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POSSIBILITIES OF ENERGY UTILIZATION OF SELECTED TYPES OF WOODY SPECIES FROM THE ASPECT OF THEIR INFLUENCE ON THE ENVIRONMENT

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This paper focuses on comparison of some energy woody species for process of combustion from the aspect of amount of produced emissions, lower calorific value, humidity and presence of solid pollutants. The measured results compare which woody species are more suitable from the aspect of influence on the environment and surroundings.
Key words: emissions, energy woody species, lower calorific value, NOx.

Mogućnosti korištenja energije iz odabranih vrsta drva s obzirom na njihov utjecaj na okoliš. U radu se uspoređuju pojedine ogrjevne vrste drva u procesu izgaranja s aspekta količine proizvedene emisije onečišćujućih tvari, donje ogrjevne vrijednosti, vlage i prisutnosti krutih onečišćujućih tvari. Temeljem rezultata mjerenja vrednovano je s aspekta utjecaja na okoliš i okolicu koje vrste drva su pogodnije kao energenti.
Ključne riječi: emisije, ogrjevne vrste drva, donja ogrjevna vrijednost, NOx.

INTRODUCTION

Although the wood used for energy purposes had gradually been replaced by fossil fuels, it is the longest used renewable raw material. Dendromass got in the background but recently, it has been making its comeback in energy utilization due to decreasing the world coal, oil and gas reserves, increasing the fossil fuels prices, the same as due to dependence on energy resources import.

The aim of this paper is to point at environmental benefits of forest biomass utilization and to support the energy woody species planting. This article concerns about analysing the combustion process of particular woody species from the aspect of amount of produced emissions, lower calorific value, humidity and presence of solid pollutants. The results of the measurements point out the thermo-energy properties of oak (Quercus), silver birch (Betula pendula in Latin), walnut (Junglas in Latin), European ash (Fraxinus excelsior) and black oak (Quercus velutina).

IMPACT OF WOODY BIOMASS UTILIZATION ON ECOLOGY

Plants use carbon dioxide contained in the atmosphere which is converted into hydrocarbons using photosynthesis. The opposite process happens at combustion and carbon dioxide is released into the atmosphere again to be used for another biomass growth. It is a closed cycle. So, biomass utilization in comparison to combustion of fossil fuels has neutral influence on increase of carbon dioxide in the atmosphere. [1].

Biomass utilization is advantageous for environment protection not only due to pollution decrease but the power generated from biomass avoids excess of food waste, insures the control of process of waste from wood producing industry and forests and recycling of household and domestic waste.

The resources of biomass are available around the world. Biomass, as an energy source, is more reliable than wind power and solar power. Grain grown for energy purposes allows utilization of agricultural wasteland areas and recovery of post-industrial areas.

The standard for heavy metals concentration in Poland was exceeded for 20 %. It meant that grown plants could be used only for industrial purposes. Utilization of biomass has also positive social effects because the need for growing these plants creates another job opportunities in the location [2].

Increased production of biomass is important due to several reasons:

1. It is not harmful for environment - volume of carbon dioxide escaping to the atmosphere during combustion is compensated by the same volume of carbon dioxide absorbed by plants during photosynthesis.
2. Amount of generated sulphur dioxide and nitrogen oxide during combustion of biomass (those are the factors contributing to acid rains) is lower than in the case of combustion of fossil fuels.
3. Heating with using biomass continuously increases cost effectivity because prices of biomass on the market of fuels are becoming more competitive. Utilization of biomass enables to control waste process and its utilization.

For example, combustion of 1 GJ of petroleum fuel oil causes that 1 255 kg of nitrogen oxides, 0,004 kg of nitrous oxide. (N_2O) and about 73,84 kg of carbon dioxide are released. Combustion of comparable volume of fuel wood would cause generation of only 0,202 kg of nitrogen oxide and emission index of nitrous oxide and carbon dioxide is zero [2].

