E-BOOK OF EXTENDED ABSTRACT

THE 14TH INTERNATIONAL INVENTION, INNOVATION & DESIGN COMPETITION 2025

14TH INDES 2025

ENVIRONMENTAL • SOCIAL • GOVERNANCE

UNIVERSITI TEKNOLOGI MARA

RIICAN
Research Innovation Industry Community & Alumni Network

E-BOOK OF EXTENDED ABSTRACT

THE 14th INTERNATIONAL
INVENTION, INNOVATION &
DESIGN COMPETITION 2025

Organized by:

Office of Research, Industry,
Community & Alumni Network
UiTM Perak Branch

Perpustakaan Negara Malaysia Cataloguing in Publication Data

No e- ISBN: 978-967-2776-52-9

Cover Design: Dr. Mohd Khairulnizam Ramlie

Typesetting : Georgia

EDITORIAL BOARD

ECOBARA STOVE: AN INNOVATIVE SMOKE-FREE WASTE INCINERATOR WITH AN INTEGRATED FILTRATION SYSTEM TO MINIMIZE HARMFUL EMISSIONS AND PROMOTE ENVIRONMENTALLY SUSTAINABLE WASTE MANAGEMENT.

Akbar Muntaqo, Nugraheni Novita Hutami, Fathia Aqila Zatadini, Rajab Bullah A. Nasution

Islamic University Of Indonesia
Jl. Kaliurang Km. 14,5, Sleman, Daerah Istimewah Yogyakarta, Indonesia

Email:24215056@students.uii.ac.id

ABSTRACT

The increasing waste problem requires innovative solutions, one of which is waste incineration. However, conventional waste burning methods produce smoke pollution that poses serious risks to human health and the environment. EcoBara Stove offers a solution through a smoke-free waste-burning stove equipped with an advanced filtration system, designed to reduce toxic gas emissions while optimizing the combustion process. This device features a multi-layered filtering system, including activated carbon filters, quicklime filters, and bag filters, which work to capture fine particles, hazardous gases, and unpleasant odors. With a heat-resistant structure and efficient design, EcoBara Stove is not only environmentally friendly but also user-friendly, making it suitable for both household and community use. The system includes a quencher box, activated carbon filter, quicklime filter, and bag filter. Results have shown a significant reduction in harmful emissions and air pollutants. This innovation is expected to serve as a sustainable alternative for waste management, supporting a green lifestyle while helping to mitigate air pollution.

Keyword: waste problem, air pollution reduction, sustainable innovation, activated carbon filter, household and community use, green lifestyle.

1. INTRODUCTION

The increasing volume of household and community waste has become a serious global environmental concern. Traditional waste disposal methods, particularly open burning, significantly contribute to air pollution through the release of hazardous gases and fine particulate matter. These pollutants not only degrade air quality but also pose severe health risks to both humans and animals. In response to this issue, innovations in waste management technology are urgently needed to provide more sustainable and environmentally friendly solutions. One such innovation is the EcoBara Stove, a smoke-free waste incinerator that utilizes a multi-layered filtration system to minimize toxic emissions.

This system consists of a quencher box, activated carbon filter, quicklime filter, and bag filter, all of which function effectively to trap harmful substances released during the combustion process. With its heat-resistant and efficient design, EcoBara Stove is not only easy to operate but also practical for use at both household and small community scales. The development of this device aims to offer an alternative method of waste processing that reduces environmental impact while promoting a green lifestyle. By significantly lowering air pollutants during combustion, EcoBara Stove contributes to improving air quality and aligns with the goals of sustainable development and public health protection.

2. METHODOLOGY

2.1 Design and Development of EcoBara Stove

The development of the EcoBara Stove began with the design of a combustion chamber optimized to ensure complete waste incineration with minimal smoke production. The stove is constructed using heat-resistant metal materials capable of withstanding high temperatures. The combustion chamber is specifically engineered to direct hot airflow efficiently, resulting in a more effective and uniform burning process.

2.2 Multi-Layered Filtration System

EcoBara Stove is equipped with a multi-layered filtration system which consists of a quencher box, activated carbon filter, quicklime (calcium oxide) filter, and bag filter. The quencher box serves to cool down combustion gases before they enter the subsequent filtration stages. The activated carbon filter absorbs toxic gases and unpleasant odors, while the quicklime filter neutralizes acidic gases. Finally, the bag filter captures fine particulate matter, preventing it from being released into the open air.

2.3 Performance Testing and Evaluation

After the assembly process, a series of tests were conducted using various types of organic and inorganic waste. The observed parameters included smoke emission levels, combustion chamber temperature, and the effectiveness of gas and particle filtration. The test results were then analyzed to assess the system's efficiency in reducing pollutant emissions and its overall environmental impact.

3. FINDINGS

This research is based on a review and analysis of previous studies related to the use of smokeless waste incinerators with integrated filtration systems. The findings are derived from secondary data obtained from credible scientific sources.

