Department of Power Engineering
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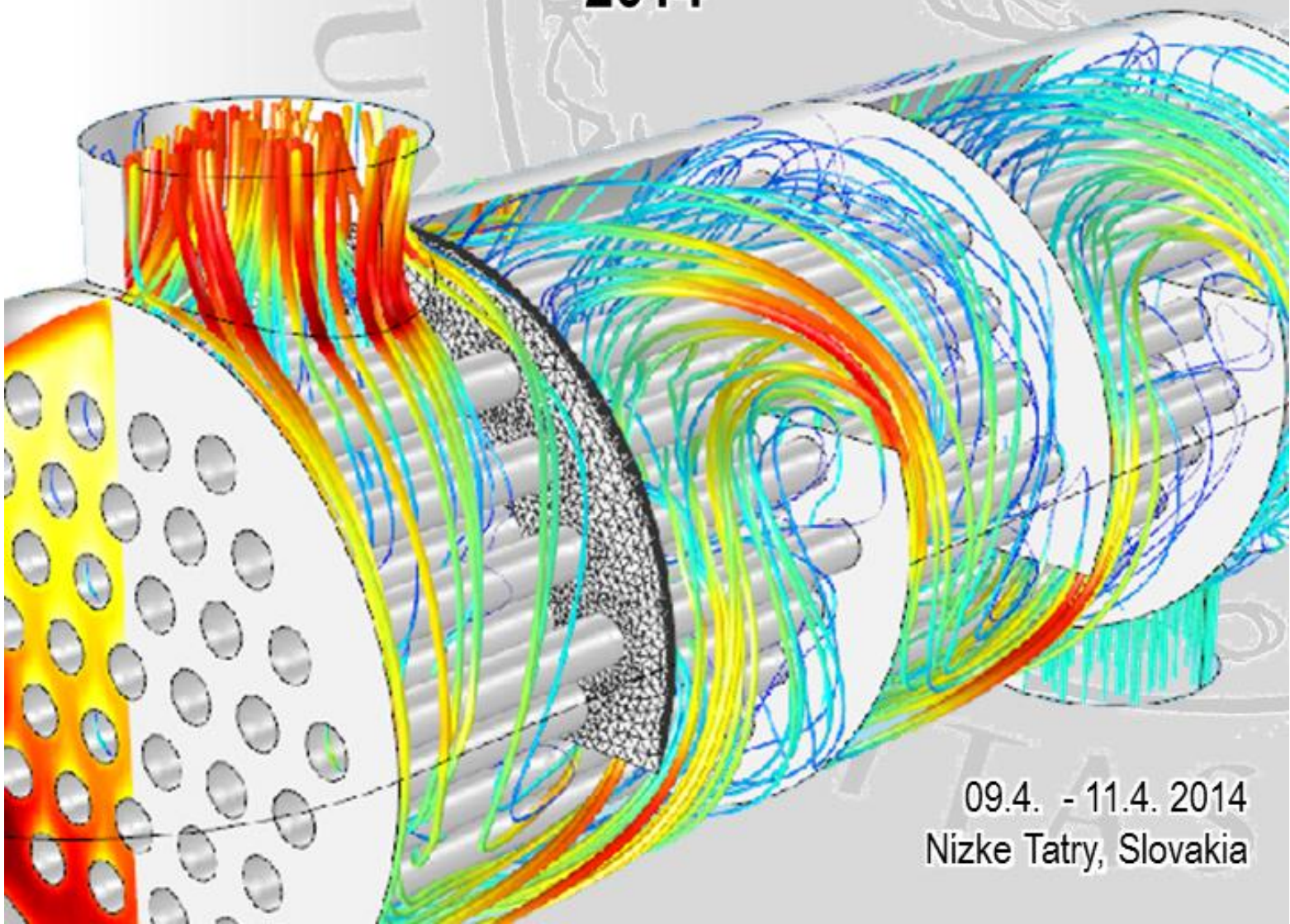
University of Žilina

