Dependence the amount of combustion air and its redistribution to primary and secondary combustion air and his depending on the boiler

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Dependence the Amount of Combustion Air and its Redistribution to Primary and Secondary Combustion Air and his Depending on the Boiler

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Abstract. The production of solid pollutants is affected by several influences. The amount of combustion air and its redistribution to primary and secondary combustion air. The experimental device, what which has been examined the amount of the combustion air on the production of the solid pollutants, methods of measurement, measurements results and analysis of the results obtained will be described in the papers.

INTRODUCTION

Biomass is organic matter that can be processed into energy for heat, power generation, or liquid fuels. Biomass sources include wood, plants, agricultural residues, animal waste, and the organic components of municipal and industrial wastes. Wood fuel describes wood used as fuel. The main sources of wood biomass (biomass) as forest management, where part of the excavated material is unsuitable for use in the woodworking industry. Another source of the timber industry, which in the manufacturing process produces wood waste suitable for energy use. Prospective source of the wood material, which can produce a less productive agricultural soils. Wood fuel may be available as firewood, charcoal, chips, sheets, pellets, and sawdust. The particular form used depends upon factors such as source, quantity, quality and application. Wood is one of the most important fuel sources.

The annual increase in global timber is estimated at 12.5 billion cubic meters with an energy content of 182 EJ, which is about 1.3 times the annual global coal consumption. Average consumption of wood for all purposes is about 3.4 billion cubic meters per year (the equivalent of 40 EJ per year). It follows that in the world there is considerable potential for using wood for energy purposes. The great advantage of wood is that in a good save to keep their energy content, let alone within the first 2 to 3 years of relative increases. It is a fact that in this dry period. This fact is important because moisture in the wood is released to the boilers at the expense of heating value.

At the same time the burning of wet wood decreases the combustion temperature, leading to incorrect oxidized all the combustible ingredients, there is smoke, choking smoke pipes and to reduce boiler life. The main sources of wood biomass (biomass) as forest management, where part of the excavated material is unsuitable for use in the woodworking industry. Another source of the timber industry, which in the manufacturing process produces wood

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waste suitable for energy use. Prospective source of the wood material, which can produce a less productive agricultural soils.

EXPERIMENTAL MEASUREMENTS

The as the heat source was used boiler with a rated output of 18 kW (Lokca). Boiler Fig. 1 is designed for burning pellets and coal type nut. The device was measured as shown in Fig. 1. Measurement of the rated power is held in different settings the intake air mass flow to the combustion burner for pellets. The device was measured as shown in Fig. 2. Each rated capacity is recorded and evaluated separately. The amount of injected combustion air be regulated by the control system via the boiler control fan speed in the range (10 % to 100 %). Set the controls for the supply of wood pellets has been set for each measurement to the same value, i.e. fuel delivery is the same for all measurements. Performance measured on pellet boilers is measured by the indirect method. Measurements was used identically fuel (pellet).

