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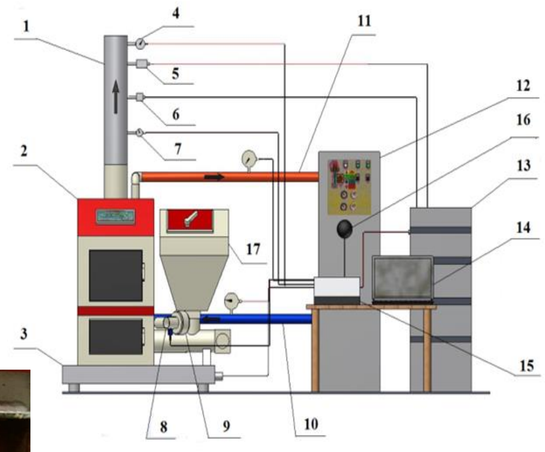
PARTICULATE MATTER PRODUCTION OF SMALL HEAT SOURCE DEPENDING ON THE BARK CONTENT IN WOOD PELLETS

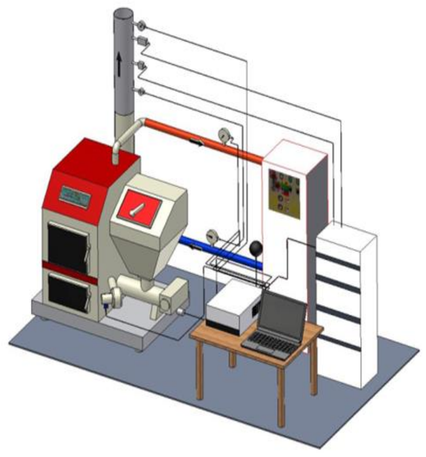
1. INTRODUCTION

Biofuel in the form of wood pellets is used also in small heat sources. Due to the fact that there are not only pellets made from pure wood but also pellets with bark content, it is necessary to pay attention to the impact of bark on fuel combustion characteristics (performance, net calorific value). Bark content in pellets influences also the fuel quality. It has impact on such parameters as moisture content, ash content, ash fusion temperature, produced emissions and particulate matter (PM). High content of bark, which is frequently a component of burned pellets, results in more frequent maintenance of heat sources as bark contains more ash than bark less wood. Increased ash content also generates higher amount of particulate matter which belongs to the most harmful emissions discharged into the atmosphere. PM discharged from local heat sources in combination with the weather has recently led several times to smog situations having adverse impact on health and living conditions of people in a particular region. The work deals with the impact of bark content in wood biomass on PM production of small heat source.

