



Osamu (Olah Sampahmu) Incinerator: Smart Technology for A Green and Sustainable Future

Rijal Fatahadin¹, Azid Johar Tauhid²

^{1,2}Sekolah Dasar Negeri Lamaransari
Subang, Indonesia

E-mail: rfatahadin@upi.edu, cmeazid@gmail.com

Abstract - This research is motivated by the prevailing view that waste disposal technology is crucial for addressing the waste crisis, reducing air pollution (carbon emissions), and supporting environmental sustainability. Given the importance of these issues, there is a need for environmentally friendly waste disposal technology that integrates automation and achieves fuel efficiency. Conventional waste disposal methods using machinery remain heavily reliant on fuel and production cost efficiency. The drawbacks of these methods include exhaust emissions that still contain particulates and pollutants, as well as ash processing systems that are still carried out manually, resulting in inefficiency. The objective of this study is to provide a technical description of the use of the Osamu Incinerator as an environmentally friendly waste disposal technology capable of achieving effective waste disposal, specifically featuring an environmentally friendly incinerator system, a stable combustion system, a multi-stage exhaust gas treatment system, and a continuous exhaust gas emission monitoring system. This study employed a qualitative research method using a Research and Development (R&D) design, with research stages including needs analysis, prototype design, expert validation, pilot testing of the machine, and qualitative evaluation. Data were analyzed thematically through reduction, presentation, and drawing of conclusions. This research employs a qualitative approach using a Research and Development (R&D) design, with research stages including needs analysis, prototype design, expert validation, pilot testing of the machine, and qualitative evaluation. Data were analyzed thematically through reduction, presentation, and drawing of conclusions. The testing method for the developed technology combines functional testing of the device, smoke emission testing, and waste reduction effectiveness testing, so that the results can serve as scientific evidence that the Osamu technology is effective, safe, and environmentally friendly. The results of this study show that Osamu is capable of effectively destroying solid waste by $\geq 85\%$ with controlled emission levels that meet applicable environmental standards. Test results show that smoke emissions are not only reduced by up to 100%, but with the use of Aerator Treatment technology, contaminated smoke is recirculated until it is clean and then supplied back to the combustion chamber. This represents a mutualistic symbiosis approach in an environmentally friendly waste disposal technology, making it a smart technology for building a green and sustainable future.

Keywords: Osamu Incinerator, Ecofriendly Waste Disposal Technology, A Green and Sustainable Future

I. INTRODUCTION

Waste management and treatment across various sectors remain significant challenges in many regions, including Subang Regency. The volume of waste continues to rise due to increasingly consumerist daily activities and the threat of microplastics, yet facilities for managing it remain limited. As a result, open burning is frequently practiced, leading to air pollution and hazardous waste. Waste management is a crucial component of environmental protection strategies aimed at minimizing negative impacts on human health and ecosystems. Waste management technologies are advancing rapidly in response to rising waste volumes and the growing need for alternative energy sources. Therefore, selecting the appropriate technology is key to achieving effective, efficient, and sustainable waste management (Tchobanoglous & Kreith, 2002). For this reason, environmentally friendly waste treatment technologies are needed, such as smokeless incinerators (Fatahadin et al., 2025). As Turn (2012) clarifies, smokeless waste incineration is a technology and combustion method designed to minimize the formation of soot, tar, and unburned volatiles.

In addition, incinerators are well-known and widely used to significantly reduce waste volume through high-temperature combustion. Technologies related to

waste incinerators have also been described in other sources; however, these technologies still have shortcomings in terms of production cost efficiency. Nevertheless, the aforementioned technologies still have weaknesses and limitations, including exhaust emissions that still contain particulates and pollutants, and an ash processing system that is still carried out manually, making it inefficient.

The objective of this study is to address the issues mentioned above by integrating automatic feeding technology, a stable combustion system, multi-stage emission treatment, and a real-time emission monitoring system—features that set this machine apart from conventional incinerators. The primary objective of this technology is to incinerate solid waste with high efficiency while producing exhaust gases that have undergone treatment. One viable solution is the use of environmentally friendly waste incinerators based on modern technology. Osamu technology is designed to efficiently reduce waste volume while prioritizing environmental sustainability. Some of the technologies currently being developed include waste-to-energy (WtE), pyrolysis, gasification, and Internet of Things (IoT)-based processing. These technologies not only significantly reduce the amount of waste but also generate alternative energy and minimize harmful gas emissions compared to open burning or conventional landfilling methods.

