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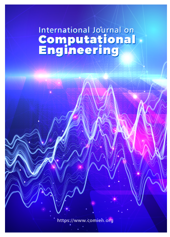

Assessment of Textile Effluent Quality: A Laboratory Analysis of ETP Effectiveness in Meeting ECR Standards

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***Abstract*— The textile sector contributes significantly to industrial pollution, especially by the release of effluents comprising dyes, chemicals, and other contaminants (Islam & Mostafa, 2019). Proper treatment of these effluents is critical for reducing their environmental impact. The purpose of this study is to analyze the effluent quality of FOURH Textile, a renowned textile manufacturing company, by examining samples collected before and after treatment at their Effluent Treatment Plant (ETP). The evaluation aims to determine if the treated effluent meets the Environmental Conservation Rules (ECR) requirements established by the regulatory authorities. Effluent samples were obtained from FOURH Textile's plant, focusing on the untreated (influent) and treated (effluent) streams. These samples were subjected to a battery of laboratory tests to determine pH, biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), and heavy metal levels. This study compares the findings of untreated and treated effluents to assess the effectiveness of the ETP in lowering pollutant levels to acceptable limits as per ECR standards. The conclusions of this investigation will shed light on the ETP's performance at FOURH Textile, as well as its compliance with environmental requirements.**

***Keywords*— Textile effluent; environmental compliance; effluent treatment plant; ECR standard.**

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I. Introduction

The textile industry is one of the most significant contributors to global water pollution. Effluent from textile manufacturing comprises a variety of toxins, including dyes, chemicals, and heavy metals, all of which represent substantial environmental and health dangers. Effective effluent treatment facilities (ETPs) are critical for reducing these effects and ensuring compliance with environmental regulations, such as the Environmental Conservation Rules (ECR) requirements. This literature review examines prior studies on the quality of textile effluent, the performance of ETPs, and the difficulty of reaching ECR criteria.

A. *Textile Effluent Characteristics*

Textile effluent is complex and varies greatly depending on the manufacturing method and chemicals used. Islam & Mostafa [1] identifies frequent pollutants in textile effluent as high levels of biological oxygen demand (BOD), chemical oxygen demand (COD), suspended particles, heavy metals, and hazardous compounds such as azo dyes. These contaminants can have serious environmental consequences, impacting aquatic ecosystems and human health [2].

B. *Environmental and Health Impacts*

The release of untreated or improperly treated textile effluent into aquatic bodies can cause eutrophication, biodiversity loss, and contamination of drinking water sources. Suresh [3] study the carcinogenic and mutagenic effects of some textile dyes, underlining the critical necessity for adequate effluent treatment.

C. *Effluent Treatment Technologies*

Textile effluent is managed using a variety of treatment technologies, including physical, chemical, and biological processes. Physical treatments such as sedimentation and filtration are frequently utilized as initial steps [4]. Chemical treatments that remove color and reduce COD include coagulation-flocculation and advanced oxidation methods. Biological therapies, including aerobic and anaerobic processes, are critical for BOD reduction.

D. Effectiveness of ETPs

The efficacy of ETPs in treating textile wastewater has been extensively explored. According to [5] integrated treatment techniques that combine physical, chemical, and biological processes are more effective at achieving regulatory requirements. However, fluctuation in ETP performance is frequently reported due to operational inefficiencies and insufficient maintenance [6].

E. Compatibility with ECR Regulations

Meeting ECR criteria presents a considerable barrier for many textile industries. Roy Choudhury [2] found that while some ETPs achieve compliance, many fail due to limited treatment capacity and poor operational methods. ETPs must be continuously monitored and upgraded to ensure long-term compliance [6].

F. Challenges and Future Directions

Despite advances in therapeutic technologies, some problems persist. High operational expenses, a scarcity of competent personnel, and insufficient regulatory enforcement impede effective effluent management. Future research should focus on establishing cost-effective and long-term treatment modalities, improving regulatory frameworks, and encouraging industry-wide best practices.

