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FUNCTIONAL FEATURES OF A ROLLER MOTOR PELLET PRESS

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Abstract: *The present paper presents the analysis of the constructive - functional solution of a pellet press made with TEHNIC ECO CDI S.R.L. on the basis of an idea developed by INOE 2000 - IHP, on the subsidiary contract of a single project on Axis POC - G. At the level of the experimental model a pellet press with a motorized sieve and it was tested in real conditions to see if it achieves the designed parameters. During the work the functional samples and the results obtained during the experiments are presented.*

Keywords*: Biomass, pellets, eco-innovative technologies, pellet press*

1. Introduction

Biomass includes all forms of material from vegetal and animal grown on land or water, as well substances produced by biological development [3].
The term biomass applies to the mass of matter generated by the development of living organisms, whether microorganisms, plants or animals. The term also includes agricultural products, agricultural crop waste, including grain straw, residues from the production of sugar, starch, beer, etc.
Plant biomass production is the result of the photosynthetic activity of all the individuals that make up a plant community (population or association). Biomass production of a plant cover (lawn, meadow, forest, etc.), referred to as primary production, is expressed by the mass of the organic substance produced per unit of land covered with vegetation (g / m2, t / ha) and in the unit of time considered (year) or expressed in energy equivalent (joule, kcal / ha-1 / year).
For any agricultural crop or natural vegetation association, four factors determine net productivity or net biomass growth: the amount of incident solar energy; the proportion of this energy intercepted by the green organs of the plant; the efficiency of photosynthetic conversion in the biomass of intercepted energy; breathing biomass losses. Only a small part of the solar radiation that reaches the earth's atmosphere is captured in the plant photosynthetic process and is transformed into biomass. It should be noted, however, that a 1% photosynthetic efficiency corresponds, in the absence of water stress, to a production of about 30-35 t of dry biomass / ha / year [2].
According to the European Union legislation, "biomass represents the biodegradable fraction of waste products and residues from agriculture (including vegetal and animal substances), forestry and related industries, as well as the biodegradable fraction of municipal and industrial waste" [2]. "
Biomass "is a generic term for energy from organic matter, mainly represented by vegetable materials (agricultural crops, agricultural waste, organic waste, forestry and gardening waste) as well as other organic materials such as manure, waste pulp and paper industry, food industry, sewage sludge, solid municipal waste

2. Pelletizing / briquetting technologies for solid agricultural and forest biomass

The degree of use for technologies based on renewable resources varies from one country to another. Biomass plants have found a market in Denmark, where about 20,000 units a year are sold, and those in cogeneration in Germany and England. The reduced purchasing power, as well as the poor ecological awareness of the Romanians, however, leads to an extremely low use of such equipment.
The production and distribution flow to the consumer for the production and use of pellets or briquettes (the green renewable fuel of the future) shown in Figure 1 starts from plant biomass as

raw material and goes through 9 phases until the consumer distributes and uses these fuels final, [52].

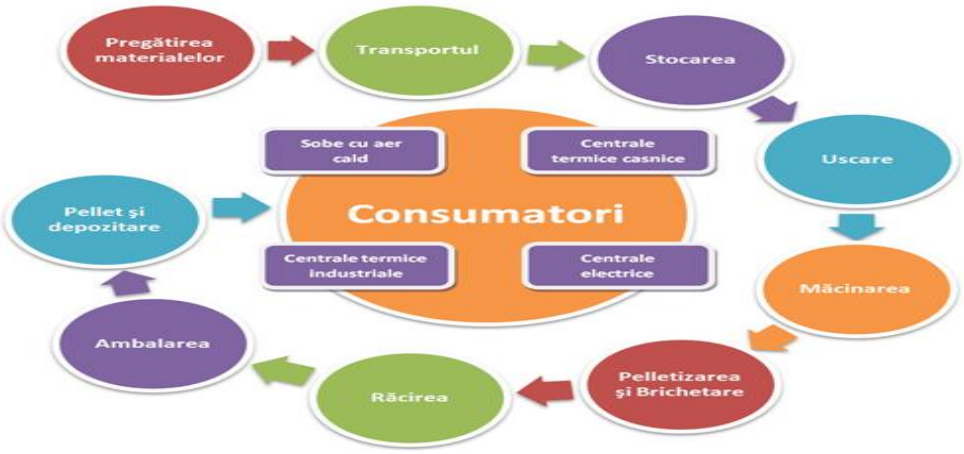
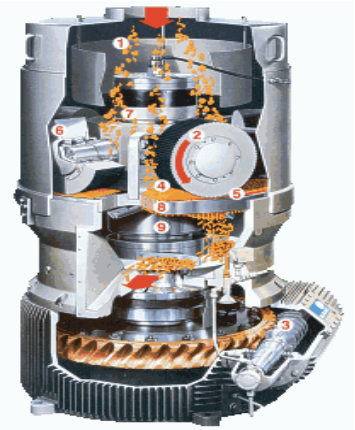


