HYDRO-PNEUMATIC SYSTEMS FOR ACTUATION OF SPECIFIC EQUIPMENT INTEGRATED IN PLANTS OF ENERGY PRODUCTION FROM VEGETAL WASTE

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Abstract: *One of the ecological modalities of finding new energy resources is the use of vegetal waste as fuel. From the agricultural and forest activities are resulting various secondary products, such as: straw, maize stalks, sunflower stalks, grape cords, wood wastes etc. These vegetal wastes are usually burnt on fields, in order to clear space for allowing performing the further agricultural and forest activities. In this respect, the article presents a number of specific hydro-pneumatic equipments, integrated in installations for obtaining energy from plant wastes, developed in the framework of various research programmes, at the Institute INOE 2000-IHP.*

Keywords*: vegetal waste, renewable energy, green energy, fluid power, hydro-pneumatic equipments*

1. Introduction

Until recently, the Earth's renewable natural resources were sufficient for the needs of humanity. Currently, due to population explosion and unprecedented development of all industries, the necessary raw materials, and especially energy, for production of material goods has grown much, and classical energy (fossil fuels), some close to exhaustion, will not be sufficient, this leading even to ecological and social imbalances.
Economic development can not be separated from the consequences of human activity on the environment. Effects of consumption and resource use on the environment are increasing. An issue of critical importance is that of the level and pace of economic and social development.
Currently, about a third of the resources are transformed into waste and harmful emissions, and already put acutely the problem of achieving energy from waste through recovery operations, that is the recovery of energy from wastes, primarily from vegetale waste plant.
That is why one of the main concerns of the nowadays research, at the Institute INOE 2000-IHP, is to find the solutions for using efficiently the vegetal wastes in economy, which are commonly burnt or spread on the land.
A lot of land cultivated with plants or woods remains uncleared of the plants stalks and wood wastes, every year, being necessary extra consumption of energy for fulfilling this action and preparing land for a new agricultural or forest cycle.
The obtaining of energetic products (pellets, briquettes etc) from vegetale wastes, to be used as fuel, may become of interest if it is proven its economic efficiency. Taking into account the fact that by burning these vegetal wastes huge wooden surfaces are saved, it may be taken into consideration the granting of subsidies for supporting this activity. It is more profitable to use as fuel vegetal wastes for impeding the huge deforestations, than to invest more money in replanting woods.

2. Hydro-pneumatic equipments investigated and tested at INOE 2000-IHP

At the Institute INOE 2000-IHP have been investigated and tested numerous tools and machineries used within facilities for production of mass / plant biomass and energy products needed in plants for energy production from vegetal wastes.
Some of them will be presented below, putting emphasis on the constructive solution adopted and, especially, on their drive ways and hydro pneumatic actuation diagrams.

2.1. The equipment for chopping-shredding vegetal wood wastes

The equipment for chopping-shredding wood is used for chopping / processing wood waste resulting from trimming trees in yards, alleys and parks, in order to obtain plant biomass necessary to obtain energy or compost, used as agricultural fertilizer.
Residual wood material, type twigs, branches, bark, etc., is shredded and ground for direct use as a fuel, or after compaction in various forms: briquettes, pellets etc.
This equipment is intended for Public Domain administrations and for average producers of compost from vegetal materials, such as SMEs working in the field, but also for individual farmers and foresters and private households, who have wood waste resulting from trimming trees in yards, alleys and parks.
The equipment for chopping-shredding wood, Figures 1 and 2, consists of a frame, on which the work mechanisms are mounted and which is placed on a chassis carried on a bridge with two wheels, equipped with a hitch for towing by a tractor.

Fig. 1 Equipment for chopping-shredding (left view)


Fig. 2 Equipment for chopping-shredding (right view)

The work mechanisms of equipment are the following:
- the mechanism for advance of wood;
- the mechanism for chopping-shredding wood material;
- the mechanism for outlet of the shredded product.

Technological characteristics of the equipment
The equipment processes the following thicknesses of wood:
- softwood (willow, poplar, lime) 5 – 60 mm;
- hardwood (beech, acacia, ash) 5 – 40 mm:
- theoretical productivity 2 – 5 m^3 /h.

