CONFINDUSTRIA CERAMICA

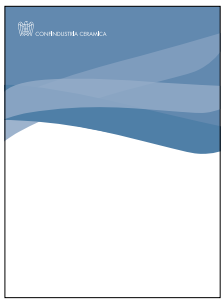
Comparative study on reaction to fire

Ceramic tiles and PBM

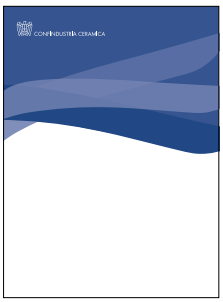
September 2020

Le collane editoriali di **Confindustria Ceramica**

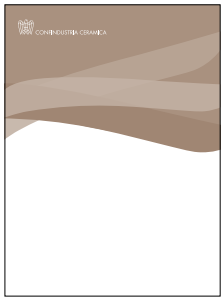
Ambiente
e Sostenibilità



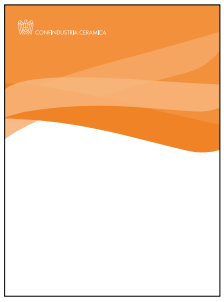
Associazione



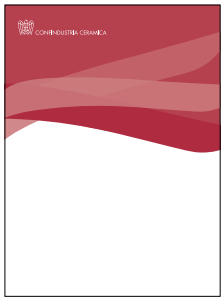
Commercio
Internazionale



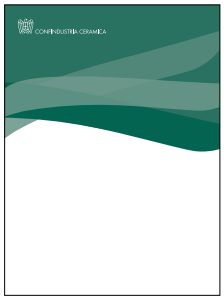
Comunicazione



Lavoro
e Sicurezza



Studi
e Ricerche



CONFINDUSTRIA CERAMICA

Comparative study on reaction to fire

Ceramic tiles and PBM

September 2020

CONTENTS

INTRODUCTION

The Association has implemented a series of actions aimed at promoting the values of ceramics in relation to competing materials, in particular PBM (plastic based material floorings).
This publication summarizes some comparative information on the fire behavior of ceramic tiles and PBM.
After a brief technical background on the characteristics of PBM and on fire (definitions and standardization), the results of a **study carried out by the *Centro Interdipartimentale di Ricerca Industriale (CIRI) Meccanica Avanzata e Materiali (MAM)* of the University of Bologna** are presented. The study analyzes the reaction to fire of PBM and investigates the correctness of the commercial statements made in the brochures, on the websites, and in the technical data sheets of these products.

1. TECHNICAL BACKGROUND

1.1. Plastic based material floorings (PBM)

Under the **category PBM** (plastic-based material) are a wide array of different flooring materials of varying composition that have as a common denominator their **plastic composition**.

The following products fall into this classification:
- Resilient floor coverings;
- LVP (luxury vinyl plank);
- WPC (wood polymer composite);
- SPC (stone polymer composite);
- CPC (clay polymer composite);
- RGB (rigid core board);
- LVT (luxury vinyl tiles).

1.2. Definitions

The **reaction to fire** of a material represents the behavior to fire of that material which, due to its decomposition, may or may not fuel the fire to which it is exposed, thus participating in the fire. It is a parameter specifically referred to materials as such, which assumes particular relevance for construction and furnishing materials.

Fire resistance is a parameter typically referred to structures and buildings and represents the ability of a system composed of one or more materials to withstand fire and insulation for a given time during a fire.

Flammability is the ease with which a material burns causing fire or combustion. The following are always needed to generate combustion: fuel (substance that burns); oxidizer (substance that participates in the reaction); and igniter (energy source that starts the reaction).

1.3. Classification of the reaction to fire

1.3.1 EUROPEAN CLASSIFICATION

According to the **European classification (EN 13501-1)** construction materials for flooring are divided into 7 classes, as shown in the following tables.

