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Integrated Waste Management Control in a Clinical Waste Treatment Facility in Sri Lanka: A Model for Sustainable Operations

Wishvajith, M.H.D.L.*, Kayanan, S.
Department of Bio Science, University of Vavuniya, Vavuniya, Sri Lanka
**lankawishna@gmail.com*

Abstract

The increasing demand for environmentally compliant clinical waste treatment in Sri Lanka highlights the need for integrated approaches that minimize pollution across liquid, gaseous, and solid waste streams. This study was conducted at a licensed clinical waste treatment facility located in the Western Province of Sri Lanka, addressing its operational performance and alignment with national regulatory requirements. Field investigations were carried out from May to August 2025 and included process flow analysis, waste tracking, and detailed on-site observations. These methods enabled the evaluation of waste handling practices, treatment system efficiency, and environmental monitoring procedures. The analyzed data and field insights directly informed the assessment, revealing several key operational characteristics observed during site visits, such as organized waste storage, appropriate housekeeping standards, controlled internal transport, structured documentation, clear effluent discharge pathways, and multi-stage emission control processes. Liquid waste generated from equipment cleaning and ash-bathing operations is systematically collected, treated, and reused within the facility, reducing freshwater demand and preventing discharge-related contamination. Gaseous emissions from incineration are managed through a multi-stage air pollution control system comprising Selective Non-Catalytic Reduction, a cyclone separator, a dry reactor, and baghouse filters, enabling consistent compliance with Central Environmental Authority emission standards. Solid residues, mainly bottom ash, are subject to resource recovery and utilized in manufacturing SLS-certified eco-blocks, supporting national circular economy initiatives. The facility also maintains continuous environmental monitoring, occupational safety training, and comprehensive operational documentation, demonstrating adherence to the National Environmental Act No. 47 of 1980 and related regulatory frameworks. The findings suggest that integrating pollution prevention technologies with systematic waste reuse and structured environmental management enhances operational sustainability, strengthens public health protection, and contributes to Sri Lanka's progress toward the Sustainable Development Goals (SDGs). Overall, the facility's management framework presents a replicable model for sustainable clinical waste treatment operations in Sri Lanka.

Keywords: *Clinical waste management, Pollution control, Incineration facility, Environmental monitoring, Sustainable operations*