

A study on selection of polymer based surface materials in interior design

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Abstract

People interact with surfaces in interior spaces, where a huge part of their life lasts. Many of these surfaces which surrounds the interior spaces are covering or coating materials in various textures and shapes. Materials used in interior surfaces are applied for various purposes. Protection, insulation or decoration can be considered as the main objective of these purposes.

This study aims to research what kind of polymer based surface materials are used by interior designers and their reasons, frequency and area of use. For this reason, the study is composed on a questionnaire. The questions are prepared by summarizing the polymer based material information obtained from the literature. The questionnaire participants are interior designers who are actively working in the field. With this group, a survey on selection of plastic materials has been made. Survey results are explained in the findings. The last chapter includes the conclusions and recommendations of the study.

Keywords: Interior design, surface materials, plastics, polymers.

1. Introduction

Surface materials are developing in line with the technological developments. Every day, newer and different materials are presented. It becomes harder for designers to track the changes that are occurred on materials and to choose convenient one through the materials. In view of polymer based materials, they are open to improvement and have lots of kinds. In this study 'polymer based materials' are describing synthetic organic materials derived from petroleum products and generally considered as plastics.

Early uses of plastics in interiors were an alternative of glass and daily objects of human life. With the technological developments, today plastics are also used in furniture and coverings for various surfaces (Sadıklar, 2014). In their production process, they can be mixed with additives, plasticizers or fillers to obtain the expected performance from plastics. It brings plastics the opportunity to find an increasing usage area day by day because of its chemical various types and these types can provide numerous compounds. However, it varies with the characteristics of polymer and its place of use.

2. Purpose and Method of Study

This study aims:

- To introduce the main types of polymers used in interior design, highlight their properties which make them a proper choice of material,
- To research what kind of polymer based surface materials are used by interior designers and for which reasons, usage frequency and area of use,

With these aims, literature research and questionnaire technique was applied in the study. The questionnaire participants are 50 interior designers who are actively working in the field.

3. Findings

3.1. Polymer Based Surface Materials in Interior Design

In interiors, polymers can be found in many different forms and applied in various ways. It is almost impossible to tell the difference by just looking at their appearance. Features of polymer based materials need to be well known to apply proper polymer based material for the purpose.

It has been indicated to determine the polymer based surface materials that are mentioned in various sources and has been determined the 10 most used plastics with putting them into order in the chart by rate of their presence in the sources (Table 1). According to Table 1, the ten most mentioned polymers are epoxy, rubber, melamine formaldehyde, polyamide, polyester, polyethylene, polycarbonate, polymethyl methacrylate, polyurethane and polyvinyl chloride.

Table 1. Frequency of polymer based surface materials in the sources (Sadıklar, 2014).

Polymer Name	Abbreviations	Beylerian & Andrew, 2007	Campos, 2007	Gagg, 2003	Schittich, 2008	Sauer, 2010	Van Uffelen, 2008
Polypropylene	PP	+				+	
Polytetrafluoroethylene	PTFE	+				+	
Polyurethane	PU	+	+	+		+	+
Rubber	-	+			+		+
Polyethylene terephthalate	PET	+	+	+		+	+
Polyamide	PA	+		+		+	
Polyvinyl chloride	PVC	+	+	+		+	+
Polycarbonate	PC	+	+	+	+	+	+
Polymethyl methacrylate	PMMA	+	+	+	+	+	+
Polyethylene	PE	+		+		+	+
Epoxy	EP	+	+	+	+	+	+
Melamine formaldehyde	MF	+			+	+	
Polystyrene	PS	+				+	

3.1.1. Epoxy

Epoxy surfaces exhibit dimensional stability, toughness, and abrasion resistance (Beşergil, 2014). In addition, it provides strong adhesion to a wide range of different surfaces, including glass, metals, fibers etc. Epoxy is suitable for such interiors: hospitals, drug stores, factories, shops, schools, laboratories, abattoirs, wineries, petrol stations and industry plants. The difference between an epoxy floor and an epoxy floor coating is thickness. Epoxy floor must be at least two millimetres thick. If it is less than two millimetres thick then it is referred to an epoxy floor coating. It can be performed with desired sizes and various filling materials and colour options provide to have different visual forms. Besides flooring, epoxy system is also used on walls and ceilings where abrasion resistance is required; for protection against mild corrosion; and as a decorative waterproof coating (Fig.1a).

