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(54) Title: COMPOSITE MATERIAL PRODUCTION BY USING PHYSICALLY RECYCLED FLEXIBLE POLYURETHANE
FOAM AND SPRAY POLYUREA COATING

(57) Abstract: The present invention is concerned with the production of preventive flooring material to reduce and prevent collapse and damage resulting from falls and slips. The invention is a waterproof, anti-bacterial, impact resistant, high tear and tensile strength, abrasion resistant, chemical resistant and environmentally compatible composite material comprising flexible recycle polyurethane foam and spray polyurea coating.



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COMPOSITE MATERIAL PRODUCTION BY USING PHYSICALLY RECYCLED FLEXIBLE POLYURETHANE FOAM AND SPRAY POLYUREA COATING

5 **Field of Invention**

The present invention relates to a waterproof, anti-bacterial, impact resistant, high tear and tensile strength, abrasion resistant, chemical resistant and compatible with outdoor conditions composite material which is bondex (2) (physically recycled flexible polyurethane foam) coated with spray polyurea
10 coating (1) to be used as a preventive flooring material to reduce and avoid damages occurred during falls and slips.

Background of The Invention

15 A wide variety of materials are used as flooring material. These are; recycled rubber, virgin rubber, EPDM (ethylene propylene diene monomer) flooring, cork flooring, EVA foam, laminate floorings, wooden mat, PVC closed cell foam, nitrile rubber, polypropylene, PVC tubing, fiber mat (like grass, coconut, cane, rushes), fabric or cotton mat, sponge rubber, fabric reinforced neoprene, patterned concrete with
20 grooved asphalt, PVC flooring mat, weaved ratten mat, polyvinyl mat and composite materials obtained by combinations of them. However, many of them are not suitable products for exterior flooring. In addition, there are limited number of exterior flooring materials to be used to prevent wounded injuries. Because of falling and slippage, it is mostly rubber material which is used as a preventive outer floor cover. Patents 2016/19143, 2011/08809, 2010/06408 and 2007/09142 are examples of the invention about
25 rubber floor coverings. Recycled rubber is preferred so that the material used is not very costly. Recycled rubber is formed by splitting the used rubber into small pieces and then connecting these small pieces with a binder. The rubber mixed with the binder is shaped in a mold at a certain temperature. This material from the production method is not very waterproof but also has no anti-bacterial properties at the same time. For this reason, instead of using recycled rubber as flooring material, it is planned to use composite material obtained by applying polyurea coating (1) spray on bondex (2) to be both waterproof and
30 hygienic product.

In the patents of US 20060156663 A1, US2002016575 A1, US 20060032175 A1, US 6212838 B1, US2013 / 0084427 A1, 2016/11342, 2014/13219, 2013/09868, composite materials obtained by bringing together layers of different materials for decorative purposes or for use in outdoor environments have been made,

but these products do not have abrasion and chemical resistance and antibacterial properties that is provided in our invention. Our invention with its ability to be cleaned is suitable for use long years in indoor and outdoor conditions due to its high impact resistance, waterproof property, chemical resistance and anti-bacterial property while preventing damage that may occur during falls and slips due to its certain flexibility.

In view of the previous inventions (PCT / TR2008 / 000115, US 20080242794 A1 and US 2010009385), the antimicrobial properties of the composite materials were obtained using antimicrobial agents, silver and antibacterial zeolite, but in our invention the antimicrobial properties of the composite material are coming from polyurea.

In US Patents 7611772 B2, CN 202544330, CN 2025443284, US 20060046068 A1, US 20050287293 A1, WO 2006037026 A2, KR 20140066618 A, WO 2012 162641 A2 and 2010/05467, the material coated with polyurea for preventing the material from abrasion, corrosion, impacts and outdoor weather conditions, but solved problem in our invention is to prevent injuries that can occur in humans and animals as a result of falls and slips. In the above patents, the polyurea coating is applied to the surface, but in our invention the polyurea coating application is carried out on the bondex and the two materials are laid on another surface as a whole.

In 2015/11236, products made of polyurethane sponge and its derivatives have been coated with polyurea for use as furniture components, but it is not enough to prevent injuries caused by hard floors (stone, earth, asphalt and concrete floor) that we solved. In the patent, the furniture (seats, chairs, sitting groups, pouffes, stools, benches, berjers, office seats, cinema seats, lounge chairs, etc.), cushions, pillows, inlays and armchairs of motor vehicles, furniture and interior furnishings, seats for business and agricultural machinery, train and tramway seats, toys, children's play areas, decorative wall and ceiling covering panels, sections of human body contact with fitness and sports equipment, screens, portable partition walls that are produced by different manufacturing methods, is made from polyurethane sponge and its derivatives and the surfaces of the products are covered with polyurea. The resultant product obtained from this patent does not have the enough durability for use in external conditions. The polyurea covered on the flexible polyurethane foam is a very thin layer which has been used instead of the textile material, thus facilitating the cleaning of the final product. The location and physical properties of the final product obtained in this patent are very different from those used in our invention. Our invention is a composite material which is made of polyurea coating (1) on bondex (2) has high tearing and tensile strength, high wear resistance, high chemical resistance, waterproof, compatible with external conditions, antibacterial and easily cleanable composite material.

