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The Use of Plant Waste from Agricultural Crops for the Production of Pyrolysis Gas

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Abstract

There are huge resources of residues, co-products and waste such as oilseed residue and woody residue in processing agricultural/forest products, which are potentially available, in quantity, at relatively low cost compared to other bioenergy feedstock. The aim of the present study is to perform a technical and economic assessment of the pyrolysis effectiveness as a secondary agricultural residues utilization process. This study included pilot test at the facility that might be suitable for implementation of biomass utilization combined cycle for evaluation of operating costs and revenue potential for a generic gasification process, and a cost sensitivity study.

Key Words:

Introduction

Ukraine is in the number of countries which have stocks of all kinds of fuel and energy resources (oil, natural gas, coal, peat, uranium, etc.), but the coverage, production and the use are not the same and they do not create the necessary energy safety level, especially in light of existing political situation [1,2].

There are huge resources of residues, co-products and waste such as oilseed residue and woody residue in processing agricultural/forest products, which are potentially available, in quantity, at relatively low cost compared to other bioenergy feedstock.

Although pyrolysis technologies are more developed and available at the present day, they are preferable to others. Pyrolysis is a type of advanced conversion that can be used to produce either a combustible gas, oil or solid char (sometimes known as biocoal) [3].

The aim of the present study is to perform a technical and economic assessment of the pyrolysis effectiveness as a secondary agricultural residues utilization process. The study included pilot test at the facility that might be suitable for implementation of biomass utilization combined cycle for evaluation of operating costs and revenue potential for a generic gasification process, and a cost sensitivity study.

To perform general evaluation of the technological process of oxidative pyrolysis, laboratory pyrolysis unit was constructed.

The unit consists of elbow shaped chamber (2) with internal diameter of 100 mm with total length of 5700 mm which allows to conduct the pyrolysis on fluidized bed. In the lower part of the chamber the air primary heated up in caloriefer is blown (1). Before entering the chamber, air goes through the numerous ceramic rings to average out air velocity profiles along the tube section.

The feedstock is loaded into the chamber by the screw dispenser. The design of the dispenser allows to control feed volume and impermeable inlet joint. In the pyrolysis chamber inlet the automatic moister control sensor (7) was installed. Thus in the feedstock before entering the chamber and passing though the moister the moister is automatically measured. The data from sensor is automatically transformed to converter (10) which controls the feed (4) (see Figure 1).

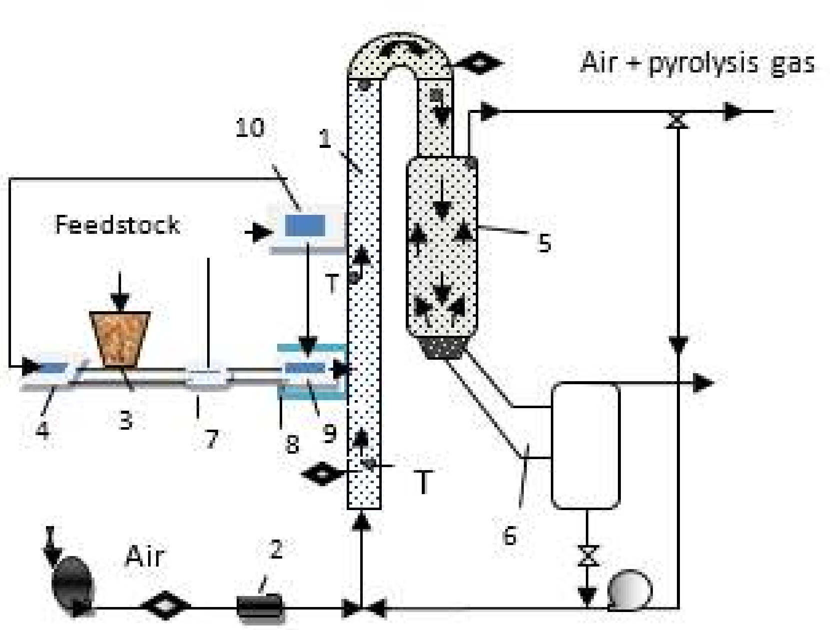

Figure 1. The general scheme of the pyrolysis unit

In the pyrolysis chamber satellite-lifting motion of particles is supported when satellite motion of particles velocity is 1,5 – 2 times lower that the air movement.

Drying, heating and party pyrolysis processeswere taking place during the movement of the particles suspended in air. The cyclone was installed on the chamber outlet where the separation the gaseous and solid phases was taking place. Solid particles were falling into cyclone bunker where further devolatilisation was taking place up to full decomposition. The air mixture of gaseous products of pyrolysis was sucked out through the smokestack and 10 % of the mixture is returned back each time for the gas enrichment which increases it's calorific value [4,5].

With some remodeling of the existing boiler equipment pyrolysis can be used as biomass utilization and energy generation process in combined energy cycle when pyrolysis gas in obtained on the primary stage and directly used in mixture with natural gas for water heating.

According to results of cost sensivity analysis, it should be considered that proposed integration of pyrolysis gas production process into existing heating systems is feasible only in case of feedstock local availability, as far as transportation and logistics cost can significantly increase the cost of generated energy.

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