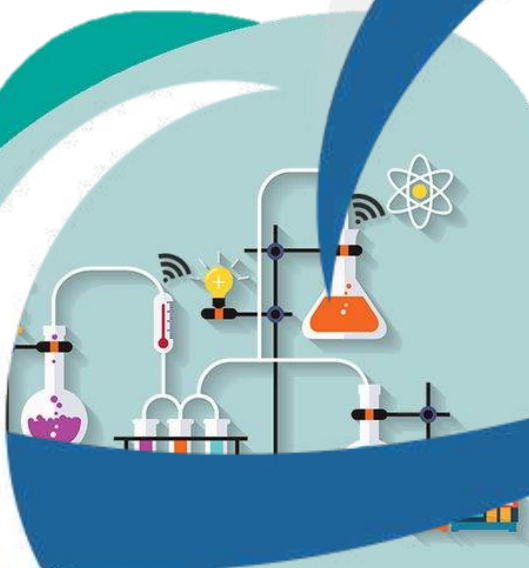
Eco-Alchemy

The Art of Simple Waste-to-Energy Transformation



ECO-ALCHEMY is a beacon of hope in Bangladesh's plastic waste crisis. Harnessing the power of incineration, we convert halogen-free plastic waste into electricity, contributing to a cleaner, greener, and more sustainable future. Join us in our journey towards innovative waste management and energy production.

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Executive Summary

Bangladesh is facing a significant plastic waste management crisis, with the annual per capita plastic consumption in urban areas tripling from 3 kg in 2005 to 9 kg in 2020. The capital city, Dhaka, faces an even more acute problem with its annual per capita plastic consumption standing at 22.25 kg. Mismanaged plastic waste is polluting cities, countryside, rivers, and canals, contributing to urban flooding and degrading into harmful micro-plastics.

Our project, **Eco-Alchemy**, proposes an innovative solution to this crisis by focusing on the incineration of halogen-free plastic waste. When these plastics are combusted in an environment with ample oxygen, they can be safely managed without producing toxic gasses. The energy released during the incineration process is converted into electricity, making the project self-sustaining and contributing to the national power grid.

The project emphasizes safe practices in the incineration process, including meticulous sorting of plastics, temperature control, adequate oxygen supply, and proper disposal methods. The deliverables of the project include a waste management system, an energy generation mechanism, a safe incineration process, and an innovative solution to waste management and energy production.

The project aims to provide a sustainable solution to the waste management crisis, reduce environmental impact, and introduce an innovative solution to waste management and energy production in Bangladesh. With the right support and implementation, this project can pave the way for similar initiatives in the future, contributing to a cleaner, greener, and more sustainable Bangladesh. We look forward to the opportunity to make a positive impact on our environment and our community. Thank you for considering our proposal.

Background

Bangladesh is grappling with a significant plastic waste management crisis, which has been exacerbated by rapid urbanization and growth. In the last 15 years, the annual per capita plastic consumption in urban areas has skyrocketed, tripling from 3 kg in 2005 to 9 kg in 2020. This surge in plastic use has led to a sharp increase in pollution, with a staggering 977,000 tons of plastic consumed in 2020 alone. Unfortunately, only 31 percent of this was recycled, leaving the majority of plastic waste mismanaged.

The capital city, Dhaka, faces an even more acute problem. Its annual per capita plastic consumption stands at 22.25 kg, which is more than three times the national average for urban areas1. Each day, approximately 646 tons of plastic waste are collected in Dhaka, accounting for 10 percent of all waste generated in the country. However, only 37.2 percent of Dhaka's plastic waste is recycled[1].

The environmental impact of this crisis is profound. Mismanaged plastic waste, particularly single-use plastics like shopping bags, packaging, and wrappers, are polluting cities, countryside, rivers, and canals. They contribute to urban flooding by clogging drains and degrade into micro-plastics, posing significant risks to human health, marine life, and ecosystems.

