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SALIX - RENEWABLE ENERGY SOURCES

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Abstract: *Renewable energy sources are the new directions in the field of scientific research. Exploring the potential of Romanian energetic results that biomass is a new direction for energy development. This paper describes the energy composition of Salix species – which can become a business in the developing countries as Romania. In the extended text of paper there are mentioned the methods how to determine the micro and macro structure of wood and the energy power of the sample from Salix viminalis.*

Keywords: *biomass, salix viminalis, renewable energy, calorific value, ecology*

1. INTRODUCTION

Renewable energy represents the future of ecological energy and heat in industry and especially in residential houses. A large study was done on existing renewable energy potential in Romania; according to which biomass represent 49% of the total renewable energy source [9, 14].

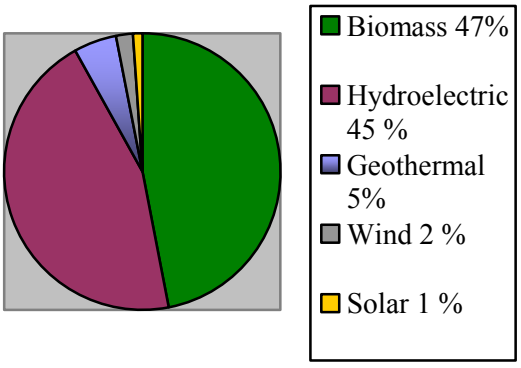

Fig.1 Potential sources of renewable energy in Romania [9]

An alternative factor for Romania is to gain energy and heat from biomass, Romania posses large areas of forests, of which 4.283 million hectares of broadleaf forests and coniferous forests about 1882 thousand hectares. Willow and poplar occupies an area of about 4 % of broadleaf forests within about 186 thousand hectares [3, 15].

In the years of energy crisis of The Golf War, and a few years ago when Romania and UE observed the weakness and dependence on gas imported from Asian countries, the authorities thought to a new alternative for producing energy for heat [12, 16]. UE expects that among the fuel materials to introduce renewable source which will occupy about 12% from the production of energy [2].

Biomass includes wood biomass, biogas, agricultural residues, which demonstrated at this time an ability power to several species: sugar cane, sun flower, rape, willow, etc. According to a study, the production of biogas began in the 1950s, in Germany, where farmers use ferment to produce biogas from biological waste of animals; they have been shown that 112 of cattle produces 86.400

m^3/year of biogas, a cow make approximately 200 liter/day of methane [5].

Energetic willow (*Salix Viminalis L*) is an agriculture plant with energetic potential and it is also ecological. In Romania there are known over 20 species of Salix, which in the past the craftmen used to produce basckets, furniture, etc., from the stems and it was very well developed in the south [6].

2. THE MACROSCOPIC AND MICROSCOPIC OF THE STEM

2.1 The macroscopic structure of Salix species. The main wood species identification keys are character dichotomy. Willow is a broadleaf species, with pores evenly scattered, small and invisible, with heartwood, narrow and invisible rays. These categories also include the: Black poplar, Wild pear, Rowan, etc. [8].

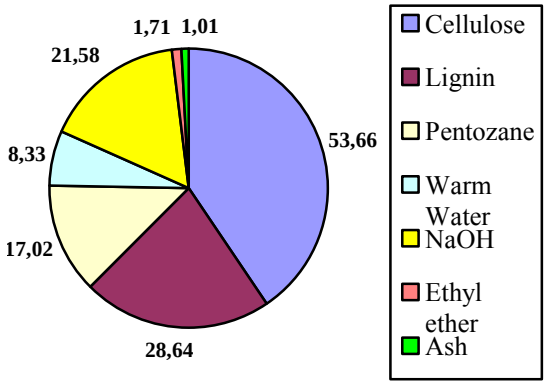

Fig.2 The chemical composition of Willow species[10]

From the chemical composition notes that the most part contains cellulose ($C_6H_{10}O_5$) in which by its chemical composition exist carbon, hydrogen and oxygen, as the essential elements for combustion [1, 10].

The macroscopic structure of wood species is determined by visible characteristics with the naked eyes (in Fig.3): sapwood (2), heartwood (3), rings (1), medullar spots (4), early wood, late wood, color, luster, texture and wood design. The macroscopic index for willow species: it is a species with a density between 600-700 kg/m^3, the faded color, yellowish-white, glossy texture, less pronounced and the sapwood is usually variable, up to 4 m tall (rarely up to 8 m), branches long, erect; shoots are long, flexible, with internal green bark, buds – unequal at least twice as long than broad, compressed stems, velvety; leaves – lance-shaped or linear lance-shaped, 8-15 cm long, 0.5 to 1.5 wide, long and gradually narrowing towards the top, margins entire or irregularly – sinuous, slightly rolled back, in front dark green, inside gray-white and covered with silky hairs, with prominent median rib, yellow patent arched lateral veins on the main ridge; petiole short, not exceeding 10 mm; flowers – male with two stamens, the females with an ovary sessile, style thin, elongated, divergent stigmas; have nectarous gland [4].

