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Flammability of polymeric materials used in construction

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Abstract. This article is devoted to the results of fire risk studies of polymer construction materials (PCMs), in particular decorative and finishing materials. The article summarizes the results of longstanding research carried out at VNIIPO EMERCOM in Russia and covers the main areas such as a review of existing regulatory and technical bases, experimental study of fire hazard (mainly the ability to ignite) for decorative and finishing facing materials, estimation of the flammability of paint and varnish coverings (P&VC), development of a method to determine fields of application for decorative and finishing materials, based on the condition of non-flammability in the case of fire, development of permissible usage conditions for decorative and finishing materials in premises (especially along evacuation routes) and determining methods for establishing permissible finish height. Research conducted in the specified areas allows to formulate the conditions for fire-safe P&VC application, taking into account the established maximum values of heat flux density, as well as to propose methods for determining the ignition time, the critical density of the heat flux ignition and the amount of heat necessary to ignite a unit of the coating surface for further practical use. Fire-safe P&VC application means no fire hazard from such coatings under the conditions of their particular use. Experimental studies of the influence of P&VC thickness (number of layers) and base (substrate) type on the flammability indexes made it possible to establish a number of corresponding dependencies.

1. Introduction

The primary objective of this work are polymer finishing materials for walls and floors, which can contribute into fire spreading and occurring of other hazardous factors (such as flame, smoke, etc.). The subject of this research is flammability of polymer building materials under the influence of heat flux of different densities and the

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assessment of their parameters which can impact their possible application. Authors have not found any published researches concerning described materials and methods which can be used for their investigating.

Some types of epoxy and alkyd enamels, water dispersion paints, samples of painted metal panels and decorative and protective plaster used for finishing the exterior and interior walls of buildings were selected for the studies.

The flammability of polymer materials is a large problem of fire safety. Works in the area of fire safety are mostly concentrated on prevention [1−4]. There are many works devoted to the flammability of polymer building materials. [5−11], however most of the researches were focused on comparative tests and experimental data analysis, which is not connected with different fire modes and possible heat fluxes in specific conditions. If we talk about the application of different polymer coatings in fire conditions, we can mention works [12−14] which are concentrated on flammability of intumescent fire-protective coatings. Some other researches concerning the low flammable building materials are represented in [15, 16].

The relevance of a work to assess the fire hazard of polymeric building materials and the development of a fire prevention measures for their use especially on the evacuation routes is due to the need to ensure the safety of people during fire and also to limit the spread of a fire in a building to minimize material and environmental damage.

The aim of the current research is to estimate flammability of polymer building materials in conditions which are close to real fire scenario. The following tasks were formulated:

- To choose and justify the parameters of forecasting and assessment of polymer building materials fire hazard;
- To choose and justify the type of materials which will be used during research;
- To investigate flammability of samples and find out correlations;
- To show the possibility of determination of the area of safe application of polymer building materials considering obtained experimental data of their flammability.

From a fire occurrence perspective, in preventing the possible spread of fire through the building (or room) the flammability of combustible of PCM is the most important fire hazard property. Having achieved non-flammability of PCMs in the case of fire (along evacuation routes in particular), it is possible to limit the spread of fire, providing a safe means of evacuation and considerably reducing material and ecological damage.

The parameters, most often used for estimating the flammability of PCMs, are flammability temperature (°C), the critical density of the heat flux rate ($q^{flm}{}_{cr}$, kW/m²) and flammability time under the predetermined density of the heat flux rate ($\tau_{flm,cr}$) [17]. Another important and informative parameter that can be used in the assessment of PCM flammability is the quantity of supplied heat needed for flammability of a material surface unit ($Q_{flm,}$ kJ/m²), calculated from Eq. (1):

$$Q_{flm} = \int_0^{\tau\,flm} q(\tau)d\tau\,, \tag{1}$$

where $q(\tau)$ is the heat flux density influencing the material at a point in time τ and τ is the current time (s).

Under $q(\tau)$ = constant rate,

$$Q_{flm} = q\mathrm{eqv} \; * \tau_{flm}, \qquad (2)$$

To obtain a more objective assessment of flammability, all the parameters need to be considered as a result of the influence of heat flux and it is necessary to implement experimental conditions maximally close to the real ones, including the correspondence of the heat flux mode to the real heat flux.