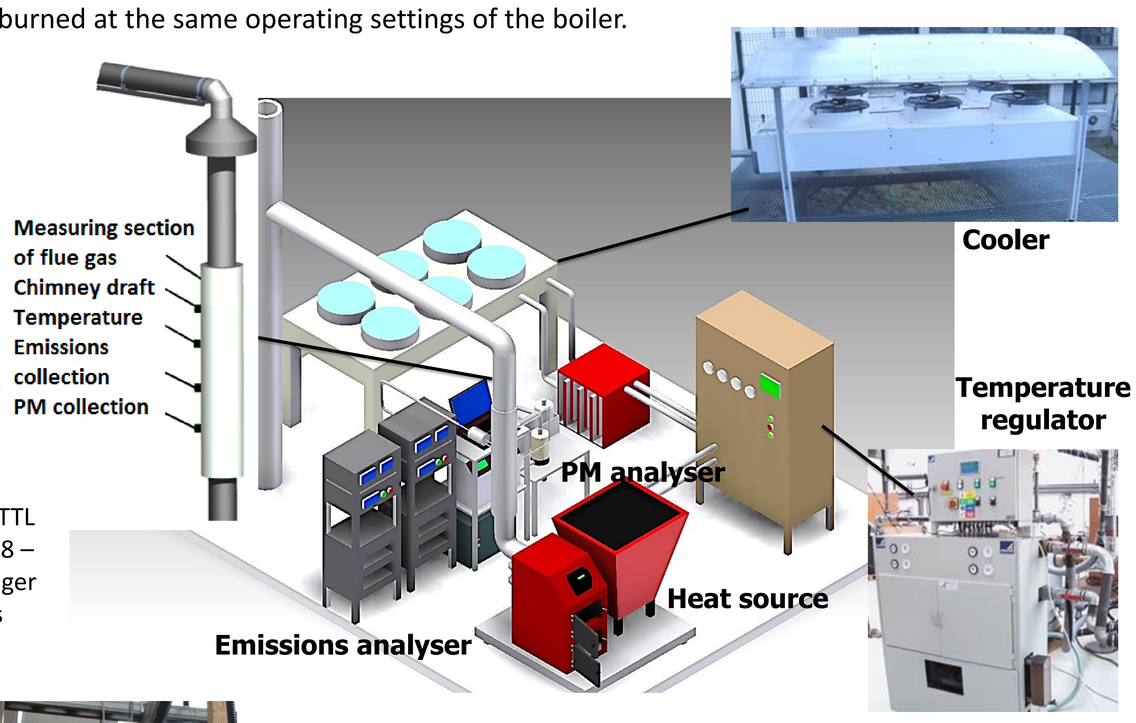
2. METHODOLOGY

In the framework of experimental activities there were spruce wood pellets samples with 1 %, 2 %, 5 %, 10 % and 20 % content of bark. Samples were produced on an experimental device for biofuel pelleting. The combustion took place in a small heat source with a rated heat output of 18 kW which was tested on an experimental device designed for the measuring of heat output and emission production. Various parameters are recorded every 20 seconds. During the measurements constant chimney draft 12 ± 2 Pa via a flue fan is ensured. Particulate matter measurement was conducted by gravimetric method in accordance with the standard ISO 9096. All pellet samples with various bark content were burned at the same operating settings of the boiler.

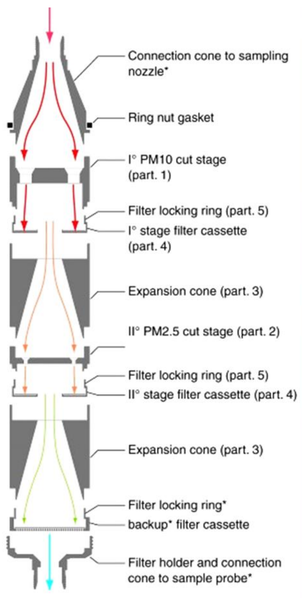


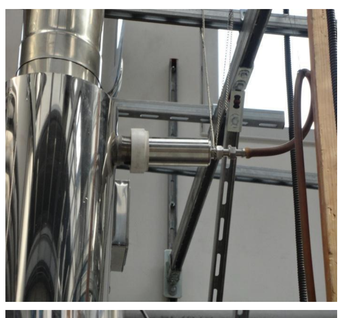


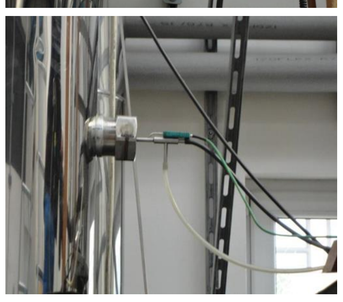
1 – chimney, 2 – automatic pellet boiler, 3 – scale, 4 – sensor of chimney draft, 5 – TTL probe, 6 – probe to measure emissions, 7 – thermometer to measure the flue gas, 8 – anemometer, 9 – fan, 10 – supply pipe, 11 – outlet line, 12 – separator heat exchanger with control panel, 13 – flue gas analyzer, 14 – laptop, 15 – logger, 16 – Vernon's thermometer, 17 – fuel storage tank