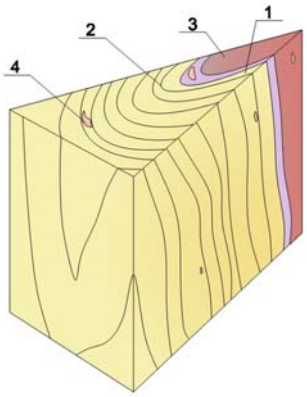

Fig.3 The Macroscopic structure of willow species [8]

2.2 The microscopic structure of willow species. The microscopic structure is characterized as a heterogeneous overall structure, the essential character of the wood are vessels, which in Fig. 4 can analyze the late and early wood composition.

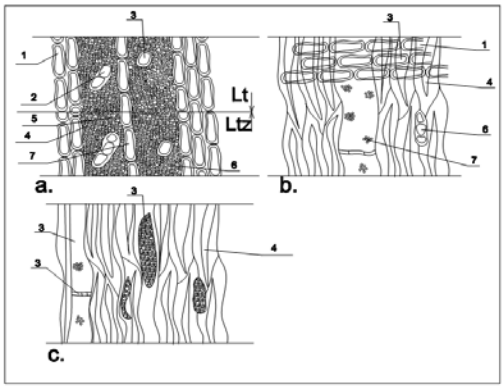

Fig.4 The microscopic structure of willow species [8]

a. cross section; b. radial section; c. tangential section; 1 – cells yoke radial, 2 – vertical resin canal, 3 – axial tracheids of late wood, 4 – axial tracheids of early wood, 5 – areole pit, 6 – fenestrated form pit, 7 – radial tracheids, 8 – horizontal resin canal [8].

3. THE CHARACTERISTICS OF THE WILLOW SPECIES

3.1 Preparation of land. Willow is a plant that grows on land, meadows and riverbeds. Researchers have determined over 200 varieties of willow, of which 18 varieties have energetic characteristics: fast growth, high calorific value, disease resistance; long life of the varieties (25-30 years), height 7-8 m. The necessary conditions for growing and harvest are:

- processed agricultural land with fertilizers;
- mechanical intervention with pesticides.

The agricultural land must be processed with fertilizers, and the pH recommended for land is 5.5 – 7.5 [17].

These are lands that contains clay and sand that keeps the moisture needed for growth and development of willow. Practing the plowing, hoeing, disking during the summer is essential for obtaining the desired harvest. The nesessary of fertilizer applicaton for every year:

- Ist year - 450 kg/ha;
- IInd year - 100-150 kg/ha;
- IIIrd year - 100-150 kg/ha.

Managing with fertilizers has a major impact on plant growth in the first two years of cultivation.

The fertilizer is taken up in spring season till the lugers begin to grow.

3.2 Planting the willow species. Planting can be done both manually and mechanize. The shoots that are plant need to be cut to the lengths of 18±1cm and kept in water at least 24 hours before planting. Between March and April, after the period of frost has passed it is recommended to plant the seedlings [15].

Fig.5 The technology of Willow planting [13]

The plants are buried in the ground in two rows with 75 cm distance between them, followed by a space for passing the combine. The distance recommended between the seedlings is 60-75 cm and the demand for a hectare is 14000 seedlings. Planting rows should be long and at the end to finish with an access road that will divides each row of seedlings.

3.3 Intervention and harvesting. Each year and season it is made work for weed and any other pests (diseases, insects).

In the first year it is necessary to ground control where we want to plant the energetically willow [12].

Fig.6 The technology of harvest the willow species [13]

In the second year is required intervention with herbicides and mechanical intervention and in coming years only need practically no intervention because there are no weeds growing.

The intervention with herbicides are necessary to maintain a rich fertilization for soil, where the energetically plants are grown.

The harvesting takes place in winter when leaves have fallen bushes. The machine is used for harvesting combine that cuts and chop them and collected in a trailer towed by a tractor.

3.4 Dissolution the willow plantations. The dissolution is easy to execute without major damage to the soil. First procedure is to harvest, then must leave the seedlings to grow approximately 0,5 m and sprinkle with pesticides that destroy crops, in the last phase occurred soil disking.

4. POWER ENERGY

4.1 The energy power of willow species. The calorific value is the amount of heat released by a unit of fuel burned completely. There are two kinds of calorific power: one expressing the high water vapor that has been condensed, so give us heat of vaporization, and the lower is the water in the flue gas is in the form of vapor, in this case developed some heat for vaporization of water is consumed [7,11].

