IMPORTANCE OF COMBUSTIBLE CHARACTERISTICS OF BIOMASS

GH.C. SPIRCHEZ[1*], A. LUNGULEASA, C. CROITORU

[1] *Transilvania University of Brasov, Faculty of Wood Engineering*
[*]*Corresponding author: cosmin.spirchez@unitbv.ro*

Abstract: *Research in the field of energy has shown that biomass has a number of combustible characteristics that determine its competitive qualities on the energy market. Biomass reserves differ across the European Union and globally. The forest area ranges from 27,6 million hectares in Sweden to 117 hectares in Cyprus. Worldwide the forest fund occupies approximately 4 billion hectares, with the largest amount being distributed in the territory of the Russian Federation 809 million hectares, Brazil 478 million hectares, Canada 310 million hectares, US 303 million hectares, China 197 million hectares. A particular interest in the use of biomass has been observed since antiquity, when people used wood as the primary source of heating and food preparation, but an essential growth was only observed in the 1990 with the development of modern combustion technologies with superior efficiency. Increasing energy efficiency has a major contribution to achieving security in the field of energy and sustainable energy development, competitiveness in saving primary energy resources and reducing greenhouse energy.*

Keywords: *biomass, calorimeter bomb, value calorific, wood*

1. Introduction

Biomass, in addition to its main advantages, has a number of disadvantages to fossil fuels.

The biomass density and calorific value of wood species is lower compared to fossil fuels.

Some biomass sources are mostly generated only seasonally, usually during the harvest period, resulting in the need to store and store the material in optimal conditions that will not influence biodegradation.

Thermal systems used for different conversion processes need to have large capacities that will lead to equaling the cost of fossil fuel installations.

Untreated biomass usually has a high moisture content, which is the main factor that causes a low heat content. Termochemical characteristics and chemical composition of biomass differ largely from fossil fuels.

The physical properties of the biomass are the content of ugliness, density, calorific value, ash content and volatile matter content of the fuel material. The chemical composition of the shall varies depending on the group of wood species (hardwood and coniferous) in the component parts of trees (branches, stem, roots) depending on geografic position, climate, soil or soil composition.

The ash obtained by burning wood is an alkaline material and contains inorganic constituents. Wood moisture content influences the calorific power of the fuel, combustion temperature and combustion efficiency.

In the first step, wet biomass enter the drying phase, where the water content is evaporated.

From the research carried out, the moisture content of biomass fuel must not exceed 4-10% (wet mass) for pellet, 20% (wet weight) for chips and chips but not exceed 50% for fire wood.

2. The energy potential of biomass

The highest inferior calorific value for cereal energy products is obtained for 17070-17370 kJ/kg, which also have a low moisture content of 5,9-6,2%.

Hemp highest have a lower calorific power of 16600-16740 kJ/kg.

The calorific value determined for combustible materials such as, cotton, walnut, pine have values between 15410-19520 kJ/kg.

To determine the calorific power, the Junkers calorimeter, which determines the calorific power for gaseous fuels, was first used. The calorific power of solid and heavy fuels is measured with a calorimetric bomb.

Heat power can be calculated as the difference between entalphy of combustion products and fuel, if known.

The ignition of the fuel is done by means of the electric current transmitted throught the nickel and cotton yarn, and the water inside the calorimeter is mixed by an electromotor stirrer.

For combustible materials with high water and hydrogen content, such as biomass, two types of calorific power can be distinguished, namely the upper calorific value and the lower calorific value.

The lower calorific power for some combustible materials is hydrogen (141,95 MJ/kg), methane gas (55,6 MJ/kg), dry wood (20,1 MJ/kg). The physical characteristics as well as the chemical composition of the biomass act on the qualityof the wood material used as solid fuel. For example contain humidity variing the moisture content between 22-50% relative to the dry mass of the firewood material, or at moisture less than 10% for pellets and briquettes.

3. Materials and method

The installation used to determine the calorific value of wood biomass was the XRY-1C explosive type burner produced by Shanghai Changji Geological Institute in China (fig.1). The method of determining the calorific value of wood material refers firstly to the preparation of the raw material, the to the actual determination and ultimately to the final result.