In addition, the concept of sustainable waste management also supports the implementation of the 3R principles (reduce, reuse, recycle) and zero waste as part of efforts to build a greener environment. The Indonesian government has even set a target for the waste sector to achieve zero emissions by 2050 through the Zero Waste Zero Emission 2050 program. This demonstrates that modern and environmentally friendly waste management is a vital component of sustainable development and climate change mitigation. Furthermore, the use of Osamu as an eco-friendly waste disposal solution is a smart

II. RESEARCH METHOD

This study employed a qualitative method using a Research and Development (R&D) design adapted from Borg & Gall. The research stages included needs analysis, prototype design, expert validation, pilot testing of the machine, and qualitative evaluation. Data were analyzed thematically through reduction, presentation, and drawing of conclusions.

This study draws on ecopedagogics principles rooted in the concept of transformative education, in which the learning process not only transfers knowledge regarding waste management and processing but also fosters a shared ecological consciousness in creating a green and sustainable future. This underscores that effective environmental education must encourage concrete action and the involvement of all global citizens in solving local environmental problems. Furthermore, the applicability of the Research and Development model (Borg & Gall, 1983) provides a scientific framework for developing academic products through systematic stages involving validity testing, implementation, and evaluation.

The design stages of the device, technical specifications, testing procedures, operational parameters, and indicators used to evaluate the device's performance including combustion capacity, operating temperature, types of waste used, combustion duration, energy consumption, and measured emission parameters are presented in the Results and Discussion section.

III. RESULT and DISCUSSION

According to Fatahidin (2025), the implementation of an eco-pedagogical approach plays a crucial role in shaping the character of teachers and students with a focus on sustainability. This aligns with the theory of innovation diffusion (Perwitasari et al., 2025), which explains that the success of adopting new technologies, such as Osamu technology, is heavily influenced by levels of social acceptance, perceived benefits, and institutional support. Therefore, the combination of the eco-pedagogical approach and the adoption of environmentally friendly technology form the conceptual foundation of this study. The smokeless incinerator prototype demonstrated high efficiency in reducing smoke emissions by up to 85%. Trained teachers showed improved eco-pedagogical competencies and integrated waste management activities into their teaching. These results support Fatahidin's (2024) findings regarding the Ecobin project.

solution for the future because it can improve the efficiency of waste management in communities, reduce dependence on landfills, and create a cleaner and healthier environment. With the right technological support, waste is no longer viewed merely as refuse but as a resource that can be reused to generate energy or produce economically valuable products. Therefore, the development and implementation of Osamu as an eco-friendly waste disposal technology represent a strategic step toward realizing a green and sustainable future, setting it apart from conventional incinerators.

1. Needs Analysis

A review of the literature on the Indonesian President's statement confirms that waste management is a national priority that must be addressed within the next 2–3 years (State Secretariat of the Republic of Indonesia: 2026). He has called for a “war on waste” because it is considered a health threat and an environmental disaster. These directives include several key focuses and specific instructions, among them: 1) Micro-Scale Waste Treatment Technology, whereby the government encourages the use of environmentally friendly micro-scale waste disposal devices developed by local universities to be installed in every sub-district. 2) Innovation Toward a Circular Economy: President Prabowo visited the BLE Banyumas Integrated Waste Management Facility (TPST) and aims to roll out an integrated system from the household level up to the regency level. He also highlighted the potential to process waste into economically valuable products, such as roof tiles, which can be utilized for public housing renovation assistance programs, and 3) The National Movement on Waste Management is being carried out in an integrated manner through the “Indonesia ASRI” Movement and the development of dozens of waste-to-energy projects. This was further emphasized by the Regent of Subang, who initiated the “Out of the Box” approach—stating that Subang does not want a landfill, and that waste issues can be resolved at the subdistrict level (Reynaldy: 2025). This represents a concrete step by the government to reduce the burden on landfills.

2. Design and Validation of Prototype

Based on these needs, the Osamu prototype was developed with an adaptive combustion capacity (1–1.5 metric tons/day) for both organic and non-organic waste. Osamu provides an environmentally friendly incinerator system designed to dispose of solid waste with high efficiency while producing treated exhaust gases.

