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Logistic supply systems of raw materials and products of biomass in the production of renewable energy

Introduction

The document "Polish Energy Policy until 2030" predicts that by 2020 the share of renewable energy sources in the energy balance of the Polish countryside and agriculture will increase to about 20%, which will provide more than 15% share of RES in the entire fuel - energy balance of the country [3]. To renewable energy sources include biomass, among others, pellets. For their production mainly uses wood waste from sawmills, factories and carpentry of wood and other plant materials. The material of which the pellet is formed has a high energy value - approx. 19,500 kJ / kg, and a low ash content - 0.5-5% - compared to fossil fuels. Fuel pellets are environmentally friendly and do not cause difficulties in transport, storage and distribution as opposed to the form of loose biomass. For logistical supplies of biomass and products in the form of pellets, it is important to define the correct type of harvested wood primary means of transport, unloading method, timing and volume of deliveries to quality and timely deliveries of pellets was high.

The aim of the work is to create an algorithm compacting materials of plant origin in the form of pellets in order to optimize production line operations and obtaining high-quality final product.

Compacting processes of raw material

Low bulk density of biomass is one of the shortcomings of the fuel of plant origin. This feature makes it difficult to transport, storage, and dispensing and distribution. It is therefore very important issue becomes the unifying and refining of biomass through the process of compacting. Pelleting increased biomass density, reduces the water content and increases the concentration of energy per unit volume in this biofuel [6].

For the production of pellets used are materials that cannot have any impurities, both chemical and mineral. Raw materials containing, for example. Sand may increase the amount of ash pellets and contribute to more rapid wear of the metal parts associated work items in the manufacturing process of the pellet.

Studios pellet buy, sort, drought, clean, grind, granulate, biomass cool and remove pollen from production. Then the finished pellets are packed and sent to customers [7, 9]. Based on the survey of literature created an original algorithm for compacting materials for pellet production line (Fig. 1).
The first step in the manufacturing process of pellets, according to the algorithm shown in Fig. One, is to build an appropriate amount of raw material required for its production. For the production of pellets used both hardwoods and conifers. However, softwood is approx. 70% of the raw materials used, and the remainder of hardwoods [2]. The best raw materials are dry sawdust, which are derived from sawmills, carpentry and furniture factories. Establishments engaged in compacting the raw material should be so ensuring its systematic supply, because to produce 1 tonne of pellets need until 6 m$^3$ of sawdust, to the production process may be continuous.

A very important issue in the compacted raw material is its purification. Often the material is contaminated with, among others, by sand, gravel, pieces of metal, glass or plastic. You must remove all impurities, as they may cause wear of metal parts in production machines, as well as affect the amount of ash produced pellet. For cleaning pellet used mechanical and pneumatic. They include magnets, which occupy an important role in the delivery of raw materials. They are supposed to attract metal parts, making it entirely clean sawdust. Permanent magnets can be distinguished through which material is moved in the form of:

- plates,
- rods,
- screens.

Another group are moving magnets in the form of:

- rollers,
- moving tape.

Their job is to discharge of attracted pieces of metal out of the stream of sawdust or wood chips.

The next step in the purification of the pellet is the removal of stones, dust and sand. Through the existing differences in weight between the sawdust or wood chips and mineral impurities is possible to identify unwanted parts and their segregation. There are many ways purification; One feed stream is caused to spin by means of a centrifuge. The swirling motion to reject a heavier part of the material on the peripheral side of gravel and eliminate them.

It is important to purify the sawdust from all parts of metal and mineral impurities; Indeed, this allows to extend the efficiency of all the devices in the production of pellets. This is also important in the formation of ash in the pellets, and reduction of its content.
After purification, a further step, namely drying. The raw material should be dried to obtain at least 8% moisture content [4]. Removal of water from sawdust and wood chips is called dehydration, which is carried out by heating the pulp, leading to evaporation of water therefrom. It should be noted that such dryings high demands because they ensure optimal conditions for maximum diffusion of water vapor removed in the entire cross section of sawdust feed stream. However, it is important to not speed drying sawdust, but their quality after drying, as well as safety and costs incurred in the use of the dryer.