COMBUSTION OF SELECTED TYPES OF LUMP WOOD IN BOILER

Research was done at Department of Power Engineering, Faculty of Mechanical Engineering, University of Žilina where the specialized departments reside. The laboratory of heat sources is equipped by modern appliances for measuring mass and volume flows, sensing temperatures, analysing flue gases etc. The aim of the research was combustion of selected types of lump wood on purpose of measuring emissions, humidity and lower calorific value. The selected types of lump wood are following: oak (Quercus), silver birch (Betula pendula in Latin), walnut (Junglas in Latin), European ash (Fraxinus excelsior) and black oak (Quercus velutina).

In the first phase, particular types of wood of the same size were prepared in order to create same conditions at combustion. Two loads of 1.5 kg of wood were prepared from each type of wood. Combustion of one load lasted for about 1 hour. There were 45 thermometers placed in the boiler to measure temperatures. The chimney was interrupted not to influence the weight of the load. There are the probes which take the samples of flue gases from the chimney for the purpose of analysis.

The flue gas probes taken from the chimney were led into the analysers. The data obtained from them, data about temperature of chimney same as data from the other measuring equipments, go to measuring central ALMEMO 5690 – 2M which is connected to computer. Tube 1 and tube 2 are connected to the chimney. The tube 1 is used to measure chimney draught (measurement of flue gases) and the tube 2 is for solid compounds at certain pressure and velocity (measurement of solid pollutants – SP).

And the flue gases continue to evaluation device ISOSTACK BASIC from there. Flue gases are led from the tube 1 (measuring of flue gases) into measuring central MULTI-FID 14 PORTABLE able to measure carbon contented in compounds which are in the gaseous state on the basis of flame ionization detector. Another device is URAS 26 A MAGNOS 206 PORTABLE – it is able to measure content of CO_2, NO, CO, SO_2, and O_2 in gaseous state compounds. The scheme of the sampling of flue gases and solid pollutants is presented in fig. 1.

