Achieving Zero Liquid Discharge through Sustainable Water Management in Hindalco Renukoot

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Abstract

In recent years, the Global Aluminium Industry's top priorities shifted from competitive to competitive and sustainable. Water is one such resource which poses a critical sustainability challenge if not addressed properly. This paper presents a comprehensive analysis of sustainable water management and a unique approach implemented at the Hindalco Renukoot Integrated Alumina and Aluminium Complex, with a specific focus on achieving Zero Liquid Discharge (ZLD). Over the past five years, these efforts have resulted in a significant reduction in freshwater consumption by 34 % and a 50 % decrease in process effluent through sustainable means. The study begins by providing an overview of the complex's water-intensive operations and their associated environmental impacts. It emphasizes the complex's recognition of responsible water management as a crucial factor in mitigating these impacts and achieving long-term sustainability. The strategies employed to optimize water consumption are then discussed, including reengineering, design, customized solution development, design of experiments, advanced process technologies, water recycling and reuse systems, and the establishment of efficient water distribution networks. Additionally, the paper highlights the complex's integrated approach to water and process condensate management, specifically targeting ZLD. Hindalco's state-of-the-art treatment facilities, incorporating advanced technologies for sustainable water management, are showcased. The study addresses the challenges faced in meeting environmental standards while striving for ZLD, highlighting the importance of environmental conservation and water resource preservation. The findings presented in this paper demonstrate the positive impact of Hindalco's water management efforts, particularly in terms of reduced water consumption. The paper concludes with a discussion on the potential scalability and transferability of these strategies to other industrial complexes, emphasizing the need for knowledge sharing and collective action in achieving global water sustainability goals.

Keywords: Water management, Sustainable practices, Resource conservation, Water footprint, Zero Liquid Discharge.

1. Introduction

This paper presents a case study on Hindalco Industries Limited's Aluminium facility in Renukoot, which has experienced substantial growth since its establishment in 1962 with an initial capacity of 20 000 tpa of primary Aluminium metal. Through strategic expansions and effective asset management, the plant's production capacity has significantly increased to reach an impressive 420 000 metric tons per annum (MTPA). Operating across the entire aluminium value chain, Hindalco's facility in Renukoot encompasses alumina refining, aluminium smelting, and downstream rolling and extrusions. A critical aspect of the facility's operations is water sourcing and treatment [1], with the primary water source being the Renu River through a pumping station located downstream of the Rihand dam. Pre-treatment of the water takes place at the riverbank before it undergoes further purification at the on-site Water Treatment Plant. This involves various processes such as clarification using clarisettlers, disinfection with chlorine dioxide, and filtration through sand filters. After receiving its final treatment, the water is supplied to the different plants and the colony through gravity. This case study focuses on the achievement of Zero Liquid Discharge through sustainable water management practices implemented

at Hindalco's Aluminium complex at Renukoot. It explores the strategies and technologies employed to ensure efficient water utilization and the minimization of environmental impact.

2. Conceptual Approach

2.1. Engaging a Third Party for Baseline Water Study

To gain a comprehensive understanding of the complex's water usage, a third party is engaged to conduct a baseline water study. This study provided valuable insights into the current water consumption patterns, identified inefficiencies, and served as a basis for future improvement initiatives.

2.2. Formation of Water Task Force

A water task force is established, comprising members across all functions at the Renukoot complex. The task force's primary objective is to collaborate to achieve water conservation and reduce the effluent load. This cross-functional team brings together diverse expertise and perspectives to develop effective strategies.

2.3. Water Mapping and Water Balance Analysis

A detailed water mapping exercise is conducted to identify all water sources, consumption points, and the flow of water throughout the plant processes. This exercise helps create a comprehensive picture of water usage patterns. Subsequently, a water balance analysis is performed to quantify water inputs, consumption, losses, and outputs across different processes. This analysis serves as a basis for identifying potential areas for optimization and reduction in water consumption.

2.4. Quantitative Tap Survey

A quantitative tap survey is conducted to measure and record the water consumption at various points of use, such as washrooms, kitchens, and other utility areas at different elevations. This survey provides valuable data on the actual water consumption at each tap and helps identify areas where water-saving measures can be implemented.

2.5. Drain Survey and Daily Monitoring

A drain survey is carried out, and pinch points are established on drains for daily monitoring. This enables the identification of potential leakages, wastages, or unauthorized discharge of water. Regular monitoring allows for the timely detection of abnormalities and swift corrective actions.

2.6. Quantitative and Qualitative Analysis of Effluent Streams

Effluent streams from different processes are subjected to both quantitative and qualitative analysis. The quantitative analysis determines the volume of each effluent stream, while the qualitative analysis assesses the composition and characteristics of the effluents. This information helps identify opportunities for treatment, recycling, or reuse of effluent streams, leading to a reduction in the effluent load.