3.1.2. Rubber

Rubber floor coverings are available in different shapes, forms and colours (Fig. 1b). Different colour options provide the various pattern arrangements. It also provides secure floors to walk on by preventing the slipping. Rubber surfaces are capable of absorb the sound that occurred by walking, furniture or machine. Rubber coatings have two forms; tile and roll. Both forms have colour options.

The most recognizable areas that rubber coatings used are schools, hospitals, labs, conference halls, factories, public transportations, cinemas, libraries, airports, ballet rooms, fields and areas used for handball, volleyball, squash, tennis and fitness. Besides it is used for floor coating, it is also used for wall coating. Hospitals' interiors that must meet the hygiene criteria are good example for this application. Also it can reduce the effect of falling and impact in interior areas because of its aforementioned features and therefore it might be useful to apply rubber material to floors and walls.

3.1.3. Melamin Formaldehit

Melamin formaldehit is one of the termoset resins. It is used for the production of panels that will be used in interior design, protective coatings and foams that will be used for acoustic purposes. Melamin foam panels are sound absorbers. They are light-weighted, decorative and can also be applied easily by sticking on (Fig. 1c).

Melamine foams are produced with different forms like flat, profile, pyramid and viol. Melamin foams are mostly used on ceiling and walls in indoors like music studios, cinemas, theatres, factories and offices.

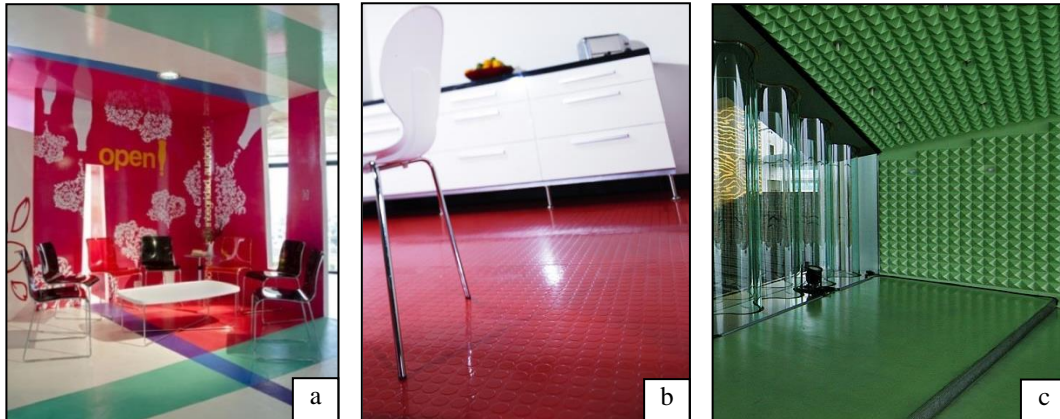


Figure 1. (a) Epoxy on the floor, walls and ceiling (URL-1); (b) Rubber on the floor (URL-2); (c) Melamin foam on the wall and the ceiling (URL-3).

3.1.4. Polyamide

Polyamide is one of the thermoplastics. Range of products can be made from polyamide due to their high durability and strength. Nylon is the generic name of polyamides. Polyamide is hard, durable, wear-resistant and have a low coefficient of friction polymer (Kaya, 2005). Polyamides are often formed into fibers and are used for monofilaments and yarns. Characteristically polyamides are very resistant to wear and abrasion, have good mechanical properties even at elevated temperatures, have low permeability to gases and have good chemical resistance (Prospector, 2014). The properties of the polyamides, which include strength, abrasion resistance, and resilience, make them very important in the manufacture of carpets. Tiles or roll carpeting are used in homes and especially in high-traffic areas; commercial buildings, theatres, offices, concert and congress halls, airport lounges, hotels and public institutions (Fig. 2a).

