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(54) **Title**: ALKALINE HYDROLYSIS RESISTANT ADHESIVE

(57) **Abstract**: There is described herewith an alkaline hydrolysis resistant carpet adhesive comprising an n-butyl acrylate acrylic polymer.

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ALKALINE HYDROLYSIS RESISTANT ADHESIVE

Technical Field

The present invention relates to an alkaline hydrolysis resistant adhesive. In one embodiment the present invention relates to an alkaline hydrolysis resistant adhesive suitable for securing a laminated floor covering such as a carpet or carpet tile to a surface having a high pH.

Background of the Invention

Carpets, such as free-lay carpet or backed carpet tiles are typically prepared as either a tufted or a fusion bonded carpet material having a wear fibrous or pile surface from which pile yarns upwardly project. Carpet tiles differ from the production of ordinary tufted or other fibrous-faced carpets because there is no requirement on a typical carpet for a heavy backing layer. In a carpet tile, a rigid stabilized mass of a thermoplastic backing layer is typically required in order to hold down the carpet tile so that it can function as a free-lay carpet tile. Generally, the backing layer has a high filler content (e.g., limestone) and is employed with various scrim materials such as glass fibres, polyester or a combinations thereof, to impart dimensional stability. Generally the thermoplastic backing layer is one or more polyvinyl chloride layers.

As an example, a tufted carpet tile generally comprises a primary backing base sheet material such as polyester or polypropylene having a plurality of tufted yarns such as Nylon® through the primary backing to form a wear surface of loop or cut pile (carpet pile). The primary backing is used to tuft the carpet yarn into and to provide the required top cloth of the product. A precoat of a latex type material such as EVA (polyethylene vinyl acetate) or carboxylated styrene-butadiene-styrene may be applied on the back (underside) surface to bond the yarn to the primary backing and to aid in the securing of the primary backing to the backing layer. The backing layer may be comprised of a first PVC layer, a fiberglass layer and a second PVC layer (reback layer) - the first layer of PVC bonding the primary backing to the fiberglass layer, the fiberglass layer ensuring dimensional stability of the carpet tile and the second layer of PVC gluing the layers above it and providing the final backing of the carpet tile.

In an alternative construction of the above carpet tiles, the PVC layer is replaced with a bitumen layer.

Fusion-bonded carpet generally has a similar backing to tufted carpet except that the fusion-bonded carpet has a plurality of cut pile yarns of nylon or other suitable fibrous material implanted in an adhesive layer, particularly a thermoplastic such as PVC or hot-melt adhesive, which may be further laminated to a reinforcement or substrate layer of a woven or non-woven material such as fibreglass, Nylon®, polypropylene or polyester. The plurality of fibrous yarns are bonded to and extend generally upright from the adhesive base layer to form the wear surface.

Carpets have many applications as a floor covering for various surfaces including wood and concrete. Typically carpets are installed by applying an adhesive to the surface such as concrete, suitably as a thin film followed by positioning of the carpet on top of the adhesive and curing of the adhesive to thereby form a bond between the surface and the carpet. Alternatively, the adhesive may be applied directly to the underside of the carpet and a releasable film provided which is removed prior to use. It has been found however that with conventional pressure sensitive acrylic adhesives and where the surface has a pH of above 9 and a high moisture content, conventional adhesives break down forming excessive volatile organic compounds, such as 2-ethyl-1-hexanol, alcohols and esters. This occurs particularly where the time from pouring the concrete surface to installation of the carpet is short and where the concrete slab has not had sufficient time to settle and fully cure. It has been found that in these conditions all the adhesive may be required to be removed or the surface sealed prior to application which may be undesirable.

Object of the Invention

It is an object of the present invention to substantially overcome or at least ameliorate one or more of the above disadvantages or at least provide a suitable alternative.

Definitions

The following are some definitions that may be helpful in understanding the description of the present invention. These are intended as general definitions and should in no way limit the scope of the present invention to those terms alone, but are put forth for a better understanding of the following description.

Unless the context requires otherwise or specifically stated to the contrary, integers, steps, or elements of the invention recited herein as singular integers, steps or elements clearly encompass both singular and plural forms of the recited integers, steps or elements.

Throughout this specification, unless the context requires otherwise, the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated step or element or integer or group of steps or elements or integers, but not the exclusion of any other step or element or integer or group of elements or integers. Thus, in the context of this specification, the term "comprising" means "including principally, but not necessarily solely".

The information provided herein and references cited are provided solely to assist the understanding of the reader, and do not constitute an admission that any of the references or information is prior art to the present invention.

The term "filament" or "filaments" means strands of extreme or indefinite length.

The term "yarn" means a collection of numerous filaments which may or may not be entangled, twisted or laid together.

The term "textured" or "texturing" means any operation of filaments which results in crimping, looping or otherwise modifying such filaments to increase cover, resilience, bulk or to provide a different surface texture or hand. It follows that a "bulked continuous filament" is a filament which has been subjected to one or more "texturing" operation(s).

