected from a sugar industry were analyzed for physicochemical characteristics. Experimental treatment involved adsorption, shaking, settling, and filtration. Results showed turbidity reduction from 96 NTU to 6 NTU. The study demonstrates that rice husk and water hyacinth are effective, low-cost, and eco-friendly materials for sugar industry wastewater treatment.

Keywords— Sugar industry wastewater, Rice husk, Water hyacinth, Turbidity reduction, Natural adsorbents.

1.INTRODUCTION

The sugar industry is one of the largest agro-based industries contributing significantly to the economy of agricultural nations. However, sugar manufacturing processes consume large quantities of water and generate substantial volumes of wastewater during cane washing, juice extraction, clarification, evaporation, crystallization, condenser cooling, and equipment cleaning operations. The wastewater generated from these processes contains suspended solids, organic matter, colloidal particles, bagasse fibers, mud particles, and dissolved impurities which increase turbidity and pollution load.

Turbidity is one of the important physical parameters indicating the presence of suspended and colloidal particles in wastewater. High turbidity in industrial effluent reduces light penetration in receiving water bodies, interferes with photosynthetic activity, affects aquatic organisms, and increases treatment complexity in downstream purification processes. Therefore, turbidity reduction is an essential preliminary step in wastewater treatment before discharge or reuse.

Conventional turbidity removal methods include coagulation, flocculation, sedimentation, and filtration using chemical coagulants such as alum and ferric chloride. However, these chemicals increase treatment cost and may generate secondary sludge disposal problems. In recent years, natural adsorbents and bio-based coagulants have gained importance due to their low cost, biodegradability, environmental compatibility, and local availability.

Rice husk, an agricultural by-product, possesses porous silica-rich structure and high surface area which enhances adsorption capacity. Water hyacinth, an invasive aquatic weed, contains cellulose, hemicellulose, and lignin that contribute to adsorption and flocculation behavior. Utilization of these waste materials for wastewater treatment provides dual environmental benefits of waste valorization and pollution control.

This study investigates the efficiency of rice husk powder and water hyacinth powder in reducing turbidity from sugar industry wastewater under laboratory conditions.

2. OBJECTIVE OF THE STUDY

The major objectives of the present investigation are:

To collect sugar industry wastewater and analyze its turbidity characteristics.

To study the adsorption behavior of rice husk powder for turbidity removal.

To evaluate the performance of water hyacinth powder as a natural adsorbent.

To compare the turbidity reduction efficiency of both materials.

To determine optimum adsorbent dosage for maximum turbidity removal.

To develop an economical and eco-friendly preliminary treatment method for sugar industry wastewater.

3. LITERATURE REVIEW

Sugar industry wastewater contains high turbidity, suspended solids, and organic impurities that require treatment before discharge. Previous studies have shown that physical and chemical treatment methods are effective for turbidity reduction.

Kushwaha (2015) reported that sugar industries generate large volumes of wastewater with high suspended solids and turbidity, requiring proper treatment before disposal. Gunjal and Gunjal (2013) observed that turbidity in sugar mill effluent is mainly caused by fibrous particles and organic residues and recommended sedimentation and coagulation for treatment.

Patil et al. (2012) found that chemical coagulants such as alum effectively reduce turbidity but increase sludge generation and treatment cost. Singh and Srivastava (2016) suggested that natural coagulants and plant-based adsorbents can serve as economical and eco-friendly alternatives.

Mishra and Patel (2015) reported that rice husk has good adsorption capacity due to its porous silica-rich structure and can effectively remove suspended particles from wastewater. Previous studies also indicate that water hyacinth biomass acts as a natural adsorbent because of its fibrous composition and large surface area.

Based on the literature, rice husk and water hyacinth show strong potential as low-cost natural adsorbents for turbidity reduction in sugar industry wastewater.

4. MATERIALS USED

A. Rice Husk Powder

Rice husk is an agricultural by-product obtained during rice milling. It contains approximately 15–20% silica along with cellulose and lignin, making it highly porous and suitable for adsorption applications. Its rough surface texture and porous morphology enhance suspended particle entrapment.

B. Water Hyacinth Powder

Water hyacinth is a free-floating aquatic weed with rapid growth rate. It contains fibrous organic matter capable of adsorbing colloidal and suspended particles. Powdered water hyacinth acts as a natural coagulant aid due to its fibrous structure.