3.1.5. Polyester

Polyesters are divided as saturated and unsaturated. Unsaturated polyesters are termosets, saturated polyesters are termoplastics. Plasticizers, panels, foams, fibers and films can be made from polyester (Kaya, 2005). Polyester panels are used to create decorative wall and ceiling surfaces (Fig. 2b). Bright or matte surfaces can be achieved. Panels can be cut in desired shapes. Also it is possible to have different styles of endings on the cut edges if desired, like rounding the edges. Polyester fiber is used to produce carpets and sound absorber wall or ceiling tiles (Fig. 2c).

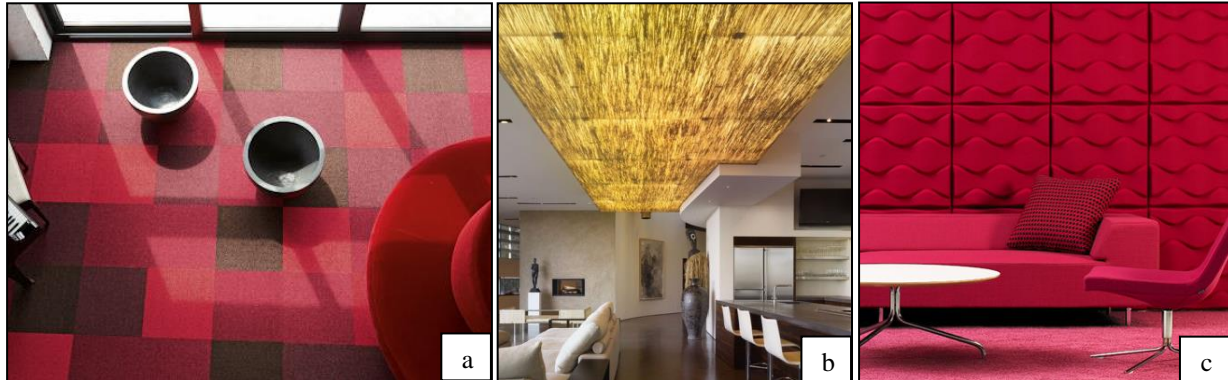


Figure 2. (a) Polyamide carpet on the floor (URL-4); (b) Polyester panels on the ceiling (URL-5); (c) Acoustic tiles made of polyester fiber on the wall (URL-6)

3.1.6. Polyethylene

Polietilen based materials are flexible and semi-flexible materials. Polyethylene based sound absorber foams are commonly used for acoustic control purposes. They have different surface styles and can be found in every colour. It is a material that sticks to surfaces easily with special adhesives (Toydemir, Gurdal, & Tanacan, 2000).

3.1.7. Polycarbonate

Polycarbonate is available in different degrees of transparency and has a very glossy surface which creates different visual effects (Fig. 3a). Polycarbonate has good long-term weather resistance but will start to yellow over time without additional measures. For this reason, polycarbonate products are given a UV protection coating to prevent premature aging (Engelsmann, Spalding, & Peters, 2012). Polycarbonates have qualities like hardness, durability and clarity. They are preferred for interior spaces because they are light, durable, transparent and resistant to impact.

3.1.8. Polymethyl methacrylate

Polymethyl methacrylate (PMMA) is one of the major members of acrylic polymers. PMMA can be poured or extruded. According to Engelsmann, et al., (2012), the poured variant offers more potential for desin variants than extruded PMMA. PMMA is a transparent plastic, when sawn the cut surface is bright and shiny compared to polycarbonate (Verleye, Roeges, & De Moor, 2001). The main character

of PMMA is optical clarity. It is useful where light transmission is important (Baki,1993). PMMA can be coloured and processed on turning machine. It is counted as a big disadvantage for transparent ones to be drawn (Kaya, 2005). Polymethyl methacrylate panels can be found in a variety of colours and patterns and has different transparency levels which allow designers to apply backlighting (Fig. 3b). Thus it is possible to achieve different ambiances in interior place.