Experimental data from [14] shows the change in heat flux density influencing the most dangerous section (from the point of flammability) during a fire. The data was obtained from results of field experiments at a polygonal installation, “High-rise building fragment”, with a fire load of 30 kg/m^2 (fire centre) in a room of 20 m^2, which corresponds to the majority of corridor-type buildings [18, 19]. In [14] it is shown how rates Q_{flm} and $q^{flm}{}_{cr}$ are calculated in a diagram. With a known value of $q^{flm}{}_{cr}$, it is possible to determine the permissible height of corridor finish [17]. In the example presented, the case of determining the maximum allowable flame propagation in a fire is not considered.

Research on the flammability of different PCMs under conditions of variable and constant heat flux density over a period of time made it possible to introduce the concept of “equivalent heat flux density over time”, q_{eqv}. q_{eqv} is a constant heat flux density over a period of time, which influences the material and provides flammability results identical to those obtained for a variable heat flux density over a period of time.

The results in [17] Fig. 2 were obtained experimentally in large-scale tests. In other specific cases, this dependence may have a different look and be different from linear. The research undertaken here can be used in future to maintain conditions for the fire-safe application of polymeric materials in a construction area, depending on the purpose of the materials and the purpose of the buildings.

The most potentially dangerous materials in terms of possible fire spread in a building are decorative and finishing facing materials used along evacuation routes and in rooms.

Any protective and decorative polymer coating applied to a non-flammable substrate (sand-cement mortar, concrete, brick, metal, mineral fibre plates, etc.) does not allow the material to be classified as non-combustible. This is because the combustibility test method (in Russia) for classifying construction materials as non-combustible or combustible only applies to homogeneous building materials. For laminates, it can only be used as an evaluation and tests are carried out for each layer of material separately. Thus, in the case of a composite of a non-flammable finishing material and a combustible polymer coating applied thereon, the composition cannot be classified as non-combustible due to the presence of a layer of combustible material in its composition. In the course of research within the present framework, an analytical evaluation was carried out of the thermal impact on the facade system structure during fire spread on the outer surface of exterior wall in tests according to [21]. For this purpose, tests were conducted at FGBU VNIIPO EMERCOM, Russia, assessing the fire hazard of facade insulating composite system samples with external plaster layers. The samples were assigned to fireproof class.

The temperature regime regulated by [21], it corresponds closely to real fire conditions and the maximum temperature values on the tested facade system surface are reached on the system surface at the flame exit point from the open aperture of the fire chamber at approximately 0.2–0.4 m from the upper boundary (upper slope). The maximum temperature values, recorded in the gas column (at 150 mm from the facade system sample surface) at the indicated location when testing various facade thermal insulation composite system (FTICS) samples were 600–650°C and on the facade system sample surface were 550–600°C, which corresponds to the average density value of incident heat flux on a facade system surface of approximately 50 kW/m^2. P&VC applied to the outer surface of the facade system finishing or facing surface almost completely burned out in the zone of direct exposure to the flame. This is confirmed by the test results for P&VC samples considered in the framework of the present work, according to standard [21]. Outside the zone of direct flame action (for example, at a distance of 1.8 m from the upper boundary of the fire chamber aperture) the maximum values of fixed temperatures in the gas column are in the range 300–350°C and on the facade system sample surface are 250–300°C, which corresponds to an average value of incident heat flux density on the facade system surface of approximately 15 kW/m^2.

2. Materials and Methods

To establish the extent to which the protective and decorative layer of the material can affect fire hazard, comprehensive experimental studies were conducted to determine the flammability, flame propagation over the surface, smoke-generating capacity and toxicity of the combustion products of certain facing materials, using different non-flammable bases (in particular, metal and cement) and different chemical compositions and thickness of P&VC paint coatings. To carry out the experiments assessing the fire hazard of such materials, standard test methods (Russian) were used.

An experimental evaluation of flame propagation was the simultaneous action of a 32 kW/m^2 radiation source and a pilot burner flame, and the measurement result was a dimensionless value of the flame propagation index taking into account the linear motion of the flame front and the temperature of the flue gases generated during combustion.

The method of determining the toxicity index (Toxicity index of combustion products) is biological and consisted of burning the test material in the combustion chamber at a known heat flux density and identifying the dependence of the lethal effect of gaseous combustion products on the mass of material, referred to the unit volume of the exposure chamber. There are four hazard classes of materials (T1-T4) according to the value of the toxicity indicator, of which class T1 is considered to be low hazardous.