As the name imply that the preventive external flooring materials is used to prevent damages caused by the impact in future accidents by means of creating a soft ground during ground use. These floorings is used in the areas such children's playgrounds, amusement parks, school gardens, kindergartens, universities, museums, public and military establishments, fitness centers, sports fields, stadiums, athletics tracks, hiking and cycling trails, recreational areas, ski resorts Garages, parking lots, garage entrance, apartment entrance, hospitals, peace houses (especially ramps), golf clubs, paddock grounds, harbors, zoo gardens, stables, animal shelters, fattening farms, pools, rehabilitation centers, rooms for the disabled, shooting ranges, industrial facilities, commercial establishments, offices, retail and transport facilities.

Summary of Invention

The object of the present invention is to produce an anti-damage exterior flooring material that is waterproof, chemically resistant, impact-resistant and antibacterial at a lower cost.

Recycled rubber is preferred so that normally used material is not very costly, but this material is not very waterproof and at the same time does not have an anti-bacterial property. In the environments such as animal barns and children playgrounds hygiene and waterproofness play a great role of importance. For this reason, as flooring material instead of using recycled rubber, it is planned to use composite material which is obtained by applying polyurea coating (1) spray on bondex (2) which is both a better waterproof and hygienic product. The wastes are occurred during the production of slabstock flexible polyurethane foam is evaluated and combined with a binder to obtain high density bondex (2). Another component of the composite material is spray polyurea coating (1), which is becoming widespread nowadays. Due to its waterproof and antibacterial property, it is generally used for coating inside of the pools and inner surface of the water tanks. In addition, it is possible to use polyurea coating (1) in the defense industry because of its high hardness and elasticity.

The bondexes (2) are cut in the direction of the desired scale and either the final product is formed by covering every part (bottom-top and edges) with sprayed polyurea material (1) (fig. 1) or standard bondexes (2) (fig. 2) or interlocking bondexes (2) (fig. 3) should be put at the place of use and only top layer is coated with polyurea material (1).

The cost of resultant composite material is low because of the reuse of the scrap material. Also, the high density of the bondex (2) prevents the collapse of the resultant composite material. In addition, the polyurea coating (1) spray ensures that the composite material to be obtained is waterproof, chemical resistant, resistant to impact, high tear and tensile strength, abrasion resistant and antibacterial.

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Brief Description of Drawings

Figure 1. Composite material is formed by applying polyurea coating (1) on all sides of bondex (2)

Figure 2. Composite material is formed by applying polyurea coating (1) only upper layer of straight-cut bondex (2)

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Figure 3. Composite material is formed by applying polyurea coating (1) only upper layer of interlaced bondex (2)

Description of The References in The Drawings

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1. Polyurea coating

2. Bondex

Detailed Description of Invention

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The composite material consists of bondex (flexible recycled polyurethane foam) (2) at high density (200-300 kg/m³) that is produced by granulating the flexible polyurethane wastes into small pieces and mixing with the binder and polyurea (1) coated with spray application on to the resultant bondex (2).

The composite material cost is low due to the use of bondex (2). Polyurea coating (1) is applied to blocks of average 1-20 cm, preferably 2-10 cm, preferably 3-7 cm, in the range of 0.5-20 mm, preferably 1-10 mm. Although the polyurea coating (1) is costly, most parts of the composites are made of bondex (2), which reduces the cost of the composite material. The applied spray polyurea coating (1) on the surface ensures that the material obtained is robust, durable, flexible, waterproof, chemical resistant and antibacterial.

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To obtain the composite material, the following operations were carried out respectively.

Granulating of Flexible Polyurethane Foam Wastes

The flexible polyurethane foam is produced in large blocks and is then brought to the desired dimensions according to customer requests. After production, the bottom, top and side sections of the blocks are separated as waste. In addition to this, products that are left out of cutting processes in certain sizes for customer need are also divided as waste. These wastes are separated into small pieces by means of granulator. These parts called clippings are being removed from the market at much lower prices. This invention provides a value-added green product to the market.

Synthesis of Bondex (2) Binder

The binder to be used in making the bondex (2) can be formed by bringing together materials such as polyol, isocyanate, amine, tin, oil, water. Besides, pre-polymer obtained by reaction of isocyanate and polyol can be used as binder. Depending on the shelf life of the pre-polymer that is obtained by using only polyol and isocyanate. Control of the reaction of isocyanate and polyol becomes more difficult as the temperature increases. The reaction temperature and time for a controlled reaction should be at 50-100 ° C and 1-7 hours, most preferably 70-90 ° C and 3-5 hours, respectively. To avoid side reactions during the reaction and to prevent isocyanate from being affected by the humidity of the air, the synthesis must be performed under nitrogen atmosphere. If desired, tin catalyst may be used during pre-polymer synthesis. The tin catalyst must be used in an amount of 0.01-10%, preferably 0.05-5%, most preferably 0.1-1%, of the total weight. It is preferred that the used polyol functionality is 2 or more and molecular weight is 2000-5000 daltons. Besides polyol, extender oils such as DOP (dioctyl phthalate) may also be used. Depends on the desired pre-polymer properties, MDI (methylene diphenyl diisocyanate), TDI (2,4 toluene diisocyanate), IPDI (isophorone diisocyanate), HDI (hexamethylene diisocyanate) may be used as an isocyanate. The NCO% of the resultant Bondex (2) pre-polymer to be used should be between 5 and 25%, most preferably between 10 and 20%.