3.1.9. Polyurethane

Polyurethane is a thermoset resin. Most materials that are produced by this resin are foams (flexible or rigid) and remainings are used in coating and fiber forms. Their mechanical (abrasion, resistance to tearing and hardness, etc.), physical (density, surface texture, etc.) and chemical (resistance to mold, etc.) features can be changed with adding various polymers during the production process (Yaşar, 2001).

Polyurethane based materials have lots of kinds. It can be applied to the floor like epoxy and it can be used when making imitation leather and so used as covering on different surfaces. Polyurethane coatings are useful on concrete and steel surfaces, easy to clean, resistant to yellowing, have high resistance of abrasion, effective and protective coatings. Polyurethane based materials have kinds that are applied by roll-brush or spray.

Polyurethane foams are light decorative materials that are easily stick on surfaces by special adhesives. The reason of pyramid surface is to increase the noise absorption and create a decorative look (Toydemir et al., 2000). Polyurethane coatings are used as one-piece and jointless in indoor sports hall, industrial facilities, pharmaceutical warehouses and factories in liquid form (Fig. 3c). It is resistant to deformations like UV light and creates aesthetics, hygienic and nonslip surfaces that have colourful matte or glossy looks. It can be applied as spray or mortar. PU is used on walls and ceilings as it is used for floors. For this kind of surfaces, mostly the spray-application is preferred.



Figure 3. (a) Polycarbonate panels on the wall (Van Uffelen, 2008); (b) Polymethyl methacrylate panels on the ceiling (Van Uffelen, 2008); (c) Polyurethane on the floor (URL-7).

3.1.10. Polyvinyl chloride

Polyvinyl chloride (PVC) can be found as wall or ceiling panels, ceiling tiles, membranes and floor coverings in interiors (Fig. 4a). PVC coverings are used in public, private and commercial places like homes, hospitals, hotels schools, offices and stores. PVC gives designers design possibilities, easy

installation and price advantages. PVC coverings can imitate natural materials like stone, wood, cork and metal.

PVC floor coatings have wide range of colour and pattern choices and it can be used in most busy and circulated areas. Because of its undetectable joints it can provide one-piece look. PVC floor coatings are very light materials and can absorb the noise caused by impacts.

PVC flooring can be divided in two general types: homogeneous and heterogeneous. Homogeneous PVC floor coverings are more durable and long lasting than other PVC floor coverings. Homogeneous coverings can be used in in high-traffic areas. Heterogeneous PVC floor coverings have layers. The most important feature of it is that it does not need to be polished.

For some reasons, it can be seen that PVC coverings are used on walls, too. Especially in places like hospitals for hygienic purposes, the walls are covered with PVC. Also it can be preferred in educational places like schools to prevent the damages that might be occurred from impacts. It can be applied as panels in various widths and also vinyl wallcoverings are used. Vinyl wallcoverings can be found in various colours and patterns. They are resistant to moisture (Fig. 4b).

Decorative PVC membranes are used for stretch ceilings and wall designs (Fig. 4c). Stretch ceiling or wall designs are assembled on the special metal construction. They can be in various colours and can have digital printings. Matte or glossy finishes can be achieved.



Figure 4. (a) PVC membrane on the wall and ceiling (Sauer, 2010); (b) PVC wallcovering on the walls (URL-8); (c) PVC panels on the ceiling (URL-9).

3.2. Questionnaire Study

Questions posed to the participants in the questionnaire and the answers are given below.

Question 1. What is the usage frequency of polymer based surface materials that you use in your designs or applications?

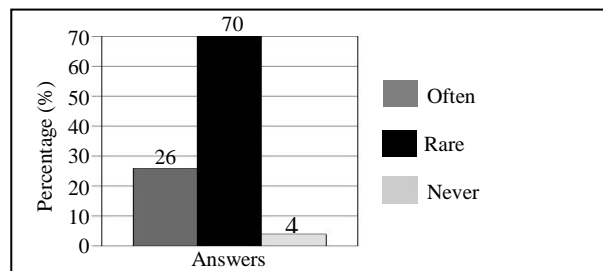


Figure 5. The Usage frequency of the polymer based surface material (Sadıklar, 2014).

