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## Fog unit *versus* electrical precipitator and filter

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### Abstract

Biomass takes an important place in the Latvian primary energy source balance. In the coming years steeper increase of the use of biomass for the production of heat can be predicted, in order to ensure the proportion of energy produced from renewable energy resources to 40 % in 2020. However, the use of biomass has increased the risk of environmental pollution, mainly with solid particles. In order to prevent an increase in quantity of particulate matter in the atmosphere, flue gas treatment is important, with special attention to small capacity boiler equipment. The research provides insight into innovative technologies for the flue gas treatment – fog unit. Technology comparison with another widely used flue gas purification methods are given in the article.

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*Keywords:* fog unit; particulate matter; flue gas treatment; water drop

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### 1. Introduction

Flue gas is formed in the result of the biofuel (wood waste (woodchips, sawdust, bark) pellets, peat, straw, etc.) combustion. Flue gas contain a quantity of energy. Most of the energy is transferred to water heating, steam generation and other heating medium, which is used in heat supply or industrial production. Water heating boilers, steam and oil boilers, economizers and other devices are used for heat transfer process.

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Small scale biomass boilers create a risk of environment pollution, especially from particulate matter [1 2]. However CO<sub>2</sub> emissions reduction can be achieved by replacing natural gas with biomass use [3]. Operational efficiency of boilers, characteristics of combustion process in the furnaces, location of energy source in urban areas and other factors affect the potential of pollution. The design of the boiler plays an important role in creation of emissions. A higher amount of produced particulate matter can be seen in boilers with pellet feed from the top, when compared to boilers with pellet feed from the bottom [4]. Boiler operation with decreased power can lead to the increase of the particulate matter concentrations in flue gases [5]. The correct ratio of the primary and secondary flows that enter the chamber can improve combustion process and promote reduction of particulate matter [6]. Type of used biomass affects not only the amount of particulate matter, but also particle size and other characteristics [7]. Recovery heat from flue gases and fuel preheating also can be an effective method for boiler efficiency increase and fuel consumption decrease [8].

Very often urban development in regions with single-family households involves building multi-storey buildings, which are integrated in existing environment. An example of such urban planning is illustrated in Fig. 1. Single-family buildings typically have installed heating systems with individual boilers, and the chimneys are below the surrounding multi-storey buildings. This means that there is an increased difficulty in dispersion of emissions and flow towards the upper atmosphere. The situation is similar to single-family buildings. Particulate matter impact on human health in the conditions of rapidly increasing use of biomass in heat production of the city, was examined in the study, which was carried out by Sarigiannis et al. [9].

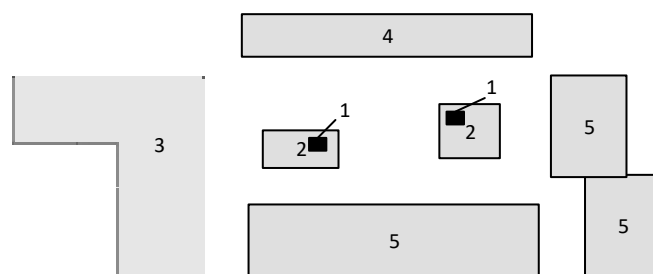


Fig. 1. Case of urban planning: 1 – emission source; 2 – one family building (2 floors); 3 – school building (3 floors); 4 – dwelling building (5 floors); 5 – dwelling buildings (9 floors).

In order to reduce air pollution and human health risk, there is a need to minimize the emission concentration of small power boilers. The European Union eco-design directive [10] stimulates the design improvement for the products which are related with energy sector, to reduce environmental impacts and to achieve energy savings that would give economic savings not only for business, but also for energy users. While the European Union regulation [11] describes the eco design requirements for solid fuel boilers. Regulation will become active from 1st January 2020. Regulation requirements are summarized in Table 1.

Table 1. Data analysis of the regression model.

Factors	Dimensions	Boilers				Biomass	Fossil fuel
		>20 kW	<20 kW	Automatically stoked boilers	Manually stoked boilers		
Energy efficiency	%	>77	>75				
Particulate matter	mg/m <sup>3</sup>			<40	<60		
Emissions of organic gaseous compounds	mg/m <sup>3</sup>			<20	<30		
Emissions of carbon monoxide	mg/m <sup>3</sup>			<500	<700		
Emissions of nitrogen oxides	mg/m <sup>3</sup>					<200	<350

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