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Classification of fire-technical characteristic of roofing materials in European and Russian regulation documents

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Abstract. The authors analyze the fire-danger index of building materials (such as roofing materials) in European and Russian regulations. The parameters which were obtained during tests in accordance with standard of roofing materials in European and Russian methods of testing were analyzed. Some of the tests to determine the properties of the fire hazard of building materials are identical. Contributors show that the European standardization system has a much wider range of test methods for determining the properties of fire safety of construction materials. In Russia, for some tests is not unique (the test in a corner room, non-flammability tests, etc.). We concluded that the European standards for building materials are more stringent and also that the correlation between the various indicators missing. We demonstrate significant differences in the European and Russian fire hazard classification of identical roofing materials.

1 Introduction

The establishment of the uniform fire safety's requirements for products, rules and forms of confirmation's accordance, comparable tests' methods is aimed to the ensuring the country's integration into the world economy and, in particular, to the export-oriented “import substitution” (government strategy that emphasizes replacement of some agricultural or industrial imports to encourage local production for local consumption, rather than producing for export markets) in the construction industry. The harmonization of European and Russian standards for test methods and classification of building materials and structures are actively investigated the last five years [1-6].

All of the properties of fire danger of building materials (combustibility, flammability, smoke-forming ability, toxicity of products of combustion, flame spread on the surface), are divided into groups. Belonging to the certain group is determined by the regulated tests and the precise grading, in Russia [7-10]. The properties of fire risk are determined on the basis of the tests, and on the totality of these properties a building materials are classified into five classes of fire danger KM0, KM1, KM2, KM3, KM4, KM5 according to the requirements of Federal Law No. 123-FZ “Technical Regulation of fire safety” [11].

The method of classification of fire hazard of building products and materials, including the products and materials applicable in building structures established in the European standard EN 13501-1-2001 «Classification of building products and materials for fire safety" [12]. According to

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[12], the building materials depending on the characteristics of their behavior on the fire are divided into two main groups: floor coverings and all other materials, excluding the floor materials in European classification.

The more differentiated approach is applied in the Russian classification. it establishes the following types of building materials: materials for covering walls and ceilings, flooring, including carpeting, roofing, waterproofing, and vapor barriers.

In the table 1 quoted comparative assessment of Russian and European classification principles for determining the fire hazard of building materials, taking into account the purpose of the building material, is shown. As we can see, despite that in the both classifications the ability to inflammation building materials from ignition source with different power is considered also as the possibility of the combustion of a variety of building materials fire hazards (high temperatures, smoke aerosol, etc.), experimental methods, which determine fire danger, and principles of classification of the building materials have absolutely different methodological approaches, as we know from the tests' results [13].

Classes of fire hazard of building materials in the Russian Federation are established according to the groups of fire risk. The assignment of the building material to a fire risk group (NG, G, B, RP, A, T) is carried the classification of parameters registered during the test according to standard experimental procedures. The degree of fire risk in the EU applies a methodological approach that is significantly different from the methods and principles of the classification adopted in the Russian Federation [14].

Table 1. Comparison of the principles of determining the classes of fire prevention class.

Fire prevention class (parameters according to the [8])	Purpose of building material	Parameters defining the fire prevention class	Notes
European (A1, A2, B, C, D, E, F)	All except flooring	ΔT, Δm, t_f, PCS, FIGRA, LFS, THR_{600s}, $F_{s.}$ SMOGRA, TSP_{600s}, dropping point	
	Flooring	ΔT, Δm, t_f, PCS, smoke emission	
Russian (КМО, КМ1, КМ2, КМ3, КМ4, КМ5)	For the walls and ceilings, including coatings of paints, enamels, varnishes and insulating	Г, В, Д, Т	The defining parameters for each mark: Г — T, S_m, S_L, $t_{с.г}$; В — q_{ign}; РП — q_{spr}; Д — D_m; T_n — H_{CL50}
	Flooring and Roofing	В, РП, Д, Т	
	Roofing	Г, В, РП	
	Waterproofing and vapor barrier with a thickness of more than 0,2 mm	Г, В	

Designations of the classification indexes: Fs—length of flame spread, mm; FIGRA – coefficient of heat W/s; LFS – lateral flame spread, m; SMOGRA – fume evolution coefficient m2/s2; THR600s – total amount of heat evolved in 600 s, mJ; TSP600s – total amount of fume, evolved in 600 s, m2; PCS – high heat value, mJ/kg mJ/m2 critical heat flux achieved after the 30 min test (i.e. quantity keeping with flame spread).