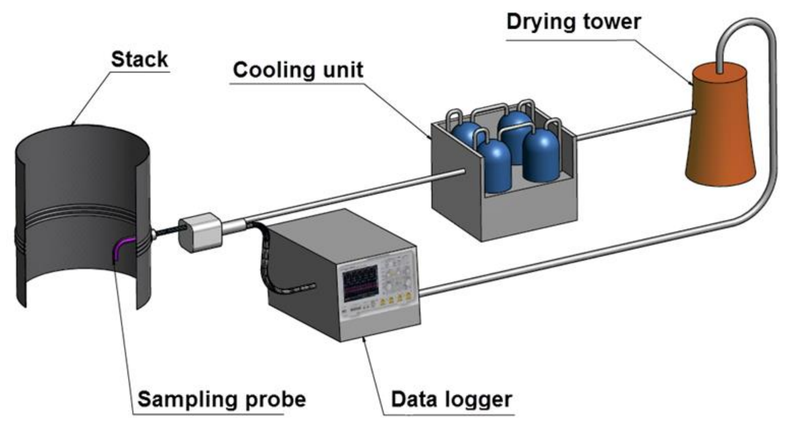
Emission Measurement





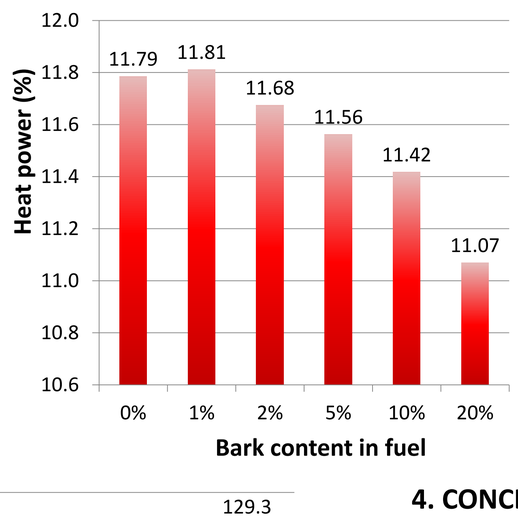


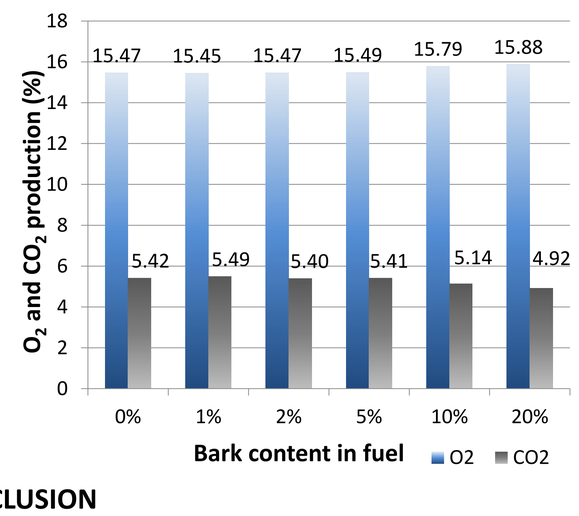
PM Measurement

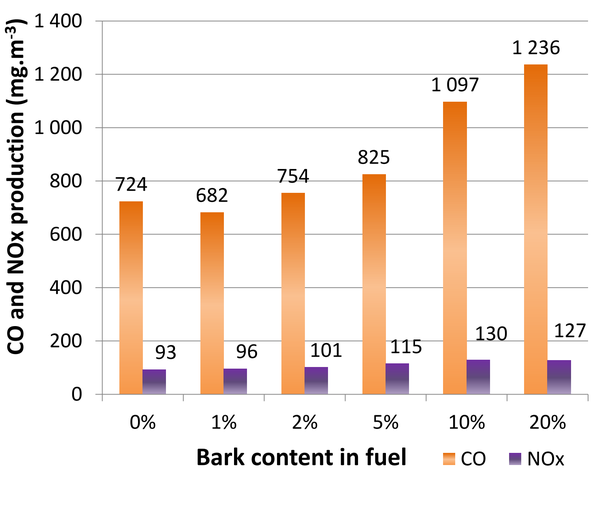


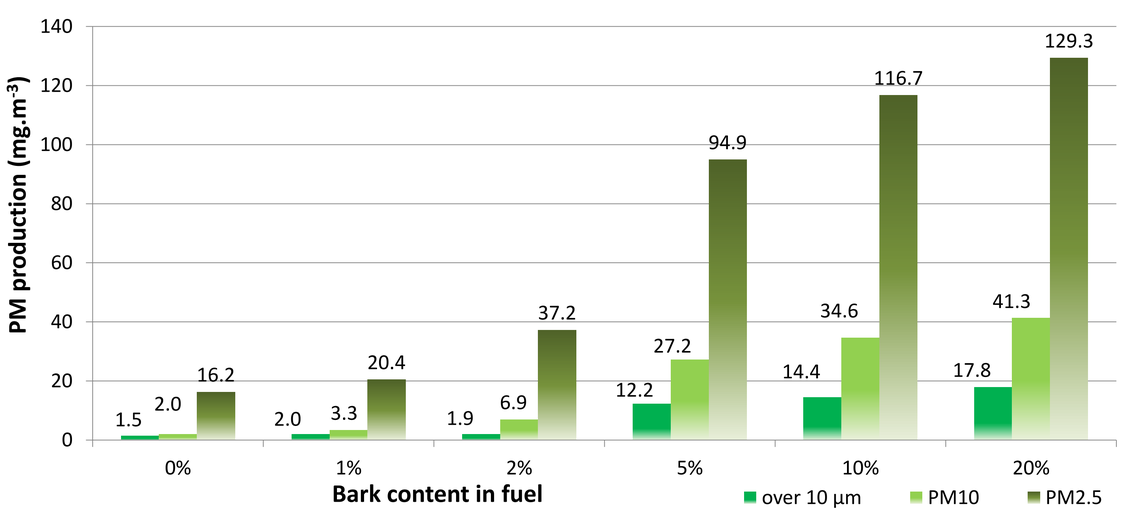
3. RESULTS

Mark		Unit	Bark content in the pellets					
			0%	1%	2%	5%	10%	20%
Density		kg.m^{-3}	428	428	429	431	433	437
Moisture		%	8.39	8.44	8.55	8.81	9.15	10.21
Gross calorific value		MJ.kg^{-1}	18.70	18.69	18.69	18.55	18.48	18.25
Net calorific value		MJ.kg^{-1}	17.12	17.11	17.11	16.96	16.89	16.63
Heat power		kW	11.79	11.81	11.68	11.56	11.42	11.07
Ash content	550°C	%	0.33	0.34	0.34	0.35	0.37	0.48
	815°C	%	0.26	0.27	0.27	0.28	0.29	0.39
Ash fusion temperature	DT	°C	1 210	1 210	1 205	1 200	1 195	1 180
	ST	°C	1 275	1 270	1 275	1 265	1 260	1 250
	HT	°C	1 315	1 310	1 310	1 305	1 295	1 290
