MACHINES FOR GATHERING AND UTILIZATION OF RESIDUAL
BIOMASS FROM TOBACCO PRODUCTION

Georgi KOMITOV, Dimitar KEHAJOV
Agricultural University - Plovdiv, 12 Mendeleev Avenue, Plovdiv, Bulgaria

Corresponding author email: gkomitov@abv.bg

Abstract

As biomass from the tobacco production can be regarded the stems of tobacco plants. They have huge market potential as a fuel, because of the available materials, that are not used (they are incinerated or buried into soil) and they have a high energy density.

Developments in technique make it possible to use new technologies and perfection systems, that allow waste biomass from tobacco to become attractive and environmentally friendly energy source with high quality and minimal costs for utilization.

In this paper is presented the technological capabilities for gathering, processing and utilization of residual biomass from the tobacco production. The machines for utilization of residual biomass from tobacco production are applicable in conditions of small and large farmers, who meet certain needs heating.

Key words: biomass, tobacco, machines, heating systems.

INTRODUCTION

Tobacco industry is an important part of agriculture in Bulgaria. The culture is from type "technical" and represented 13.8% of total agricultural exports. In our country are grown as large leaf and small-leaved tobacco. Tobacco is grown in weak soils (mountainous and hilly areas) and without irrigation. Tobacco has large energy potential, but it is used only 50% extremely leaf mass. The other part in form of stems is not used or is used as a mineral fertilizer of the soil, on which it is grown (Komitov, 2014).

Rational use of resources, necessary for the utilization of residual biomass from tobacco production requires the use of highly efficient processing technologies, the cost of which is minimal.

Technologies of use (even small scale) of the energy sources by agricultural and forest origin (biomass) developed quickly and making use of such resources competitive (Komitov, 2015; Failoni, 2006).

Outlook for energy saving and the development of new energy sources are related to economic models, aimed at maintenance and local development. This leads to the following favourable benefits: the development of new regions for agricultural and forestry production and markets, reducing the energy costs for domestic enterprises, economic growth regions, low cost of the energy conversion, stimulate large-scale construction of small installations, favourable impact on the environment (Failoni, 2006).

RESULTS AND DISCUSSIONS

For use of one or another machine for harvesting and utilization of biomass from tobacco industry is necessary advance to create route technology for movement of energy raw materials.

In the main idea of using residues from tobacco industry stand an economically accessible energy source with a large stock (Komitov, 2014).

For its transform in energy is not necessary complicated and expensive processes.

First operation in this transformation of the bioenergy from tobacco stems is collecting from the field. This can be done in two ways:

- By using an self-propelled forage harvester, (Figure 1). The harvester is having large price and usually this machine is used by large manufacturers of tobacco. The possession of this machine is warranted, because it has big efficiency. The principle at harvest is crawled the area from tobacco stems at least possible moves.
By using the forage harvester, attached to tractor (Figure 2). The method is suitable for small farmers, because isn’t necessary to use expensive equipment.

Drawback of this method is double crawl on the tobacco field, primarily with working unit and secondly with transport unit for biomass. This can be avoided by using of trailers, attached to a forage harvester.

Another function of forage harvester (except function for collecting tobacco stems) is crushing the stems at harvest. The result is heterogeneous mixture (with various sizes). For transportation of biomass from agricultural field into enterprise for further processing using suitable trailers (Figure 3).

When choosing a trailer should be borne in mind the small size of already crushed tobacco stems (10-20 mm in length and thickness 10-5 mm).

Because of this specificity is necessary the select trailer, as not to lost the biomass when transporting. This can be done in enclosed trailers for grain, type "gondola" with cover.

After transport in factory processing it is necessary to dry the biomass with humidity, suitable for further processing. For this technological operation used grain dryers, which may be rotary (Figure 4) or band (Figure 5).

In rotary dryer the raw biomass is fill into inclined rotating bunker. There entrance for blowing hot air. The biomass humidity decreased after contact with hot air.