Analyzing the criteria and indicators of fire danger in the European and Russian standards, it can be concluded that European standards for building materials to satisfy more stringent requirements [1, 2, 13, 15].

Thus, for the classification of building materials is necessary to adopt the European standard classification completely. In this case, the relevance is determined by the need for additional research

methods and changes in the currently existing test methods for determining fire danger and fire resistance building structures [16].

2 Results and Discussion

Table 2 provides data on the parameters of fire danger according to the Russian and European classification of roofing. For roofing harmonized standard GOST R 56026-2014 "Building materials. The method of determining the group of fire danger roofing materials" [17] match to ENV 1187:2002 «Test methods for external fire exposure to roofs. Test 2: Method with burning brands and wind» [18]. Standards harmonized as a non-equivalent and European classification is not taken into account.

It will cause the acceptance of all the provisions of tests' ways. Some tests for determination the fire safety's properties of construction materials are similar according to the Russian and European standards. The European system of standardization has the much wider range of test methods for determining the fire safety's properties of construction materials which have no analogues in Russian regulations (table 3). The following table compares the roofing materials of different manufacturers. In connection with this direct correlation between the European and Russian parameters is difficult.

Table 2. Comparison of Russian and European classification of building materials on fire danger.

<table>
<tr><th>Classification parameter according to EN 13501-1</th><th>Test methods for fire danger</th><th>Classification parameter according to FZ-123</th><th>Test methods for fire danger</th></tr>
<tr><td>A1</td><td>EN ISO 1182:2010</td><td>КМ 0</td><td>ГОСТ 30244-1994</td></tr>
<tr><td>A2 (s1,s2,s3)* (d0,d1,d2)**</td><td rowspan="5">ISO 5657:1997
ISO 9239- 1:2010
ISO 5659 – 2:2012
ISO 13344:2004</td><td rowspan="6">КМ1
КМ2
КМ3
КМ4
КМ5</td><td rowspan="6">GOST 30402-96
GOST P 51032-97
GOST 12.1.044-89
p. 4.18
GOST 12.1.044-89
p. 4.20</td></tr>
<tr><td>B (s1,s2,s3) (d0,d1,d2)</td></tr>
<tr><td>C (s1,s2,s3) (d0,d1,d2)</td></tr>
<tr><td>D (s1,s2,s3) (d0,d1,d2)</td></tr>
<tr><td>E/E-d2</td></tr>
<tr><td>F</td><td>not rated</td></tr>
</table>

Notes: *s1 – SMOGRA ≤ 30 m2/ sec2, TSP600 ≤ 50 m2, s2 - SMOGRA ≤ 180 m2/ sec2, TSP600s ≤ 200 m2, s3 – all other cases.

**d0 – burning melt drops are absent (according to EN 13823) during 600 sec, d1 – more than 10 sec, but no more than 600 sec, d3 – all other cases.

Table 3. Comparison of Russian and European classification of roofing materials on fire danger.

