

Study of selected characteristics thermal degradation wood materials modified by coatings with the occurrence of risk substances

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Abstract: *Study of selected characteristics wood materials modified by coatings with the occurrence of risk substances.* The aim of the paper is to present in detail the proposal to test of ignitability for wood materials of the finished treatment for solvent and water-based diluted polyurethanes. In this paper, attention was paid to the preparation and specification of test specimens, test equipments, as well as implementing and evaluating the test ignitability (due to STN EN ISO 11925-2: 2010) prefinished wood materials PUR coatings which when burned can release dangerous chemicals (diisocyanates, respectively isocyanates and others from the group VOC).

Keywords: risk substances, surface treatment, wood materials, environmental protection, coatings, thermal degradation, test of ignitability

INTRODUCTION

In addition to the problematic ecological and hygienic acceptability of solvent based coatings the issue of fire safety is equally important not only due to the presence of dangerous chemicals (VOC), but also for the presence of dangerous flammable substances represented in solvents, thinners, and additives.

For predicting the behavior of surface-treated wood by solvent based coatings in realistic conditions of use it is important to assess the characteristics of thermal degradation of these materials in simulations of reaction to fire and add the other necessary criteria, allowing an overall assessment of fire-technical and related hygiene and ecological properties.

The test procedure is determined according to STN EN ISO 11925-2: 2010. Using this test we determine the ignitability of a product when exposed to a small flame. This test method has high explanatory power of information on the response of materials to fire and is a suitable method for the prediction of the real behaviour of the wood materials finish.

The test is in accordance with STN EN 13501-1 + A1: 2009 used in the reaction classes to fire B, C, D, E (construction products besides flooring and thermal insulation products for linear pipes), also for B_{fl}, C_{fl}, D_{fl}, E_{fl} (floor coverings) and the B_L, C_L, D_L, E_L (thermal insulation products for linear pipes), published (RUŽINSKÁ ET AL., 2013).

In this paper the attention is paid to the preparation and specification of test specimens, test kits, as well as implementation and evaluation of test ignitability prefinished wood materials PUR coatings that may be released during combustion of hazardous chemicals (diisocyanates, respectively isocyanates and other groups of VOC).

MATERIALS

For the purposes of the selected test methods the tested samples were prepared from MDF boards surface treated by different types of polyurethane coatings on the solvent and for comparison, also on the water-soluble base (Table 1).

The test samples (MDF board) according to the standard must have the length of 250 mm, width 90 mm and the thickness of less than or equal to 60 mm. In our case, the sample thickness was 19 mm – Figure 1.

Tab. 1 Polyurethane coatings applied to the surface of MDF boards*

Producer	PUR varnish	Sample designation
ADLER (Austria)	solvent based	Adler 15
ADLER (Austria)	water soluble	Adler 16
CHEMOLAK (SR)	solvent based	Chemop.
ICLA (Italy)	solvent based	Icla
MILESI (Italy)	solvent based	Milesi

*Details of the coating substances are also listed in the paper the authors RUŽINSKÁ ET AL., 2013.



Fig. 1 The test specimens according to STN EN 11925-2 – before the test of ignitability

THE TEST DEVICE

Test of ignitability is standardized test method, used in the model tests of burning. The device whose schematic representation is shown in Figure 2.

The test device is a combustion chamber (Figure 2.) in which the samples of prescribed size are exposed to a small flame for a specified time. The fuel is technical propane with a minimum purity of 95%, for the stability of flame burner at an inclination angle of 45 ° the gas must have pressure from 10 kPa to 50 kPa.



Fig. 2 The test device equipment according to STN EN 11925-2

Samples were tested in terms of end use, i.e. only by stressing the test surface using flame, if in the intended end use a direct flame strain of the product edge can not occur, or if in the conditions of end use the edges of the product may be exposed to flame then both ways of exposure to flame must be used. Methods of exposure to flame test specimens are shown in Figure 3.

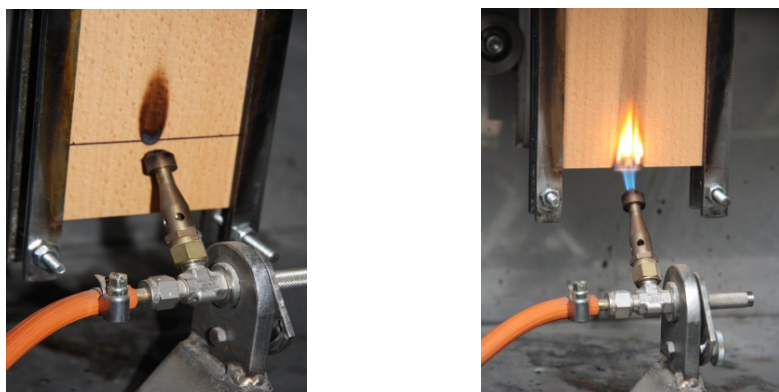


Fig. 3 Methods of exposure to flame test specimens – the test of ignitability

METHOD – TEST OF IGNITABILITY

The burner in a vertical position is ignited and the flame is set to the height of 20 mm and we let it stabilize. The burner is inclined by an angle of 45° to the vertical axis and shifted horizontally until the flame reaches a pre-set point of contact with the test sample. At the moment when the flame touches the test specimen secured in a holder (Figure 3.), the time machine turns on. The flame is applied to the sample for 15 s or 30 s (depending on the classification class), then the burner is retracted by a continuous manner and if the sample is ignited then the flame spread over its surface is monitored.