The essence of the method for determining the smoke generation coefficient (D_m, m^2/kg) was to determine the optical density of the smoke generated during combustion or decay of an amount of material distributed in some volume. Three groups of materials are distinguished with low (S1), moderate (S2) and high (S3) smoke-generating ability.

To obtain the dependences of the critical falling heat flux density (CFHFD) and the linear velocity of flame propagation over the surface from the thickness of the P&VC, various types of epoxy and alkyd enamels and water-dispersion paints were used for finishing the exterior and interior walls of buildings. In addition, comprehensive study of fire hazard indicators was carried out for samples of finished painted metal panels and finishing compositions for the external surfaces of exterior walls of buildings and structures (facade compositions).

It is important to note that the P&VC layers were applied to a non-flammable substrate (or composition) in accordance with the normative and technical documentation development, with a consequent increase in the thickness of the upper layer (samples 1, 3, 4 and 5). Since in most cases of decorative property loss, P&VC layers are not removed, but are applied over the existing (“old”) P&VC layer (repainting), the thickness of the upper layer of the coating increases. Samples 6–8 comprised the external coating of building materials and structures (in this work, metal facing panels and facade composition).

The total thickness of outer decorative and protective plaster (base and finishing layers) in the facade compositions was not less than 7.0 mm, with a thickness of the base plaster layer not less than 5.0 mm. The thickness of increased strength, weatherproof, vapour permeable P&VC, used for thin-layer colouring (levelling) on the outer surface of the finishing/finishing layer of decorative protective plaster, was not more than 180–200 μm.

According to the results of the experimental studies conducted according to the [22], it was established that none of the samples of materials (compositions) investigated are in the group of non-combustible (NC) materials, with only one parameter considered – combustion duration (more than 10 s).

To answer the question of the extent to which the protective and decorative coating applied to different base types can affect composition flammability as a whole, experimental studies of various chemical compositions and thicknesses of P&VC were carried out. For this purpose, the chosen P&VC types were those used for finishing and repairing building premises and structures (walls, ceilings), in particular, water-dispersion acrylic enamel (WD) and pentaphthalic (PP) and oil (O) enamels. The bases were chrysotile cement sheets (CCS), gypsum plasterboard sheets (GPS) and GPS with glued fibreglass wallpaper. The bases for P&VC were chosen taking into account the most common surfaces for painting in buildings and structures. The main characteristics of the bases for coating are shown in Table 1. The term consumption (g/m^2) refers to the amount of paint applied to the surface to be protected to achieve the required coating thickness.

Table 1. Main characteristics of bases for coating.

Base	Thickness (mm)	Consumption (g/m^2)	Density
Chrysotile cement sheets	10	–	1600 kg/m^3
Plasterboard sheets	9.5	–	800 kg/m^3
Fibreglass wallpaper	0.3–0.5	–	120–140 g/m^2
PVA glue “Builder” universal	–	140–160	–

The choice of the number of P&VC layers was based on the possibility of repeated coatings of paint being applied in the case of repair work, mainly because of the need to allow for the required decorative and operational properties of the structure surface.

To establish the most probable numerical values of heat flux density during the development of fire in a room (or along evacuation routes), the following circumstances were taken into account. In large-scale studies of the behaviour of corridor wall finishing in conjunction with fire development in an adjacent room, it has been established that thermal impact intensity varies with the height from the floor level. The corridor wall section at a height of 2.0–2.5 m is exposed to the greatest thermal impact, with a heat flux density in the range of 25–30 kW/m^2 [23]. In this regard, when studying the flammability of P&VC used for finishing walls and ceilings, a maximum value of 30 kW/m^2, as the most dangerous, was taken as the value of the incident heat flux density.

For an intermediate number of layers (from 3 to 5), the P&VC values are determined to a great extent by the thermophysical properties of the base, namely its thermal diffusivity, i.e. the value characterizing the change rate in the temperature field of material when exposed to an external heat source. The density data and thermophysical properties of the bases considered in this work, as well as the results of calculating the thermal diffusivity coefficient based on these, are presented in Table 2. From these data, it is evident that gypsum board thermal diffusivity is more than 1.7 times higher than the corresponding coefficient for asbestos-cement, which qualitatively explains the regularities obtained in experiments for the case in which the P&VC is thermally thin and the dynamics of heating to a significant degree depend on the thermophysical properties of the substrate to which it is applied.