*Main classification**		
A1fl	+++++	Incombustible materials (ceramics, glass, metals, etc.)
A2fl		
Bfl	++++	Nonflammable combustible materials
Cfl	+++	Non-easily flammable combustible materials
Dfl	++	
Efl	+	
Ffl	-	Easily flammable materials

* = the abbreviation fl after the class indicates flooring materials

Secondary classification				
Production of smoke during combustion	s	1	++	Absent or weak emission quantity and velocity
		2	+	Medium emission quantity and velocity
		3	-	High emission quantity and velocity
Dripping during combustion	d	0	++	No dripping
		1	+	Slow dripping
		2	-	High dripping

1.3.2 ITALIAN CLASSIFICATION

The classification of materials according to their reaction to fire in Italy is defined by the **UNI CEI EN ISO 13943/2004 standard**, and is summarized in the following table:

Italian classification	*Definition*
0	Incombustible materials
1	Non-flammable combustible materials
2	Non-easily flammable combustible materials
3	Flammable combustible materials
4	Easily flammable combustible materials
5	Extremebly flammable combustible materials

A **comparison between Italian and European classes** is not entirely possible, since the evaluation criteria and the methods employed are completely different; however, to apply the laws that require a certain reaction to fire, the Ministerial Decree of 15 March 2005 introduces a table comparing the Italian classes with the European ones.

Definition	*Italian classification*	*European classification Flooring materials*
Incombustible materials	0	A1fl
Non-flammable combustible materials	1	A2fl – s1 A2fl – s2 Bfl – s1 Bfl – s2
Non-easily flammable combustible materials	2	Cfl – s1 Cfl – s2
Flammable combustible materials	3	Dfl – s1 Dfl – s2
Easily flammable combustible materials	4	Efl – s1 Efl – s2
Extremebly flammable combustible materials	5	Ffl – s1 Ffl – s2

2. REACTION TO FIRE OF PBM

2.1. Composition of PBM

The **Centro Interdipartimentale di Ricerca Industriale (CIRI) Meccanica Avanzata e Materiali (MAM)** of the **University of Bologna** highlights in its study that PBM are mostly **composite materials**, formed by **layers** of modest thickness of **PVC** (polyvinyl chloride), with a **polyurethane surface finish**, in several cases strengthened by a layer of PVC-impregnated **glass fiber** or calcium carbonate still impregnated with PVC. In some cases, there are also internal layers made of recycled plastic materials.

Relevant data for understanding the fire behavior of the main PBM components are summarized in the table below:

Layer	*Combustible*	*Ignition temperature*	*Minimum critical trigger flux*	*Combustion heat*	*Substances produced during combustion*
PVC	yes	318°C	10 kW/mq	18 MJ/kg	Hydrochloric acid Carbon monoxide
Polyurethane	yes	271°C	23-40 kW/mq	27 MJ/kg	Cianidric acid Carbon monoxide
Glass fiber	It does not participate in the fire, however in case of destruction of the organic matrix that impregnates it, the fibers can be airborne, creating a potential respiratory exposure, which requires the adoption of specific protections.				

2.2. Reaction to fire of PBM

The study performed by **CIRI - MAM of the University of Bologna** has analyzed the **claims** made in the brochures and technical data sheets of a total of **47 products** from different brands belonging to the product category of plastic based material floorings (PBM).
The examination of the documents revealed that, with reference to the claims related to the characteristics of reaction to fire, they only indicate the corresponding class of the product according to **EN 13501-1**, referring to the use for flooring.

In all cases considered, the classification corresponds to the condition of c**ombustible materials** that, compared to the test conditions, show a **reduced participation in the fire**. The class reported is:
- **Bfl-s1** for the great majority of cases and
- **Cfl-s1** for the remaining part,
which is referred to the use in **floor coverings** and for assigned test conditions.

The **reaction-to-fire performance** of the **PBM** reviewed is **stated for floor installation only**; the reaction performance of these materials **remains unknown for wall** and raised floor applications.

The **combustion products of PBM** are particularly **hazardous to humans** in general, and in specifically in the conditions specific to a fire. Since they are not incombustible, even if they have a good reaction class to fire, they **participate** in the fire, with general fire conditions. In the **post-fire phase** they generate **pollution and corrosion**.