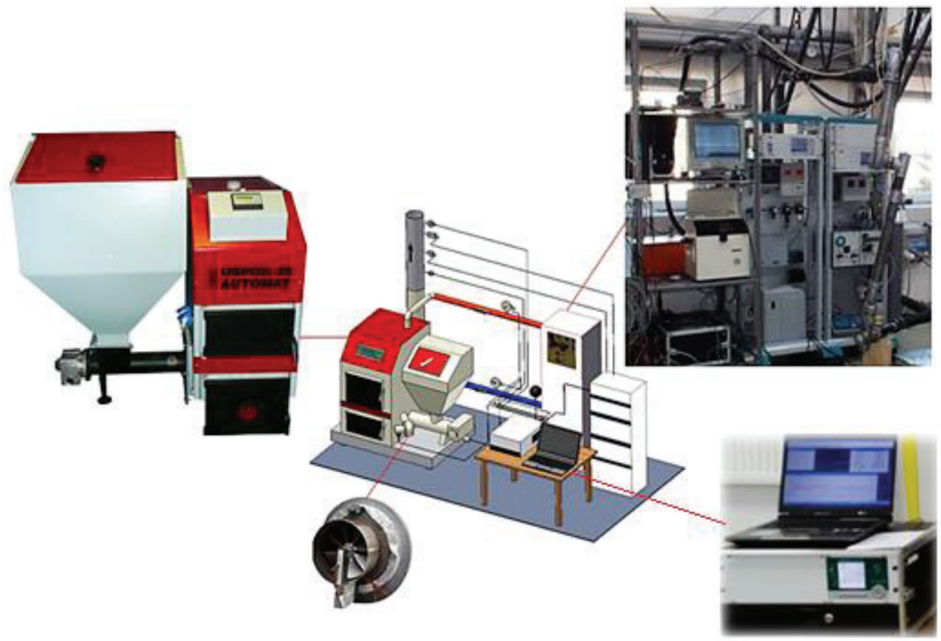

FIGURE 1. Experimental measurements boiler

To evaluate the quality of combustion flue gas composition was measured by gas analyzer ABB AO 2020. The unit focuses on the analysis of gaseous emissions. Taking the single-gas, stainless steel probe. The input samples into the sampling line is heated in a protective housing ceramic filter captures impurities. The sample continues the sampling line to the measuring system. Management is heated in order to prevent condensation of sample. The measured gas is fed into the refrigerator. It is guided through the filters and valves transported to the analyzer unit. Analyzer ABB AO 2020 is folded according to the requirements and nature of the measurement. If measurements of emissions from burning wood in fireplaces stoves were used measuring devices 26 and Uras MAGNOS 206th. To accurately analyze the performance and emission parameters of a single set of incoming air to the burner is always measured about 100 min.

During the combustion process one batch of fuel is recorded following values: the ambient temperature [°C]; flue gas temperature [°C]; temperature of the injected air to the burner [°C]; chimney draft [Pa]; output of the boiler water [°C]; inlet water to the boiler [°C]; heat transfer fluid flow rate [m3.h-1]; air supply rate to the burner [m.s-1]; the composition of gases: oxygen [%], carbon dioxide [%], carbon monoxide [ppm], nitric oxide [ppm], sulfur dioxide [ppm], solid organic carbon [mg.m-3].

ANALYSIS RESULTS

During the experimental measurements were monitored and recorded values these parameters of carbon monoxide CO, carbon dioxide CO2, sulfur dioxide SO2, nitric oxide NOx, oxygen O2, solid organic carbon TOC in the flue gas and then to evaluate the performance and efficiency of test equipment, each set of air injected into the burner. Were measured emissions and the parameters as temperature of the flue, chimney draft and ambient temperatures. Were measured, as mentioned above, each set separately injected air into a pellet burner to record data using the panel to a computer (program AMR – WinControl - AHLBORN ALMEMO 5690) in the ten-second intervals.

The data is post edited by Microsoft Office software in a minute diameters of which made the overall average for each single measurement of the rated power. Finally, did the overall mean of the measured values of all benefits. The resulting readings are brought to the graphs. The measured results is interesting to know whether the results of emission and performance parameters. The measured parameters of hot water boiler, depending on the amount of combustion is seen as affecting the amount of combustion air to their mean values. Figures 2-5 shows the average values of each of the experimental measurements.