Bondex (2) Production

The obtained scraps and binder are mixed with the aid of a mixer and then transferred to the hopper to be pressed. The amount of binder should be from 1 to 25 %, preferably from 5 to 20 %, most preferably from 10 to 17 %, of the total amount. Due to the movable piston on this reservoir, the piston is compressed to a certain point for the desired bondex density. The compressed material can stand for 10 minutes to 10 hours, preferably 30 minutes to 5 hours, most preferably 1 to 2 hours with applying steam. Cutting operation is performed after the residual bondex (2) is rested for 1-24 hours, preferably 2-12

hours, most preferably 3-9 hours. The density of the bondex obtained should be 40-500 kg/m³, preferably 100-400 kg/m³, most preferably 200-300 kg/m³.

MDI Pre-Polymer Synthesis

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MDI (methylene diphenyl diisocyanate) pre-polymer is used in spray polyurea applications. The MDI pre-polymer can be obtained by reaction of polyol and isocyanate at a certain temperature and time. Control of the reaction of isocyanate and polyol becomes more difficult as the temperature increases. The reaction temperature and time for a controlled reaction should be at 50-100 ° C and 1-7 hours, most preferably 70-90 ° C and 3-5 hours, respectively. To avoid side reactions during the reaction and to prevent isocyanate from being affected by the humidity of the air, the synthesis must be performed under nitrogen atmosphere. If desired, tin catalyst may be used during pre-polymer synthesis. The tin catalyst must be used in an amount of 0.01-10%, preferably 0.05-5%, most preferably 0.1-1%, of the total weight. It is preferred that the used polyol functionality is 2 or more and molecular weight is 2000-5000 daltons.

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The NCO content of the pre-polymer to be used in polyurea coating (1) should be between 5 and 25%, most preferably between 10 and 20%. The MDI pre-polymer viscosity varies with NCO%. Viscosity decreases as NCO% increases. However, products with high NCO% have difficulties in terms of applicability. For this reason, there is a problem of workability in products with high NCO%. In order to eliminate viscosity problem, either a diluting solvent is added to the system after the reaction or the quasi-pre-polymer synthesis is carried out. Quasi pre-polymer synthesis is achieved by adding monomeric MDI instead of solvent to reduce the viscosity of the pre-polymer obtained after the reaction.

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Spray Polyurea Coating (1) Application

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Because the polyurea reaction is a very rapid, the application is made by means of the spray system. There are two separate compartments in the system, component A and component B. Polyether amines of different molecular weight and chain extender are added at certain ratios in the component A section. MDI pre-polymer is added to the component B section. Additives such as coloring and filling agents can be added to the system to change the color and mechanical properties of the spray polyurea to be obtained. If there are also ingredients such as colorants or fillers in the formulation, these materials are also added to the component A section.

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They do not meet two components until they come into the spray chamber because reaction starts and curing is occurred when the two components come together. The materials are circulated and heated to 70-80 ° C with the help of a resistance. Since the system is usually set to spray equal volumes of material,

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it is important that the two components have close viscosities at this temperature. Pressure is adjusted to 16-20 bars by means of piston that is connected with two components, and polyurea (1) is sprayed onto bondex (2) with the help of the spraying hopper.

- 5 Generally, 2-functional polyether amines having a molecular weight of 2000 and 3 functionalities of 5000 molecular weight are used in polyurea coatings. In addition, amines with two functionalities and low molecular weight are used as chain extenders. MDI pre-polymer is also determined according to the hardness of the coating to be obtained and NCO content of 10% and 20% are used for soft and hard coatings, respectively.

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Industrial Applicability

Everything described in the disclosure section of the invention is the same as the manner of industrial application. The bondex section of the composite material described above is produced within the company as described above. The polyurea applications of the products which are to be covered with certain dimensions and the upper and lower sections are made in the company and presented to the customers as final products. In the application to large areas, certain cuts of plain cut or interconnection bondexes (2) are applied to the application area and composite material is obtained by applying polyurea (1) coating.

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Examples

Used Chemicals

- 25 Polyol – with 3 functionality, and molecular weight of 3500 dalton
 PPG-2000 – (polypropylene glycol, mwt 2000)
 PPG-400 – (polypropylene glycol, mwt 400))
 TDI - 80:20 2,4: 2,6 toluene di isocyanate
 Modified MDI – Carbodiimide modified monomeric MDI
 30 Standard MDI – 80:20 2,4:4,4 MDI
 Polymeric MDI
 Extender Oil - DOP (Dicetyl Phthalate)
 Flexible Polyurethane Scraps – Granule Polyurethane
 PE-1 - polyether amine at 2000 molecular weight with 2 functions

PE-2 - polyether amine of 5000 molecular weight with 3 functions

Chain Extender

Pigments

5 *Bondex Binder Synthesis*

The amount of polyol is weighed and transferred into a 5-necked 1-liter glass reactor. Add the isocyanate which is weighed into the polyol which is heated to 70 ° C in a nitrogen atmosphere for half an hour. After 3 hours at 70 ° C, the temperature is turned off and the pre-polymer is stirred in the nitrogen atmosphere until it cools down to room temperature and transferred to the containers in a way that does not get air and is kept. The experiments are given in Table 1. The properties of the binders are given in Table 2.