The test sample 1 binds to the cotton yarn 2 and put in the crucible of the bomb 3. Connect the spiral nickel wire 4 to the sample and the cotton yarn, the place the protective cap 5 correctly. The crucible is connected to the calorimetric bomb cap 6 by 2 electrodes 7 and 8, which continues with the electrical coupling bomb of the calorimetric bomb 9 and 10.

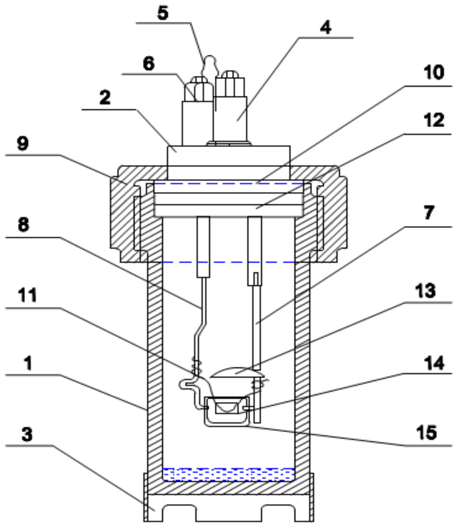

Fig. 1. *Calorimeter bomb*

By bombing cap, the bomb 11 is coupled throught the stator 12 to the oxygen cylinder, introducing 3 atmospheres.

The test contains three distinct periods (fig.2).

The initial period aim to determine the the temperature variations of the water in the calorimetric vessel due to the heat exchange with the outside before the combustion.

The main period start with the ignition of the sample and consequently increases the temperature of the water in the calorimetric vessel.

The final period aim to determine the average temperature variation of the water in the calorimetric vessel due to heat exchange with the outside.

For spruce, m1 = 0,700 g, U = 0%, gross calorific value is 20051 kJ/kg, net calorific value is 19476 kJ/kg, m2 = 0,9020 g, U = 10 %, gross calorific value is 18121 kJ/kg, net calorific value is 17833 kJ/kg, m3 = 0,8803, U = 20%, gross calorific value is 16480 kJ/kg, net calorific value is 15904 kJ/kg, m4 = 1,080 kJ/kg, U=50%, gross calorific value is 11555 kJ/kg, net calorific value is 10115 kJ/kg.

In fig.3 is presented variation valorific value for spruce.

