

# Effect of Sewage on the Sugar Factory Waste Treatment by using Water Hyacinth

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**Abstract**—Water hyacinth (*Eichhornia crassipes*), a very fast growing plant and serious water weed has now emerged as a plant capable of absorbing large quantity of nutrients from sewage and industrial wastes. In the present study, feasibility of water hyacinth in the treatment of sugar factory waste was examined. The water hyacinth was grown in two different combinations: one with sugar factory effluent alone and another with a mixture of effluent and sewage. The results showed a significant reduction in BOD, COD and suspended solids in the waste. The water hyacinth exhibited healthy growth in the effluent, especially in the presence of sewage. The addition of sewage enhanced the treatment process, demonstrating its potential role in wastewater remediation.

**Index Terms**—Bioremediation, BOD and COD reduction, Sewage treatment, Sugar factory effluent, Water Hyacinth.

## I. INTRODUCTION

In recent years, there has been significant development in the use of vascular aquatic plants for wastewater treatment. Among them, water hyacinth (*Eichhornia crassipes*) has shown the greatest potential. Although it is considered an invasive weed and a serious threat to freshwater ecosystems, it has demonstrated remarkable efficiency in nutrient absorption from sewage and industrial waste. The water hyacinth could reduce pH in the water. (Wang, Z., et al, 2012).

The suitability of vascular aquatic plants for wastewater treatment primarily depends on their capacity to remove nutrients from aqueous solutions. These plants possess a tremendous ability to absorb nutrients and other pollutants from water (Boyd, 1970), thereby reducing pollution levels. Numerous studies conducted over the past few decades (Boyd, 1970; Rogers & Davis, 1972) have shown that plants can be effectively used for wastewater treatment. The treatment mechanism

involves growing the plant in wastewater for a certain period. Its tufted roots provide a large surface area, facilitating the breakdown of suspended matter into simpler substances, which in turn reduces BOD, COD, and suspended solids in the effluent.

Water hyacinth has an exceptionally high growth rate and an extensive ability to absorb nutrients. The water hyacinth growth of the plant is very much dependent on temperature. (Thangiah, W.J.J, et al, 2022). It has been found to effectively remove BOD, COD, nitrogen, phosphorus, organic carbon, suspended solids, phenols, pesticides and heavy metals from wastewater (Gopal et al., 1985). Several reviews on this topic have been conducted (Haque & Sharma, 1980; Gupta, 1982; Trivedy & Gudekar, 1985).

Various types of wastewater have been treated using water hyacinth. The present study focuses on sugar factory waste to evaluate the effectiveness of water hyacinth treatment, both with and without sewage additions. Some studies suggest that the addition of sewage enhances the speed of the treatment process.

**Experimental planning:**

The untreated sugar factory waste was collected from Harinagar Sugar Mill in Harinagar, West Champaran. The waste was diluted according to the following scheme and stored in five separate containers. A total of 10 liters of wastewater was used for the experiment, with dechlorinated tap water serving as the diluting agent.

Container	Contents
1.	2.5 L Sugar factory waste + 7.5 L. water
2.	2.0 L Sugar factory waste + 0.5 L sewage + 7.5 L water

Fresh and small plants of water hyacinth were brought from nearby ponds and a known quantity of them was put in each container. The physico-chemical characteristics of the waste water were analyzed in the beginning of the experiment and after 2 and 4 days the hyacinth was weighted after the completion of the experiment. The physico-chemical analysis was carried using APHA (2020).

The waste:

Sugar factory waste is recognized as one of the most polluting types of industrial waste. India is a leading sugar producer globally, with Bihar contributing a significant share. Numerous sugar factories have emerged in North Bihar, generating millions of liters of effluent daily. The commonly employed treatment methods include aerobic lagooning and the activated sludge process. The waste contains extremely high levels of BOD, COD, as well as suspended and dissolved solids.

## II. OBSERVATIONS

The data on the changes in the physico-chemical characteristics of the sugar factory waste and percent reduction obtained with respect to various parameters is given in Table 1.

Table 1: Changes in the physico-chemical characteristics of the sugar factory waste after hyacinth treatment (% reduction for some is given in parenthesis).

Parameters	Initial		After 2 days		After 6 days	
	Sugar factory waste	Sugar factory waste + Sewage	Sugar factory waste	Sugar factory waste + Sewage	Sugar factory waste	Sugar factory waste + Sewage
pH	7.8	7.23	7.42	7.21	7.22	7.20
COD mg/L	248.0	200.0	180.0 (27.4%)	104.0 (48.0%)	144.0 (42.0%)	80.0 (60.0%)
BOD mg/L	180.0	164.0	120.0 (33.0%)	104.0 (51.2%)	102.0 (43.3%)	64.0 (64.5%)
Suspended Solid mg/L	146.2	128.4	42.5 (70.9%)	40.1 (38.7%)	36.6 (74.9%)	32.4 (74.8%)
Dissolved Oxygen mg/L	3.00	3.0	2.6	2.6	3.8	3.5

The pH of the waste was found to decline over time. In the first two days, the COD of the waste

decreased by 27.4%, reaching a reduction of 42.0% after six days. When combined with sewage, the reduction was more significant, at 48.0% after two days and 60.0% after six days.