By "biobased" is meant that the relevant material is made from substances derived from living matter.

It will be understood that although the description of the carpet or carpet tile of the present invention has been given in terms of "layers", that following processing the carpet tile is a bonded unitary integral structure in which the individual layers are not necessarily readily discernible or removable from one another.

Summary of the Invention

According to a first aspect of the present invention, there is provided an alkaline hydrolysis resistant carpet adhesive comprising an n-butyl acrylate acrylic polymer.

According to a second aspect of the present invention, there is provided a method of positioning a carpet on a surface comprising:

forming a film of the adhesive of the first aspect on the surface or applying the adhesive to an underside of the carpet,

positioning the carpet on the surface; and

allowing the adhesive to cure to thereby from a releasable bond between the carpet and the surface.

According to a third aspect of the present invention, there is provided a carpet having an adhesive according to the first aspect applied to an underside of the carpet and a releasable protective layer attached to the adhesive.

Detailed Description of the Preferred Embodiments

It has been discovered that in the presence of a high pH (above about pH 9) and in high moisture environments (for example above 5wt%), for example on green slabs, conventional carpet adhesives breakdown forming high volatile compounds such as 2-ethyl-1-hexanol. Even at pH 9 the adhesive may begin to breakdown up to a year after installation of the carpet. Such volatile compounds are typically pungent and can cause nausea, headaches and vomiting. It was originally thought that the presence of such high volatile compounds was a result of the PVC backing generally used in carpets however this is not the case and it has been found that it is a function of a reaction occurring in the adhesive itself as a result of the high pH and moist environment. This was not expected. Volatile Organic Content (VOC) emissions of 2800μg/m^2/h have been measured using conventional adhesives.

The present invention relates to an alkaline hydrolysis resistant carpet adhesive comprising an n-butyl acrylate acrylic polymer. The n-butyl acrylate acrylic polymer is suitably an aqueous dispersion of a thermoplastic acrylic polymer based on n-butylacrylate having a total solids content of about 60% and having a glass transition temperature of about -42 °C.

The adhesive may be in an aqueous formulation.

The butyl acrylate acrylic polymer may be combined with any crosslinked acrylic polymer. For example the polymer may be combined with an APEO (alkyl phenol ethoxylate) free acid-containing acrylic emulsion copolymer.

In one embodiment the adhesive has a total solids content suitably in the range of 44 to 46 wt%.

The adhesive may include additional additives such as fillers, thickeners, defoamers, antimicrobials, fungicides, biocides, pH adjusters/neutralising agents, tackifiers, surfactants, rheology modifiers, wetting agents, polymer blends and mixtures thereof.

Suitable fillers may include calcium carbonate, barium sulphate, zinc oxide, aluminium hydrate, titanium dioxide, lime, clays, recycled glass, ash or mixtures thereof. Fillers may be used in amounts up to 5wt% but in an amount not affecting surface tack properties.

Suitably thickeners may include acrylic copolymers, alkali swellable thickeners, sodium polyacrylate, cellulosic thickeners and mixtures thereof. The thickeners may be included in amounts up to 10wt%, for example 2 to 10wt%.

Suitable defoamers include oil based defoamers such as oil based without silicone defoamers. The defoamers may be used in amounts up to 0.2wt% for example 0.1 – 0.2wt%.

Suitable pH adjusters/neutralising agents include sodium hydroxide, potassium hydroxide or ammonia. Amounts used will depend on the desired pH of the final formulation. In one embodiment the adhesive has a pH of from 7 to 10, for example 7 to 9.

Suitable biocides include zinc omadine and MIT/BIT biocide (a 5% equal blend of 2-methyl-2H-isothiazol-3-one/1,2-benzisothiazol-3(2H)-one). Other biocides may be used. The biocide may be used in amounts up to 0.3wt%, for example 0.1 - 0.3wt%.

Suitably the adhesive has a viscosity within the range of 2000 cps to 50000 cps. For rollable viscosity suitably should be 2,000 cps minimum and trowellable viscosity minimum suitably 10,000 cps. For example the viscosity may be 15000 to 17000cps stirred (RVT 6/10).

The adhesive may have a density of 0.95 to 1.15 g/cm^3 at 20°C, for example 0.95 to 1.05 g/cm^3.

The present invention also relates to a method of positioning a carpet on a surface comprising:

forming a film of the adhesive of the first aspect on the surface or applying the adhesive to an underside of the carpet,

positioning the carpet on the surface; and

allowing the adhesive to cure to thereby from a releasable bond between the carpet and the surface.

The surface may be concrete or timber and may include a sealer or an epoxy coating on the surface. Sealers should suitably be of an acrylic or similar type and not contain waxes or any chemicals that will affect wetting of the adhesive.

The surface may have a pH of above 9. In one embodiment the surface may have a pH above 10. In another embodiment the surface may have a pH above 11. In another embodiment the surface may have a pH above 12.

The surface may have a moisture content of 5wt% or above.