5. EXPERIMENTAL METHODOLOGY

A. Sample Collection

Wastewater samples were collected from K.C.P Sugar and Industries Corporation Limited located at Vuyyuru, Krishna District, Andhra Pradesh. Samples were collected in clean airtight plastic containers and transported immediately to the laboratory.

B. Preparation of Adsorbents

Rice husk and water hyacinth were washed thoroughly with distilled water to remove dust and impurities. The materials were sun-dried and oven-dried to remove moisture content. Dried materials were ground into fine powder and sieved for uniform particle size.

C. Batch Adsorption Test Procedure

Known dosages of adsorbent material were added to fixed volume wastewater samples. The mixtures were agitated in a mechanical shaker for 1 hour to ensure proper contact between adsorbent and suspended particles. After shaking, samples were allowed to settle under gravity. The supernatant was filtered and turbidity measured.

6. RESULTS AND DISCUSSION

A. Initial Wastewater Characteristics

S.NO	PARAMETER	VALUE(mg/L)
1.	pH	1.15
2.	TUBIDITY(NTU)	270
3.	BOD	32
4.	COD	252
5.	CHLORIDES	599.98
6.	SULPHATES	133.63
7.	ALKALINITY	0
8.	IRON	3
9.	FLUORIDES	1
10.	PHOSPHATES	133.63
11.	TOTAL SOLIDS	17600
12.	TOTAL DESOLVED SOLID	48000
13.	TOTAL SUSPENDED SOLIDS	12800

B. AFTER ADDING NATURAL MATERIALS

1.RICE HUSK

S.NO	DOSAGE (gm/L)	VALUE
1.	0.5	13
2.	1	6
3.	1.5	7
4.	2	7
5.	2.5	8
6.	3	7

1.1 Effect of Rice Husk Dosage

Rice husk showed significant turbidity reduction with increasing dosage up to 1 g/L. Beyond optimum dosage, turbidity reduction slightly decreased due to possible particle restabilization and excess suspended adsorbent.

Optimum turbidity reduction was observed at 1 g/L dosage, reducing turbidity to 6 NTU.