2.7. Brainstorming Sessions and Project Identification

The water task force conducts a series of brainstorming sessions to generate ideas and tests through lab-scale experiments for reducing river water consumption and effluent load. These sessions involve

Moving forward, it is essential to continue monitoring and evaluating the implemented measures, identifying additional opportunities for improvement, and fostering a culture of water conservation within the complex. By maintaining a proactive and collaborative approach, the complex can further enhance its environmental performance and serve as a model for sustainable water management practices in industrial settings (refer to Figures 17-19).

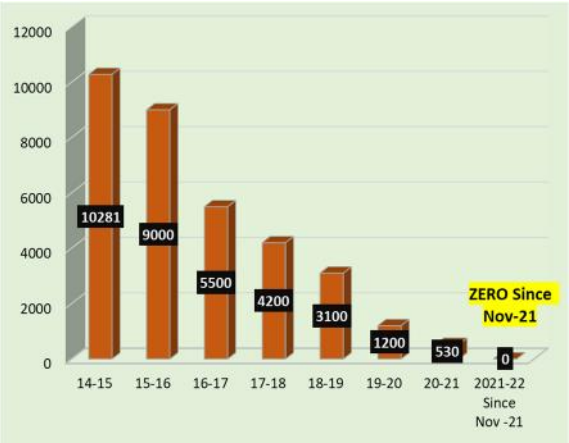

Figure 17. Effluent discharge in kL/day.

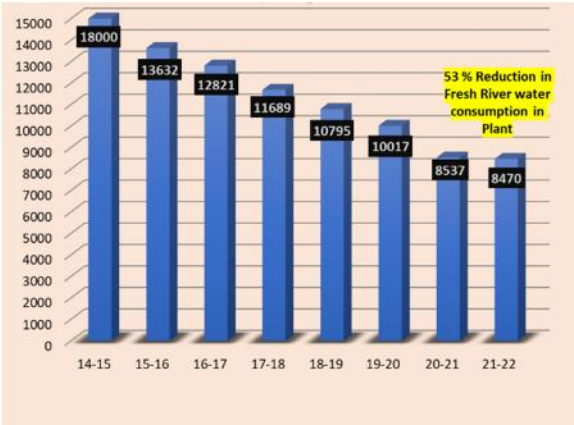

Figure 18. Reduction in freshwater cons. in plant

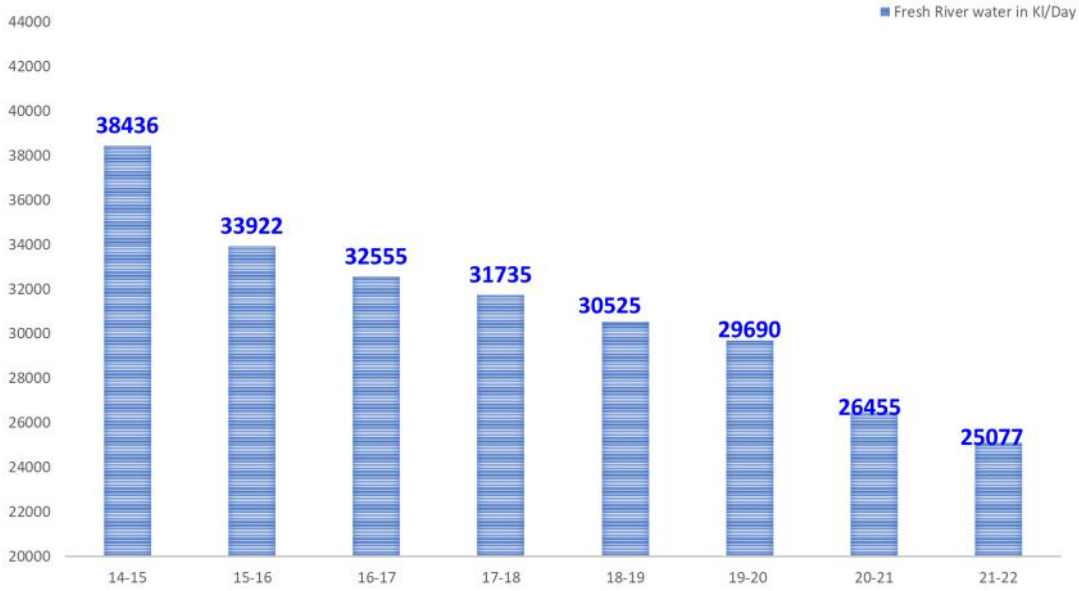

Figure 19. River water consumption in kL/day overall (plant and colony)

5. References

1. Metcalf & Eddy, Inc. et al., *Wastewater Engineering: Treatment and Resource Recovery*, McGraw-Hill, 2014.