XIX. International Scientific Conference

THE APPLICATION OF EXPERIMENTAL AND NUMERICAL METHODS IN FLUID MECHANICS AND ENERGY 2014



09.4. - 11.4. 2014
Nizke Tatry, Slovakia

The Application of Experimental and Numerical Methods in Fluid Mechanics and Energetics 2014

Proceedings of the International Conference

Measurement and calculation of state variables in the fluid flow, Modeling and simulation in fluid mechanics and energy, Optimization of flow parameters in the thermal and hydraulic machines and systems, Application of latest developments in the field of fluid mechanics and energy in technical practice, visualization of flow, Measurement of energy systems and systems, Special experimental methods in fluid mechanics and energy, Renewable energy, Current problems in the energy.

09.04. – 11.04.2014
Liptovský Ján, Slovakia

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ISBN 978-80-554-0855-2

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Parameters of Central Boiler Depending the Amount of Combustion Air

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ARTICLE INFO

Article history:
Received 28 February 2014
Accepted 08 March 2014
Published 09 April 2014

Keywords:
Pellet boiler, biomass, experimental measurements

ABSTRACT

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

Nomenclature

p_k	chimney draft, Pa	T_c	flue gas temperature, °C
P	boiler output, kW	T_o	the ambient temperature, °C
t	output of the boiler water, °C	v	rate of supply air, m/s
tr	inlet water to the boiler, °C	Q	flow rate, m^3/h
T	temperature, °C	Q_{vh}	heat transfer fluid flow rate, m^3/h

1. Introduction

Wood is the many millions of years for man one of the most important fuel sources. Essential for its use is that energy can be recovered in a sustainable manner. 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 waste suitable for energy use. Prospective source of the wood material, which can produce a less productive agricultural soils, respectively. Other non-forest land cultivation so. fast-growing trees. Tree material consists of wood, bark and green materials, i.e. branches and needles of conifers. Coniferous trees consist of 70 to 80 % wood, 10 to 15 % bark and 10 to 15 % of green matter. Deciduous trees shall consist of 60 to 75 % wood, 10 to 20 % bark and 15 to 20 % of green matter.

2. Experimental measurements

The as the heat source was used pellet boiler firm. Lokca with a rated output of 18 kW with the type designation Lokca 18 automatic savings that have been involved with measuring elements according to Fig. 1.

Pellet boiler Fig. 1 is designed for burning pellets and coal type nut. Measurement of the rated power is held in different settings the intake air mass flow to the combustion burner for pellets.

Each rated capacity is recorded and evaluated separately, and each measurement was used identically fuel. The amount of injected combustion air be regulated by the control system via the boiler control fan speed in the range 10 % - 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, according to the measurement of small heat sources. Schematic diagram of the boiler is measured by the Fig. 2.

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 pellet burner is always measured about 120 min.

During the combustion process one batch of fuel is recorded following values: the ambient temperature T_o [°C]; chimney draft p_k [Pa]; flue gas temperature T_c [°C]; output of the boiler water t [°C]; inlet water to the boiler t_r [°C]; heat transfer fluid flow rate Q_{vh} [$m^3.h^{-1}$]; air supply rate to the burner [$m.s^{-1}$]; temperature of the injected air to the burner [°C]; the composition of gases: oxygen O_2 [%], carbon dioxide CO_2 [%], carbon monoxide CO [ppm], nitric oxide NO_x [ppm], sulfur dioxide SO_2 [ppm], solid organic carbon TOC [$mg.m^{-3}$].

Fig. 1 experimental measurements of pellet boiler.