Mechanical-hydraulic drive diagram
Hydraulic drive system is based on the hydraulic diagram shown in Figure 3, and it consists mainly of a gear pump mounted on the heat engine shaft, and through a manual hydraulic distributor is operated the hydraulic motor driving the advance / supply mechanism. The other mechanisms are driven via a belt drive, also from the engine shaft.

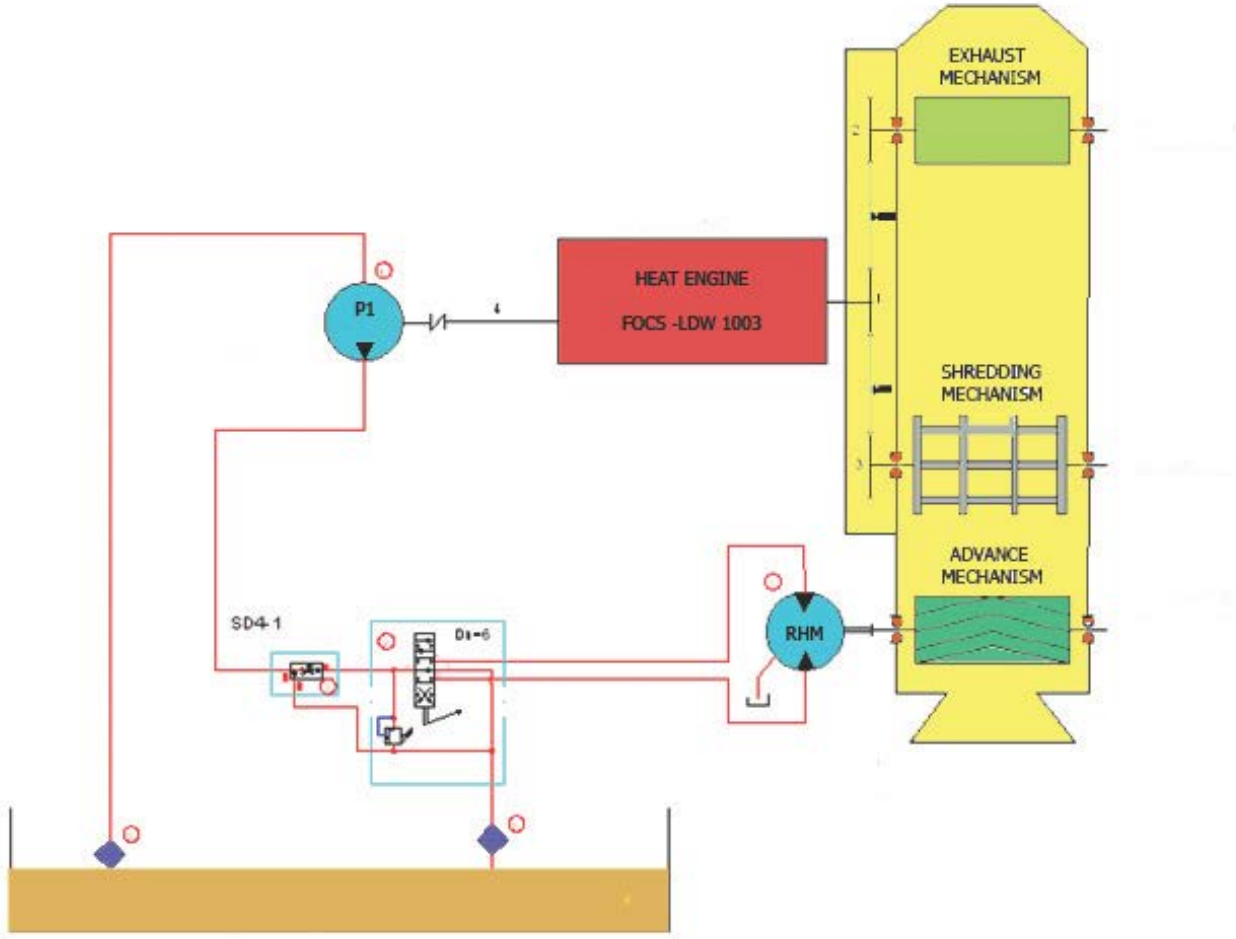

Fig. 3 The mechanical-hydraulic drive diagram of the equipment for shredding

2.2. Equipment for preparation of the vegetal biomass

The equipment for preparation of compost **is used in the preparation of composts** and biomass from degradable vegetal materials, **necessary to fertilize farmland and forestry**, in order for greening agricultural and forestry production and, respectively, for biogas obtaining.
The equipment for preparation of compost is intended for average producers of compost and biomass from vegetal materials, such as SMEs working in the field, but also for individual manufacturers and private households, who own a tractor of power 40-100 hp.
Through the use of this equipment, the energy value of the ground increases, and also there is used the energy from the vegetal fractions embedded in the mixture.