Fig. 1. The technological flow of pellet production and distribution, [8]

The operations performed in each production phase as well as the equipment contributing to the realization of each technological process, specifying also their technical characteristics, are:
The preparation of the materials starts from the basic concept that in the technological flux of pellets or briquettes the material is used only in the form of sawdust. For the transformation into sawdust of materials in different forms, such as wood waste resulting from the manufacture of lumber or the manufacture of furniture with massive elements, remains left from logging, logs, branches, cages, leaves or scrap agricultural crops, etc., the preparation of the material for the production of pellets or agricultural pellets requires additional machinery in addition to harvesting, transporting, chopping and shredding. The preparation of the materials consists in sorting and grinding of wet materials in order to obtain the granulation necessary for the use of the materials in the production stream by means of disk or drum (mobile or stationary) scrapers. But the main materials to be removed from sawdust that is coming from sawmills and woodworking remain wood waste in the form of edges from lumber cutting, lobes from cutting, pieces of wood from machining. All of these materials can be removed by dimensional sorting which besides the role of removing the wood pieces also have the role of selecting only the size of the grain allowed to be introduced into the sawdust dryer, knowing that only granules of certain sizes can be introduced in continuous flowing drying systems provided with various magnetic separation systems.
Drying of woody granular materials is carried out with equipment (dryers), in continuous flow and with fully automated systems, using biomass, sawdust or briquettes and wood waste, for producing the necessary thermal energy. The range of dryers, ranging from 400 kg / h to 12,000 kg / h, can be stationary or mobile.
The grinding of woody granular materials is a necessary operation to obtain a certain constant and homogeneous dimension for use in pelleting machines. Choosing a milling hammer mills is based on several criteria such as material type, assortment, degree of humidity, production capacity, etc. Each type of hammer mill requires special power and exhaust systems to integrate into the production stream.
Palletization / briquetting is the transformation process of materials specially prepared by the components of the manufacturing process fuel into the fuel. The palletization is carried out by extrusion, meaning by a forced and continuous passage of a very large quantity of material through a very small hole, in Figure 2 there is shown a section through a press used for the manufacture of pellets. The choice of the type of pelletizing machine as well as the systems for feeding, mixing and conditioning the material at the entrance to the machine must be made on the basis of several criteria which take into account besides the desired capacity of the type, assortment and humidity of the material, but also by the way preparation of the raw material in the equipment used before

introduction into the pelletizer [7]. The wood chips and wood pieces with a moisture content of less than 10% are introduced into the pellet press, the shreds being shredded to the size of the shank, then placed in a homogenization tank where the humidity required for the technological process is obtained (if necessary, a surplus spraying water). The pulp is then pressed by extrusion, where the wood binder becomes active, helping to form the pellets, while giving the glossy surface of the pellets, important in the initial automatic ignition stage. No adhesives are added to the pellets, after pressing the pellets are cooled, dosed and loaded into bags.



1. Loading the chips
2. Pressure roller
3. Motor
4. Contact surface
5. Mold for pellets
6. Bearing
7. Spreader
8. Extrusion plate
9. Schrader

Fig. 2. Section through a press for the production of pellets, [7]

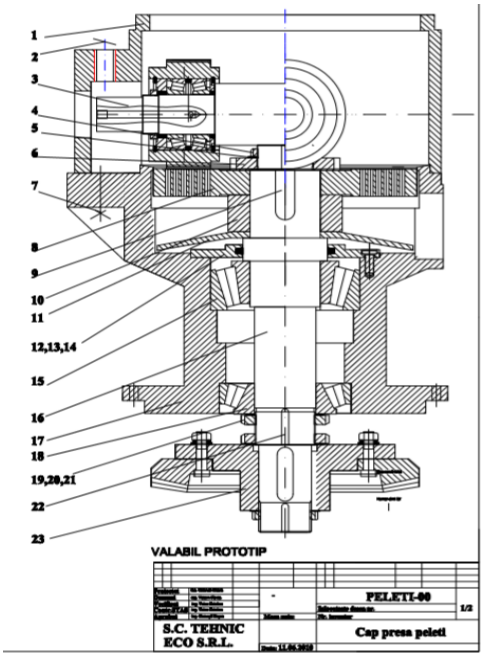
Cooling after the pelletizing operation is a mandatory operation in the manufacturing process stream due to the high temperature of the finished product at the exit of the extrusion die. The outlet temperature can reach 90 ÷ 100°C which results in damage to the finished product if it is still stored or packaged at this temperature. The technological line must be fitted with a dust extraction system in the pellet cooling unit.
Packaging of the finished product - pellets is made in plastic bags weighing from 10 to 15 kg and up to 25 kg as required. It is also used to pack large bags of special material weighing 500 ÷ 1000 kg for the industrial use of these fuels. There are various packaging machines in plastic bags and bag sealing systems in both semi-automatic version and in the fully automated version with robots for picking up and positioning the bags with pellets on pallets.
Storage is the required operation especially for the final customer before the pellets are used to power the respective heat exchangers.
The final consumer is the user of the thermal power plants for the production of hot water or hot air.