The COVID-19 pandemic has further intensified the situation, with an increase in single-use plastics from masks, gloves, and personal protective equipment1. Despite Bangladesh being one of the first countries to ban plastic bags, there is a lack of specific laws, rules, or outlines for comprehensive plastic waste management. The absence of proper management and operation of the recycling supply chain exacerbates the issue.

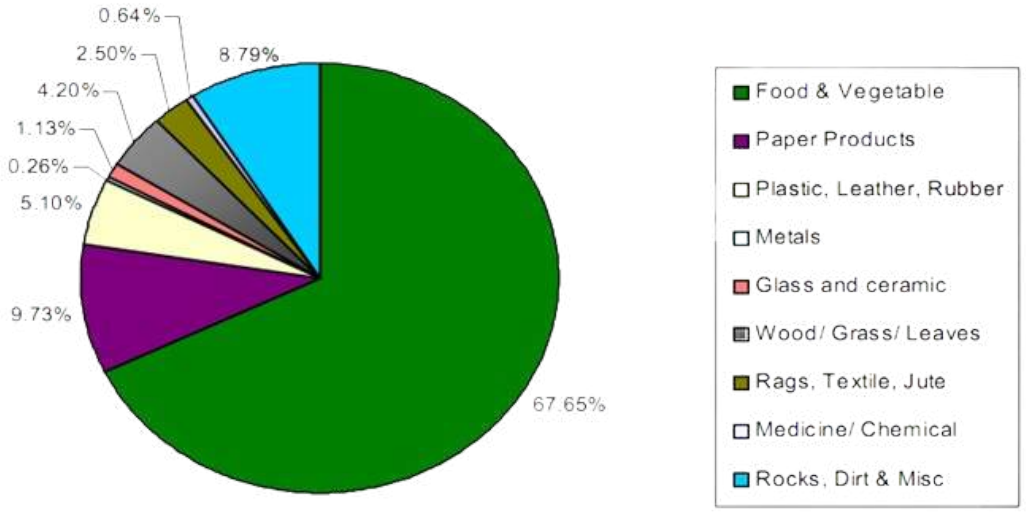

Figure 1: Comparison of waste produced in Bangladesh (Courtesy: ResearchGate)

1 www.worldbank.org/en/news/feature/2021/12/23/meeting-bangladesh-s-plastic-challenge-through-a-multisectoral-approach

Solution

Bangladesh is grappling with a daunting challenge: the management of an enormous and growing volume of waste. The current waste management processes are not fully effective due to environmental implications and infrastructural constraints. Therefore, we propose an innovative solution that not only addresses waste management but also contributes to energy production.

Our project focuses on the incineration of plastic waste, specifically those devoid of halogens. Halogens are highly reactive elements that can be harmful or lethal to biological organisms in large quantities due to their high electronegativity and effective nuclear charge. When these halogen-free plastics are combusted in an environment with ample oxygen, they can be safely managed without producing toxic gasses.

It's important to note that not all plastics are safe to burn. Certain types, such as Polyvinyl Chloride (PVC) and Polytetrafluoroethylene (PTFE, commonly known as Teflon), can produce toxic gasses when burnt. Therefore, our process begins with a meticulous sorting phase to ensure that only halogen-free plastics are selected for incineration.

Sources of Plastic

The types of plastics suitable for our process include High-Density Polyethylene (HDPE), Low-Density Polyethylene (LDPE), Polypropylene, Polyurethanes, Silicones, Acrylics, and Polyesters. These materials are commonly found in various sources and can be safely incinerated to manage waste and generate a significant amount of electricity. A brief description of the probable source of plastic is cited below:

1. **High-Density Polyethylene (HDPE)**:
    HDPE is a rigid and opaque plastic with high tensile strength and excellent chemical resistance.
    - It is widely used in various applications, including:
        - **Bottles**: HDPE bottles are commonly used for milk, detergents, and household chemicals.
        - **Pipes**: HDPE pipes are durable and resistant to corrosion, making them suitable for water supply, drainage, and gas distribution.
        - **Crates**: HDPE crates are used for storage and transportation of goods.
        - **Toys**: HDPE is used in the manufacturing of toys due to its toughness and safety.
    - HDPE's linear structure contributes to its strength and rigidity.
2. **Low-Density Polyethylene (LDPE)**:
    - LDPE is a soft, flexible polymer with lower density, strength, and temperature resistance.
    - Common applications of LDPE include:

        - **Plastic Bags**: LDPE's flexibility and lightness make it ideal for plastic bags used in packaging and shopping.
        - **Domestic Films**: LDPE films are used for food packaging, wrapping, and other domestic purposes.
    - LDPE has more branching in its chemical structure, which results in its lower density and flexibility.
3. **Polypropylene**:
    - Polypropylene (PP) is another thermoplastic material.
    - It is commonly used in:
        - **Food Packaging**: PP containers, cups, and food storage containers.
        - **Automotive Parts**: PP is used in car interiors, battery cases, and bumpers.
        - Medical Devices: PP is suitable for medical syringes, vials, and laboratory equipment.
4. **Polyurethanes**:
    - Polyurethanes (PU) are versatile materials used in:
        - **Foam**: PU foam is used in mattresses, cushions, and insulation.
        - **Coatings and Adhesives**: PU coatings provide protection, and PU adhesives bond various materials.
        - **Footwear**: PU is commonly used in shoe soles.
        - Automotive Interiors: PU materials are found in car seats and panels.
5. **Silicones**:
    - Silicones are synthetic polymers with silicon-oxygen bonds.
    - They are used in:
        - **Sealants and Adhesives**: Silicones provide water-resistant seals and bonding.
        - **Cookware**: Non-stick silicone bakeware and kitchen utensils.
        - **Medical Devices**: Silicones are used in implants, catheters, and prosthetics.
6. **Acrylics**:
    - Acrylics (PMMA) are transparent plastics.
    - Common applications include:
        - **Signage and Displays**: Acrylic sheets are used for signs, display cases, and light fixtures.
        - **Optical Lenses**: Acrylic lenses are used in eyeglasses and cameras.
        - **Aquariums**: Acrylic is a popular material for fish tanks.
        - **Art and Craft Supplies**: Acrylic paints and sheets for artistic purposes.
7. **Polyesters**:
    - Polyesters are widely used in textiles (such as polyester fabric), packaging, and engineering plastics.
    - **PET (Polyethylene Terephthalate)** is common polyester used for beverage bottles, clothing, and food containers.

By implementing this solution, we aim to address the pressing issue of waste management in Bangladesh while also contributing to the country's energy sector. This approach is not only environmentally responsible but also economically beneficial, making it a sustainable solution for the future.

Right Conditions for Burning Plastic

Temperature Control: Plastic requires high temperatures to burn efficiently. A temperature range of 800°C to 1000°C (1472°F to 1832°F) is necessary to break down the plastic molecules. This can be achieved using specialized equipment, such as industrial incinerators or commercial-grade burn barrels.

Oxygen Supply: Adequate oxygen supply is essential for complete combustion. Ensure that the burning area has sufficient ventilation to prevent the buildup of toxic fumes.

Proper Disposal: Burning plastic should only be done in a controlled environment, such as a commercial incinerator or a specialized burn barrel designed for plastic disposal. Never burn plastic in a domestic fireplace or open flame, as this can lead to serious health risks and environmental pollution.

Type of Plastic: Not all plastics are created equal. Some plastics, like polyethylene and polypropylene, are more prone to burning than others. However, it’s still crucial to follow the guidelines above and use proper equipment to minimize risks.

Deliverables and Goals

Project Deliverables:

Based on the provided project proposal, here are the project deliverables articulated with precision:

1. **Waste Management System**: The project will deliver a system that incinerates halogen-free plastic waste under controlled conditions. This system will be designed to ensure that no harmful gasses are released into the environment, addressing the pressing issue of waste management in Bangladesh.
2. **Energy Generation**: The project will also deliver a mechanism for converting the energy released during the incineration process into electricity. This mechanism will not only make the project self-sustaining but also contribute to the national power grid, serving a dual purpose.
3. **Safe Incineration Process**: The project will establish a meticulous sorting phase to ensure that only halogen-free plastics are selected for incineration. It will also ensure the right conditions for burning plastic, including temperature control, adequate oxygen supply, and proper disposal methods.

