# MODERN TECHNOLOGICAL ALTERNATIVE FOR OBTAINING ECOLOGICAL ENERGY – EQUIPMENT FOR RECYCLING OF THE ORGANIC WASTES IN AGRICULTURE

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*Abstract:* - This article presents a modern technological alternative for obtaining ecological energy – equipment for recycling of the organic wastes in agriculture. It is presented a cost-benefits analysis which must be carried to prioritize rural agricultural project with a higher return on the use of solid organic wastes.

*Key-Words:* - organic wastes, biomass, agriculture, equipment for recycling, resources rentability, briquettes

## 1 Introduction

Organic urban and agricultural wastes need no longer be an environmental hazard. Combining highland low-carbon wastes to form compost will not only reduce the amount of organic wastes that need to be land filled or burned, but will also reduce surface- and groundwater pollution. Composts can be returned to cropland, turf, landscapes, and mine spoils to improve soil structure, conserve moisture, and increase productivity through nutrient recycling. Managing organic waste, as a sustainable asset not only improves the environment, it means greater profitability.

## 2 Status of organic wastes in Romania

In Romania, the transition to the free market economy after 1989 was accompanied by a deep down turn in gross domestic product, the collapse of traditional foreign markets, a slump in domestic consumption and decreased industrial output. All these factors determined a decrease of gross domestic energy consumption.

The closure of unprofitable coal mines and exhausting of the domestic crude oil and gas reserves determined a decreasing of the domestic energy production in the last period. In the present, the production of biomass participated with 10.94% in the total energy production of the country. In Romania statistical records, all biomass categories are grouped in only two: "firewood & agriculture waste, etc." which accounts about 95% of the total and "wood waste from industrial processes" with about 5%.

The category "firewood & agriculture waste, etc." contents: wood from forestry exploitation; wood sorting from gardening cuttings in rural area and in grove; agriculture waste such as: straws, corncobs, maize stems, hemp and flax waste, vine cords, sunflower needs shells, etc. The wood waste from industrial process contents: wood waste from primary processing of wood (fabrication of timber, plywood, veneer, etc.); wood waste from secondary processing of wood products (furniture, doors - windows, chipboards, parquet, panels, etc.); wood waste and liqueurs from pulp & paper industry.

From the total "firewood & agriculture waste, etc." it is estimated that only a share of 30% is commercial biomass and the share of 70% represents the contribution of the biomass harvested by the owners from the private forests and gardens and of the agriculture waste resulted in the rural households.

It is important to mention that biomass plays an important role in the supplying with fuels of many categories of consumes such as: population with a share of biomass in total fuel consumption of about 50%; Agriculture & Forestry sector with the share of biomass in total fuel consumption of 25%; hotels in mountain area, schools and other public buildings located mainly in the rural area for which category the share of biomass in the total fuel consumption represents about 15%.

**Table 1** Structure of the biomass gross consumption by consumer types and heating systems [6]

| Consumer types | 1998 | | | 1999 | | |
|---|---|---|---|---|---|---|
| | Total biomass | out of which: | | Total biomass | out of which: | |
| | | Firewood & agriculture waste, etc. | Wood waste from industrial processes | | Firewood & agriculture waste, etc. | Wood waste from industrial processes |
| **Total consumption** | **126,3** | **120,5** | **5,8** | **118,0** | **112,7** | **5,3** |
| *direct use* | *118,4* | | | *109,6* | | |
| - Agriculture & Forestry | 1,3 | 1,0 | 0,3 | 0,6 | 0,6 | - |
| - Industry | 2,0 | 1,4 | 0,6 | 1,6 | 1,0 | 0,6 |
| - Construction | 0,2 | 0,2 | - | - | - | - |
| - Population | 112,2 | 111,6 | 0,6 | 105,1 | 105,1 | - |
| - Others | 2,7 | 1,2 | - | 2,3 | 2,3 | - |
| heat generation in thermal plants | 7,9 | 3,6 | 4,3 | 8,3 | 3,7 | 4,7 |
| - district heating | - | - | - | 0,02 | - | 0,02 |
| - autoproducers | 7,9 | 3,6 | 4,3 | 8,3 | 3,7 | 4,7 |

## 3 Technical description of the equipment

The experimental equipment is dedicated to process the solid organic wastes (stalks, straws, dry branches or leaves etc.) which result from rural agricultural activities. As a result of this processing technology, combustible briquettes are obtained, useful to an economic heating of the population from the rural area.