Can be distinguished:
- Direct tumble driers;
- Indirect drying drum;
- Belt drying sawdust and wood chips;
- Streaming drying sawdust;
- A fluid bed dryer. [4]

Drum dryers are direct device of choice by the producers of biomass. The first stage of the drying process when used to download material into the drum drying. This is done by inserting the raw material feed connected to the metering screw, which via a linker loading dryer enters the center of the drum, wherein the competent process begins. With the built-in fan blades on the inner side of the drum is possible to continuously tumbling active fan sawdust. Air from the flue gas at a temperature of about 400 degrees Celsius goes towards the furnace air, and then into the drum. Then the stream of flue, and relatively light and dry sawdust are collected and sequestered in cyclones [1].

Another group of drying are drum drying intermediates in which the air heat exchangers or steam. This makes it possible to acquire higher-quality wood chips and sawdust, as well as reducing problems associated with the digestion and overheating of the raw material during drying. In the process the material is subjected to a lower temperature than the direct drum drying. Method that can improve the dryer drum is a place between the stove and the dryer air heat exchanger. This procedure allows the injection of heat to the drum clean and heated air free of emissions.

Another group are drying belt dryer. The drying process in drying sawdust and wood chips tape is a mild and uniform. It consists in introduction of moist product to the dryer where the transport screws uniformly distributed over the entire width of the material strip. Then it goes on to the tunnel kiln, where it is subjected to a stream of high temperature air that comes from the heat exchangers heater. The material is dried by hot air from above and below. To get the best quality final product, embankment after traveling half the length of the process shall be screened in the form of the return mechanism. Thanks to the embankment layers are mixed and balanced in terms of humidity. At the end of the drying process, the product is transferred from the conveyor belt and the screw device is subjected to further processing.

After purification and drying of biomass raw material is collected in an intermediate tank. The next phase of the production process is the milling of the pellet (grinding) which consists in turn of the three intermediate stages:

1. first pre-grinding;
2. secondary crushing;
3. grinding final [8].

Grinding End is on the final grinding of the dried material. In order to obtain a compact and hard pellets with a diameter of 6 mm fraction of fine particulate should not exceed 3 mm. Tiny had allows for both high quality pellets, as well as greater efficiency in burning.

Granulation (compacting), is the most important step of the whole process of pellet production. Due to the type of matrix used a granulator, there are two types of compaction: matrix and the annular flat (Fig. 2).
The compaction process in the granulator flat commence at a pelletizer matrix material on which the rollers act thickening. Channel matrix has a frustoconical through which sawdust is jacked. Squeezed compacted sawdust pellets are trimmed to the appropriate length by knives. Another type of pelletizer is the matrix ring granulator. The process consists of forcing the pulp by means of rollers in the inner part of the die, and a centrifugal extrusion. The crushed material is squeezed out, which knives cut the pellets to a predetermined length.

The compacted granules reached a temperature of about 100 °C. Therefore to cure the pellets must be cooled to a temperature of approx. 25°C. After the cooling step the pellet gets special screen that removes various kinds of pollen. Then purified pellet is transferred to a tank where it is stored. Pelletizer produce several tons of finished products per hour [4].

Summary

Currently, the use of pellets produced from plant biomass for heating purposes is becoming increasingly common in many countries, also in Polish, due to the increasing number of companies producing this type of biofuel. Very important is a process of compacting the raw material, so that the final product have high quality and was efficient. But before that happens he has to go a long way through sorting, drying, cleaning, grinding, pelletizing, cooling, removal of pollen. Then the finished pellets are packed and sent to customers. Each step of the process is extremely important and cannot be overlooked. The normal flow of raw material in the process of compacting affect the final quality of the resulting product. It is important that both the raw material logistics of distribution and product under the optimum conditions for plant material and compacted material.

Abstract

The article presents an original algorithm for compacting the raw materials for pellet production line. Are discussed the various stages of the process of compacting, such as sorting, drying, cleaning, grinding, pelletizing, cooling and removal of pollen. Biomass in the form of pellets is nowadays a very popular form of renewable energy sources. Therefore, the process of its creation should be efficient and economical.

SYSTEMY LOGISTYCZNYCH DOSTAW SUROWCÓW I PRODUKTÓW BIOMASY W PRODUKCJI ENERGII ODNAWIALNEJ

Streszczenie

W artykule przedstawiono autorski algorytm procesu kompaktowania surowców na linii produkcyjnej peletów. Zostały omówione poszczególne etapy procesu kompaktowania, takie jak: sortowanie, suszenie, oczyszczanie, mielenie, granulowanie, chłodzenie oraz usuwanie pyłków. Biomasa w formie peletu jest w
dziś dzisiejszych czasach bardzo popularną formą odnawialnych źródeł energii. Dlatego też proces jego tworzenia powinien być efektywny i ekonomiczny.

References