Table 2. Thermophysical properties of bases.

Base	Density (kg/m^3)	Coefficient of thermal conductivity (W/m·K)	Specific heat (J/kg ·K)	Thermal conductivity (10^7·m^2/s)
Chrysotile cement sheet	1600	0.35	1500	1.5–1.6
Plasterboard sheet	800	0.2	950	2.6

3. Results and Discussion

The characteristics of samples and finishing compositions and the results of the experimental studies are presented in Table 3. CFHFD reflects the value of the heat flow delivered to the exposed surface at which steady flame burning was observed when approaching the specified surface of the pilot flame. Repeatability of the results obtained was less than 15 %, and the error of the determined parameters did not exceed 10 %.

Experimental studies determining the critical surface heat flux density for paint materials considered within the framework of this work were carried out using the test method and measuring instruments in accordance with the requirements of [24]. Experimental data characterizing the CFHFD changes for P&VC samples, depending on the chemical composition, thickness and type of the base, are shown in Fig. 1, 2 and 3.

With a CFHFD of 30 kW/m^2, P&VC samples based on WD enamel do not ignite when 2–5 layers are applied to CCS, GPS and GPS with glued fibreglass wallpaper glued, which indicates the potential for fire-safe application in corridors of buildings. In this case, taking into account the maximum heat flux density, q_{max} (30 kW/m^2), which affects the most heated section of the wall, the condition of CFHFD q_{max} will be fulfilled, thus ensuring non-flammability and hence system fire safety.

From the dependences presented in Fig. 1, 2, and 3, it also follows that differences in the chemical composition of P&VC and different types of bases have different coating critical thickness values at CFHFD = 30 kW/m^2. This conclusion is of practical interest because it is possible to regulate the fire-safe (permissible) number of deposited layers or the thickness of P&VC along evacuation routes and in indoor spaces.

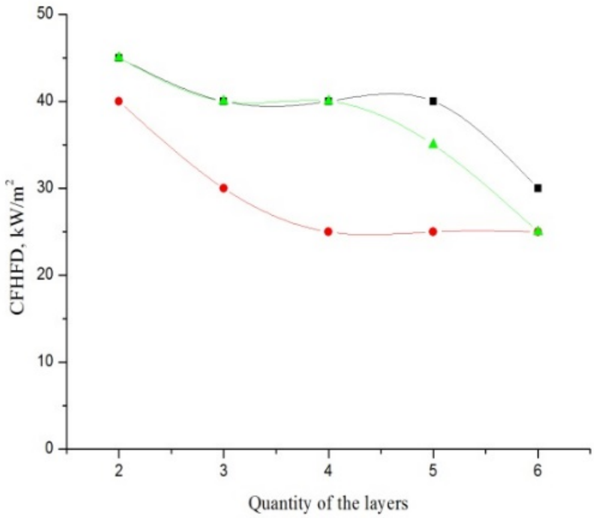

Figure 1. Dependence of CFHFD based on the number of layers:
■ water-dispersive enamel (base – chrysotile cement sheet);
● water-dispersive enamel (base – gypsum plasterboard sheet);
▲water-dispersive enamel (base – plasterboard sheet with glued fibreglass wallpaper).

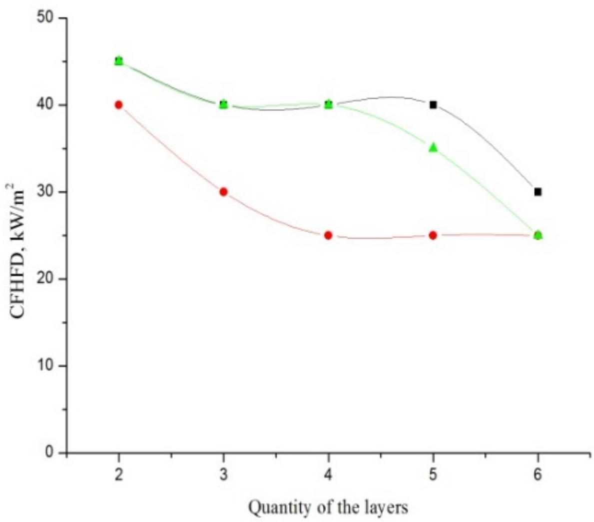

Figure 2. Dependence of CFHFD based on the number of layers:
■ water-dispersive enamel (base – chrysotile cement sheet);
● water-dispersive enamel (base – gypsum plasterboard sheet);
▲water-dispersive enamel (base – plasterboard sheet with glued fibreglass wallpaper).