Parts of the equipment
The equipment for preparation of compost / vegetal biomass, Figures 4 and 5, consists of the following main parts:

- welded frame;
- mechanism for compost preparation- overturning;
- rolling mechanism;
- towing mechanism;
- hydraulic drive installation

Fig. 4 Front view of the equipment

Fig. 5 Side view of the equipment

Hydraulic diagram for equipment drive

Hydraulic drive system is based on hydraulic diagram shown in Figure 6. Hydraulic drive of the equipment is made using the hydrostatic energy from the tractor pump and its manual hydraulic distributor, for controlling the drum rotating mechanism, through two slow rotational speed and large torque hydraulic motors and, respectively, for driving the lifting-lowering mechanisms, by means of two linear hydraulic motors (hydraulic cylinders).

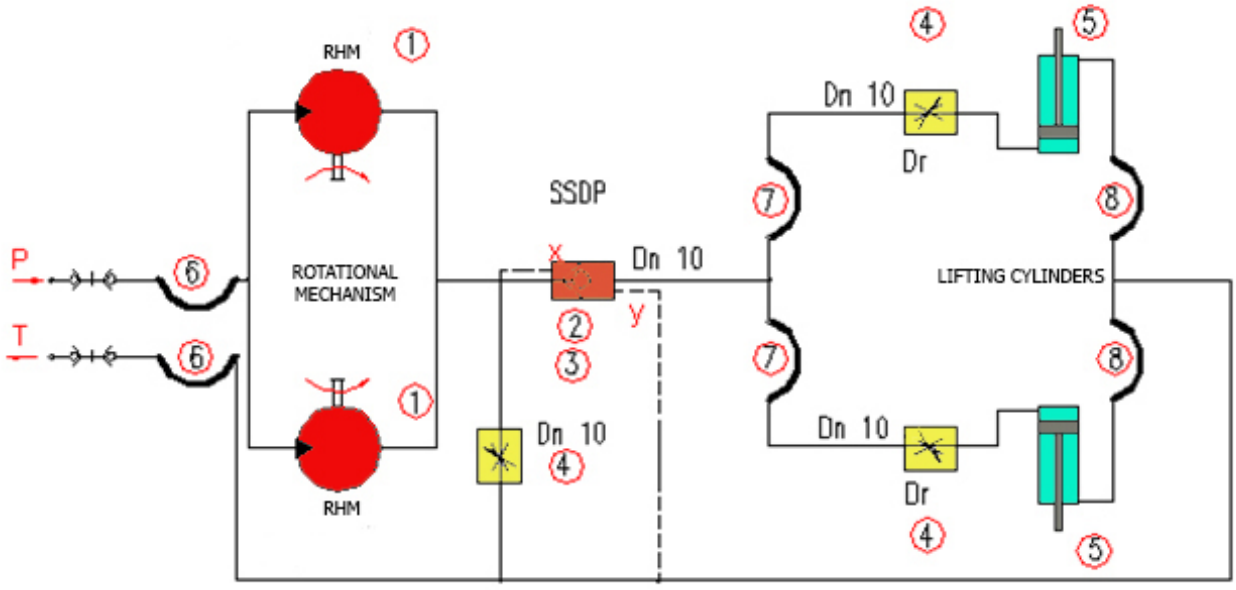

Fig. 6 Hydraulic diagram for driving the compost preparation equipment

2.3. Equipment for obtaining corn briquettes

The production of maize briquettes to be used as fuel may become of interest if it is proven its economic efficiency. At INOE 2000-IHP experimental tests have been performed in order to get corn briquettes by using pressing machines designed and developed initially for sawdust. It was aimed to reach the pressing parameters depending on the various degrees of humidity of the maize stalks. The presses are provided with force and displacement transducers for determining the optimum pressing modality.

