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IGNITION TEMPERATURE OF DUST LAYER AND DUST CLOUDS OF WOOD PELLETS

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ABSTRACT

In the production, transport, storage and use of wood pellets forming a flammable and explosive dust. To assess the fire risk of wood pellets was determined ignition temperature of dust layers and dust clouds. We used two commercially produced pellets from wood waste and wood and studied the dependence of ignition temperature on the thickness of dust layer and also observed the ignition temperature dependence of dust clouds from the weight and pressure of air in combustion chamber.

KEY WORDS

wood pellets, dust layer, dust clouds, ignition temperature

INTRODUCTION

The pellet is a circular shape with the diameter 6-8 mm and length 30 to 40 mm. It consists of biomass (wood, wood waste, sawdust, hay, straw) with-out chemical additives. The calorific value of wood pellets is from 18 to 19 MJ.kg [1]. The production of pellets is used for the most of the mass in the form of wood sawdust with a minimum of wood dust, which deteriorates the strength of pellets. The moisture contents is nearly 10%. Biomass for production of wood pellets are dried and then compressed into form. The natural extractives and lignin found within the wood hold the pellets together. The process of making pellets is stamping so-called pelletization [1,3,6].

METHODS

Determination of the minimum ignition temperatures of dust layer and dust clouds is carried out according to STN EN 50281-2-1:2002 Electrical apparatuses for use in the presence of combustible dust. Part 2-1: Test methods - Methods for determining the minimum ignition temperatures of dust. To determine the ignition temperature of dust, we used powder samples with a diameter less than 500μm, and was prepared by sieve analysis.

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Fig. 1 *Sample B – pellets made of softwood with bark, Sample C – pellets made of softwood*

Preparation of samples of dust from wood pellets

Dust samples were prepared by grinding the pellets in a blender (Fig. 1). Dust sample B - pellets made of softwood with bark, Dust sample C - pellets made of softwood (Fig. 2).

Fig. 2 *Samples of dust from wood pellets*

For determining the minimum ignition temperature of dust clouds and dust layer by use of sieving machine, we obtain fractions of less than 500μm. Dust samples are stabilized before analysis in a desiccator for 24 hours at 24 °C and humidity 33% [5]. The results of the analysis of samples are shown in Tab. 1.

THE PERCENTAGE FRACTIONS SIEVING DUST SAMPLES

Table 1

Sieve size [μm]	**Percentage by weight [%]**	
	Sample B	**Sample C**
> 500 μm	56,98	39,51
500 μm	24,98	27,5
250 μm	3,72	5,88
200 μm	4,42	7,37
150 μm	5,05	8,94
90 μm	1,65	2,2
< 71 μm	3,76	8,11
The losses	0,45	0,49

DETERMINATION OF THE MINIMUM IGNITION TEMPERATURE OF DUST LAYER

Determination of the minimum ignition temperatures of dust layer is carried out according to EN 50281-2-1:2002: Methods for determining the minimum ignition

temperatures of dust (Method A). It shall be considered that ignition of a dust layer has taken place when glowing and/or flaming burning observed or the measured temperature has achieved the value 450 °C or the measured temperature has exceeded by 250 °C the temperature of the heating plate [2,4,5]. To determine the ignition temperature of dust layer samples were used with a particle size smaller than 500μm. The results of determining the minimum ignition temperature of dust layer from wood pellets are given in Tab. 2 and on Fig. 3 is the time-history of ignition of dust layer.

MINIMUM IGNITION TEMPERATURE OF DUST LAYER SAMPLE ACCORDING TO STN EN 50281-2-1:2002 Table 2

Sample of dust	**Ignition temperature [°C]**	
	Thickness of the dust layer 5 mm	**Thickness of the dust layer 12 mm**
B	340	310
C	350	310

			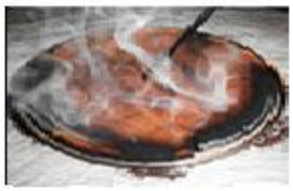
5 minutes	8 minutes	12 minutes	16 minutes
The location of the samples on a hot surface	Temperature increases on the sample surface	Smoldering on the sample surface and subsequent ignition	Smouldering and glowing of sample

Fig. 3 *Ignition time-history of dust layer when tested according to EN 50281-2-1:2002 on electrically heated plate*

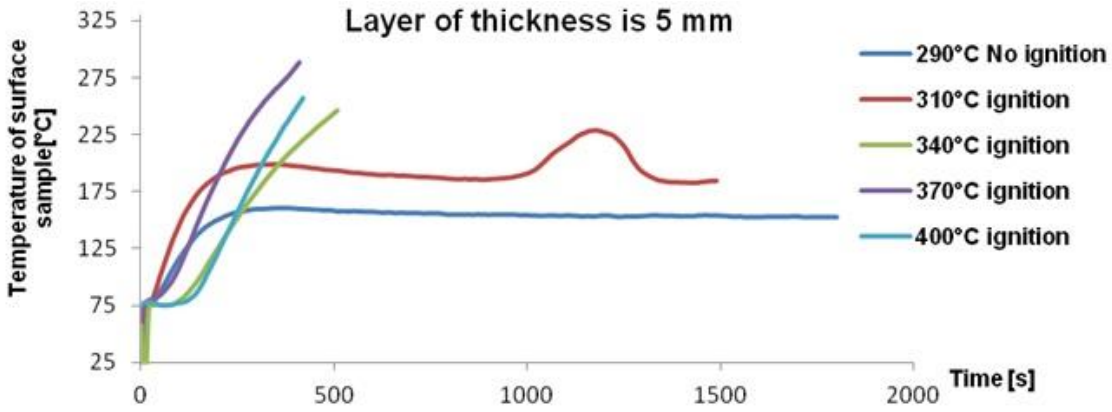

Fig. 4 *Temperature dependence of the surface dust samples from the time of exposure to hot surface (sample B)*