Band dryer is a conveyor belt, which is placed in a suitable furnace. The hot air blows into biomass to a suitable humidity. The tape must be selected, so as to provide blown the biomass from all sides.

The choice of dryer is determined by the volume of biomass which will be dried. Here can be used dryers with continuous or intermittent operation in drying process. The output humidity can be controlled with a suitable controller.

Suitable option for small farmers are mobile dryers. The drying process is done on the field. Another good option for those producers is natural drying. Disadvantages of natural drying are a long drying time, required large indoor areas and impossible for briquetting and peletizing the same heating season. Advantage of this type of drying is zero price of costs.
For ease further processing, drying continues until receive humidity from 8 to 12%. The temperature of the heating champer should be in range from $65^0$ to $700^0$ C.

Biomass after drying must be submitted in machines for briquetting or pelletizing with suitable sizes (4 mm length and 1.5 mm thickness). The dimensions are recommended for better functioning of subsequent process. Fragmentation of biomass is carried out in a mill machine (Figure 6). As suitable for simple use and exploitation proved hammer mill. The process helps to align the particles of the biomass. The peripheral speed of the hammers is in the range 55-80 m/s, and the desired particle size can be adjusted within certain limits, by replacing the output grid.

By dispenser biomass (after drying and fragmenting) is delivered in the press or granulator for forming granules. The extrusion process may be carried out at high or low pressure and temperature. In biomass are contains lignin and tar. They are natural adhesive at low temperatures and soften at temperature of about $80^0$ C. This allow the material to acquire another form. Thus the elements behave pellets or briquettes in compressed form, without adhesives (potato starch). A favourable effect on the process small amount of lubricant can be added to the product.

Briquetting and pelletizing are technology which compacts biomass. Finished products are solid biogenic fuels. They are ready for combustion in heating installations. The purpose of sealing the biomass compaction is improving indicators (quality and cost) of the original biomass as fuel. Such indicators are calorific value, density, keeping and s.o. (Komitov, 2015).

For pelletization may be applied variations of pelleting machines. They are generally separated into two types depending on the method for introduction biomass into the matrix. The machines for pelletizing are separated through this methods on machines with a flat matrix or a cylindrical matrix (Figure 7).

The choice of pelleting machine depends on the desired performance. The productivity
range is from 15 to 20 kg for pelletizing machines with cylindrical matrix and from 450 to 500 kg for pelletizing machines with flat matrix (per hour).

Principle of pelletization (in both cases) is the sealing of the biomass in the holes of the matrix by pressure with the roller. The pellets, after the customization, leave the matrix from the other side. Suitable length of pellets is formed with knife for cutting. The dimensions of the product are 6-8 mm thick and 10-15 mm in length.

For production of briquettes can be used press - mechanized or manually (Figure 8).

Piston press has small performance and is usually used for supporting the household for heating. Briquettes are produced with a diameter 80 mm and a length of 40 mm.

For the production of the briquettes can be used presses with piston or with extruder (extruder press is shown on Figure 9).

Solid fuels produced from biomass is used in heating installations. On the market there are many types of heating systems. Before choosing a press machine, it is necessary to choose a heating system. When using briquettes do not need adaptation of the heating system. Automating the combustion process is not necessary. They are normally applied to small or family heating installations.

Application of pellets as a source of energy is carried out by applying the automated pellet burners for biomass combustion. Through the use of the burner is avoiding the need for regular charging and adjusting the heat in the heating system. The power of the heating systems of this type varies widely - from 10-15 kW to 1000 kW. For the use of waste from the tobacco industry could use a boiler, shown on figure 10. The fuel is full in appropriate bunker. By screw fuel is fed into the combustion chamber, in the appropriate mode of choice. In boilers with an appropriate selection of the screw it is possible to burn briquettes.

CONCLUSIONS

Technology-route has been created for movement of energy raw materials and utilization of waste biomass in the tobacco industry.

Below are the different variants of machinery for the implementation of various technological operations in utilization of biomass in tobacco.
REFERENCES


Failoni, 2006. Renewable energy sources. Trakia University, Stara Zagora.