Name of material and number	Classification parameter according to [19]	Classification parameter according to [11]	Notes
1. Reinforced synthetic roof waterproofing sheet based on polyvinylchloride (PVC-P-NB), WOLFIN (thickness: 1,2- 3,0 mm.)	Class E	КМ5, Г4, В3, РП4	

2. Roof waterproofing PVC-P membranes for mechanically fastened systems LOGICROOF V-RP (thickness: 1,2- 2,0 mm.)	Class E	КМ2*, Г1, В2, РП1 КМ3**, Г2, В2, РП1	*1,2 mm. **1,5 - 2,0 mm.
3. Plastic sheets for roof waterproofing covered sheets, gravel ballasted ALKORPLAN L 35177 (thickness: 1,2 mm., 1,5 mm.)	Class E	КМ5, Г4, В3, РП2	
4. Reinforced bitumen sheets for roof waterproofing Monarplan FM, Icopal (thickness: 1,2 mm., 1,5 mm.)	Class E	КМ3*, Г1, В2, РП1 КМ3**, Г2, В2, РП1	*1,2 mm. **1,5 mm.
5. Underlays for discontinuous roofing (thickness: 0,3-6 mm.) type Armourbase Pro, «IKO»	Class E	КМ5, Г4, В3, РП4	
6. Bitumen shingles with mineral reinforcement SHINGLAS type «Flamenco» «Jive» и «Foxtrot»	Class E	КМ5, Г4, В2, РП2	
7. Roof waterproofing membrane for covered flat roof systems with gravel ballast, roof garden or park deck Sikaplan-SGmA	Class E	КМ5, Г4, В3, РП2	
8. Roof waterproofing membrane for exposed mechanically fastened flat roof systems Sikaplan 18VG, Sikaplan 15VG	Class E	КМ3, Г2, В2, РП2	
9. Roof waterproofing membrane for exposed adhered flat roof systems Sarnafil G 410-12EL	Class E	КМ5, Г4, В3, РП1	

Felt			
10. Closed- cell polystyrene for thermal insulation of inverted roofs and floors Ravatherm XPS 500	Class E	КМ5, Г4, В2, Т3, Д3	
11. The wired mat for thermal acoustic insulation of industrial applications reaching high temperatures ProRox WM 950 ALU	Class A1	КМ1, Г1, В1, Д1, Т1	
12. Clay roofing tiles and fittings Koramic, «Wienerberger Ceramika Budowlana»	Class A1	КМ0, НГ	
13. Liquid applied roof waterproofing kit, based on polyurethane HYPERDESMO PB 2K	Class F	КМ3, Г2, В2, РП1	
14. Liquid applied roof waterproofing kit, based on polyurethane HYPERDESMO	Class F	КМ5, Г2, В2, РП3	
15. PVC membrane for waterproofing of roofing FLAGON SR	Class E	КМ5, Г1, В3, РП1	
16. Roof waterproofing membrane Protan SE	Class E	КМ5, Г2, В3, РП2	
17. Homogenous sheet waterproofing membrane with a signal layer, based on polyvinylchloride (PVC-P) (thickness: less 3 mm.) Sikaplan WP 1100-15HL, Sikaplan WP 1100-30HL, Sikaplan WP 2110-20HL	Class E	КМ5*, Г3, В3 КМ5**, Г4, В3 КМ5***, Г2, В3	* Sikaplan WP 1100-15HL ** Sikaplan WP 1100-30HL *** Sikaplan WP 2110-20HL

For instance, as we can see, the materials HYPERDESMO PB 2K and HYPERDESMO (numbers 13 and 14) have a class F. But these materials have respectively КМ3 and КМ5 class in Russian classification.

Materials ProRox WM 950 and Koramic (numbers 11, 12) have class A1 in European classification, while they have classification codes KM3 and KM5 in Russian classification. If we look in more detail, even if the same class, such as KM5, indicators flammability, flame propagation will also vary (numbers 14 - 17), etc.

3 Conclusions

As a result of analysis of the harmonization's process in European and Russian normative and technical documentation, it was found that currently in force in the Russian Federation regulations of fire safety in many ways contain different as from the European fire safety's requirements for products (buildings and structures, building materials and construction, fire -technical products, products of general purpose) [20, 21]. Research methods and measurements of fire safety's requirements which are comparable with European ones are also absent [17].

The scientific community thinks that after the harmonization of test methods will be necessary to come to uniformity in the classification of obtained parameters and their ranking on the principle of increasing the fire safety of construction materials and structures [22-26].

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