Buddhist Community Innovation Development for Natural Energy Waste Incinerator and Environmentally Friendly

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Abstract

This research study aimed to 1) investigate waste management problems, 2) develop an environmentally friendly biomass energy waste incinerator prototype, and 3) evaluate the efficiency of the environmentally friendly biomass waste incinerator. A qualitative research methodology was employed, including in-depth interviews with 21 key informants and focus group discussions with 9 participants, along with experiments burning waste in various ratios.

Research findings revealed:

1) Waste management problems stemmed from accumulating solid waste from teaching activities and increasing personnel numbers. People needed to change the way they thought about waste management by combining what they knew about the Four Paths of Accomplishment (desire, persistence, attention, and investigation) with information about how to separate waste into five groups: food waste, recyclable waste, material/wood waste, hazardous waste, and non-recyclable waste.

2) The development of the environmentally friendly biomass energy waste incinerator prototype considered five aspects of value: designing a small incinerator from high-temperature resistant steel, energy conservation by using dry waste as fuel instead of diesel oil, reducing pollution and being environmentally friendly, promoting proper waste management, and creating added value from waste incineration.

3) Efficiency evaluation through experiments with various waste ratios and pre-incineration waste sorting resulted in gasoline and wood vinegar production. The incinerator could dispose of up to 200 kilograms of waste per hour and a half, demonstrating its efficiency in environmentally friendly waste management.

Keyword: Innovation Development; Buddhist Community Way; Natural Energy Waste Incinerator; Environmentally Friendly

Introduction

Waste is a significant problem that every institution is facing, including densely populated educational institutions, especially Mahachulalongkornrajavidyalaya University. Upon resuming full on-site teaching, they observed a significant increase in waste, with an average daily volume of about 5-7 tons. The volume of foam boxes, plastic bags, and coffee cups increased by five times (Kitchen Department and Building Administrators, interview, 2023). Consistent with the national waste situation, which has been continuously increasing, data from the Pollution Control Department indicates that in 2016, Thailand had a community waste volume of 27.06 million tons per year, or approximately 74,130 tons per day, averaging 1.14 kilograms per person per day (Pollution Control Department, 2016). This waste problem causes significant economic losses, with the government spending approximately 13 billion baht annually on waste management, not including expenses for disease control, soil degradation management, and flood mitigation due to waste blockage (Post Today, 2023).

Mahachulalongkornrajavidyalaya University did a survey on waste management from July 1, 2022, to September 31, 2022. They found that there are three main types of waste: organic waste, which is biodegradable waste from leftover food and amounts to about 2 tons per day; recyclable waste, which can be remelted and used again, which amounts to about 100 kilograms per day; and general waste, which includes things like snack wrappers, foam boxes, and plastic bags and amounts to about 500 kilograms per day (Kitchen Department and Building Administrators, interview, 2023). These figures reflect the urgent need to find systematic and sustainable solutions to the waste problem.

Solving the waste problem sustainably requires changing people's mindsets and attitudes. Mahachulalongkornrajavidyalaya University has applied Buddhist principles to waste management through the development of community-based Buddhist innovation in the form of an environmentally friendly natural energy waste incinerator. This was developed by combining the Kontiki stove and the gasifier system, aiming to provide benefits in terms of efficient waste disposal and the production of useful by-products for agriculture. This study therefore aims to present a waste management approach that integrates scientific knowledge with Buddhist principles to create a sustainable environmental conservation strategy.

This research presents a waste management solution that integrates scientific knowledge and Buddhist principles to create sustainability in waste management and environmental conservation. The objectives of the research are as follows:

Research Objectives

1) To investigate waste management problems

2) To develop an environmentally friendly biomass energy waste incinerator prototype.

3) To evaluate the efficiency of the environmentally friendly biomass waste incinerator.