The specifications of this incinerator system consist of several main components, namely: 1) Sliding door, which functions as a door for feeding waste into the combustion chamber; 2) Combustion chamber 1, where waste entering through the loading door is rapidly incinerated by a stable flame and an appropriate oxygen airflow to destroy and re-burn dioxins and furans; 3) Chamber 2, which breaks down the smoke before it enters the treatment

stage; 4) Smoke piping, through which the broken-down smoke enters the treatment aerator; 5) Exhaust blower, which draws in and forces air; 6) Treatment aerator, which removes and breaks down soot not captured in Chamber 2; 7) Fresh air to Chamber 1: The treated, clean air is then supplied back to maintain oxygen pressure in the combustion chamber; 8) Residue/fly ash output: This component discharges the remaining combustion ash; 9) Control panel: This component controls the operation of the Osamu waste incinerator.

The Osamu Incinerator is an incineration system designed to improve the efficiency of environmentally friendly waste combustion and eliminate exhaust gas emissions through the integration of various treatment technologies, without requiring fuel consumption. Expert validation shows that the design meets environmental criteria and is suitable for implementation across various sectors. This is consistent with previous studies on smokeless incinerators. The prototype uses a two-chamber combustion system (primary and secondary) with a closed-loop air circulation system, ensuring that no smoke is emitted at all.

Test results show that smoke emissions are not only reduced by up to 100%, but with the use of Aerator Treatment technology, the contaminated smoke is recirculated until it is clean and then returned to the combustion chamber. This represents a mutually beneficial symbiotic approach in an environmentally friendly waste incineration technology. The measurement instruments used include digital scales, infrared thermometers, stopwatches, and Ringelmann charts. These instruments are sufficient to measure combustion efficiency, smoke levels, and the effectiveness of the device in a scientific manner at a relatively affordable cost. This supports the findings of the Brilliance Journal that smokeless incinerators are effective for processing both organic and inorganic waste (Riyanto et al., 2021).

The planning and design stages for the Osamu device are presented in Figure 1. The specifications of the components attached to Osamu are presented in Figure 2.

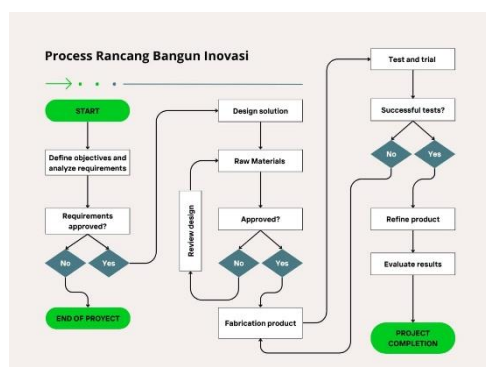


Figure 1. Design and Construction Process of the Osamu Incinerator

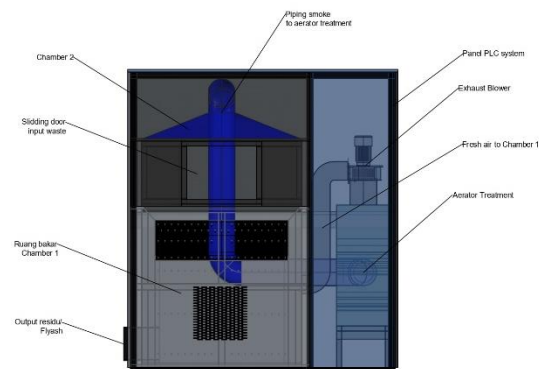


Figure 2. Osamu Incinerator Components



Figure 3. Osamu Incinerator Prototype

3. Osamu's Process as a Sustainable Waste Disposal Technology

The Osamu Incinerator's operating process includes the following: 1) Waste is fed into the sliding door; 2) Waste entering through the loading door is rapidly incinerated by a stable flame and an appropriate oxygen airflow to destroy and burn off dioxins and furans in the combustion chamber (Chamber 1); 3) In Chamber 2, the smoke is broken down before treatment; 4) In the smoke piping, the broken-down smoke enters the aerator treatment unit; 5) The exhaust blower draws in and pushes air; 6) The aerator treatment unit removes and breaks down soot that was not captured in Chamber 2; 7) Fresh air to Chamber 1: The treated and clean air is then supplied back to maintain oxygen pressure in the combustion chamber; 8) Fly ash output: This system removes the remaining combustion ash; 9) Control panel: This panel controls the operation of the Osamu waste incinerator.

The Osamu incinerator offers several advantages over conventional incinerator technology, including: An automatic feeding system that enhances combustion stability; a multi-stage emission treatment system capable of significantly reducing or even eliminating emissions and particulates; an automatic ash disposal system that improves operational safety; a real-time emission monitoring system using a touchscreen control panel; and a modular system design that allows for

application across various waste processing capacities. And this technology truly offers a highly practical improvement, particularly in the Osamu Incinerator.