	FT	°C	1 340	1 340	1 335	1 325	1 310	1 305



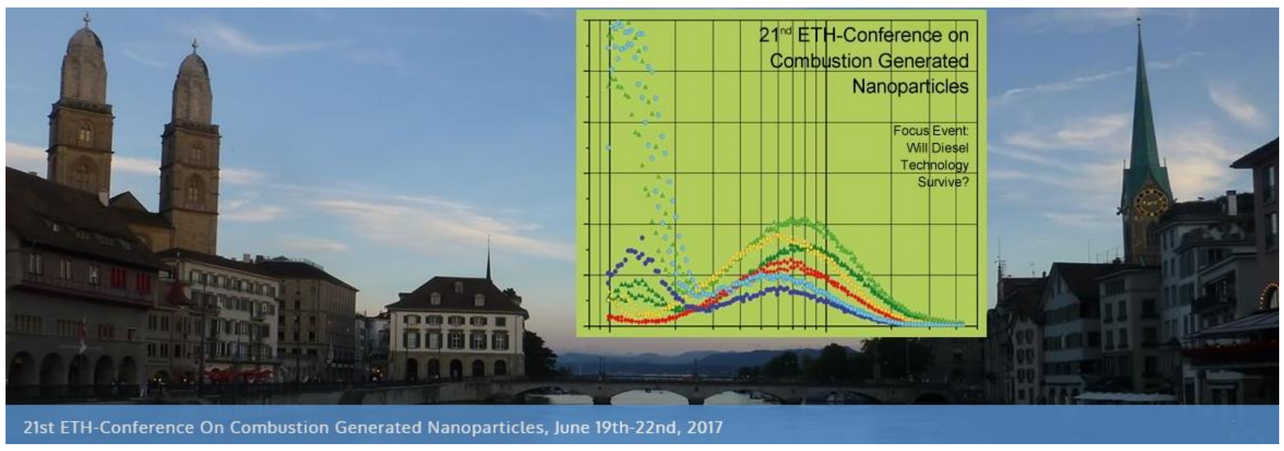






4. CONCLUSION

Based on the achieved results we can conclude that bark content in pellets has a significant impact not only on performance but also on environmental characteristics of pellets. Higher bark content in pellets increases ash content, which can adversely influence combustion process, mainly due to higher ash production during combustion and consequent necessity of more frequent boiler cleaning. Wood bark has relatively high net calorific value; therefore, its potential can be energetically used. Attention should be paid to its negative impact on the environment due to higher concentrations of CO, NOx and PM as mentioned in this work.



Acknowledgment

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