Table 1. Bondex Binder Synthesis

	TDI	Polymeric MDI	MDI	Polyol	Extender Oil	Catalyst	T(°C)	t(h)
PR-1	38	-	-	200	-	-	70	3
PR-2	37	-	-	100	-	0,1	70	3
PR-3	-	57	-	100	-	0,1	70	3
PR-4	-	-	57	100	-	0,1	70	3
PR-5	23	-	50	100	30	-	70	3
PR-6	-	-	650	250	-	-	70	3
PR-7	-	-	800	115	-	-	70	3
PR-8	400	-	-	475	-	-	70	3
PR-9	495	-	-	400	-	-	70	3
PR-10	-	-	510	385	-	-	70	3
PR-11	-	-	375	520	-	-	70	3
PR-12	-	-	250	680	-	-	70	3

TDI, polymeric MDI and modified MDI were used in the experiments. In addition, extender oils were used besides polyol. Having 3 functional and 3500 molecular weight polyol is used in all of the binder production trials. Subsequent analyzes showed that the NCO% of the binders varied between 5 and 25, and it was understood that viscosity decreased as the NCO% increased. There was no difficulty in the application since the workability was easier in low viscosity products.

Table 2. Properties of Bondex Binder

	NCO %	Viscosity (cp)
PR-1	4,1	6791
PR-2	9,1	1425
PR-3	5,3	8782
PR-4	9,3	2093

PR-5	9,7	770
PR-6	19,4	795
PR-7	23,7	241
PR-8	20,0	367
PR-9	25,0	164
PR-10	14,7	2435
PR-11	9,5	9613
PR-12	8,3	1775

Bondex Production

Calculated clippings amount is taken to the mixing chamber. When the clippings are mixed, the binder is added to the system. After mixing for 15-30 minutes, the materials are transferred to the hopper. The hopper is compressed to the dimension calculated for the desired bondex density by means of a piston. Steam is given to the hopper after compression. After 2 hours, the steam is cut off and the bondex is removed from the hopper and leave to rest. Bondex is then cut to the desired dimensions. The experiments are given in Table 3. Experiments using different clippings and binders are shown in Table 3. Experiments are succeeded in producing bondex with different density.

Table 3. Bondex Trials

	Scraps			Form. No.	Binder		Density (kg/m ³)
	Amount (g)	Type	%		Amount (g)	%	
BF-1	450	Visco	83	PR-1	90	17	-
BF-2	300	Mixed	80	PR-2	75	20	120
BF-3	300	Mixed	80	PR-5	75	20	189
BF-4	2125	Mixed-Big	85	PR-5-2	375	15	40
BF-5	2125	Mixed-Small	85	PR-1	375	15	44
BF-6	1600	Mixed-Big	80	PR-6	400	20	62
BF-7	3200	Mixed-Big	80	PR-6	800	20	160
BF-8	4000	Mixed-Big	80	PR-7	1000	20	190
BF-9	6000	Mixed-Big	80	PR-9	1500	20	280
BF-10	6000	Mixed-Big	80	PR-10	1500	20	240
BF-11	4000	Mixed-Big	80	PR-11	1000	20	160
BF-12	5000	Visco	83	PR-12	1000	17	183
BF-13	4000	Mixed-Small	80	PR-1	1000	20	178
BF-14	4000	Mixed-Big	80	PR-2	1000	20	123
BF-15	4000	Mixed-Small	80	PR-5	1000	20	126

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MDI Pre-polymer Synthesis

The amount of polyol is weighed and transferred into a 5-necked 1-liter glass reactor. Then isocyanate is added into the reactor after polyol is heated to 70 ° C and stirred in a nitrogen atmosphere for half an hour. After 3 hours at 70 ° C, the temperature is turned off and the pre-polymer is stirred in the nitrogen atmosphere until it cools down. The product arriving at room temperature is transferred to the containers in a way that does not get air and is kept. If the viscosity of the product needs to be reduced, the needed amount of solvent or monomeric MDI is added to the pre-polymer, that is cooled to room temperature after the reaction, in order to bring the viscosity to the desired level. The experiments are given in Table 4. The properties of the products are given in Table 5.

Modified MDI, standard MDI and polymeric MDI were used as isocyanate in the experiments. PPG-2000, PPG-400 and triol were used as a polyol. In the calculations made before the synthesis, MDI pre-polymers with NCO% 10, 15 and 20 are produced and then the theoretical value was compared with the experimental value and it was seen that calculations were successful. To reduce the viscosities of the pre-polymers obtained in the experiments, the systematic diluent and monomeric MDI were added in the last four trials and succeeded. PEG-400 was used in the preparation of PREPO-3 and the viscosity of the obtained product was too high to be measured.