Table 3. Characteristics and test results of paint and varnish coatings.

No.	Name (characteristic) of the paint and varnish coating (enamel)	Thickness of a layer of the material, μm	Combustibility group T °C/ S_L,%	Flammability group CFHFD (kW/m^2) (flammability time, s)	Coefficient of smoke formation (D_m, m^2/kg) smoke-forming capacity	Toxicity index of combustion products combustion product toxicity group	Flame spreading index
1.	Complex coating (waterborne acrylic facade primer, waterborne acrylic facade paint)	180–200 (primer:10–15 μm, paint:170–185 μm)	106/11	F1/40 (304)	174/S2	> 120/T1	0.7
		280–300 (primer: 10–15 μm, paint: 270–285 μm)	108/12	F1/40 (196)	174/S2	> 120/T1	1.2
		370–400 (primer : 10–15 μm, paint; 360–385 μm)	114/17	F2/30 (676)	174/S2	> 120/T1	2.3
2.	Complex coating (facade primer based on an aqueous silane/siloxane emulsion, water-based facade paint based on emulsion of silicone resin)	280–300 (primer: 10–15 μm, paint: 270–285 μm)	108/13	F1/40 (46)	192/S2	> 120/T1	2,8
3.	Complex coating (waterborne acrylic primer, waterborne acrylic paint)	200–240 (primer: 15–20 μm, paint:185–220 μm)	106/11	F1/40 (138)	165/S2	> 120/T1	0.5
		280–300 (primer: 15–20 μm, paint: 265–280 μm)	109/13	F1/40 (21)	165/S2	> 120/T1	1.1
		370–400 (primer: 15–20 μm, paint: 355–380 μm)	115/16	F2/30 (324)	165/S2	> 120/T1	1.8
4.	Complex coating (latex putty, alkyd enamel)	280–310 (putty: 240–260 μm, paint: 40–50 μm)	110/13	F1/35 (214)	292/S2	> 120/T1	23.4
		320–350 (putty: 240–260 μm, paint: 80–90 μm)	112/16	F2/25 (302)	292/S2	> 120/T1	>20
		360–410 (putty: 240–260 μm, paint: 120–150 μm)	123/24	F2/25 (118)	292/S2	> 120/T1	>20

No.	Name (characteristic) of the paint and varnish coating (enamel)	Thickness of a layer of the material, μm	Combustibility group T °C/ S_L,%	Flammability group CFHFD (kW/m^2) (flammability time, s)	Coefficient of smoke formation (D_m, m^2/kg) smoke-forming capacity	Toxicity index of combustion products combustion product toxicity group	Flame spreading index
5.	Complex coating (two-component epoxy putty, three-component epoxy enamel)	190–230 (putty: 120–140 μm, paint: 70–90 μm)	108/15	F2/20 (742)	802/S3	42/T2	2.72
		260–320 (putty: 120–140 μm, paint: 140–180 μm)	112/15	F2/20(608)	802/S3	42/T2	7.43
		380–420 (putty: 120–140 μm, paint: 260–280 μm)	113/16	F2/20 (496)	802/S3	42/T2	>20
6.	Polyether powder paint	80	107/11	F1/50	43/S1	> 120/T1	0
7.	Coating based on polyvinylidene fluoride (PVDF)	30	107/11	F1/50	32/S1	> 120/T1	0
8.	Organic-soluble acrylic paint on cement plaster with a layer of 2 cm	200 (paint)	105/9	F1/50	40/S1	> 120/T1	1.3

Note: For samples 1–5, paint and varnish coatings were applied to 10 mm thick chrysotile cement sheets; for samples 6–7, paint coatings formed a protective layer for metal panels with a thickness of 3 mm); sample 8 was a composition of a facade mineral plaster on a non-combustible mineral wool board.