The experimental equipment consist on four working modulus (Figure 1), as follows:

1. Mechanical mill for the organic wastes;
2. Alimentary modulus;
3. Compressing modulus;
4. Heating and evacuating modulus.

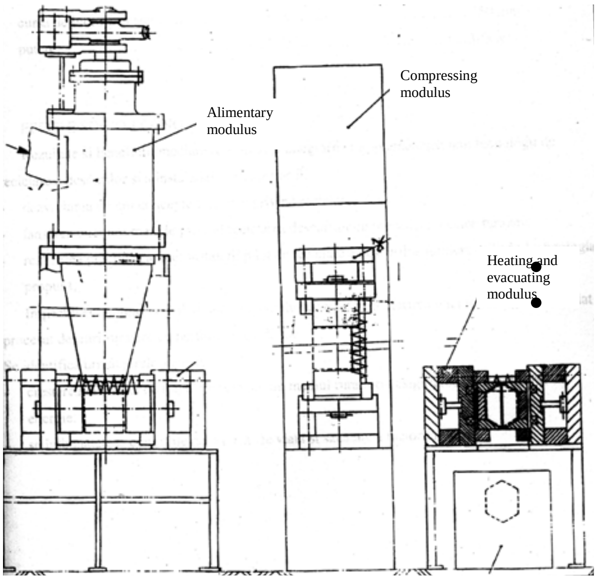


**Fig. 1** Experimental equipment

The purpose of the mechanical mill (Figure 2) is to chop the solid organic wastes, at the beginning of the technological processes.

**Fig. 2** Mechanical mill and alimentary modulus

The alimentary modulus (Figure 2) consist on a pushing and compacting device of the organic wastes, in order to introduce the pre-formed briquettes in the compressing modulus (Figure 3). The function of this third modulus is to complete the forming of the briquettes, by compressing them in a special mould.

The fourth modulus is the heating and evacuating modulus (Figure 4). This modulus permits the final dry and the superficial carbonizing of the briquettes.

The main technical characteristics of the recycling equipment are:

- Tension voltage 380V/50Hz
- Current intensity 20 A
- Stroke of alimentary device 60 mm
- Pression force 200 kN
- Working stroke of press 350 mm
- Number of mould pockets 2
- Time for drying 2 – 3 min
- Time for superficial carbonizing process 4 – 6 min

Power of equipment 3.5 kW

During the technological process, the organic wastes are chopped in the mechanical mill and after that, an aspirator collects them. The bag of the aspirator is overflowed in the feeder of the alimentary modulus, which realizes the primary compressing. After this operation, the mixture of the organic waste is introduced in the pockets of the mould, from the compressing modulus. In this stage, the mixture is compressed, finally obtaining the briquettes. The last operation of this technology is the heating and drying stage, which conduce to the combustible properties of the briquettes.

**Fig. 3** Compressing modulus

**Fig. 4** Heating and evacuating modulus

## 4 Conclusion and social-economical effects

In order that the technology and the equipment proposed should be viable, a cost-benefits analysis must be carried out to prioritize rural agricultural project with a higher return on the use of solid organic wastes.

The benefits of solid organic waste technology are determined and demonstrated in terms of :

- Lower collection and final disposal costs as a result of recycling organic wastes ;
- Lower production costs by using organic wastes instead of conventional combustibles;
- Number of jobs created;
- Reduced risks (and associated costs) to public health by decreasing environmental pollution through the reduction of the volume of waste;
- Increasing of the life quality of the people from the rural area, by creating of low cost combustible, easy to obtain and to use.