Even **thermal attacks** that **do not result in fire** may cause **functional or aesthetic alteration** of PBM.

2.3. Critical analysis of commercial statements

The **University of Bologna** study then conducts a critical review of **commercial claims** for the reaction to fire performance of various polymer-based interior floor and wall covering materials. The main assessments made are reported below.

- Although there are no clearly misleading claims or communications with respect to the reaction to fire characteristics or performance in case of fire of the products, there are **elements of ambiguity** in some of the technical sheets, referring to possible applications of the products not supported by the specific certification of reaction to fire. In the documentation there are no examples or specific representations of the behavior of the products in conditions of exposure to flames, fire, embers or specific effects in case of fire.

- As mentioned above, the reaction to **fire performance of the PBM** examined is **only declared for floor installation**; however, in several **brochures,** alongside the characteristics that highlight the class of reaction to fire relative to floor installation, **images are shown in which the product is used in walls**, or information is provided on the availability of elements for covering the riser and **tread of stairs** or, more

simply, the **generic indication** of use in "**coverings for internal use**" is reported. Communication elements of this type may give the consumer the impression that the product has fire performance characteristics suitable for installation other than on the floor.

- The sheets do not contain any information regarding the extension of the reaction to fire certification for **laying conditions that envisage the use of adhesive systems**, for which an ad hoc certification must be considered necessary, since the certified classification for laying without glue (typical of floating floors) cannot be considered extended to this application.

3. REACTION TO FIRE OF CERAMIC TILES

Ceramic materials are inherently non-combustible and therefore products made from **such materials have the best possible fire reaction performance**, regardless of the conditions of installation or use.

This condition is specifically recognized by current regulations, which require that ceramic is to be considered as belonging to the **classes A1 and A1fl**.
The fire safety of ceramic materials is intrinsic, since it **does not depend on specific limitations imposed on the installation conditions**. Ceramic materials do not participate in the fire and even in the post-fire phase they remain inert.

In the **communication campaign "The values of ceramics. A safe choice"** composed of 8 video clips, centered on aspects that characterize the ceramic product (hygiene, durability, fire resistance, sustainability, safety, resistance, versatility, stability), the **video that recorded the most views is the one on fire ("Ceramic does not burn")**, demonstrating the sensitivity of the issue in some markets.

OTHER MATERIAL ON PBM

The following PBM-related materials are available for member companies in the private area of the Confindustria Ceramica website:

a) **Technical summary** prepared by Confindustria Ceramica of the results of the study of comparison between ceramic tiles and LVT commissioned to the **Fraunhofer Institute**.

The following aspects are dealt with: microbial resistance (performance of materials and microbial growth, leaking test, toxicity of materials), water resistance, chemical resistance (determination of volatile organic compounds - VOC, resistance to solvents), fire resistance (degree of combustion of the flame, analysis of fumes), thermal expansion, evaluation of toxicity, life cycle analysis (LCA)

Available in: **Italian, English, French, German**.

b) **Comparative table** of the performance of PBM and ceramic tiles, elaborated by **Centro Ceramico**.
Concise information tool, particularly useful in commercial relations.

Available in: **Italian, English, French, German**.

c) **Technical summary** prepared by Confindustria Ceramica of the results of the study on PBM carried out by **TCNA** in collaboration with **Clemson University**.

The following aspects are covered: resistance to the growth of mold and mildew, impermeability tests, wet floor slip resistance.

With regard to the use of documents a and b, reference should be made to the contents of the Media Kit (paragraph "The legal context"), available for consultation in the private area of the Association's website.

NOTE

NOTE

This document is a summary made by Confindustria Ceramica
of the study conducted by the Centro Interdipartimentale di Ricerca
Industriale (CIRI) Meccanica Avanzata e Materiali (MAM)
of the University of Bologna.

Viale Monte Santo, 40 - 41049 Sassuolo (MO)
T 0536 818111 - F 0536 807935
www.confindustriaceramica.it - info@confindustriaceramica.it