Table 4. MDI Pre-polymer Synthesis

	MDI			Polyol		
	Type	Func.	E. W. (g)	Type	E. W. (g)	Func.
PPERO-1	Modified	2	135	PPG-2000	1000	2
PPERO-2	Modified	2	135	PPG-2000	1000	2
PPERO-3	Modified	2	135	PPG-400	200	2
PPERO-4	Modified	2	135	Triol-3000	1145	3
PPERO-5	Modified	2	135	Triol-3000	1145	3
PPERO-6	Modified	2	135	Triol-3000	1145	3
PPERO-8	Modified	2	135	Triol-3000	1145	3
PPERO-9	Standard	2	135	Triol-3000	1145	3
PPERO-10	Polymeric	2	135	Triol-3000	1145	3
PPERO-13	Modified	2	144	Triol-3000	1145	3
PPERO-14	Modified	2	144	Triol-3000	1145	3
PPERO-15	Modified	2	144	Triol-3000	1145	3
PPERO-16	Modified	2	144	Triol-3000	1145	3

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Table 5. Properties of MDI Pre-polymer

	NCO %	NCO %	Viscosity (cP)
	Theoretical	Experimental	
PPERO-1	10	8,6	8128

PPERO-2	15	13,7	2585
PPERO-3	15	13,7	-
PPERO-4	15	14,1	3359
PPERO-5	10	14,0	13587
PPERO-6	20	19,3	1131
PPERO-8	15	10,1	13737
PPERO-9	15	12,0	2861
PPERO-10	15	-	4751
PPERO-13	15	10,6	810
PPERO-14	15	13,5	237
PPERO-15	15	16,9	1485
PPERO-16	15	15,5	1341

Spray Polyurea Application

PE-1, PE-2 and chain extender are added to the component A at the specified quantities. In the component B part, MDI pre-polymer is added in the determined amount. Component A and B are circulated and heated to 75 ° C with resistance. The warmed components are sprayed with a gun at 16-20 bar. The two components meet at the tip of the gun and harden within 5-30 seconds after application to the surface.

According to the demanded product, high NCO content MDI is used for hard product and low NCO content MDI is used for soft product during application. If the requested product is 200x100x5 cm3 dimensions, each side of the bondex (2) and in its upper and lower parts are covered with polyurea (1) and given to the customer as a final product (fig. 1). If the product is to be covered on the entire floor of a particular area, being economic, standard (fig. 2-2) or interlaced cut (fig. 3-2) bondexes (2) are placed on the floor to be applied and the polyurea coating (fig. 2-1 and fig. 3-1) is sprayed on the bondex surfaces at that time and made into the final product at the place of use.

The experiments are given in Table 6. The properties of the products are given in Table 7.

Table 6. Spray Polyurea Coating Application

	Type	ISOCYANATE			POLYETHERAMINE			Chain Ext. Amount (kg)	Index
		NCO %	Amount (kg)	E. W. (g)	PE-1 Amount (kg)	PE-2 Amount (kg)	E. W. (g)		
PU-1	PREO-4	15	10	280	7,6	0	1000	2,4	470
PU-2	PREO-5	11	10	420	7,6	0	1000	2,4	313
PU-3	PREO-6	20	10	210	7,6	0	1000	2,4	627
PU-4	PREO-4	15	10	280	7,2	1,3	1102	1,5	463
PU-5	PREO-6	20	10	210	7,2	1,3	1102	1,5	617

PU-6	PREO-4	15	10	280	6,4	1,5	1127	2,1	452
PU-7	PREO-13	15	10	280	7,6	0	1000	2,4	407
PU-8	PREO-13	15	10	280	7,2	1,3	1000	1,5	401
PU-9	PREO-14	15	10	280	7,6	0	1000	2,4	470
PU-10	PREO-14	15	10	280	7,2	1,3	1000	1,5	463
PU-11	PREO-14	15	10	280	6,4	1,5	1127	2,1	516
PU-12	PREO-15	15	10	280	7,6	0	1000	2,4	470
PU-13	PREO-15	15	10	280	7,2	1,3	1000	1,5	463
PU-14	PREO-14	15	10	280	7,6	0	1000	2,4	470
PU-15	PREO-15	15	10	280	7,2	1,3	1000	1,5	463
PU-16	PREO-16	15	10	280	7,6	0	1000	2,4	470
PU-17	PREO-15	15	10	280	7,6	0	1000	2,4	470

Polyurea coatings made by spray application are also coated on the glass for testing the properties of the coating. It can be seen that a product with high elasticity and hardness, waterproof and high impact strength is obtained from the results. In impact strength test (ASTM D-1709-15), there are no change, cracks or damage were observed in the coating. In the chemical resistance test (ASTM D-543-06), matting and color change were observed only when strong acids were applied to the surface. Tensile strength and elongation at break were made according to ASTM D638-10. The Shore A hardness is made according to ASTM D 2240-05. The ASTM D 570-98 standard has been taken into account in the water absorption test. For elasticity, ASTM D-3574 standard has been applied.

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Table 7. Polyurea Properties

	Density (kg/m ³)	Max. Strength (Mpa)	Tensile Strength (N/mm)	Elongation (%)	Tear Strength (N/mm)	Hardness (Shore A)	Water Absorption (%)	Resilience (%)
PU-1	1028	12,32	36,31	240	23,59	85	1,24	31
PU-2	1011	2,33	2,95	146	6,09	55	1,86	15
PU-3	958	15,85	87,65	254	24,51	79	0,99	27
PU-4	1029	9,35	35,09	241	14,77	77	1,17	32
PU-5	998	15,26	51,33	285	23,27	83	1,16	28
PU-6	1082	9,51	18,35	234	11,81	78	1,75	20
PU-7	1058	12,03	19,23	259	21,50	80	1,83	23
PU-8	1087	6,55	19,24	237	17,34	79	1,42	26
PU-9	1045	13,62	29,22	238	22,6	80	1,52	37
PU-10	1097	6,50	14,94	203	13,56	69	1,74	46
PU-11	1082	10,02	20,90	218	20,29	70	1,49	38
PU-12	1051	11,16	30,29	231	26,96	73	1,65	38
PU-13	1065	11,74	34,88	291	19,72	67	1,53	19
PU-14	1063	9,83	20,50	262	15,06	68	1,45	37
PU-15	1088	5,98	13,64	237	11,06	77	1,45	50
PU-16	1015	10,84	25,07	210	28,96	88	2,18	-
PU-17	1084	8,54	21,75	211	20,54	76	1,50	42