Based on the above, it can be understood that Osamu achieves an 85% reduction in waste volume with an incineration capacity of 1–1.5 metric tons per day; it is energy-efficient, requires no fuel consumption, and produces no exhaust emissions with a Ringelmann smoke opacity rating of 0–1, significantly reduces particulate matter, and achieves a combustion efficiency of over 85%.

4. Discussion of Findings and Relevant Theories

Environmental and sustainable approaches can serve as alternatives for improving the efficiency of waste management in communities, reducing dependence on landfills, and creating a cleaner and healthier environment. With the support of appropriate technology, waste is no longer viewed merely as refuse, but rather as a resource that can be reused to generate energy or produce goods of economic value. These findings can be explained through the following theories.

a. Sustainability Development

According to the Brundtland Commission (WCED, 1987), sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The OSAMU machine supports this principle because it reduces waste accumulation, minimizes environmental pollution, and sustainably improves the quality of the community's living environment.

b. Circular Economy

The concept of the circular economy emphasizes waste reduction through the principles of reduce, reuse, recycle, and recover, so that resources can be utilized optimally. According to Kirchherr, Reike, and Hekkert (2017), the circular economy aims to reduce waste and preserve the value of resources through a systemic approach. The OSAMU machine contributes to the circular economy through the waste recovery process, which reduces the volume of waste ending up in landfills and optimizes residue management more efficiently.

c. Environmental Innovation

According to Kemp and Pearson (2007), environmental innovation (eco-innovation) is the development of new products, processes, or methods capable of reducing environmental impact compared to available alternatives. The OSAMU machine can be categorized as an environmental innovation because it features cleaner combustion technology, produces lower emissions, and improves the effectiveness of waste management compared to open burning or direct disposal in landfills.

d. Sustainable Waste Management

According to Wilson (2007), sustainable

waste management is a system that not only focuses on the technical aspects of waste processing but also takes into account environmental, public health, economic, and social participation aspects. The OSAMU machine supports this concept because it reduces the burden on landfills, minimizes the risk of pollution, improves environmental cleanliness, and can be implemented as a community-based waste management solution. Thus, this technology not only solves waste problems but also supports environmental sustainability and public health.

Based on this theoretical perspective, the OSAMU machine can be positioned as an innovative technology that supports sustainable development through more efficient waste management, the application of circular economy principles, the reduction of environmental impacts, and the strengthening of sustainable waste management systems at the community level. These findings indicate that local technological innovations can serve as a strategic solution in creating a cleaner, healthier, and more sustainable society.

5. Program Sustainability Strategy

OSAMU Incinerator technology can be applied across various sectors, including: municipal waste treatment facilities, integrated waste treatment facilities, industrial zones, healthcare facilities, and integrated wastewater treatment plants. The sustainability of district-scale waste incinerator programs depends on four main pillars: 1) a circular economy model (converting waste into marketable products such as fertilizer or RDF fuel), 2) technology tailored to regional specifications, 3) strong institutional frameworks (through BLUDs/BUMDs), and 4) active community participation.

IV. CONCLUSION

Based on the discussion and study results, the researchers drew the following conclusions: 1) The Osamu Incinerator is an incineration system designed to improve the efficiency of environmentally friendly waste combustion and eliminate exhaust gas emissions through the integration of various treatment technologies. Expert validation indicates that the design meets environmentally friendly criteria and is suitable for implementation across various sectors. 2) The Osamu Incinerator can benefit both the public and the government because it provides a practical and efficient solution for environmentally friendly waste disposal; this incinerator offers several advantages over conventional incinerator technologies, including: an automatic feeding system that enhances combustion stability, A multi-stage emission treatment system capable of significantly reducing or even eliminating emissions and particulate matter, making it a smart solution for building a green and sustainable future, and 3) Osamu is an innovative technology that supports sustainable development through more

efficient waste management, the application of circular economy principles, the reduction of environmental impacts, and the strengthening of sustainable waste management systems at the community level. These findings demonstrate that local technological innovations can serve as a strategic solution in creating a cleaner, healthier, and more sustainable society.

Recommendations:

1. The government should support the implementation of similar tools across various institutions in line with the Zero Waste Zero Emission 2050 and Subang Out of The Box programs.
2. Integrate waste management projects into elementary school curricula, such as local content or school environmental projects, at all levels.
3. Further research is recommended to conduct quantitative studies (e.g., emission reduction measurements, cost-benefit analyses) and longitudinal studies to assess long-term impacts.

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