METHOD OF EVALUATION

The result of measurement is the finding whether the sample is ignited, and if the flame peak during 20 s or 60 s of the test (according to the classification class) reached the height of 150 mm above the point of application of the test flame and the time when it occurred, the physical behavior of the test specimen is also observed.

The results of the test procedure according to STN EN 11925-2 are collectively shown in Table 2, where the results of both methods of sample exposure to flame (i.e, the main surface and aslo the edge) are presented, at 30-second load of samples by flame.

Tab. 2 The evaluation of the exposure of the main surface and edges of the test samples to flame*

Sample		stress area			stress strain on the edge		
		evaluation criteria			evaluation criteria		
		inflammation of sample	spontaneous combustion (s)	$F_s \leq 150$ mm in period 60 s	inflammation of sample	spontaneous combustion (s)	$F_s \leq 150$ mm in period 60 s
Chemopur	1	yes	47	to meet the criterion	yes	145	to meet the criterion
	2	yes	10		yes	64	
	3	yes	9		yes	64	
Milesi	1	no	-	to meet the criterion	yes	17	to meet the criterion
	2	no	-		yes	28	
	3	yes	18		yes	20	
Icla	1	yes	13	to meet the criterion	yes	66	to meet the criterion
	2	yes	7		yes	148	
	3	no	-		yes	48	
Adler 15	1	yes	8	to meet the criterion	yes	16	to meet the criterion
	2	yes	7		yes	38	
	3	yes	10		yes	27	
Adler 16	1	yes	10	to meet the criterion	yes	51	to meet the criterion

* Results published in the work of authors RUŽINSKÁ ET AL., 2013.

DISCUSSION

From the results of the experiment conducted by ignitability tests, we can conclude:

- ✓ by comparing the results in terms of ignition of samples relating to the manner of load (stressing), more sensitive were the samples stressed on the edge. This finding corresponds to the final times of spontaneous combustion (Table 2), which are visibly higher in the samples tested by exposing their lateral surfaces (edges) – Figure 4.
- ✓ During both methods of loading the ignition of the samples occurred, as well as spontaneous combustion, but the spread of flame vertically in 60 seconds time did not reach the limit of 150 mm not even in one case, i.e. that all the specimens tested in accordance with the evaluation criteria according to basic standards of classification of the reaction to fire STN EN 13501-1 + A1 met the criterion $F_s \leq 150$ mm in 60 s and also fulfilled one of the conditions for their entry into the particular class of reaction to fire.

CONCLUSION

On the basis of the evaluation of ignitability test it was shown that all evaluated wood materials (MDF) surface treated by polyurethane solvent based and water based varnishes comply with currently valid standards from the point of the reaction to fire STN EN 13501-1 + A. The ignitability test provides the data for a complex understanding of fire-technical properties of these materials as well as the reactions of the tested materials to fire for the needs of the practice and to predict their behavior in real conditions. This test completed the

complexly necessary knowledge of thermal degradation of wood materials in simulated conditions - reaction to fire.

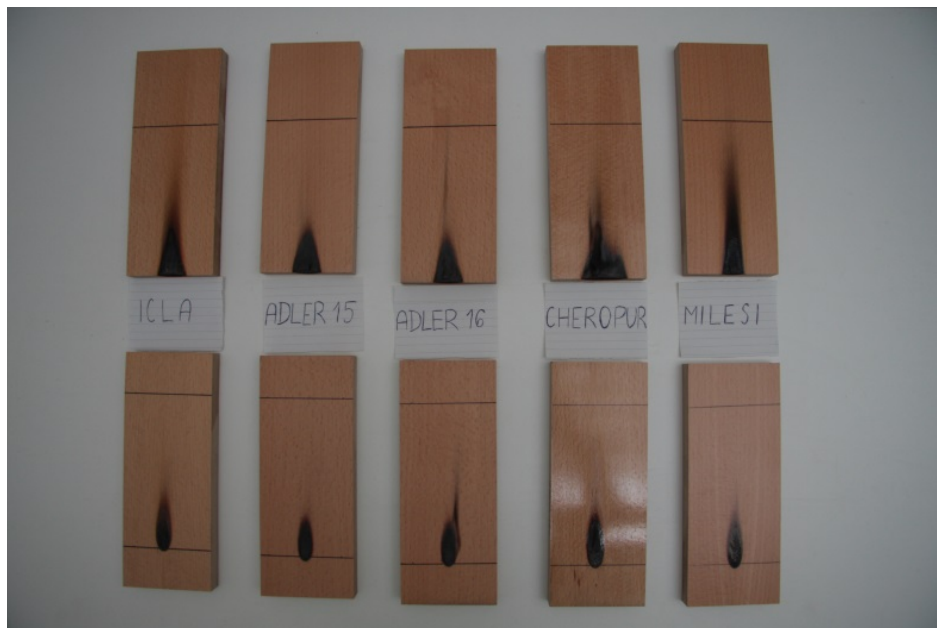


Fig. 4 The test specimens after testing ignitability

In this paper, attention was paid to the preparation and specification of test specimens, test devices, as well as implementing and evaluating the test ignitability prefinished wood materials PUR coatings which when burned can release dangerous chemicals (diisocyanates, respectively isocyanates and others from the group VOC).

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