In the anti-bacterial test according to ASTM 2149A, 2 different bacteria were tested and the PU-17 product was found to be anti-bacterial. The results are given in Table 8.

Table 8. Antibacterial Testing

	Decrease Amount of Bacteria (24 hr)			
	Stphylococcus Aureus (ATCC 6538)		Escherichia Coli (ATCC 35218)	
	%	Log	%	Log
Control	-20,35	-0,10	207,49	0,49
Bondex	10,62	0,04	277,01	0,58
PU-10	-38,05	-0,21	841,18	0,97
PU-11	-36,73	-0,20	723,53	0,92
PU-16	-85,66	-0,84	605,88	0,85
PU-17	-89,56	-0,98	-99,96	-3,37

CLAIMS

- 1) The invention is a composite material comprising a polyurea coating (1) and a bondex (2).
- 5 2) A composite material for reducing and preventing damages to occur as a result of falling and slipping in claim 1, characterized in that: is made of polyurea coating (1) by spraying on bondex (2), it is waterproof, antibacterial, resistant to impact and has high chemical resistance.
- 3) The polyurea coating (1) spray method according to claim 1, characterized in that:
- 10 - on-site application on the upper layer after the bondex (2) in is brought to the flat-edge form,
- or only in situ application to the upper surface of the interlocking bondex (2)
- or applying bondex (2) to all surfaces of the material by spraying
process steps.
- 15 4) Bondex (2) part in Claim 1, which makes the invention economical.
- 5) The bondex (2) according to claim 4, wherein the physical recycled flexible polyurethane is characterized by:
- binder synthesis,
- 20 - granulating the flexible polyurethane wastes by means of the granulator with small pieces to obtain scraps,
- mixing the obtained scraps and binders with the aid of a mixer,
- 10 minutes to 10 hours, preferably 30 minutes to 5 hours, preferably 1 to 2 hours pressed by means of a piston and steam,
- 25 process steps.
- 6) The bondex (2) according to claim 4, wherein the bondex (2) is composed of binding and clipping regions, has a binder content of 1-25%, preferably 5-20%, most preferably 10-17%, and a density of 40-500 kg/m³, preferably 100-400 kg/m³, most preferably 200-300 kg/m³.
- 30 7) A binding pre-polymer according to claim 6, characterized in that has an NCO content of 5-25%, most preferably 10-20%.
- 8) A binding pre-polymer according to claim 6, characterized in that

- formation by reaction of isocyanate and polyol at 50-100 ° C for 1-7 hours, preferably at 70-90 ° C for 3-5 hours,

- the use of nitrogen to avoid side reactions during the reaction and not to affect the isocyanate air humidity,

5 process steps.

9) A binding pre-polymer according to claim 6, characterized in that

- the use of a polyol having a reactivity of 2 or more and a molecular weight of 2000-5000 Daltons,

10 - the use of MDI (methylene diphenyl diisocyanate), TDI (2,4 toluene diisocyanate), IPDI (isofuron diisocyanate) and HDI (hexamethylene diisocyanate) isocyanates as isocyanate in the reaction,

If desired, from 0.01 to 10%, preferably from 0.05 to 5%, most preferably from 0.1 to 1%, of the total weight of the tin catalyst is used during the synthesis.

15 10) The invention has a polyurea coating (1) according to claim 1 which is waterproof, high impact strength, high tear and tensile strength, high abrasion resistance, antibacterial and chemical resistance.

11) The polyurea coating (1) of claim 10, wherein the polyurea coating (1) comprises the component A and the component B,

- heating the components to 70-80 ° C with circulation of a resistor,

20 - spraying of components with similar viscosity at 70-80 ° C with the help of a gun with 16-20 bar pressure, process steps.

12) The component B of claim 11 is MDI (methylene diphenyl diisocyanate) pre-polymer, wherein has an NCO content of 5-25%, most preferably 10-20%.

25 13) The component B of claim 11 is MDI (methylene diphenyl diisocyanate) pre-polymer, wherein:
- formation by MDI (methylene diphenyl diisocyanate) and polyol reaction at 50-100 ° C for 1-7 hours, preferably 70-90 ° C for 3-5 hours,

30 - the use of nitrogen to avoid side reactions during the reaction and not to affect the isocyanate air humidity,

process steps.

14) The component B of claim 11, wherein the MDI (methylene diphenyl diisocyanate) pre-polymer is characterized by:

35 - the use of a polyol having a reactivity of 2 or more and a molecular weight of 2000-5000 Daltons,

- the use of MDI (methylene diphenyl diisocyanate) as the isocyanate in the reaction,
If desired, from 0.01 to 10%, preferably from 0.05 to 5%, preferably from 0.1 to 1%, of the total weight of the tin catalyst is used during the synthesis.