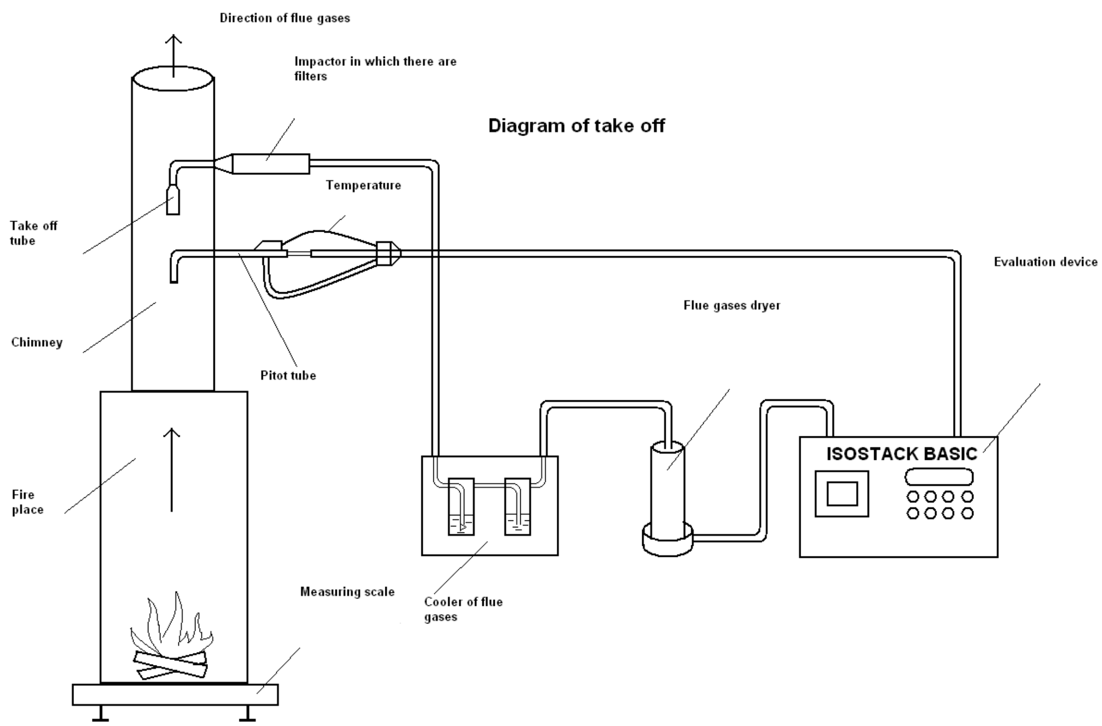

Figure 1. The scheme of the sampling of flue gases and solid pollutants
Slika 1. Shema uzorkovanja dimnih plinova i krutih onečišćujućih tvari

COMPARISON OF MEASURED RESULTS

The measured results are shown in the figures no. 2 – no. 5. Silver birch (Betula pendula in Latin) resulted as the best possible variant and it was based on the lowest content of CO_2 and the lowest content of NO and average content of SO_2, the highest efficiency and the highest thermal performance. Based on the lowest humidity and the highest low calorific value, it also resulted that the best possible variant is silver birch (Betula pendula in Latin). Oak (Quercus) is the best suitable variant according to the same indicators.

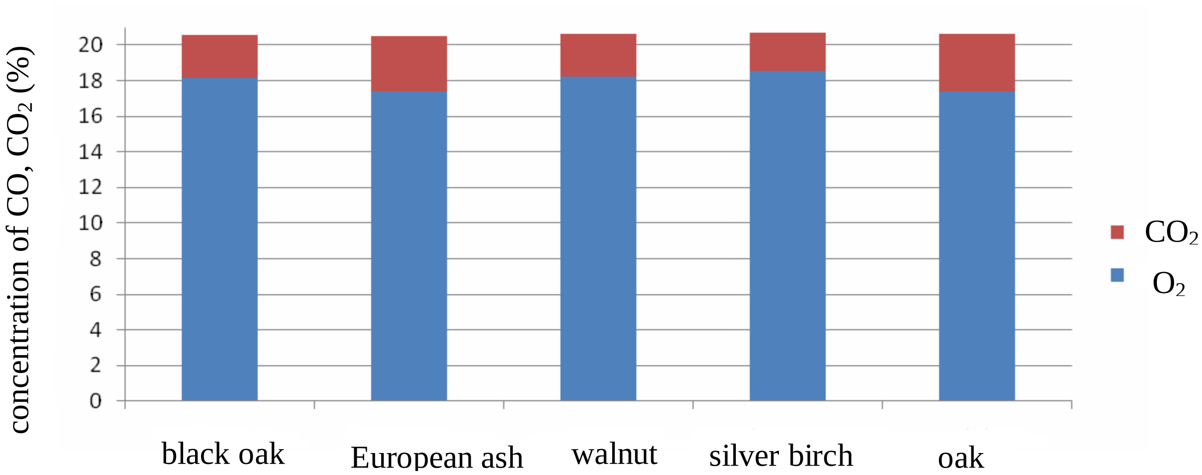

Figure 2. Concentration of CO_2 and O_2 in flue gases
Slika 2. Koncentracija CO_2 i O_2 u dimnim plinovima