Conceptual Framework

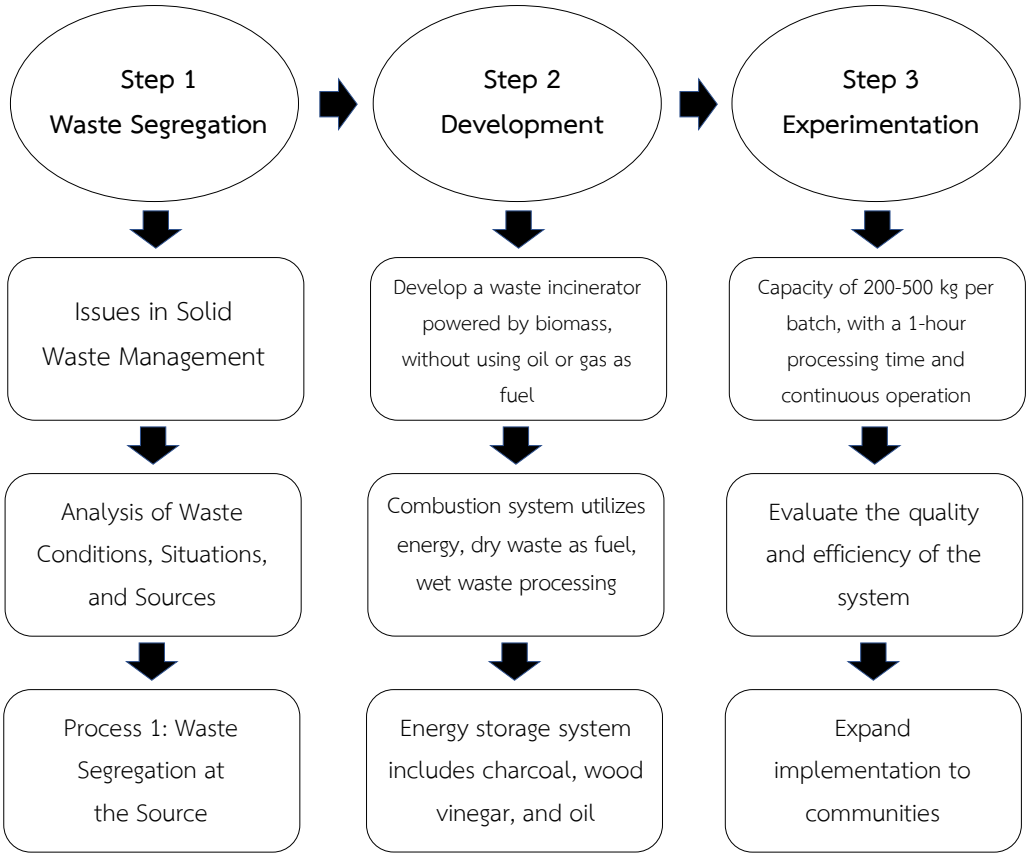

Figure 1: Development of a biomass waste incinerator model

Research Methodology

1. Research design

This research study is qualitative research that employs a mixed-methods approach, combining documentary research from secondary sources with field action research. The focus is on studying the sources of waste and waste management to analyze and synthesize the two parts into a research and development process. This aims to develop community-based Buddhist innovations for creating natural energy waste incinerators that are environmentally friendly. The details are as follows:

2. Key informant

The study divides key informants into two groups: Group 1 consists of executives, faculty members, independent scholars, and community representatives, totaling 21 individuals. Group 2 includes representatives from government and private sectors participating in a workshop discussion, totaling 13 individuals.

3. Research tools

One of the tools used to collect data was a survey that was given to the right people to get important overall data. The goal was to create integrated motivation based on Buddhist principles for sorting trash before throwing it away. We prepare the interview plan in advance, ensuring that all interviewees answer the same questions in the same order. The measurement and testing equipment consists of a 60-kilogram scale for weighing waste. An air velocity meter checks the airflow conditions, while the thermocouple measures temperatures up to 1,600°C. UAE-IDEA Advanced Analytical Co., Ltd. manufactures the PM 2.5 air pollution measurement device. The workshop discussion is facilitated by a moderator who initiates the topics for discussion, allowing participants to express their opinions on the topics or seminar directions.