All the costs involved in the implementation of this equipment need to be calculated, as well as their direct and indirect benefits. It is necessary to take into account installation, operation, and maintenance costs of the equipment, as well as the benefits of using the new technology. The benefits could be direct (income generated through farming) and indirect (savings from using classical combustibles).

The principle parameters of the costs-benefits analysis, regarding the technical equipment realized are:

- Time interval for the project development: 2 years;
- Total investment: aprox. 17000 Euro;
- Production expenses for one tone of briquettes: 27 Euro;

Table 2 presents the estimation for evolution of the briquettes production in Romania for the next six years.

**Table 2** Briquettes production

| Year | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|
| Estimated Production [kg] | 65625 | 67167 | 68966 | 70809 | 72700 | 74638 |

Based on this estimation, an analysis of two main economical rentability parameters was made:

- Ratio of the resources rentability, Figure 5;
- Ratio of the revenues rentability, Figure 6;

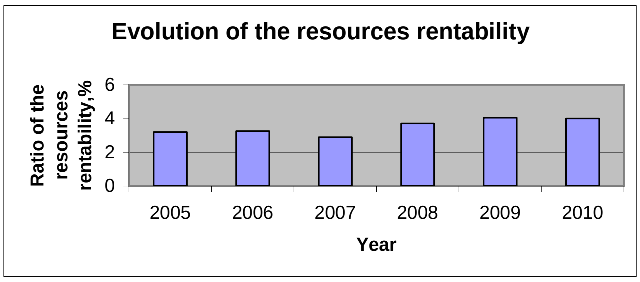


**Fig. 5** Evolution to the resources rentability

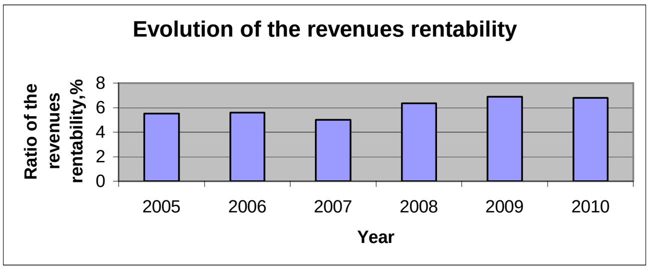


**Fig. 6** Evolution of the revenue rentability

*References:*

[1] Beck-Friis, B., S. Smårs, H. Jönsson, Y. Eklind and H. Kirchmann, *Composting of Source-Separated Household Organics at Different Oxygen Levels: Gaining an UnderstAnding of the Emission Dynamics, Compost Science & Utilization*, Vol. 11, No. 1, 2003, pp. 41-50.

[2] Changa, C.M., P. Wang, M.E. Watson, H.A.J. Hoitink and F.C. Michel Jr., *Assessment of the Reliability of a Commercial Maturity Test Kit for Compost, Compost Science & Utilization*, Vol. 11, No. 2, 2003, pp. 125-143.

[3] Venelampi, O., Assi W., Timo R. and Merja I., *The Biodegradation and Disintegration of Paper Products in the Composting Environment, Compost Science & Utilization*, Vol. 11, No. 3, 2003, pp. 200-209.

[4] Fratric, M. *The New Waste Management Legislation in the Slovak Republic and the Requirements for the Organic Waste, 10th International Conference of the RAMIRAN Network, Strbske Pleso, Slovak Republic*, May 2002, pp. 133-136

[5] Santandreu, A., Castro, D. and Ronca, F., *La cría de cerdos en asentamientos irregulares, Agricultura Urbana, No. 2, Quito, 2001*, www.ipes.org/aguila

[6] *** *Small and medium scale biomass-boilers and stove manufacturers, Country picture Bulgaria & Romania*, www.eva.ac.at/(en)/opet/bioboiler/bulrum_cp.htm

[7] *** *The Collection and Recycling of Compost Mixture in European Countries, Rapport WIAUX JP, Collect Nicad*, February 2002

[8] *** *Biodegradable Municipal Waste Management in Europe, Agence Européenne Pour l'Environnement*, Avril 2002

[9] *** *USEPA, 1993. 40CFR503. Standard for the Use on Disposal of Sewage Sludge.*