The main findings from the literature review are as follows:

1. Effectiveness of Emission Reduction in Previous Studies:
   Previous research has shown that incinerators equipped with multilayer filtration systems—such as activated carbon filters, quicklime filters, and bag filters—can significantly reduce smoke and harmful emissions during the combustion process. This has resulted in improved air quality in industrial areas (Rahmansyah, 2018).
2. Air Quality Improvement Through Filtration Systems:
   Research on solutions to address toxic gas emissions through the application of multilayer smoke filtration systems (including quencher boxes, activated carbon filters, quicklime filters, and bag filters) on the waste incinerator at Bank Sampah Cempaka 2 in West Bandung Regency revealed that this system effectively reduces toxic gas emissions and airborne pollutant particles generated during waste combustion (Muldiani, 2024).
3. Potential for Household and Community Use:
   This mini incinerator technology has been implemented by a Community Self-Help Group (KSM) in Karang Bindu Village. The implementation results indicate that the use of this incinerator is effective in reducing waste volume and minimizing air pollution caused by open burning. Additionally, the technology has raised community awareness about the importance of environmentally friendly waste management (Permata, 2025).

4. Supporting Sustainable Waste Management:
   This low-smoke waste incineration innovation aligns with sustainable development goals by offering a more environmentally friendly alternative to conventional waste burning methods, which often pollute the air and pose health risks to the public (Putri, 2024).

Note: These findings are derived from secondary sources and are used as supporting evidence in the development and design of the EcoBara Stove.

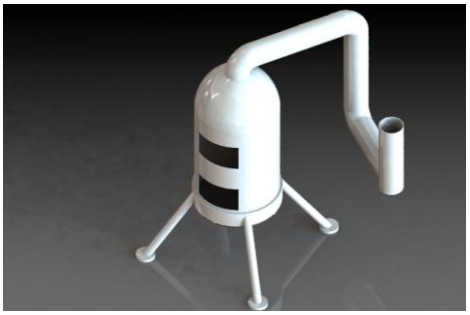


Figure 1 EcoBara Stove: A Smoke-Free Waste Incinerator Equipped with an Advanced Filtration System

4. CONCLUSION

The increasing volume of household and community waste has worsened global environmental issues, particularly due to open burning practices that release hazardous air pollutants. EcoBara Stove presents an innovative solution by offering a smoke-free waste incinerator that utilizes a multi-layered filtration system including a quencher box, activated carbon filter, quicklime filter, and bag filter to significantly reduce toxic gas emissions and fine particulate matter. The development and testing of the EcoBara Stove demonstrate its effectiveness in lowering air pollutants during the waste combustion process, thereby improving air quality and supporting public health and environmentally conscious living. With its heat-resistant, efficient, and user-friendly design, EcoBara Stove serves as a more sustainable and eco-friendly waste management option for households and small communities.

REFERENCES

Rahmansyah, M. I., Firdaus, M. Y. N., Muhajir, D. C., Septian, M. B., & Radianto, D. O. (2024).

Evaluasi Program Pengurangan Emisi Limbah Industri Dalam Upaya Mencapai Target Perlindungan Lingkungan. *Jurnal Penelitian Rumpun Ilmu Teknik*, *3(2), 01-11*.

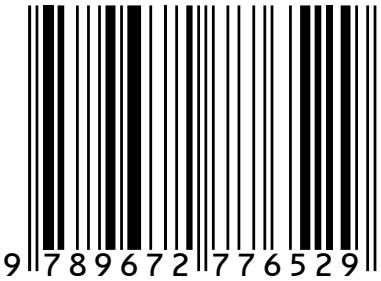
Muldiani, R. F., Supriyanti, Y., Gantina, T. M., Koesoemah, N. H., & Pratama, D. (2024). Penerapan Teknologi Filter Asap Untuk Penanganan Gas Buang Insinerator Pada Pengolahan Sampah. *Qardhul Hasan: Media Pengabdian Kepada Masyarakat*, *10*(2), *117-124*.

Permatasari, R., Rusmaryadi, H., & Firda, A. (2025). INOVASI TEKNOLOGI INCINERATOR MINI RAMAH LINGKUNGAN UNTUK PENANGGULANGAN SAMPAH PADAT DI DESA KARANG BINDU, PRABUMULIH–SUMATERA SELATAN. *JUARA: Jurnal Wahana Abdimas Sejahtera*.

Putri, E. A. P., Suryadi, N. F. N., Al Cameel, M. T., & Fitri, S. A. (2024). Optimalisasi Pengelolaan Sampah Dengan Alat Pembakaran Minim Asap Di RW 007 Desa Waluya. *PROCEEDINGS UIN SUNAN GUNUNG DJATI BANDUNG*, *5(2), 1-9*

E-Book of Extended Abstract THE 14th INTERNATIONAL INVENTION, INNOVATION & DESIGN COMPETITION 2025

e ISBN 978-967-2776-52-9



Unit Penerbitan UiTM Perak
.

(online)