# Concentration and size distribution of solid particle emissions from oxy-fuel combustion of biomass in a fluidized bed

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## Introduction

The presented work summaries results of measurement of solid particle emissions from experimental 30 kW combustion unit, which has been used for research of oxy-fuel combustion of biomass in fluidized bed. This technology is one of the promising ways for decreasing amount of $CO_2$ in atmosphere, as its flue gas, rich in $CO_2$ content, makes it suitable for use with carbon capture and storage/usage technology. Decreasing amount of $CO_2$ in atmosphere is desirable in order to slow down global warming. However before getting into CCS/CCU process, various impurities have to be separated from the flu gas. Therefore the goal of this work was to identify solid particles contained in the flue gas. Scheme of the boiler used for the measurement is shown in Fig. 1. The fuel used during the experiment were spruce wooden pellets with 6 mm diameter.

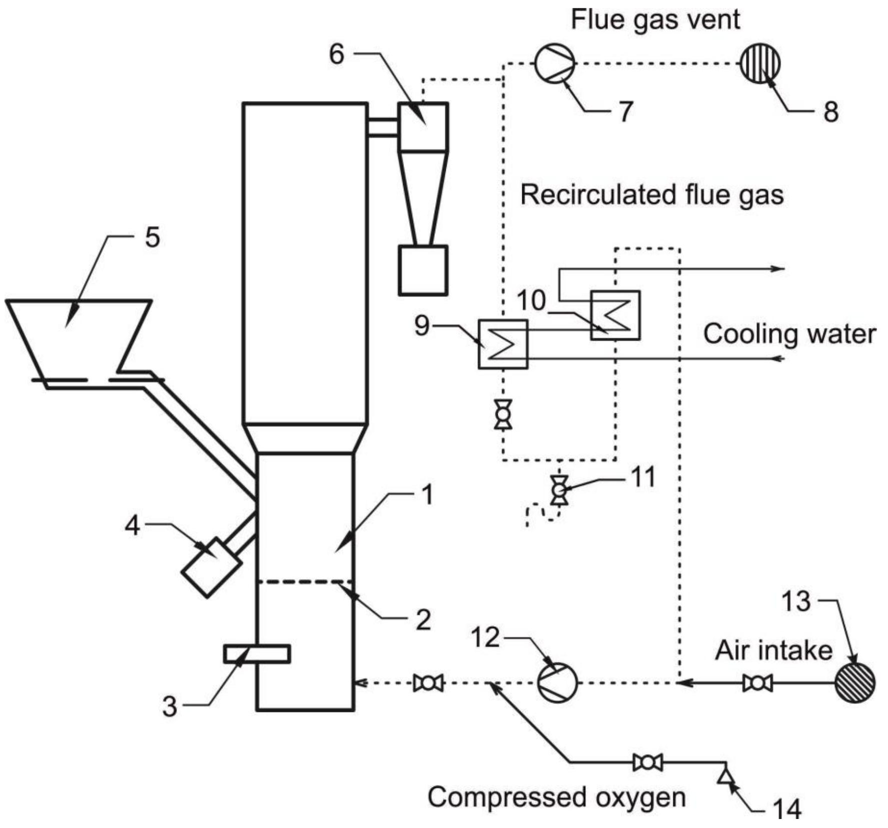


**Fig. 1**: Scheme of the 30 kWth BFB experimental facility

1) fluidized bed region, 2) distributor of the fluidizing gas, 3) gas burner mount, 4) fluidized bed spillway, 5) fuel feeder, 6) cyclone separator, 7) flue gas fan, 8) flue gas vent, 9) and 10) water coolers, 11) condensate drain, 12) primary fan, 13) air-suck pipe, 14) vessels with oxygen. [1]

## Method

To determine the properties of solid particles contained in the flue gas, we used the gravimetric analysis. The apparatus used was a three-stage impactor with an ejector dilutor, both from Dekati® company. Experimental set-up and its scheme can be seen in Fig. 2 and Fig. 3. The impactor classifies the solid particles into three fractions, which are PM10, PM2,5 and PM1. The use of dilutor provides longer time for each measurement and also helps to avoid condensation of water vapour, which is useful here, because flue gas from this combustion technology is specific for its high water vapour content (more than 40 % vol.). The dilutor was heated up to the temperature of the flue gas in the vent.