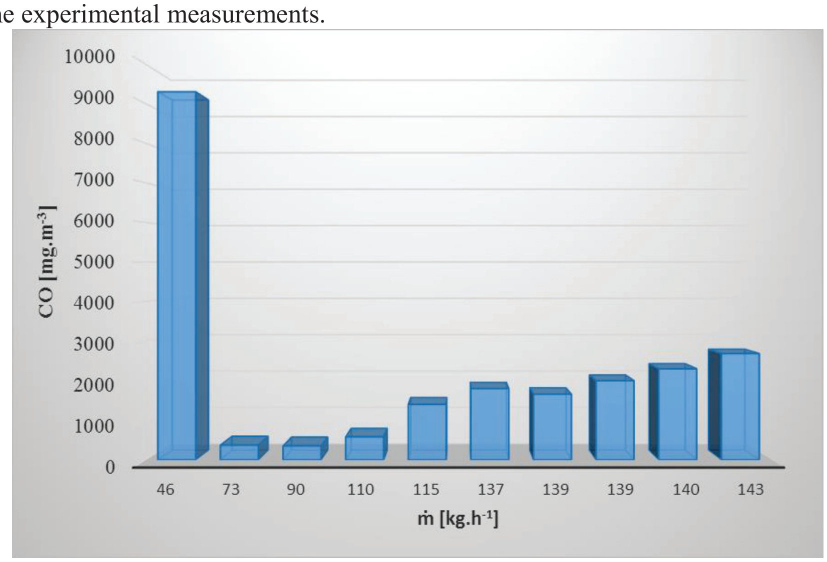

FIGURE 2. The average value of production of CO, depending on the mass flow combustion air

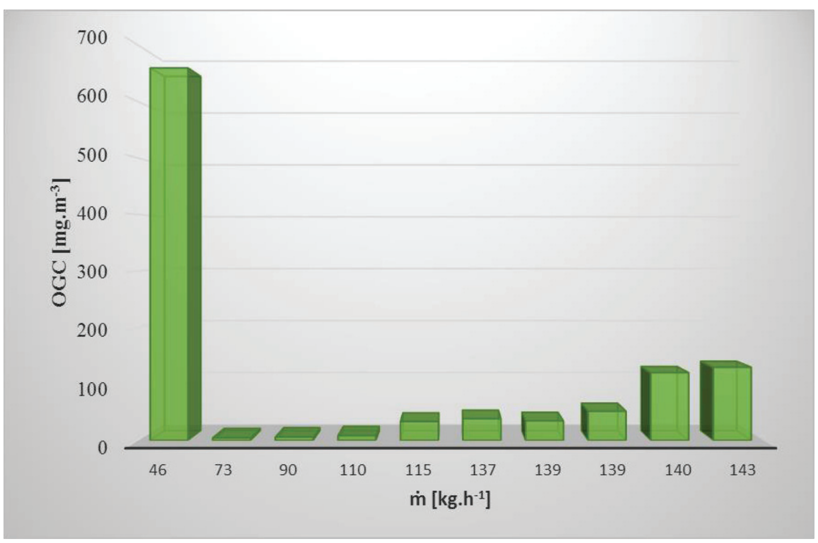

FIGURE 3. The average value of production OGC based on mass flow combustion air

The insufficient amount of combustion air inlet to produce significantly higher concentrations of CO Fig. 2 and Fig. 3. OGC. However, the supply of large quantities of combustion air is reflected in the increased production of CO Fig. 3, respectively. OGC Fig. 3. Increasing the concentration of CO respectively. OGC has a major impact on the heat capacity Fig. 4, respectively. Efficiency of the heat source Fig. 5. To change the amount of combustion air to substantially change the concentration of NOx, unless the least amount of combustion air.