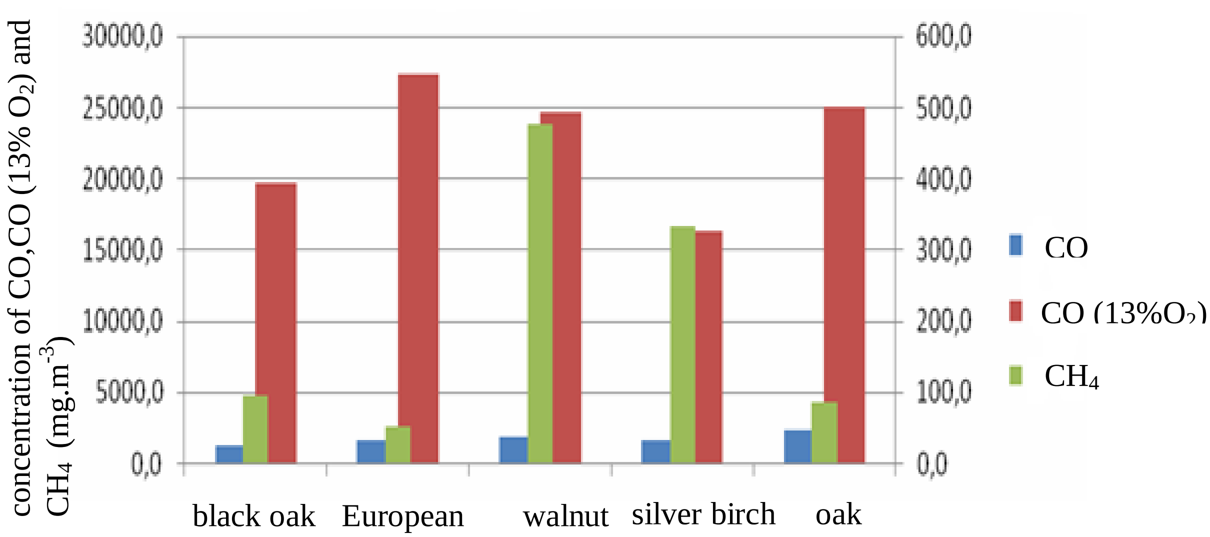

Figure 3. Concentration of CO, CO (13% O_2) and CH_4
Slika 3. Koncentracija CO, CO (13% O_2) i CH_4

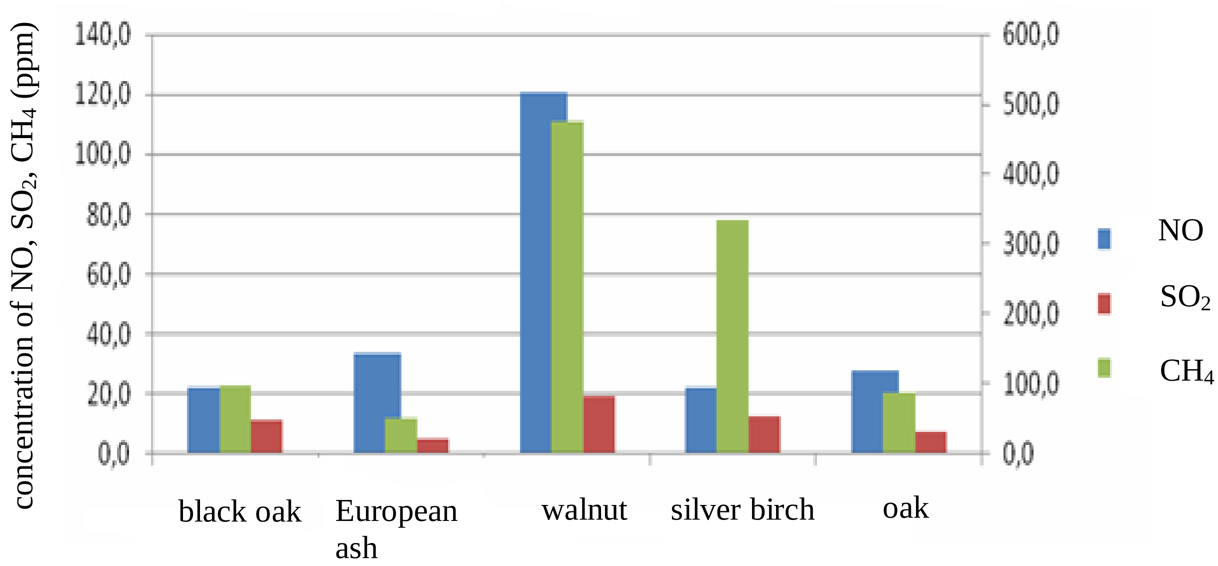

Figure 4. Concentration of NO, SO_2 and CH_4
Slika 4. Koncentracija NO, SO_2 i CH_4