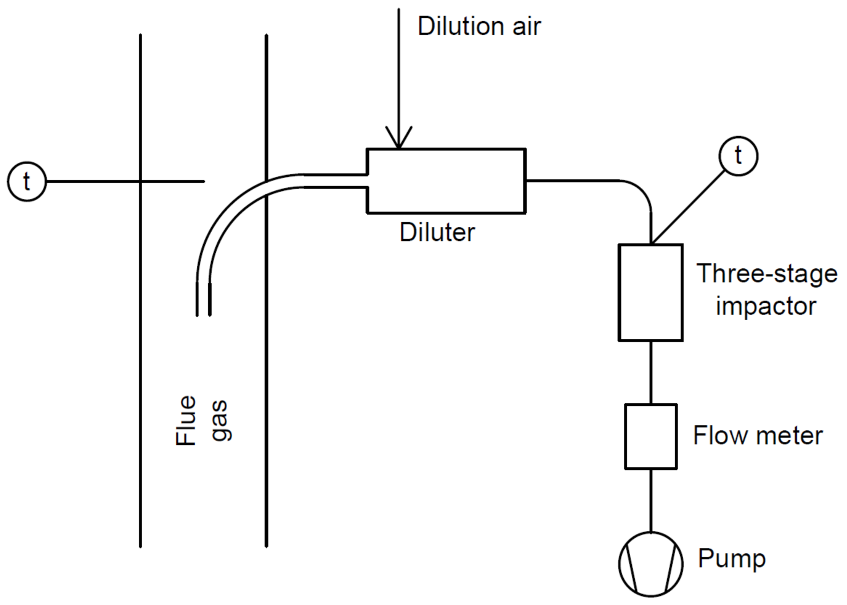


**Fig. 2**: Scheme of experimental set-up

**Fig. 3**: Experimental set-up

## Results

With the apparatus described, we performed five separated measurements and specified concentration and particle size distribution in the flue gas. Cut-off diameters of the impactor were corrected according to temperature. Our results showed a relatively small mass median aerodynamic diameter, which was **1,6 μm**. Solid particles concentration in the flue gas was found to be cca **30 mg/Nm3**. Acquired particle size distribution is shown in Fig. 4 with a curve plotted with average values. It is important to add, that these results were influenced by the fact, that the flue gas goes through a cyclone before exhausting to the vent. According to different theories, the cut-off diameter of this cyclone was estimated to lay between 3 and 5 μm. That explains the relatively small median and concentration found.

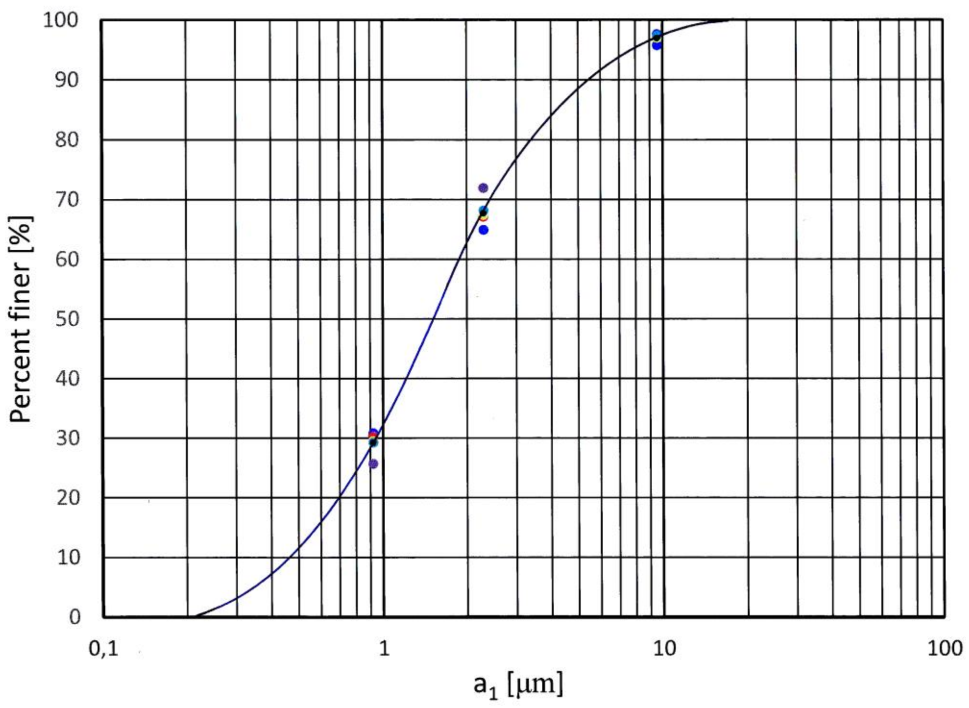


**Fig. 4**: Particle size distribution curve

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## References

[1] VODIČKA, M., N. E. HAUGEN, A. GRUBER a J. HRDLIČKA. NOX formation in oxy-fuel combustion of lignite in a bubbling fluidized bed – Modelling and experimental verification. International Journal of Greenhouse Gas Control. 2018, 76, 208-214. ISSN 17505836. doi:10.1016/j.ijggc.2018.07.007

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