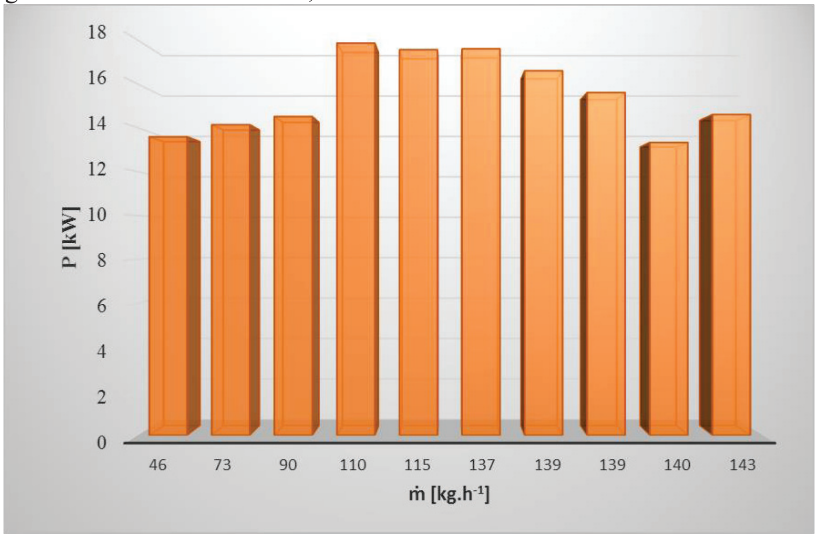

FIGURE 4. The average values of heat output depending on the mass flow combustion air

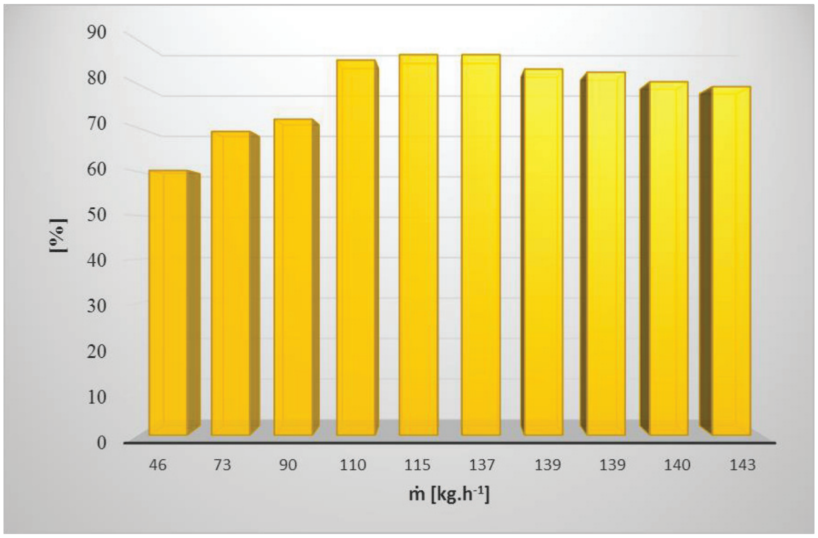

FIGURE 5. The average values of heat efficiency on the mass flow combustion air.

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REFERENCES

1. R. Buczyński, R. Weber, A. Szlek and R. Nosek, Energy & fuels (2012).
2. R. Nosek, J. Jurkechová, Š. Papučík and J. Jandačka, Influence of fuel supply to in small capacity boiler on efficiency and pollutant emissions, Experimental fluid mechanics. (2010).
3. J. Jurkechová, R. Nosek, Š. Papučík and J. Jandačka, Journal of engineering and technology, 27–32 (2011)
4. M. Branc and M. Bojko, Journal of Applied Science in the Thermodynamics and Fluid Mechanics, (2009).
5. S. Gavlas, J. Matušov and M. Malcho, Analýza veľkosti a hustoty tuhých znečisťujúcich látok zo spalín produkovaných pri tavbe sekundárneho hliníka. 32. stretnutie katedier mechaniky tekutín a termomechaniky. (2013).
6. J. Jandačka, A. Kapjor, Š. Papučík and R. Lenhard, Emission and power parameters of combined heat source on wood biomass combustion, Annals of Warsaw University of Life Sciences (2010), pp. 245–249.
7. P. Burya, S. Skoblia, T. Ochodek, J. Najser and Z. Beňo, Distribúcia tuhých častíc v plyne zo splynenia biomasy, Energetika, (ČSZE, 2011), pp. 299–303.
8. P. Nemec and J. Hužvár, Materials science and technology, 66–76 (2011).
9. J. Najser, T. Ochodek and R. Chlond, „Rynek Gazu“, (Kazimierz Dony, 2009), pp. 229–235.
10. T. Ochodek and P. Janásek, Aspekty spalování biomasy, (ČZU v Praze, 2007).