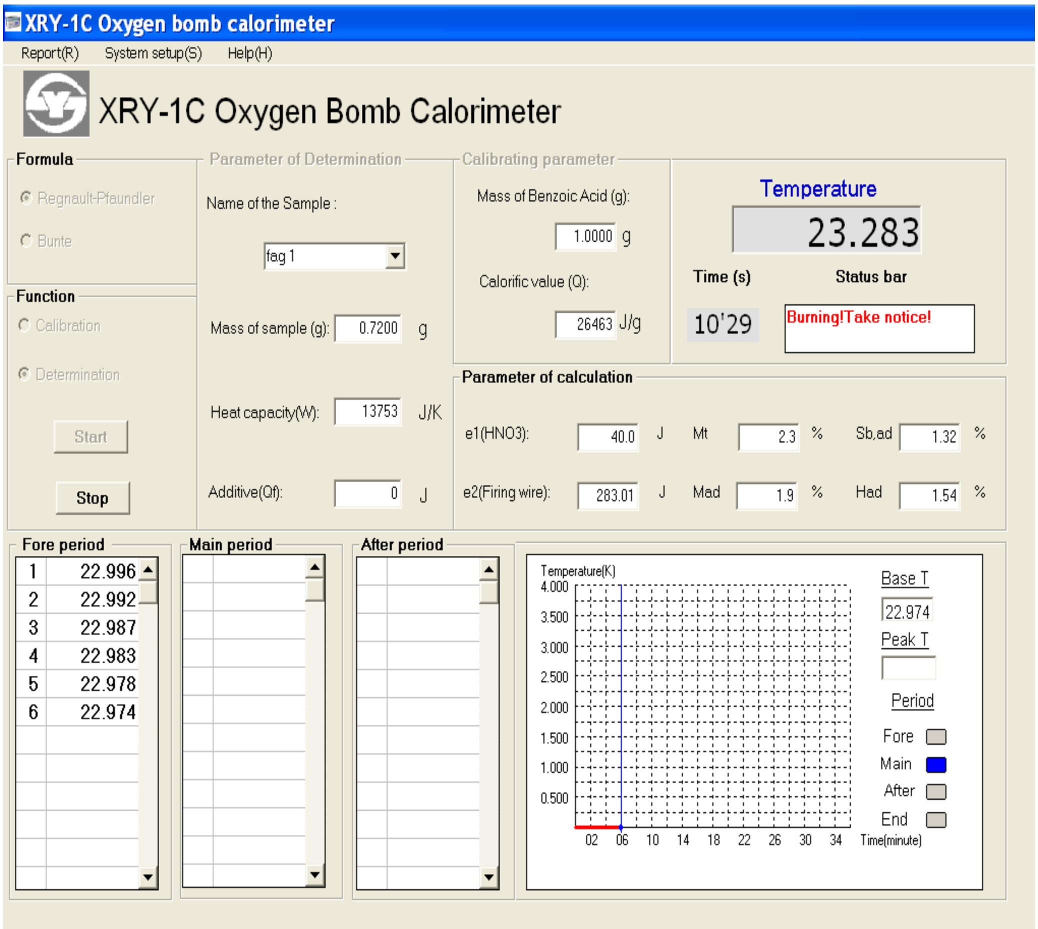

Fig. 2. *Three distinct period at calorimeter bomb*

For spruce, m1 = 0,700 g, U = 0%, gross calorific value is 20051 kJ/kg, net calorific value is 19476 kJ/kg, m2 = 0,9020 g, U = 10 %, gross calorific value is 18121 kJ/kg, net calorific value is 17833 kJ/kg, m3 = 0,8803, U = 20%, gross calorific value is 16480 kJ/kg, net calorific value is 15904 kJ/kg, m4 = 1,080 kJ/kg, U=50%, gross calorific value is 11555 kJ/kg, net calorific value is 10115 kJ/kg.

In fig.3 is presented variation valorific value for spruce.

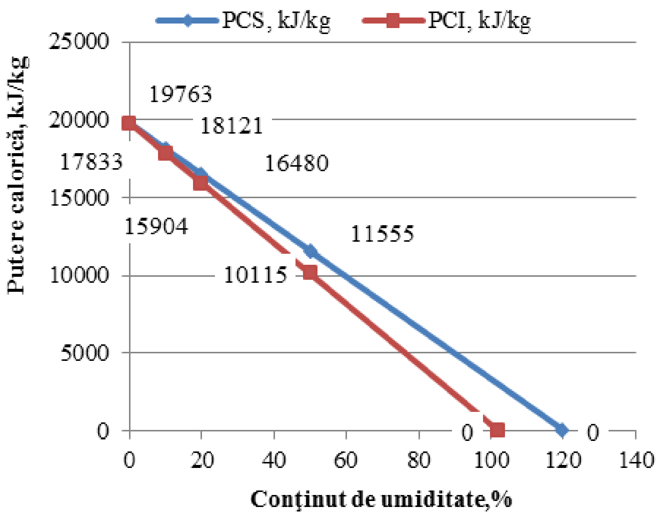

Fig. 3. *Variation value calorific for spruce*

For pine, m1 = 0,8300 g, U = 0%, gross calorific value is 22286 kJ/kg, net calorific value is 21676 kJ/kg, m2 = 0,7700 g, U = 10 %, gross calorific value is 19904 kJ/kg, net calorific value is 19660 kJ/kg, m3 = 0,7320, U = 20%, gross calorific value is 17828 kJ/kg, net calorific value is 17340 kJ/kg, m4 = 1,3455 kJ/kg, U=50%, gross calorific value is 11598 kJ/kg, net calorific value is 10378 kJ/kg.

In fig.4 is presented variation valorific value for pine.