3. The functional constructive solution developed by S.C. TEHNIC ECO CDI S.R.L.

The pelletizing presses can be with discontinuous operations and with hydraulic actuation and hydraulic cylinder pressing chamber, respectively with continuous operation, with the screw-operated press chamber.
The company SC TEHNIC ECO S.R.L Bucuresti had as main objective assimilation in manufacturing and entering this market segment with production capacity equipment adapted to the requirements of individual agricultural producers or costly in small and medium associations, at a competitive price / quality ratio.
The pellet press proposed to be carried out within the project is a vertical motor shaft press with rotary extrusion plate and fixed press rollers.
The drive group consists of an electric motor with a power of 30 kW and a conical gear with an evolving profile to transmit the torque from the electric motor shaft to the press shaft.

The transmission is mounted in the lower case of the press, the motor shaft being provided with bearings with conical roller bearings, able to take over the forces developed in the conical gear and transmit them to the casing.
The two press rollers are mounted on a horizontal axis in the top housing of the press via conical bearings.
The distance between the pressing rollers and the extrusion plate with 6 mm holes is adjusted by means of screws and compression springs.
By rotating the extrusion plate between it and the pressing rollers, friction forces develop, causing the previously processed biomass to be pushed (fragmented to 15-30 mm and max. 15% humidity) through the holes, resulting in the pellets.
Between the extrusion and transmission chamber is placed a Tron conic shield with the role of biomass targeting and transmission protection.
The working capacity of the press is 500 kg of biomass per hour.
The technical solution is presented in figure 3 a and b in which is presented the functional constructive solution (variant), the roller motor.

a



b

Fig. 3. The technical solution chosen to be carried out within the project

Desired technical characteristics of pellets:
Diameter: 3-15 mm (6 mm diameters)
Length:<60 mm
Bulk weight: ~650 kg/mc

Density: >1200 kg/mc
Humidity: <8%
Ash: <1.5%
Heat power: between 3500 and 4500 kcal/kg
The equipment was developed in the experimental model phase and subjected to verification and operation tests to be validated in order to pass the prototype phase.

4. Experimental results obtained on the experimental model:

The equipment was connected to the power supply and the equipment was switched on (Figure 4) to check its functionality. This corresponded with the fact that the engine started and moved the engine sieve and the rollers.

Fig. 4.

Fig.5.

Verification at start-stop and verification of electrical safety systems were also carried out. The equipment was turned off and started several times and found to respond to orders. It tried to start with the door from the command and control system open and it did not start what corresponds to the designed function Check that the equipment stops when the metal elements enter the pressing area (fig. 5). To perform this test, some metal elements (nails) were inserted into the pellet press and it was observed that it stopped. It was necessary to remove and extract the metal parts between the pressure rollers and the motor sieve. The product also corresponds to this point of view.
Samples with unsorted compaction material to check for load performance.
Prior to performing the tests, the possibility of priming the press and the technological process of pellet production was checked. Within these two activities, the compaction parts were also drilled by grinding the holes of the site with mined biomass, but also with specific material (fine sand, engine oil, etc.).
It has been observed that it is necessary to prepare the equipment for operation in real conditions by polishing the extrusion holes of the motorized web. This has been achieved by:
a) 6 times the abrasive material (consisting of a mixture of 5 kg of raw material (sawdust, straw pastry), 1 kg of fine sand and 1 kg of used motor oil)
b) Compaction samples resulted in low density pellets (Fig. 6) which led to the conclusion that an additional crossing of the abrasive mixture for grinding the holes of the motorized web
The samples from a) and b) were repeated three times so it was concluded that only after a passage of at least 18 times the material the specifics obtained were within the limits required by the design theme from point in view of the density (Fig. 6), (Fig. 7), (fig. 8).

5. Conclusion

Following the experiments, it was concluded that the pellet press projected and realized within the project is appropriate in terms of functioning. Make pellets at the desired size and density only after a proper start is made. It has been shown to be easy to make and use.
Analyzing the statistics that assess the current and prospective state of the development for the agricultural in Romania and Eastern Europe. The management of TEHNIC ECO CDI S.R.L. through its development strategy, it has proposed medium and long-term objectives, assimilation into production and development of innovative new products (pellet presses, biomass shredders, oil presses, vegetable-fruit driers, atomizers, machines to be packed, etc.). These products meet the

needs of small rural entrepreneurs to help them achieve their goals and implementation indicators, ensuring their economic efficiency and sustainability.

Fig. 6.

Fig. 7.

Fig. 8.

Since the financing of the projects of the small entrepreneurs in the rural area is still in the beginning in Romania, the assimilation in production and the approval of the new products, in order to put them on the market in a short time, represents a major strategic objective and a challenge of managerial on short and medium term.

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