

**ENERGY OPTIMIZATION OF DESALINATION PLANT  
IN LAKVIJAYA POWER STATION.**

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Thesis submitted in partial fulfillment of the requirements for the degree  
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## DECLARATION

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Under my direction, the aforementioned applicant completed research for his master's degrees' dissertation.

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## ABSTRACT

Seawater reverse osmosis (SWRO) desalination has become an increasingly important technology in power plants for production of demineralized water for steam turbines and water for other uses. This study focused on optimizing the energy efficiency of the SWRO desalination plant at the Lakvijaya Power Station in Sri Lanka. The current specific energy consumption of this plant is (SEC) of  $6.35 \text{ kWh/m}^3$ , which is double the typical benchmark value.

Initially the research analyzed the existing SWRO system and investigated into methods to reduce energy consumption through dilution of the seawater feed. Theoretical calculations were performed to determine the optimal mixing ratio of seawater with treated wastewater and rainwater to minimize the SEC. Furthermore, Energy recovery device efficiency was also evaluated. Various scenarios were modeled to identify the operating conditions that would approach the thermodynamic limit for minimum energy usage.

By the research, it was observed that diluting the seawater feed with treated wastewater and harvested rainwater could significantly reduce the SEC. The optimal mixing ratio was found to be 5:1 seawater to treated wastewater, reducing feed salinity from  $5,000 \mu\text{s/cm}$  to  $35,000 \mu\text{s/cm}$ . This allowed increasing the recovery ratio to 40%. At this optimized condition, the theoretical SEC was calculated to be  $4.28 \text{ kWh/m}^3$ , compared to  $6.35 \text{ kWh/m}^3$  for the existing process. A basic economic analysis showed the proposed modifications could potentially save over million rupees annually in energy costs, with an estimated payback period of only 107 days.

This study demonstrates the significant potential for energy optimization in SWRO plants through strategic feed water management and provides a framework for similar analyses at other facilities. Further research is recommended to validate the theoretical results through pilot testing and to explore additional efficiency improvements.

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