The percentage reduction in BOD followed a similar pattern, showing a slightly higher decline than COD. A much greater reduction in suspended solids was observed, with reductions of 7.0% after both two and six days. In the presence of sewage, the reduction improved significantly to 68.7% after two days and 74.8% after six days.

The dissolved oxygen levels initially fell from 3.0 mg/L to 2.6 mg/L after two days in both sets. However, after six days, the levels increased to 3.5 mg/L in both the waste and sewage treatments.

Growth of water hyacinth:

Table 2 presents data on the growth of *Eichhornia crassipes* in various waste combinations. The plant showed poor growth, with only a 16.0% increase in sugar factory waste. However, its growth improved significantly to 21.9% when combined with sewage.

## III. DISCUSSION & CONCLUSION

The study indicates that the ability of water hyacinth to treat sugar factory waste is not highly significant. While the reduction in BOD reached 67.0% after six days, this result is noteworthy but not exceptionally effective. Wolverton et al. (1975) and Kumar et al. (1982) reported BOD reductions ranging from 60% to 100% within 3 to 16 days when sewage was included. The higher reductions observed in other studies are partly attributed to better growth conditions for *Eichhornia crassipes*.

The reduction in suspended solids, however, was quite significant. A rapid settling of suspended solids was observed soon after *Eichhornia crassipes* was introduced into the tanks. This reduction was due to both the degradation of suspended organic particles and rapid sedimentation.

The addition of sewage has been reported to enhance the reduction of BOD, COD and solids, likely due to improved growth conditions for *Eichhornia crassipes* in sewage-mixed effluent. (N.A. Noukeu, et. al, 2016). The essential nutrients required for the plant's growth, which are lacking in sugar factory waste, are supplemented by sewage.

Conclusions from the Study:

1. Water hyacinth alone does not provide an effective treatment for sugar factory waste. Other treatment methods may prove to be more viable; however, the plant does grow in this waste. Further experimental research is required to arrive at a definitive conclusion.
2. The addition of sewage enhances the waste treatment process.

Table-2: Increase in the biomass of *Eichornia crassipes* in wastewater tanks.

Parameters	Sugar Factory Waste+ Sewage	Sugar Factory Waste+ Sewage
Initial weight of <i>Eichhornia crassipes</i> in fresh weight	225.0	178.0
Final weight (after 6 days) in. g fresh weight	262.0	217.0
Increases in Biomass in 6 days/ increases in %	16.0	21.9

REFERENCES

[1] APHA. (2020). *Physico-chemical and biological analysis of wastewater*.

[2] Boyd, C. E. (1970). Vascular aquatic plants for mineral nutrient removal from polluted waters. *Economic Botany*, 24(1), 94-105.

[3] Gopal, P. K., Trivedy, R. K., & Vadia, R. R. (1985). Accumulation of nutrients from wastewater by water hyacinth (*Eichhornia crassipes*). *Geobios*, 12, 115-119.

[4] Gupta, C. C. (1982). Use of water hyacinth in wastewater treatment: A brief literature review. *Journal of Environmental Health*, 43(2), 80-82.

[5] Haque, A., & Sharma, S. (1980). Water hyacinth to fight water pollution. *Science Reporter*, December 1980.

[6] N.A. Noukeu, I. Gouado, R.J. Priso, D. Ndong, V.D. Taffou, S.D. Dibong, G.E. Ekodeck, (2016). Characterization of effluent from food processing industries and stillage treatment trial with *Eichhornia crassipes* (Mart.) and *Panicum maximum* (Jacq.), *Water Resources and Industry*, Volume 16, Pages 1-18, ISSN 2212-3717,

<https://doi.org/10.1016/j.wri.2016.07.001>.

[7] Rogers, H. H., & Davis, D. E. (1972). Water hyacinth for nutrient removal. *Hyacinth Control*, 6, 27-30.

[8] Thangiah, W. J. J., Arivendan, A., Basha, A. M., Rajini, N., & Daphne, R. (2022). Serious environmental threat water hyacinth (*eichhornia crassipes*) plant natural fibers: different extraction methods and morphological properties for polymer composite applications.. <https://doi.org/10.21203/rs.3.rs-1309954/v1>.

[9] Trivedy, R. K., & Gudekar, V. R. (1985). Wastewater treatment using water hyacinth: A review of progress in current pollution researches in India (R. K. Trivedy & P. K. Goel, Eds.). *Environmental Publications*, 109-145.

[10] Wang, Z., et al. Large-scale utilization of water hyacinth for nutrient removal in Lake Dianchi in China: The effects on the water quality, macrozoobenthos and zooplankton. *Chemosphere* (2012), <http://dx.doi.org/10.1016/j.chemosphere.2012.08.001>.

[11] Wolverton, B. C., Barlow, R. M., & McDonald, R. C. (1975). Application of vascular aquatic plants for pollution removal, energy, and food production in a biological system. *NASA Technical Memorandum TN-72726*, 15 p.