The high calorific value is the amount of heat released from the fuel burned completely, while the lower amount is the difference between higher heating value and amount of heat consumed in vaporization of water in the flue gas.

The Willow species (*Salix Viminalis L*) [17] is an energetically plant with a capacity of approximately 18000-19000 kJ/kg, which is higher than the species of poplar – 14600 kJ/kg or compressed sawdust – 17500 kJ/kg. The willow species are some common species in Romania; it can see them in the beds of the rivers and meadows.

3.2 XRY-1C Oxygen Bomb Calorimeter. Calorific value of solid fuels for eg. the wood species is determined by bomb calorimeter and the difference in temperature is indicates by the amount of water that cools bomb calorimeter**.**

In this way determine the quantity of heat released by a unit mass of solid fuel analysis; value is ultimately the calorific value of fuel.
The installation is composed of: bomb calorimeter body (1) which is made of stainless steel cover (2) – is provided with two valves (4) and (5), and an electrode (6). The valve (4) connects the tube (7) on where enter the oxygen pressure in the system. The valve (5) is discharged at the end of the experiment. The tube (7) is fixed - shield (13), which protects the body when it is exposed to the flame of combustion process. Crucible (15) has the role of protection and is made of quartz [7].

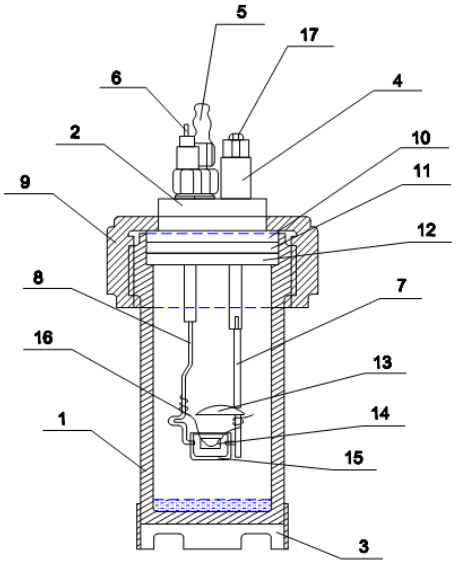

Fig. 7 Bomba Calorimeter XRY-1C Oxygen

Combustion process consists of three periods: fore, main, after. As graphical analyzed (Fig.8) note that it is starting with the initial period (Fore), where there is water in the tank to determine temperature variation of heat, because heat exchange with the enveroment. The following period from chart that lasts about 6 minutes, it is observed the fact that the temperature does not increase

essentially, it remains between 0,1 - 0,2 K. After this period the willow sample begins to burn.

Main period (Main) aims to determine the increase of water heat in the tank, because of the burning wood particle. Where looking at the chart in Fig. 8 shows that the main period lasts from the time 6 minute to 22 minutes and the temperature is increasing.

In the final period (After) is determined the averange water temperature variaton due to exchange with external environment. Final period lasts from 22 minutes to 31 minutes, the temperature remaining constantly.

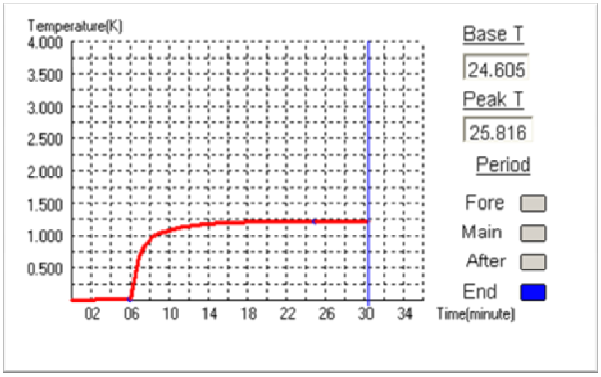

Fig.8 Performance of combustion in the XRY-1C Oxygen Bomb Calorimeter

4. CONCLUSIONS

According to a firm from Miercurea-Ciuc [17], it may find that the *Salix Viminalis L* cultivation can become a profitable business, with an estimated net profit of 800-900 euro/ha/year and a simple calculation can be determined as a plantation of about 20000 ha necessary to provide energy for 145000 apartments, and for all this we can have a net profit about 16-18 millions/year.

Annual production of willow is 30 t/ha. Willow can be used for other purposes like: paper production, raw material for pulp, pharmacy industry, raw material for methanol, furniture and wood industry, construction etc.

Another reason for investment in energetic willow (*Salix Viminalis L*) production is to maintain and value the lands that are in decay. The plantation with energetic willow can protect people that live in open fields to blizzards from snowing, or in spring from flood, because willow like water and moisture.

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