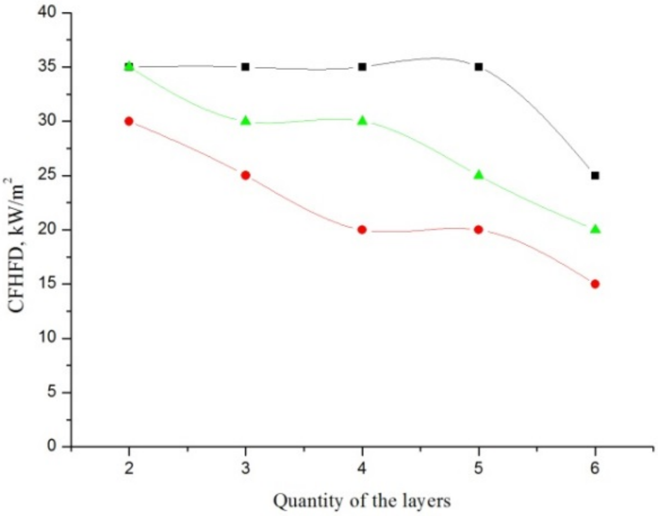

Figure 3. Dependence of CFHFD based on the number of layers:
■ pentaphthalic enamel (base – chrysotile cement sheet);
● enamel pentaphthalic (base – plasterboard sheet);
▲pentaphthalic enamel (base – gypsum plasterboard with glued fibreglass wallpaper).

Analysing the dependences obtained (Fig. 1), one more important conclusion can be drawn. Given the absence of any control over the number of coatings applied along evacuation routes in buildings, the use of P&VC with synthetic varnishes should be allowed on any base because the condition of CFHFD q_{max} cannot be met.

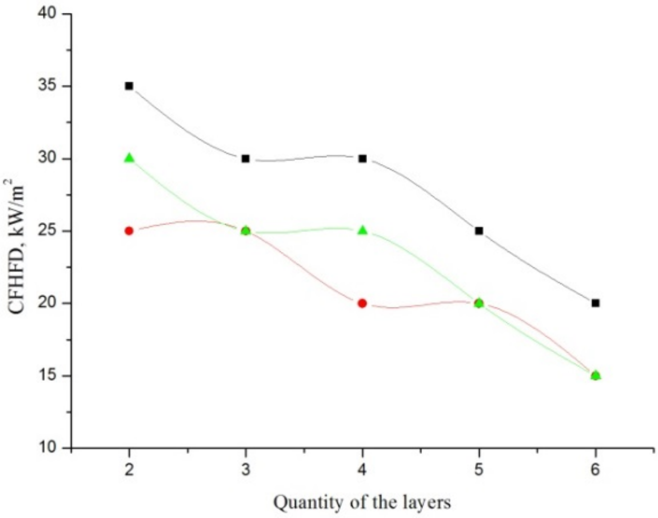

Figure 4. Dependence of CFHFD based on the number of layers:
■ enamel oil (base – chrysotile cement sheet);
● enamel oil (base – plasterboard sheet);
▲ enamel oil (base – plasterboard sheet with glued fibreglass wallpaper).

The results of the analysis of the influence of base type, namely the thermophysical properties, on the CFHFD values of the P&VC studied in the framework of this work are important. For example, for WD enamel in the case of four layers deposited on a non-flammable substrate, the indication for the number of layers deposited corresponds to the maximum possible in accordance with the requirements of [21], with the CFHFD value ranging from 25 to 40 kW/m^2, i.e. 60 % with respect to the minimum value for the various types of bases investigated in the present work. This requires an explanation, both from the point of view of an objective assessment of the CFHFD for P&VC applied on various bases and from the analytical point of view due to deficiencies in the regulatory requirements for the test procedure determining the CFHFD.

It should be noted that the smallest differences in the CFHFD values, depending on the type of the non-combustible base, are observed for the minimum number of layers (2) and for the maximum number of layers (6). In the case of the minimum number of layers, the CFHFD values are in the range 40–50 kW/m^2 and 30–35 kW/m^2 for WD and PP enamels, respectively. In terms of the values for incident heat flux derived using the standard test procedure according to [24], the impact on the sample under investigation is a result of thermal shock and the ignition of the P&VC sample occurs in a considerably shorter time than the corresponding time for P&VC samples with a deposit of 3–5 layers on a non-flammable substrate, which indicates that there is no effect of dissipation (removal) of heat from the source of thermal radiation through a non-flammable base. In the case of the maximum number of layers, the coating applied to the substrate ceases to be thermally thin, that is, the thermophysical properties of the coating itself have a significant influence on the heating of the composition of the P&VC base.