4. **Innovative Solution**: The project will deliver an innovative and environmentally-friendly solution to waste management and energy production. This solution will be designed to be both effective and sustainable, contributing to the long-term management of waste and energy production in Bangladesh.
5. **Support Request**: The project deliverables include a proposal seeking support for the implementation of this solution. This proposal will detail the project's objectives, methods, and expected outcomes, providing a comprehensive overview of the project for potential supporters.

Project Goals:

1. **Effective Waste Management:** The primary goal of this project is to address the significant plastic waste management crisis in Bangladesh. This will be achieved by implementing a system that incinerates halogen-free plastic waste under controlled conditions, ensuring no harmful gases are released into the environment.
2. **Energy Production:** In addition to waste management, the project aims to convert the energy released during the incineration process into electricity. This not only makes the project self-sustaining but also contributes to the national power grid, serving a dual purpose.
3. **Environmental Responsibility:** The project seeks to mitigate the environmental impact of mismanaged plastic waste. By incinerating suitable plastics, the project aims to reduce pollution in cities, countryside, rivers, and canals, and minimize the degradation into harmful micro-plastics.
4. **Sustainable Solution:** The project aims to provide a sustainable solution to the waste management crisis. By turning waste into energy, the project not only addresses the immediate issue of waste management but also contributes to the country's energy sector, making it economically beneficial.
5. **Safe Practices:** The project commits to safe practices in the incineration process. This includes meticulous sorting of plastics to ensure only halogen-free plastics are incinerated, maintaining high temperatures for efficient burning, ensuring adequate oxygen supply for complete combustion, and proper disposal methods.
6. **Innovation:** The project aims to introduce an innovative solution to waste management and energy production in Bangladesh. It seeks to demonstrate the viability of such a solution and pave the way for similar initiatives in the future.

These deliverables and goals align with the project's goals and contribute to its overarching objective of providing an innovative, environmentally-friendly, and sustainable solution to waste management and energy production in Bangladesh.

Requirements

The following hardware is required for constructing the prototype:

1. 3.7 Volt Chargeable Battery
2. Switch
3. Transistor BC547
4. 1k Resistance
5. 10k Resistance
6. Diode 1N4007
7. Yellow LED
8. Green LED
9. Small Solar Panel
10. Thermoelectric Generator
11. Ten Core Wire
12. LED Bulb in 12 Volt
13. Wire Mesh
14. Light Wire
15. Super glue
16. Glue Gun and Glue Stick
17. Soldering iron
18. 28AWG Copper Wire
19. PVC pipe
20. 1.5mm wire
21. IRF840 N-Channel Mosfet
22. 3.3uF 50V Capacitor- 3PCS
23. 100K Trimmer Potentiometer (W104)
24. 330 Resistor
25. Aluminum foil
26. LED Bulb

Conclusion

In conclusion, the proposed project presents an innovative and sustainable solution to the pressing issue of plastic waste management in Bangladesh. By focusing on the incineration of halogen-free plastics, the project not only addresses the environmental crisis but also contributes to the country's energy sector. The energy generated from the incineration process will make the project self-sustaining and contribute to the national power grid, serving a dual purpose.

The project also emphasizes safe practices in the incineration process, including meticulous sorting of plastics, temperature control, adequate oxygen supply, and proper disposal methods. These measures ensure that the project is not only effective but also environmentally responsible.

The proposal seeks support for the implementation of this solution, which promises to deliver significant benefits in terms of waste management and energy production. By turning a pressing problem into an opportunity for innovation and sustainability, the project represents a significant step forward in addressing the plastic waste management crisis in Bangladesh.

We believe that with the right support and implementation, this project can pave the way for similar initiatives in the future, contributing to a cleaner, greener, and more sustainable Bangladesh. We look forward to the opportunity to make a positive impact on our environment and our community. Thank you for considering our proposal.