4. Data collection

The researcher employed a variety of data collection methods, including secondary sources such as books, textbooks, journals, academic articles, and related research reports. Online surveys through online platforms to understand information related to waste management. We gather data through a workshop discussion, inviting all relevant stakeholders to participate. The data collection from the waste incineration experiment consists of sorting and weighing each type of waste. Recording the temperature every 2 minutes during the incineration period, recording the time of burning municipal and general waste, measuring the amount of air used for combustion and the amount of ash after incineration, and recording images and videos as evidence to support the research report.

5. Data analysis and statistics used in data analysis

Data analysis: After the researcher has collected data, facts, or detailed information about a particular subject, it will be used as evidence in finding a conclusion, which is the answer to what is being studied or researched. We have classified and analyzed the data accordingly. Step 1: Analyze the interviews, focus group discussions, and practical workshops. Step 2: Analyze the weight of the waste using a 60 KG weighing scale to find the weight of the waste and the moisture content of the organic or municipal waste. Step 3: Analyze the heat using a thermocouple. The waste incineration process must maintain a maximum temperature of 1600°C to effectively control and reduce air pollution and PM. 2.5 Step 4: Analyze wind speed or direction using an air velocity meter—a tool to measure

wind speed—to check the airflow conditions or examine the weather conditions. Step 5: Analyze the efficiency of the combustion system by conducting real waste incineration tests, with three actual burn tests, to gather data on areas that need improvement. Step 6: Analyze the results from the waste incineration experiment. In the first incineration, the waste was incinerated in a mixed manner without sorting, and in the second incineration, the waste was incinerated in the same combustion chamber but with sorting before incineration.

Research Results

1. The problem of waste management in universities, which are institutions that produce graduates with virtue and wisdom, faces the issue of increasing waste in line with educational growth. The waste consists of food scraps, paper, plastic, and various hazardous materials. The failure to separate waste before disposal leads to significant problems, including 1) air pollution from outdoor waste burning, 2) water pollution from accumulated waste, 3) disease vector breeding grounds, and 4) nuisance and unsightliness. According to the study, waste management follows the law when three things are done: 1) defining the types, categories, and scope of the environment that can be used; 2) making rules to encourage integrated teaching and learning through social and natural environmental activities; and 3) using technology to control waste disposal and treatment, like wastewater treatment for reuse.

2. Development of an environmentally friendly biomass energy prototype incinerator. Biomass waste incinerators are a popular choice for managing the increasing amount of waste. The developed incinerator has a simple structure made from a special type of steel; 4.5 mm thick, resistant to temperatures of 600 - 1,000 degrees. It stands 6 meters tall and has a circumference of 3 meters. This incinerator is valuable in three aspects: 1) It is easy to install, use, and maintain, with no complex systems and no need for electricity, assembled within one hour. 2) It can continuously incinerate waste for 24 hours without using oil or gas, but using biomass waste, with a design that efficiently controls heat and air circulation. 3) It is a small, environmentally friendly waste incinerator that can measure air quality to meet standards, suitable for use in schools, temples, resorts, communities, or small enterprises.

Figure 2: Developing a biomass waste incinerator model
Source: Research team

3. Evaluate the efficiency of environmentally friendly biomass waste incinerators

1) Evaluation of the integrated waste incineration experiment. We tested the biomass energy waste incinerator's efficiency by burning waste in two different ways: not separated and separated ahead of time. This was done by combining our knowledge, experience, and theory about renewable energy. The results of the non-separated test showed that food scraps and various materials partially melted into ash, plastic and foam melted into clumps, and the incinerated waste could not be utilized. Although the experimental results met the objectives, practical application must consider the different environments in each area, village, or community, as well as the mindset of the local people, which may affect development. Therefore, it is necessary to survey the community's needs before analyzing and developing the data to meet the users' requirements.