As the standard procedure for determining CFHFD according to [24] allows only one type of non-flammable substrate (asbestos-cement [chrysotile cement] sheets with a thickness of 10 or 12 mm), the results will be a characteristic not only of the coating, but also its composite combination with the chrysotile cement sheet. This can be disputed on the grounds that the CFHFD value is a classification characteristic defined under standard conditions and is intended only for assigning the material to a particular flammability group F1-F3 in accordance with Russian classification of building materials. The conditions of standard tests should, as far as possible, approximate the conditions of thermal impact on the material under investigation, which is realized in real fires. The main problems arising and their solutions are as follows.

First, the definition of the CFHFD as exclusively a characteristic of the material under investigation implies the absence of influence of the non-combustible base type (its thermophysical properties). For this, non-combustible bases with thermal diffusivity values that are significantly smaller than the corresponding values for the types of bases studied herein can be used. P&VC thickness should be such that the effect of the incombustible base on its heating is negligible. This can be achieved, for example, by increasing the minimum number of P&VC layers required for a standard test. Such an approach may not meet the conditions for the application of P&VC in practice (in terms of the number of layers deposited on the base), but will give a certain margin of safety with regard to determining the CFHFD.

Second, there is the problem of determining the CFHFD as a characteristic of the composite combination of P&VC and a specific non-flammable base (or other non-flammable base with similar thermophysical characteristics). The approach herein allows us to determine the CFHFD for P&VC not only in combination with a non-flammable base, but also with a combustible base. In this case, an objective assessment of the CFHFD will be obtained to predict the behaviour of the PP under the conditions of the development of a real fire.

As already noted above, the practical purpose of the studies presented is to ensure the fire safety of PCMs used in construction and their non-flammability, in particular focusing on P&VC. In this regard, we focus on ensuring non-flammability in a fire, for which it is necessary to have a distribution of the heat fluxes affecting the building structures under real conditions. As an example, let us consider the distribution of heat fluxes along the height of the corridor during a fire in a room. At a known value of $q^{flm}{}_{cr}$ (established under the influence of time-varying heat flux), it is possible to determine the permissible height of the corridor wall finish. Taking into account the experimental data obtained, the conditions $q^{flm}{}_{cr} > q_{max}$ and CFHFD > q_{max} are satisfied only for WD enamel applied to non-flammable substrate ($q^{flm}{}_{cr}$ and CFHFD for WD enamel of more than 40 kW/m^2).

The presented experimental data on the dependence of the values of heat fluxes (CFHFD (kW / m^2)) on the thickness of the applied coating and the type of basis sufficiently correspond to similar research results obtained by S.V. Stebunov in his PhD thesis «Investigation of the fire hazard properties of paint coatings» with regard to complex coating (waterborne acrylic facade primer, waterborne acrylic facade paint).

Also it is important to note that due to information we possess no researches on the similar coatings were performed before us.

4. Conclusion

1. In this article, the results of longstanding research assessing the ignitability of PCMs (including P&VC) are presented, according to the standards and especially the methods developed by the FGBU VNIIPO EMERCOM, Russia, which are designed to solve various problems in ensuring the fire safety of buildings (assessment of ignition in classification, development of formulations, confirmation of compliance, determining the area of acceptable use, etc.).

2. This article describes approaches to forecasting of flammability of decorative, finishing, facing materials and paint coatings. These approaches are based on particular experimental data and findings

about a possible fireproof application of those materials, for example, on the evacuation routes of public buildings. This research is of practical and scientific interest for a wide range of specialists, approaches and methods represented in it can be applied by specialists both in Russia and abroad for assessment of the possibility of using building materials in rooms of various functional purposes. The presented approaches are illustrated by specific examples.

3. Studies of the fire hazard of various P&VC have been conducted, taking into account the type of material, base thickness (number of layers) and coating. Appropriate dependences have been obtained, which make it possible to resolve practical issues of the application of P&VC in construction, ensuring the non-proliferation of fire in a building (premises) and the safety of people. New methods have been developed with the aim of determining more complete and objective indicators for PCMs.

4. A complex of experimental data on fire hazard of finishing materials was obtained. This data (mostly on the critical heat flux densities which cause burning of polymer building materials) contributes into previous results obtained by other researchers.

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