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Investigation of chosen species of wood, which are used for floor, reaction to fire

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Abstract: The article presents the results of ranges spread flame, critical radiant heat flux , the maximum rate of heat release, the total amount of heat generated by wooden finishing materials used on the floor. For experimental study used for industrial parquet prepared from Scots pine (*Pinus sylvestris* L.), European ash (*Fraxinus excelsior* L.), European oak (Quercus sp.) and red balau (*Shore sp.*). Studies were carried out using the measuring technique described in PN-EN ISO 9239-1:2010.

Keywords: flammable properties, the spread of flames, wood

INTRODUCTION

Despite the expire of time, the development of civilization and technology, the importance of wood in human life has not changed. So far an ideal substitute for wood which could successfully replace this raw material, has not been created. It could be argued that the demand for timber is growing. They are undoubtedly affected by the new technologies used in the wood industry and also access to exotic wood, which recently wins the Polish market effectively. Its usability and aesthetics make it a valuable raw material used for the production of finishing materials used for paneling, floors (parquet) and furniture. The floor is one of the elements of interior design, significantly affecting the aesthetic of the room. The top layer of the floor should meet the many requirements of utility, which could include i.a.: abrasion resistance, dimensional stability, resistance to humidity and others. Type of flooring material (wood) should be selected according to his dominant performance characteristics depending on the destination of the room where the floor will be arranged. In addition to the performance characteristics of materials used for floors should meet certain requirements for fire safety set out in applicable regulations. The current classification of building materials, including use on the floor is a derivative of the Directive 89/106/EEC, hereinafter abbreviated Directive CPD (an abbreviation of the English name Constructed Product Directive). In Poland (also in other European Union countries) in accordance with the Directive, it was adopted classification of the building materials depending on the reaction to fire. In the PN EN 13501 - 1:2010. Fire classification of construction products and building elements. Part 1: Classification on the basis of the results of reaction to fire. From this follows the standard division of materials into 7 groups so-called EUROCLASSES (A1, A2, B, C, D, E, F) (Troitzsch 2005, Östman et al 2006). The most important is the main Euroclass, which determines the extent to finishing material will contribute to the spread of fire. Appointed and qualifies standard defines different types of materials, on the other hand separates the finishing materials used for floor from the other construction materials. During the classification of the floor with the class an index *fl* is given, which in English means the *floor*.

MATERIALS AND METHODS

The materials used in this work were wood flooring used from Scots pine (*Pinus sylvestris* L.), European ash (*Fraxinus excelsior* L.), European oak (Quercus sp.) and red balau (*Shorea sp.*). The wood samples were prepared from pieces obtained from a commercial supplier. The samples were pre- conditioned by keeping them in an atmosphere of 50 ± 5 % relative humidity and at 23^0C ± 3^0C before the tests until the mass was stabilized. The density and moisture content of the test specimens are shown in table 1.

Table 1. The density and moisture content of the tested species of wood

No.	Botanic name of wood according to EN 13556:2003	Trade name of wood	Density [kg/m^3]	Moisture content [%]
1.	*Shorea sp*	red balau	860	7
2.	Quercus sp.	European oak	660	6
3.	*Fraxinus excelsior* L.	European ash	650	8
4.	*Pinus sylvestris* L.	Scots pine	480	8

The study was conducted using the measurement methodology described in PN-EN ISO 9239-1:2010 shown in Figure 1. Samples of the test material with dimensions of 1050 ± 5 mm x 230 ± 5 mm were subjected to the impact of radiant panel with a specific profile of thermal radiation resulting from the conditions specified in the standard. In addition, after 2 minutes from the start of the study, directly influenced for the test material on a single flame (from the combustion of propane gas). The maximum duration of the study was 30 min or was terminated before the measurement because the combustion flame was completed earlier. During the test the critical radiation flux recorded by switching off (CHF), the rate of dynamic of spread of flame, the maximum intensity of the heat release. The results are the average value obtained from three measurements for each sample material.