Figure 3: The result of burning plastic or foam boxes will turn into black lumps.
Source: Research team

2) Evaluation of the pre-sorting waste incineration experiment

The pre-sorting waste incineration experiment is crucial for the efficiency of the waste incineration furnace, considering pollution, smoke, and wind direction. Waste sorting is divided into four categories: 1) Biodegradable waste (food scraps) placed in green bags for composting or animal feed; 2) Recyclable waste (glass bottles, plastics) placed in yellow bags; 3) General waste that is hard to decompose (Styrofoam) placed in blue bags; and 4) Hazardous waste (batteries) placed in red bags. The experiment results showed that burning 100 kilograms of plastic waste produced 5 liters of gasoline, which can be used as fuel for waste incineration or lawn mowers. Additionally, wood smoke was obtained from burning fresh branches at a temperature of 300-400 degrees Celsius, approximately 20 liters, and leftover plastic waste from incineration can be made into pellets to add value and reduce environmental pollution.

1. Incinerated waste tray
2. Dry waste disposal or thermal energy generation
3. Containers for various types of waste
4. Plastic bottle containers, water bottles, foam boxes, and Coffee cup, coffee straw
   4.1 Refined into diesel fuel
   4.2 Making wood smoke vinegar
5. Ventilation or oxygen circulation channel
6. Heat exhaust vent

Figure 4: Prototype biomass waste incinerator and demonstration of the incinerator's operation system
Source: Research team

Knowledge from research

Figure 5: Knowledge gained from research

From the conceptual diagram, if waste management is implemented and waste is sorted into different categories with color-coded bins as symbols before being incinerated

in a waste incinerator that does not use oil as fuel but uses biomass waste or dry waste, the incineration of contaminated waste and the byproducts from burning plastic waste, such as plastic bags, will result in the condensation and distillation into oil. Additionally, wood smoke from burning fresh branches will produce wood smoke condensate, a clear brown liquid with a smoky odor, from the condensation of smoke generated by burning wood into charcoal in an oxygen-rich environment. Food scraps, such as rice, bread, fish bones, eggshells, and fruit peels, can be composted for agricultural use, or the remaining plastic waste from burning can be finely ground and mixed with animal manure and EM according to a calculated formula. After that, it can be pelletized into a biofertilizer. We can see what happens and what waste is made of when we burn trash in an incinerator by looking at the idea, combustion theory, and the results of burning both sorted and unsorted trash.

Suggestion

The research results summarize the following recommendations.

1. Policy recommendations

1) The research findings indicate a relationship between the contextual factors of waste management issues and waste management administration. Therefore, promoting waste reduction management in the university should be prioritized by all university departments.

2) Bring together people who know how to develop community-based Buddhist innovation to make natural energy and waste incinerators that are good for the environment. This could be Mahachulalongkornrajavidyalaya University, the Pollution Control Department, or the Ministry of Natural Resources and Environment. This will encourage academic collaboration and hopefully make it a government policy in the future.

3) The research showed that the waste incineration experiment produced the desired outcomes when compared to the features of the biomass energy waste incinerator, the combustion process, and the mixed combustion system without waste segregation. This made the public and private sectors want to use it.

2. Practical recommendations

1) The results of this research should be used to create a prototype model for trial use in other community areas as action research to develop a natural energy and environmentally friendly waste incinerator to be more efficient.

2) More research should be done to come up with environmentally friendly criteria for building natural energy waste incinerators. This will help people who design environmentally friendly natural energy waste incinerators in the future figure out what those criteria should include.

3. Suggestions for future research

Research is being conducted on the development of natural energy and environmentally friendly waste incinerators of various sizes in Bangkok and provincial urban communities, with the aim of developing natural energy and environmentally friendly waste incinerators that are suitable for each area.

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