G. Conclusion

The quality of textile effluent and the efficiency of ETPs in achieving ECR criteria are still important areas of research. While great progress has been accomplished, ongoing advancements in treatment technologies and regulatory compliance are required to protect the environment and public health. This literature analysis emphasizes the importance of using a multidisciplinary approach to addressing the complex difficulties of textile effluent control.

II. Materials and Methods

A. Sample Collection

Four separate water samples were taken at various phases of the water and effluent treatment processes at a textile manufacturing facility. The samples are labeled as follows:

1) *S1 (Raw Water):* Groundwater serves as the textile facility's source water.

2) *S2 (Treated Water):* Water that has been treated in the facility's water treatment plant prior to use in textile processes.

3) *S3 (Discharge Water):* Untreated effluent discharged straight from textile processes and collected prior to entering the Effluent Treatment Plant (ETP).

4) *S4 (Treated Effluent Water):* Effluent collected after treatment in the ETP is ready for disposal into the environment.

B. Lab Analysis

Each sample underwent extensive laboratory testing to determine crucial physicochemical properties. The following parameters were evaluated:

1) *Chemical Oxygen Demand (COD):* The closed reflux titrimetric method measured the amount of oxygen needed to oxidize organic and inorganic compounds in water.

2) *Biochemical Oxygen Demand (BOD):* To evaluate Biochemical Oxygen Demand (BOD), samples were incubated at 20°C for five days and oxygen consumption was determined. This indicates the presence of biodegradable organic materials.

3) *Total Suspended Solids (TSS):* Total Suspended Solids (TSS) were measured by filtering a known amount of water through a pre-weighed filter, drying it, and weighing the retained solids.

4) *Total Dissolved Solids (TDS):* A conductivity meter was used to measure the concentration of dissolved ions.

TABLE I
LAB ANALYSIS

Parameters	RAW water	Treated water	Inlet	Outlet After ETP
BOD	1	0.2	280	9
COD	10	2	720	36
TDS	696	682	2300	2100
TSS	185	138	140	2

III. Results and Discussion

A. Biochemical Oxygen Demand (BOD)

1) *ECR 2023 Standard:* Maximum of 30 mg/L.

2) *The Outlet After ETP (S4):* The sample S4 has BOD level of 9 mg/L, which is significantly lower than the ECR 2023 requirement. This indicates effective reduction of biodegradable organic matter.Four separate water samples were taken at various phases of the water and effluent

B. Chemical Oxygen Demand (COD)

1) *ECR 2023 Standard:* Maximum 200 mg/L.

2) *The Outlet After ETP (S4):* The sample S4 has a COD level of 36 mg/L, much lower than the ECR 2023 limit, indicating effective removal of chemical pollutants.

C. Total Dissolved Solids (TDS)

1) *ECR 2023 Standard:* Maximum 2100 mg/L.

2) *Outlet After ETP (S4):* The sample S4 has TDS level of 2100 mg/L, fulfilling the standard. Although within permissible limits, this implies a modest reduction from input to outflow.

D. Total Suspended Solids (TSS)

1) *ECR 2023 Standard:* Maximum 150 mg/L.

2) *Outlet After ETP (S4):* The sample S4 has TSS level of 2 mg/L, which is significantly lower than the standard, indicating good efficiency in eliminating suspended particles.

IV. Conclusion

The investigation shows that the treated effluent (S4) from the textile facility's Effluent Treatment Plant (ETP) satisfies all of the ECR 2023 guidelines for Bangladesh [7]. The considerable reduction in BOD, COD, and TSS levels indicates how successful the ETP is at treating wastewater. However, the TDS levels, while within the acceptable range, indicate that further adjustment may be advantageous for improving overall water quality. The facility's adherence to regulatory criteria ensures that the effluent discharge has a low environmental impact.

Further ETP modification, particularly in terms of TDS reduction, has the potential to improve overall water quality. Continuous monitoring and adherence to current regulatory criteria are critical for sustainable water management and environmental protection. The facility's commitment to maintaining high treatment standards is crucial for safeguarding public health and the environment.

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