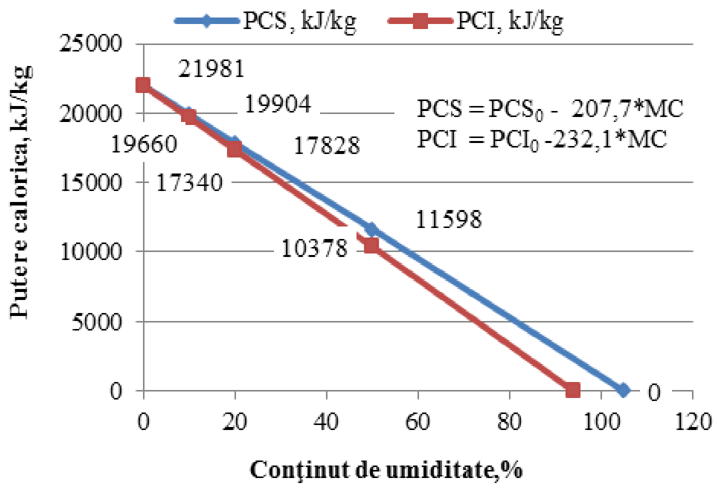

Fig. 4. *Variation value calorific for pine*

Conclusions

Combustion is one of the most important termo-chemical processes of energy production.

Increasing the calorific power of biomass through dry torrefied processes is a current research and investment direction of all the world's states. Current research results in a reduction in biomass leading to increased caloric density.

References

1. Abassi, S.A, Nipaney, P.C., Schaumberg, G.D. Bioenergy potential of eight common aquatic weeds, Biological Wastes, vol.34, No.4, pag.359-366, 1990;

2. Gaceu L., Lepadatescu B., Monitoring of the Vegetables Drying Process using Infrared Images, Advances in Environment Technologies, Agriculture, Food and Animal Science, pg. 267-272, 2013;

3. Ospanov, A. and Gaceu, L. and Timurbekova, A. and Muslimov, N. and Dzhumabekova, G., Innovative technologies of grain crops processing, Project Report. Brasov: "Infomarket" (Romania), 2014, ISBN:978-973-1747-42-2;

4. Gavrilescu, D Energy from biomass in pulp and paper mills, Environmental Engineering and Management Journal, pag.537-546, 2009;

5. Lako J., Hanesok J, Yuzhakova T. Biomass-A source of chemicals and energy for sustainable development, Environmental Engineering and Management Journal, vol. 7(5), pp. 499-509, 2009;

6. Lăzăroiu G, Mihăescu L. Combustion of pitcoal-wood biomass briquettes a boiler test-facility, Environmental Engineering and Management Journal, pp 595-601, 2008;

7. Lunguleasa A. The calorific power of wooden biomass, Bulletin of the Transilvania University of Brasov-Series II, vol.2(51), pp.65-70, 2010;

8. Moya R., Tenorio C. Fuelwood characteristics and its relation with extractives and chemical properties of ten fast-growth species in Costa Rica, Biomass and Bioenergy, vol.56, pp.14-21, 2011;

9. Nielsen NPK, Gardner D. Importance of temperature, moisture content a species for the conversion process of wood residues to fuel pellets, Wood Fiber vol.41, pp 414-425;

10. Prasertsan S., Sajjakulnukit B. Biomass and bioenergy in Thailand: Potential, opportunity and barriers, Renewable energy, vol.31 , Nr.5, 2006;

11. Rahmann A, Masood MA Influence of size and shape in the strength by briquettes, Fuel Process Technology, vol.22, pp125-145,2013;

12. Roser D., Asikainen A. Sustainable use for Forest Biomass for Energy, Springer Series in Wood Science, 2006;

13. Sjostrom E. Wood chemistry, Academic Press, Helsinki, 2006;

14. Teuch O, Hofeanuer A, Troger F, From J. Basic properties of specific wood based materials carbonised in a nitrogen atmosphere, Wood Science and Technology, Springer, vol.38, nr.3, 2004;

15. Uslu A, Faaji A.P.C, Bergman P.C.A Pre-treatment technologies, and their effect on international bioenergy supply chain logistics. Techno-economic evaluation of torrefaction, fast pyrolysis and pelletisation, Energy, vol. 33(8), pp. 1206-1223;

16. Walkowiak, M., Bartkowiak M., The kinetics of the thermal decomposition of the willow wood (Salix Viminalis L.) exposed to the torrefaction process, Drewno (wood), vol. 55(187), pp.37-50;

17. Wang G.J., Luo Y.H., Deng J., Pretreatment of biomass by torrefaction, Chinese Science Bulletin, vol. 56(14), pp. 1442-1448;