The hydraulic press, see figure 7, is composed of an actuator including a servo valve and a displacement transducer which is fixed on the downside part of a layer. The layer, two guys and an upper support form a close framework. In this framework supported by the rod of the actuator

it is introduced a cylinder provided with a piston. On the rod of the actuator is mounted a force transducer.

The check up method at pressing

The cylinder is filled with chipped stalks, it is introduced the piston with the force transducer and the assembly is set on the rod of the actuator. The actuator is set into action until the transducer is propped by the upper support. It is continued the action, performing the pressing. There are measured the pressing force, deplacement and it is found the deplacement speed depending on time. It is made the diagram of force depending on deplacement and pressing speed depending on deplacement. In figure 8 there are shown the obtained briquettes.

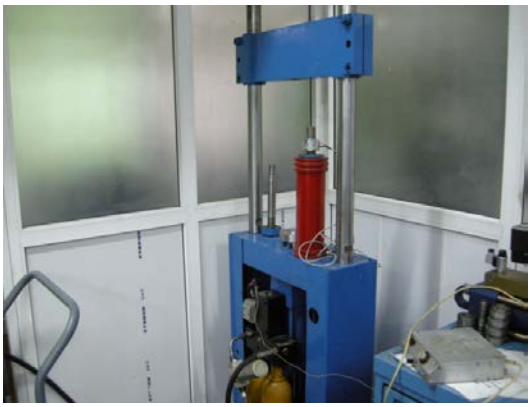

Fig.7 Hydraulic press for determining the pressing drive of the briquettes

Fig.8 Briquette in the pressing cylinder; it is shown how the material is compacted

In the diagram in figure 9 it is shown the graphic of the pressing force which depends on the piston deplacement. The force from the axis y gets higher when the deplacement from the axis x reaches that (this presenting the briquette pressing). It is also presented the graphic of the piston speed depending on the pressing degree (deplacement).

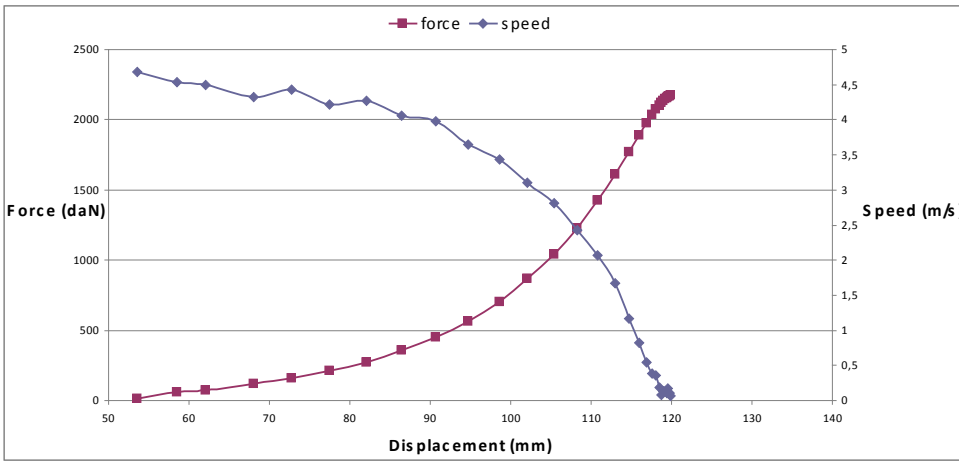

Fig. 9 Diagram showing the pressing of the briquettes by the pressing force and the piston speed

The press for briquetting, see figure 10, is composed of a hydraulic cylinder for briquetting driven by a hydraulic installation which presses the material through a **choke**. The material is introduced in the press by a cylinder by means of a charging piston which takes over the maize bio mass from the charging zone and pushes it in the briquetting press. The briquetting **choke** releases the briquette after it is performed the pressing stroke by the piston of the hydraulic cylinder.

There have been performed tests on a hydraulic press (see figure 10) used for sawdust briquettes. The new operational drives were found depending on the humidity and the changes required for working at pressing maize stalks.
Maize stalks briquettes obtained on the sawdust presses are presented in figure 11.