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Figure 1

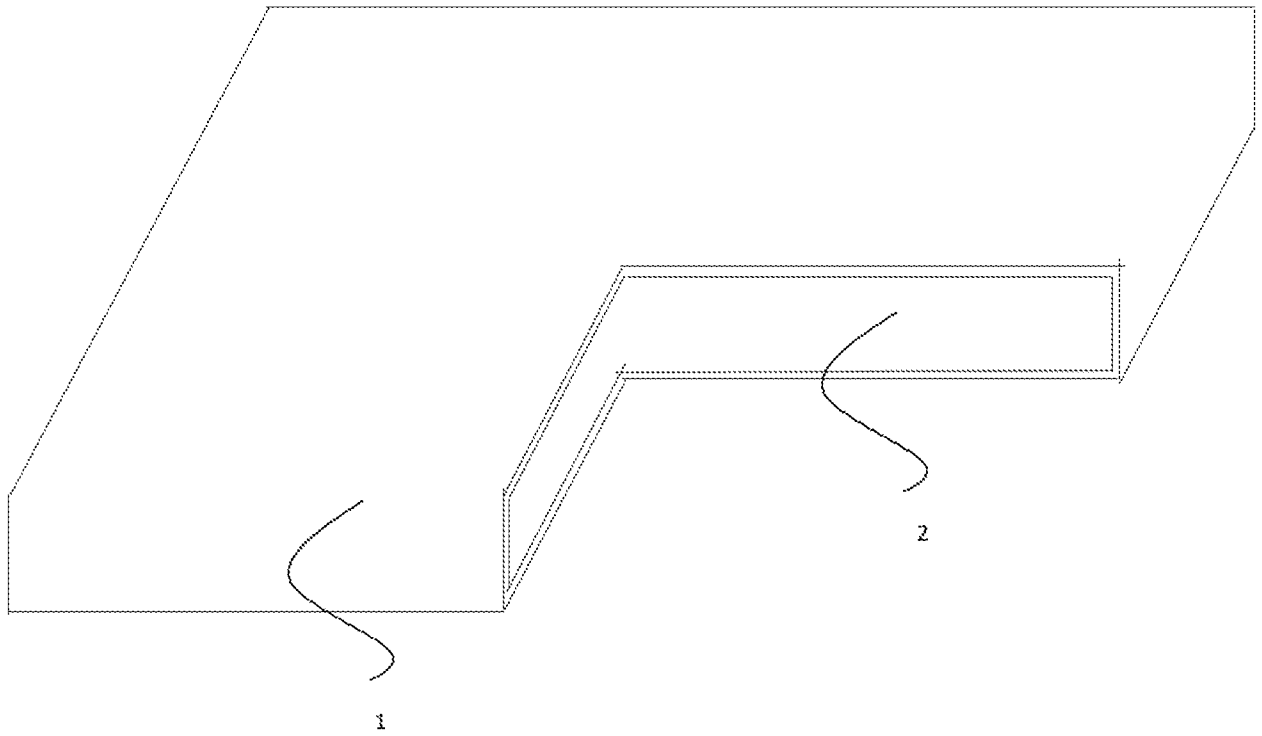


Figure 2

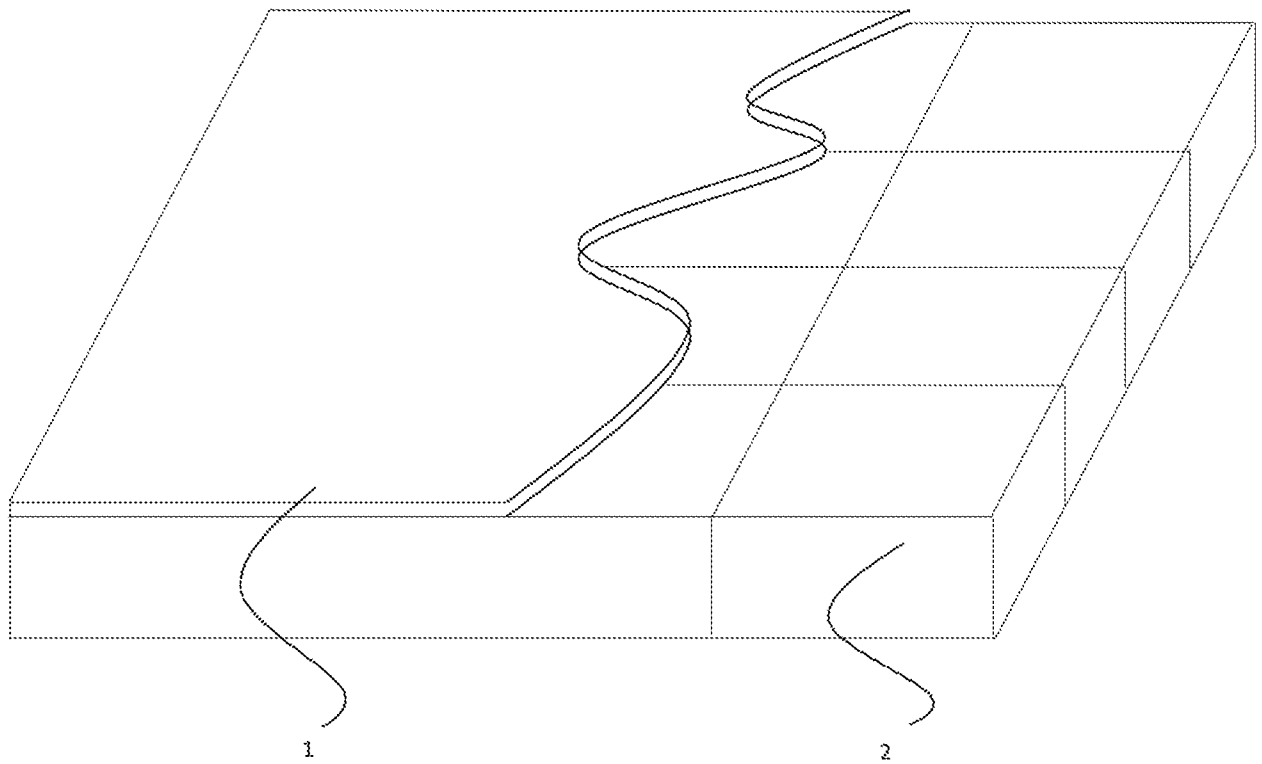
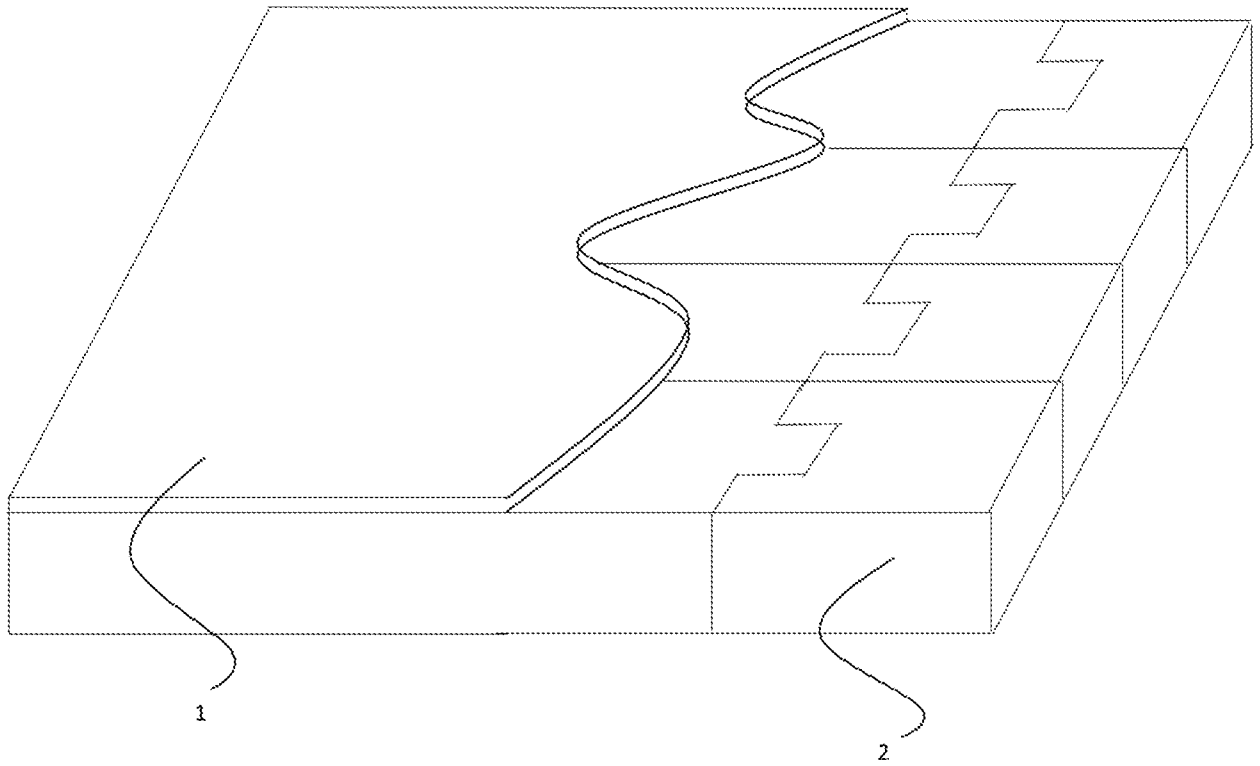


Figure 3



INTERNATIONAL SEARCH REPORT

International application No
PCT/TR2017/050403

A. CLASSIFICATION OF SUBJECT MATTER INV. C08G18/48 C08G18/50 C08G18/76 C08G18/79 C08J9/33 C08J9/35 C08J9/42 C08G18/12 ADD. According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) C08G C08J Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 026 760 A (PHILLIPS JERRY S [US] ET AL) 22 February 2000 (2000-02-22) example 3 -----	1-14
X	US 2013/084427 A1 (ERNST RANDALL ROB [US]) 4 April 2013 (2013-04-04) cited in the application claims 1,4 -----	1-14
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
23 May 2018		01/06/2018
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Bergmeier, Martin

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/TR2017/050403

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6026760	A	22-02-2000	NONE

US 2013084427	A1	04-04-2013	NONE
