SUSTAINABLE WASTE TO ENERGY: PRODUCTION AND CHARACTERIZATION OF BIOMASS-LDPE WASTE NUGGETS AS AN ALTERNATIVE FUEL

INTRODUCTION

This project focuses on converting rice husk and straw, reinforced with low-density polyethylene (LDPE) waste, into clean, energy-dense solid fuel nuggets using torrefaction.

The goal is to provide an eco-friendly alternative fuel suitable for blacksmith forges, like bakeries and other small-scale applications.

PROBLEM STATEMENT

Rice residues and plastic sachets are often burned or discarded, causing greenhouse gas emissions and pollution. This study transforms these wastes into usable energy, addressing both environmental and energy challenges.

OBJECTIVES

1. Design and develop an integrated torrefaction machine
2. Evaluate torrefaction conditions on rice husk/straw-LDPE composites.
3. Characterize thermal, morphological, flammability, and mechanical properties.
4. Assess suitability for blacksmith forge and other applications.

JUSTIFICATION

Using biomass and plastic waste as fuel aligns with sustainable energy goals. The process reduces landfill volume, limits open burning, and supports renewable energy adoption in rural industries.

METHODOLOGY

Rice husk and straw from farms and LDPE sachet waste will be prepared (cleaned, shredded, dried). Blends (0-8% LDPE) will be torrefied at 250-300°C under limited oxygen for 30-60 minutes. Analyses include TGA, DSC, morphology and flammability tests (ignition and extinguishing times).

EXPECTED RESULTS

1. Improved calorific value (>7,000 kcal/kg).

2. Higher mechanical strength and reduced moisture uptake.

3. Better combustion efficiency and uniform fuel structure.

SIGNIFICANCE

The innovation promotes waste-to-energy research and supports Nigeria's renewable energy targets, with potential for industrial scaling and rural energy access.

DELIVERABLES

1. Prototype torrefaction machine
2. Standardized biomass-LDPE fuel nuggets.
3. Full characterization data for commercialization