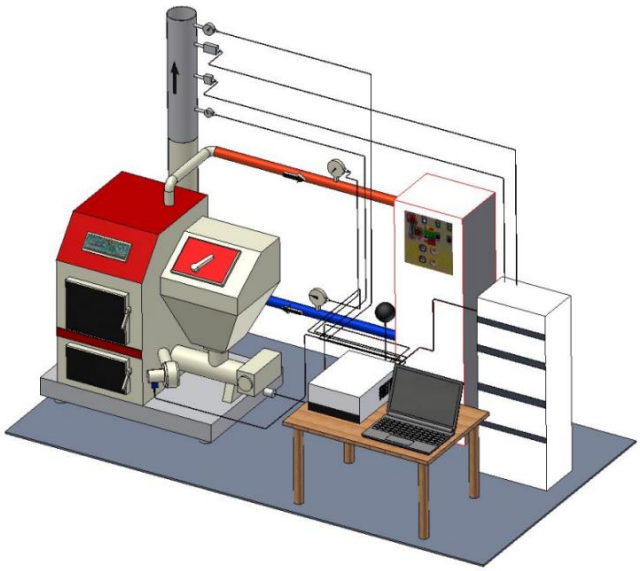

Fig. 2 schematic diagram of the boiler.

3. Analysis results

During the measurements were monitored and recorded values of CO, CO_2, SO_2, NO_x, O_2, TOC in the flue gas and then to evaluate the performance and efficiency of test equipment, each set of air injected into the burner. In addition, emissions were measured and the parameters: temperature of the flue, chimney draft and ambient temperature. Were measured, as mentioned above, each set separately injected air into a pellet burner to record data using the panel to a computer in the twenty-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 bar 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.

The insufficient amount of combustion air inlet to produce significantly higher concentrations of CO Fig. 3, OGC Fig. 4. However, the supply of large quantities of combustion air is reflected in the increased production of CO Fig. 3, respectively. OGC Fig. 4. Increasing the concentration of CO respectively. OGC has a major impact on the heat capacity Fig. 5, respectively. Efficiency of the heat source Fig. 6. To change the amount of combustion air to substantially change the concentration of NO_x, unless the least amount of combustion air.

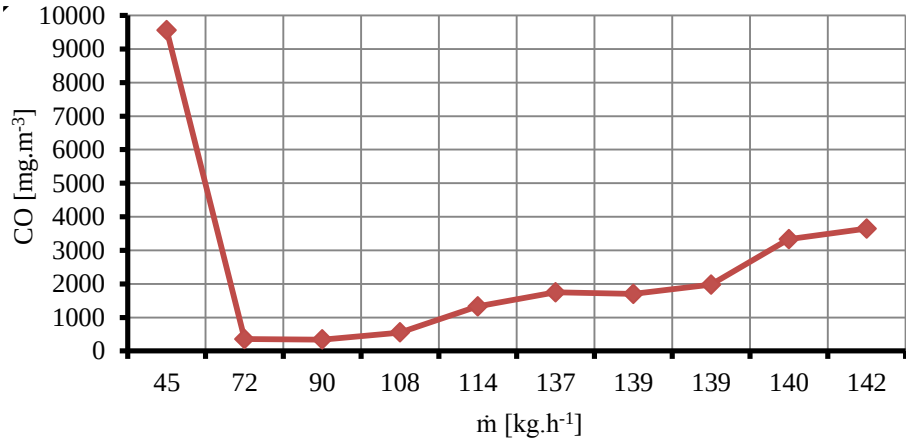

Fig. 3 the average value of production of CO, depending on the mass flow combustion air.

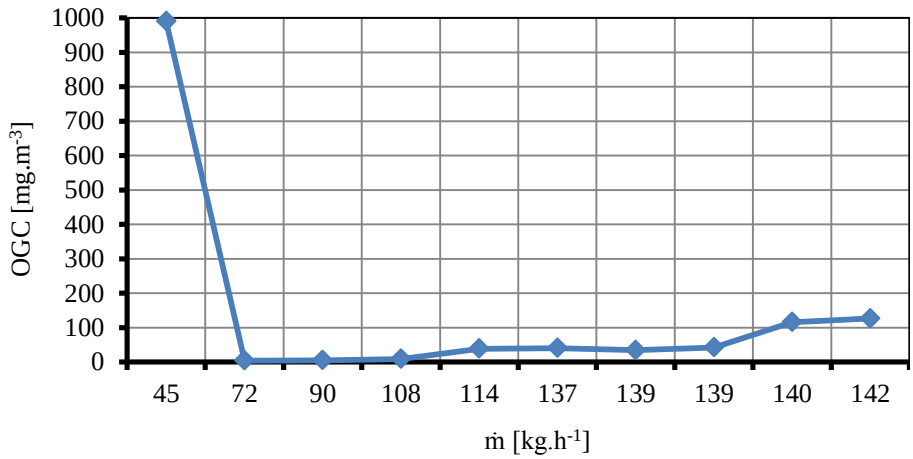

Fig. 4 the average value of production OGC based on mass flow combustion air.