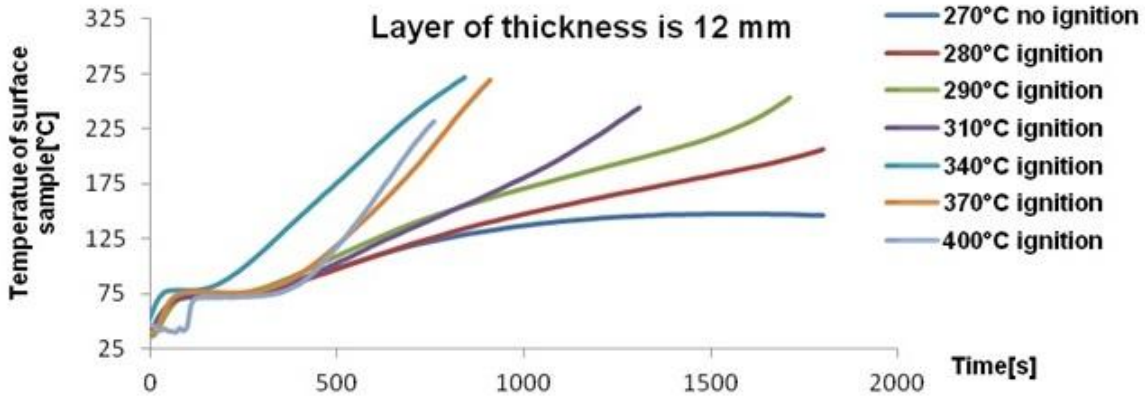

Fig. 5 *Temperature dependence of the surface dust samples from the time of exposure to hot surface (sample B)*

DETERMINATION OF THE MINIMUM IGNITION TEMPERATURE OF DUST CLOUDS

Determination of the minimum ignition temperatures of dust clouds is carried out according to EN 50281-2-1:2002: Methods for determining the minimum ignitio temperatures of dust. Method B: Dust clouds in the oven at a constant temperature [2,5]. For determining the ignition temperature of dust clouds according to the weight of the sample was used a different mass of dust (0.1 g - 0.5 g). We also observed the ignition temperature dependence of dust clouds from the pressure of air in combustion chamber (10 kPa - 50 kPa). The results of determining the minimum ignition temperature of dust cloud from wood pellets are given in Tab. 4 and Tab. 5. and on Fig. 6 is the time-history of ignition of dust cloud.

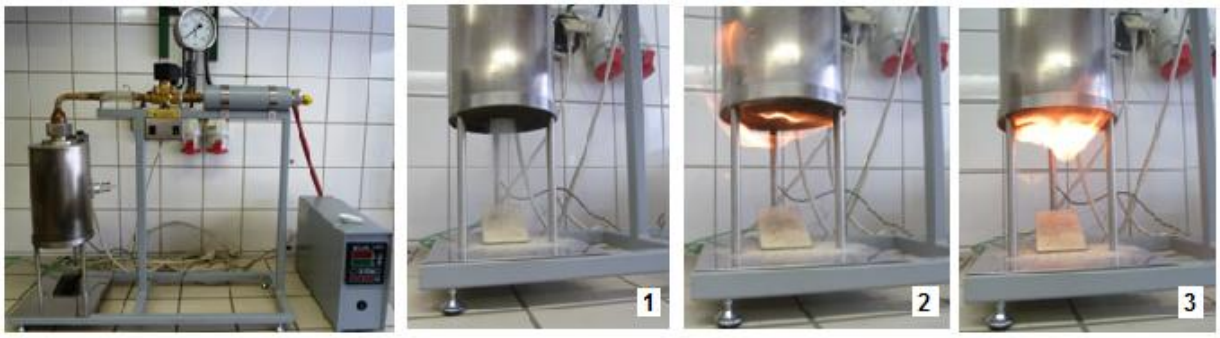

Fig. 6 *Ignition time-history of dust clouds when tested according to EN 50281-2-1:2002*

MINIMUM IGNITION TEMPERATURE OF DUST CLOUDS DEPENDING ON WEIGHT AND THE PRESSURE (SAMPLE B) Table 1

Weight [g]	0,1			0,2			0,3			0,5		
Pressure [kPa]	10	20	50	10	20	50	10	20	50	10	20	50
t^{r}_{min} **[°C]**	480	460	440	460	440	440	440	440	440	440	440	440

MINIMUM IGNITION TEMPERATURE OF DUST CLOUDS DEPENDING ON WEIGHT AND THE PRESSURE (SAMPLE C) Table 2

Weight [g]	0,1			0,2			0,3			0,5		
Pressure [kPa]	10	20	50	10	20	50	10	20	50	10	20	50
t^{r}_{min} **[°C]**	480	440	440	460	440	440	460	440	440	480	440	440

CONCLUSIONS

Forming dust from wood pellets during production, transport and use can create an explosive atmosphere. To develop preventive fire protection measures need to know ignition sources of ignition and established the dust clouds. Determination of ignition temperature of dust pellet is important to assess the fire hazard. Ignition temperature of the deposit dust significantly affects the thickness of the dust. It has been found that with an increase of thickness of dust layer ignition temperatures are reduced. The ignition temperature of dust clouds significantly affects moisture and particle size of the wood dust.

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