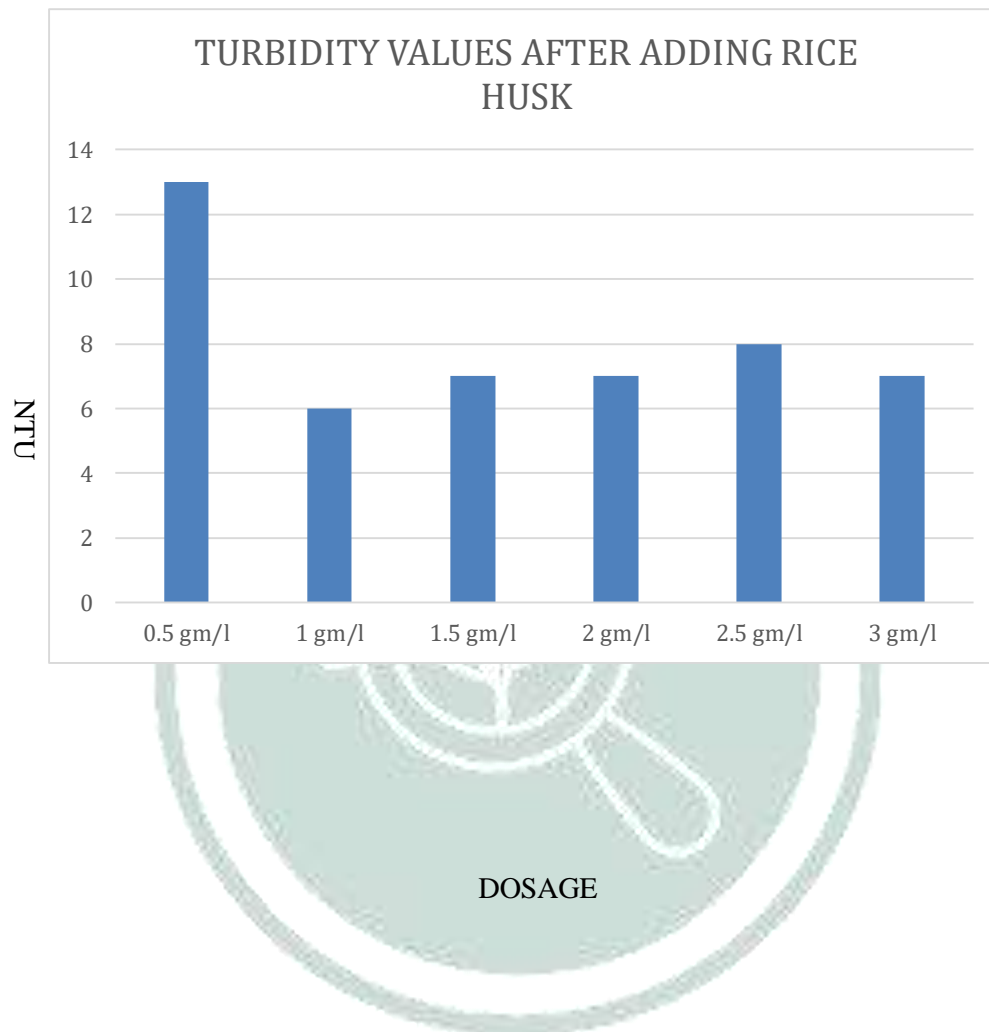
2.WATER HYACINTH

S.NO	DOSAGE (gm/L)	VALUE
1.	0.5	22
2.	1	7
3.	1.5	11
4.	2	8
5.	2.5	6
6.	3	10

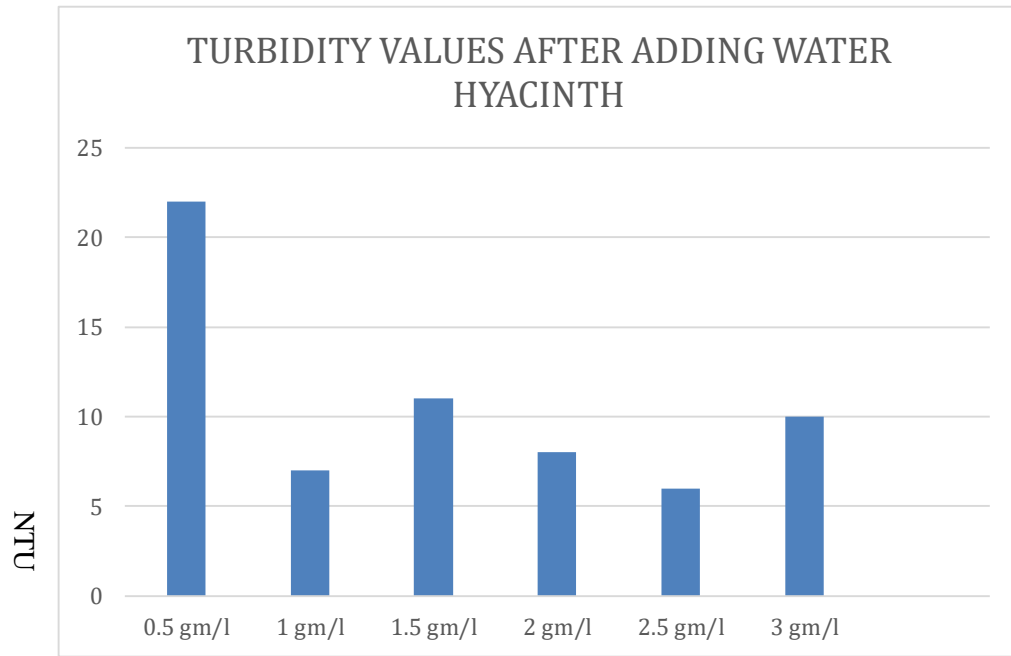
2.1 Effect of Water Hyacinth Dosage

Water hyacinth also reduced turbidity effectively, with best performance at 2.5 g/L dosage achieving 6 NTU turbidity. However, rice husk demonstrated better consistency and required lower dosage for equivalent treatment.

RICE HUSK



WATER HYACINTH





TURBIDITY METER READING

7. MECHANISM OF TURBIDITY REDUCTION

The turbidity reduction mechanism involves:

Adsorption

Suspended particles adhere to the porous surface of rice husk and water hyacinth through physical adsorption.

Bridging Flocculation

Fibrous structure of adsorbents helps bridge fine colloidal particles into larger flocs.

Sedimentation

The formed flocs settle under gravity during the settling period.

Filtration

Residual fine particles are removed during filtration.

8. CONCLUSION

The experimental investigation confirms that rice husk powder and water hyacinth powder are effective natural adsorbents for turbidity reduction in sugar industry wastewater.

Both materials significantly reduced turbidity through adsorption and flocculation mechanisms. Rice husk exhibited superior performance due to lower dosage requirement and stable treatment efficiency.

The proposed treatment method is economical, environmentally sustainable, and suitable for preliminary industrial wastewater treatment applications.

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