Question 2. Why do you choose polymer based surface materials in your designs or applications?

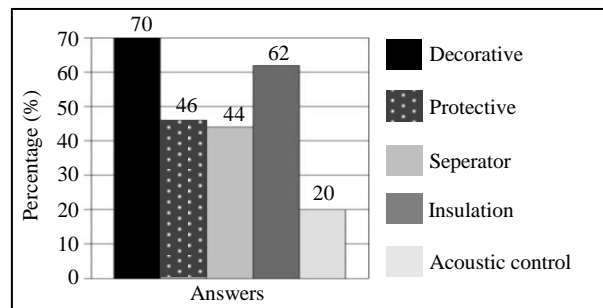


Figure 6. The reasons of choice (Sadıklar, 2014).

Question 3. Which polymer based surface materials do you use in your designs or applications?

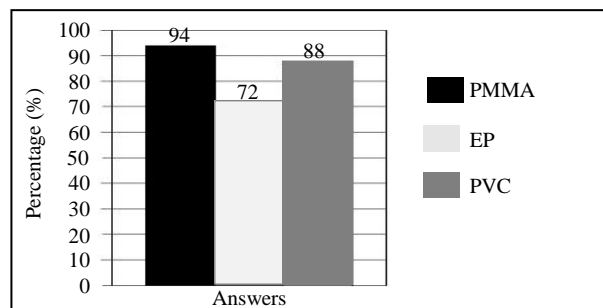


Figure 7. Choice of the material (Sadıklar, 2014).

Question 4. On which surfaces do you use polymer based materials?

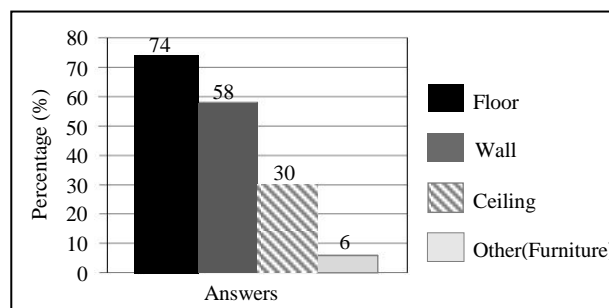


Figure 8. Usage areas of the polymer based materials (Sadıklar, 2014).

4. Conclusions

The 10 most used plastics in interior design have been determined as epoxy, rubber, melamin formaldehit, polyamide, polyester, polyethylene, polycarbonate, polymethyl methacrylate, polyurethane, polyvinyl chloride. According to the questionnaire, respectively polymethyl methacrylate, polyvinyl chloride and epoxy are the most used polymer based surface materials.

Polymer based materials are used in interiors due to the following properties: protection, decoration, insulation, separation and acoustic control. It is shown that they are mostly used for their

decoration properties. Despite this, protection and insulation properties are also significant factors (Table 2).

It revealed that the polymer based materials are used mostly on floors according to questionnaire. Floors are the most interacted surfaces in interiors. For this reason flooring materials have a major significance. Because of their various advantages like protection, slipping resistance, walking comfort, wear resistance, easy application, plastics are suitable surface materials for interiors.

Table 2. Material features related to their form

Polymer	Form	protection	decoration	insulation	separation	acoustic control
Epoxy	resin	+	+	+		
Rubber	sheet		+	+		+
Melamin formaldehit	resin	+				
	foam		+	+		+
Polyamide	woven		+	+		+
	panel		+		+	
Polyester	woven		+	+		
	nonwoven		+	+		+
	panel		+		+	
Polyethylene	panel		+		+	
	foam		+	+		+
Polycarbonate	panel		+		+	
Polymethyl methacrylate	panel		+		+	
Polyurethane	foam		+	+		+
	resin	+	+	+		
Polyvinyl chloride	membrane		+			+
	panel		+		+	

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