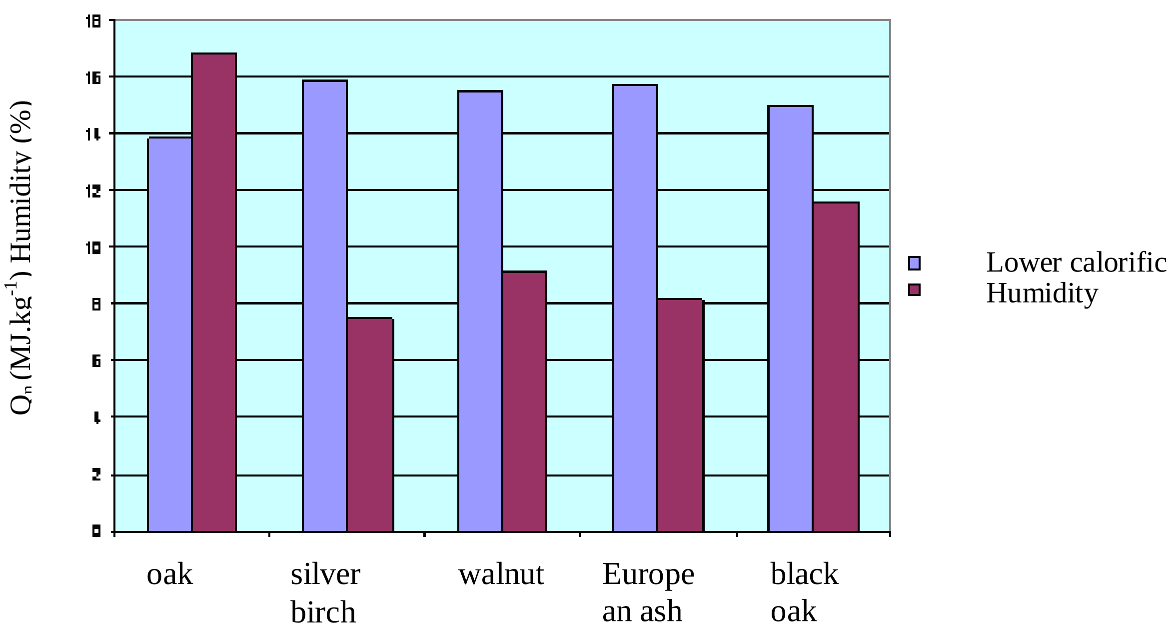

Figure 5. Comparison of lower calorific value and humidity
Slika 5. Usporedba nižih ogrjevnih vrijednosti i vlage

CONCLUSION

The presented paper was focused on the process of evaluation of combustion of particular woody species from the aspect of amount of produced emissions, degree of lower calorific value, humidity and presence of solid pollutants. The results showed the strong and weak points of selected types of woody species on the basis of combustion: oak (Quercus), silver birch (Betula pendula in Latin), walnut (Junglas in Latin), European ash (Fraxinus excelsior) and black oak (Quercus velutina). Whereas it resulted from the measurement that the best possible variant is silver birch (Betula pendula in Latin) based on the lowest humidity and the highest low calorific value. Oak (Quercus) is the least suitable variant according to the same indicators. As the best possible variant is also silver birch (Betula pendula in Latin) which is based on the aspect of the lowest content of CO_2 , the lowest content of NO and average content of SO_2, the highest efficiency and the highest thermal performance.

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