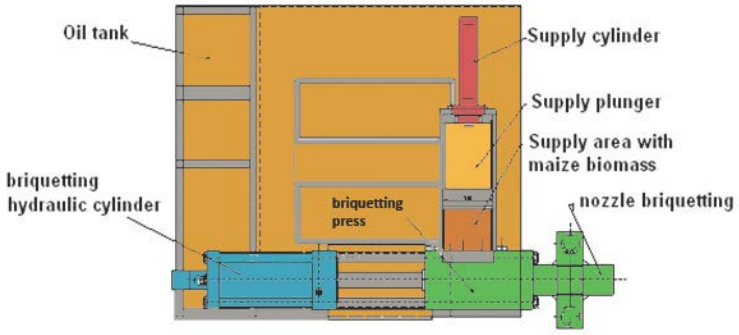

Fig.10 Graphic representation of the press for obtaining maize stalks briquettes

Fig.11 Maize stalks briquettes obtained on the sawdust presses

2.4. Complex instalation for obtaining and using the gas produced by gasification of vegetal wastes

The use of gas produced by a gas generator, although not a novelty in terms of energy production, is reset in actuality by specialists working as researchers in environmentally advanced countries.
Among the concerns of the Institute INOE 2000-IHP, there have been concerns for designing, developing and testing various technologies and equipment for the development of a complex installation energetic generating and using vegetal waste, with transportation mobility and sufficient capacity to drive a low flow irrigation pump.
In this respect, in Figure 12 is shown a general schematic diagram of a complex installation for obtaining and using gas produced by gasification of vegetal waste in order to drive an irrigation pump with internal combustion engine, adjusted to gas.

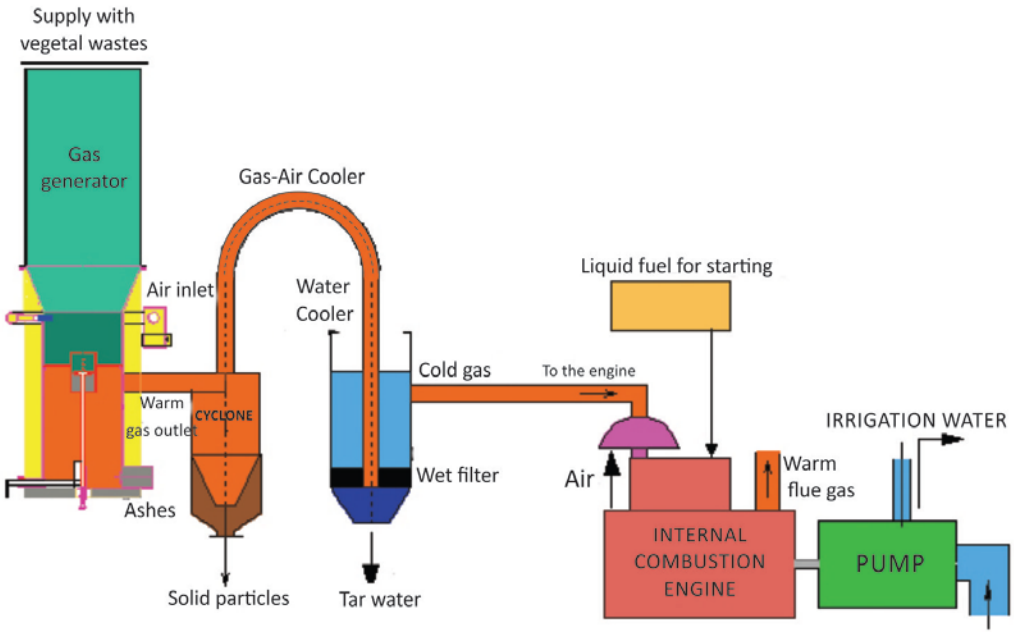

Fig. 12 The general schematic diagram of a complex installation for obtaining and using gas produced by gasification of vegetal waste

Following the studies and research undertaken, has resulted a facility for obtaining gas through gasification of vegetal waste, gas which can be used as fuel for heat engines. Potential beneficiaries of the facility are small households in rural and remote areas, where biomass is available.

3. Conclusions

The article presents a range of equipments specific to lines / installations for generating and using energy obtained by processing vegetal wastes, equipments using, as means of actuation / drive, hydraulic and / or pneumatic systems.
From the description of these equipments, it can be seen both the ease of operation achieved by way of hydro-pneumatic systems, and the possibility of finding solutions / models with high energy efficiency.
Each of the equipments shown can be integrated into lines / installations for generating /obtaining energy from vegetal wastes, with known advantages over the use of classic fuels.

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