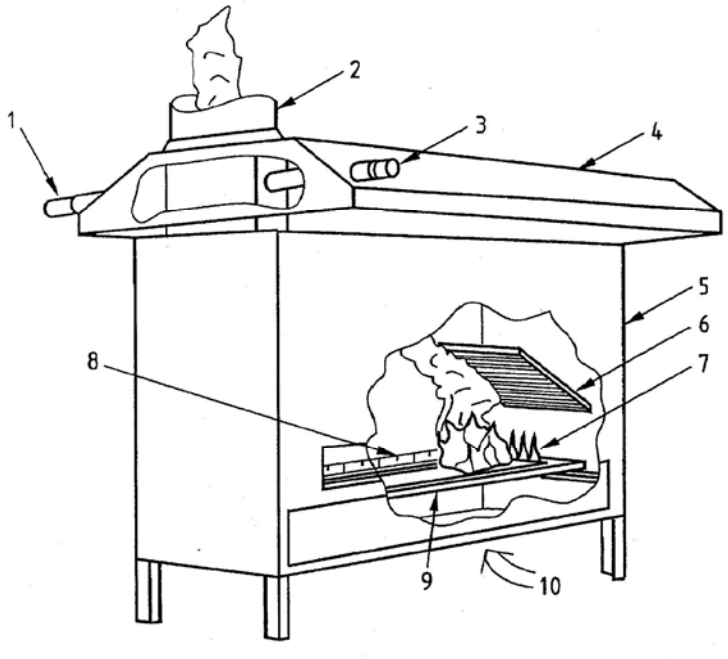

Fig.1. The test set to determination of the burning behavior using a radiant heat source

RESULTS AND DISCCUSION

The obtained results: critical heat flux (CHF), heat release rate (HRR), total heat release (THR), dynamics of heat index (DHI) and range of flame spread (RFS) are shown in table 2.

Table 2. The results of reaction to fire tests chosen species of wood

No.	Trade name of wood	Critical heat flux (CHF) [kW/m^2]	Heat release rate (HRR) [kW]	Total heat release (THR) [kJ]	Dynamics of heat index (DHI) [kJ/m^2]	Range of flame spread (RFS) [mm]
1	red balau	4,5	6,1	4452,2	9341,7	433
2	European oak	6,2	4,0	1858,0	5987,2	348
3	European ash	10,2	3,3	3632,9	4453,0	132
4	Scots pine	3,9	5,4	1891,0	6697,3	442

The smallest range of flame spread was obtained for the European oak wood. Subsequently, it was European ash wood, red balau, and Scots pine. Critical radiation flux is highly dependent on the range of flame spread, and therefore the ranking of materials is similar (see Table 2).

The greatest value of the rate of heat release, the total amount of heat generated and the rate of dynamic of flame propagation is obtained for red balau. Analysis of the results in this field permit us to conclude that this material during fire potentially contributes to the fastest increase of a temperature in the room and thus shortens the time needed for effective evacuation during a fire.

Measurements made using this investigative method provide a basis for determining one of the aspects of the behavior of the finishing materials used on the floor during operation of the fire. The results obtained can be used for classification of finishing materials used on the floor according to PN-EN 13501-1:2010. In order to assign a specific EUROCLASSES it is also necessary to carry out tests in accordance with the methodology described in PN-EN ISO 11925-2:2010. However, carried out and the results determine the reaction to fire and thus can be used to assess fire risk assessment in building constructions, especially in the categories human risk through the use of these data in modern methods of fire safety engineering, regarding the estimation of fire hazard.

CONCLUSIONS

On the basis of made experiments and obtained results for European oak, European ash, Scots Pine (European wood) and red baulau (exotic wood from south-eastern Asia wood) we can present following conclusions:

1. The smallest range of flame spread (RFS) was obtained for the European oak wood and the biggest for the Scots Pine.
2. Critical radiation flux (CHF) is highly dependent on the range of flame spread (RSF). The higher the vale of range of flame spread is, the lower the critical heat flux is.
3. The greatest value of the rate of heat release (HRR), the total amount of heat generated (THR) and the rate of dynamic of flame propagation (DHI) is obtained for red balau.
4. Tested species of wood during fire potentially contributes to the fastest increase of a temperature in the room and thus shortens the time needed for effective evacuation during a fire.

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Streszczenie: *Badanie reakcji na ogień wybranych rodzajów drewna stosowanego na parkiety.* W artykule przedstawiono wyniki badań zasięgów rozprzestrzeniania się płomieniu, krytycznego strumienia promieniowania cieplnego przy zgaśnięciu, maksymalnej szybkości wydzielania ciepła oraz całkowitej ilości wydzielonego ciepła z wybranych gatunków i rodzajów drewna stosowanych na parkiety. Do badań eksperymentalnych wykorzystano parkiet przemysłowy (bez uszlachetnionej powierzchni licowej) przygotowany z drewna sosnowego, jesionowego, dębowego oraz damarzyku – balau czerwonego (przedstawiciela drewna egzotycznego z południowo-wschodniej Azji). Badania przeprowadzono z wykorzystaniem techniki pomiarowej opisanej w normie PN-EN ISO 9239-1:2010. Największy zasięg płomienia odnotowano dla sosny. Jednocześnie dla tego gatunku otrzymano najniższy krytyczny strumień promieniowania cieplnego. Największą odporność na bezpośrednie działanie płomienia (najmniejszy zasięg rozprzestrzeniania) uzyskano dla drewna jesionu.

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