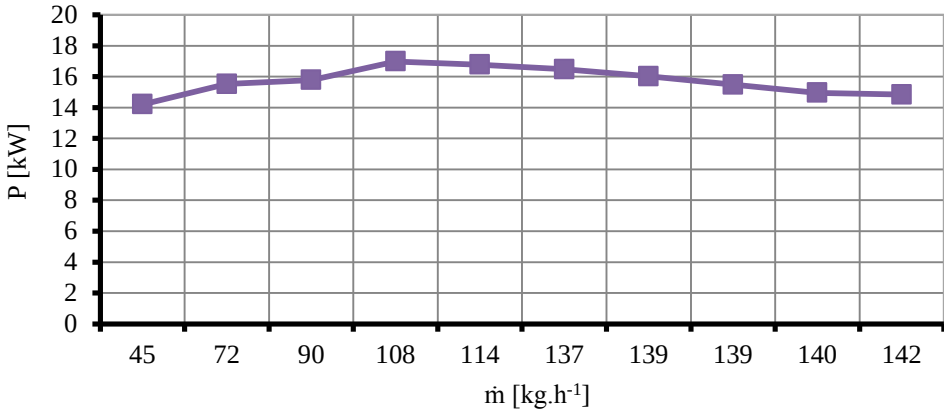

Fig. 5 the average values of heat output depending on the mass flow combustion air.

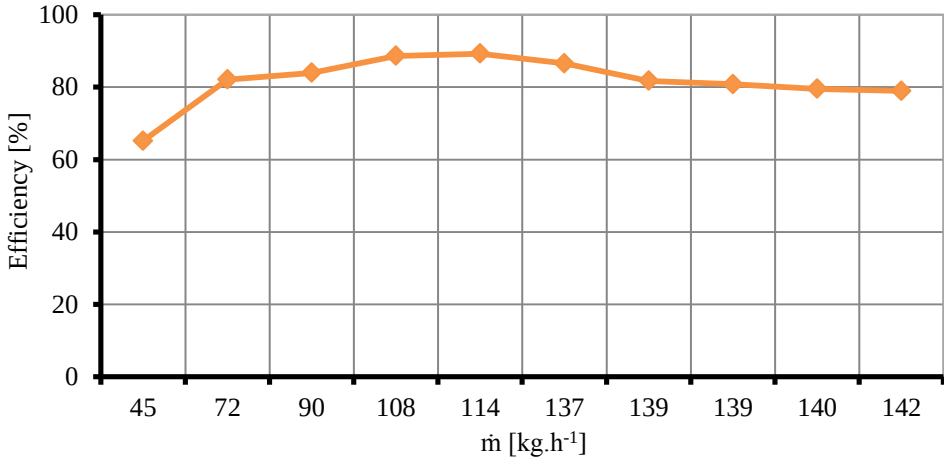

Fig. 6 the average values of heat efficiency on the mass flow combustion air.

Acknowledgement

This paper was prepared within the project "Rozvoj spolupráce medzi VEC a KET so zameraním na odborný rast doktorandov a výskumných pracovníkov" ITMS 22410320106.

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The Application of Experimental and Numerical Methods in Fluid Mechanics and Energy 2014

XIX. International Scientific Conference

Edited by:	Richard Lenhard, Katarína Kaduchová
Published by:	University of Žilina
Edition:	First
Printed by:	EDIS – Žilina University Publisher
Impresion:	90

ISBN 978-80-554-0855-2