<u>Carpet</u>

In one embodiment the carpet includes a primary backing having a fibrous face and an underside, wherein the fibrous face is formed from yarn tufted or implanted into the primary backing. The carpet may additionally include a cured precoat layer on the underside of the primary backing and a backing layer fixed to the primary backing.

The primary backing may be a tufted fibrous layer or a fusion bonded material. When a tufted fibrous layer is used, it may be prepared by feeding the primary backing material to a conventional tufting machine which tufts fibres through interstices in the material. Tufting is typically performed such that the resulting tufts protrude from the underside face with back stitches which hold the tufts in place on the topside of the material during processing.

The primary backing is suitably formed from a woven or non-woven synthetic or non-synthetic fibre. Suitably a thermoplastic backing such as a woven polypropylene backing or a non-woven polyester, with a fibrous face or wear surface such as a tufted face, and a fibrous back surface, such as a loop or tufted surface where the carpet tile is tufted is used. A polyester such as Lutradur® is preferably used when making a PVC backed floor covering because it does not suffer too much from shrinkage due to heat during the gelling process, thus minimizing the risk of tile uplift due to not enough drape. Other suitable backings include Nylon®, fibreglass, cotton, jute, rayon, paper, natural or synthetic rubbers, sponge or foam rubbers, polychloroprene, acrylonitrile-butadiene copolymers, ethylene-propylene-diene rubbers, petroleum resin, vinyl polymers (such as polyvinylchloride, polyvinylidene chloride, polyvinyl acetate, polyvinyl acetal, polyvinyl butyral, copolymers or mixtures thereof), polybutene resin, polyisobutene-butadiene resins and copolymers and mixtures thereof.

The yarn may be any suitable yarn or fibrous material that can be tufted of implanted into the primary backing. Suitable fibrous materials and yarns may include synthetic, natural or a combination of synthetic and natural fibre, such as but not limited to polyamides like nylon, olefins like polypropylene, wool and wool blends, cotton, acrylic, acrylic-nylon blends, polyester yarns, biobased yarns and combinations and blends thereof. The yarns/fibrous materials may be used to form face or back yarn with the primary backing. The yarns may be dyed and may be textured.

For a fusion bonded carpet tile, the fibrous material and yarns employed in the carpet tile are implanted into a material such as PVC or a hot melt adhesive which may be laminated to a substrate, such as a woven or nonwoven material, such as fibreglass, Nylon®, polypropylene or polyester.

The primary backing layer may be precoated with latex or with another suitable precoating composition of the invention prior to applying a backing layer. Typically the precoat is applied to cover the loop backs and to lock in the loops.

The latex may be an EVA latex or another vinyl polymer or acrylic-like polymer latex. For example, the latex may be a copolymer of acrylic and methacrylic acid and alkyl acrylates and esters (such as ethyl acrylate or methyl acrylate), acrylic-styrene copolymers, acrylonitrile-styrene copolymers, vinylidene chloride-acrylonitrile copolymers, and combinations thereof. Suitably the latex is non-halogenated. Other suitable latex materials which can be used include other vinyl, short-chain carboxylic acid copolymers, butadiene-acrylonitrile copolymer, styrene-butadiene, carboxylated styrene-butadiene or carboxylated styrene-butadiene-styrene. Urethane, PVC, acrylics or vinylidine chloride may also be used.

The precoating composition/latex may further comprise a thickener, an antibacterial, a fire retardant and/or a surfactant. A suitable antibacterial is zinc omadine – zinc2-pyridinethiol-1-oxide. A suitable fire retardant is aluminium hydroxide. A suitable surfactant is sodium lauryl sulphate.

In one embodiment a precoating composition is used comprising: at least one copolymer derived from an acrylic or methacrylic monomer and a styrenic monomer; at least one copolymer derived from an acrylic ester and a methacrylic ester; at least one thickener; and water. The copolymer derived from an acrylic or methacrylic monomer and a styrenic monomer is suitably an acrylate/styrene copolymer dispersion such as that supplied by BASF Corporation as Acronal® S 728 na. The precoating composition may also contain a copolymer derived from an acrylic ester and a methacrylic ester. This copolymer facilitates the acrylic styrene sticking to thermoplastic materials such as PVC suitably used in the manufacture of the floor coverings. A suitable polymer is Acronal® AX 8281 AP available from BASF Aktiengesellschaft. Suitably the thickener is a thickener suitable for polymer dispersions, for example, an acrylic copolymer containing carboxyl groups. A suitable thickener is Latekoll® D available from BASF Aktiengesellschaft and is a low-viscosity, milky white anionic dispersion. The thickener helps to prevent the precoating composition from wicking down holes in the primary backing layer. The thickener is suitably pre-diluted with water to form a homogeneous solution prior to the addition to the resins.

The latex/precoating composition can be applied to the primary backing by roller coating, spraying or by foaming. The latex/precoating composition serves to lock in the fibre on the back of the primary, such as a tufted back layer and acts as a barrier, separating the fibrous carpet from the underlying backing. The pre-coating is suitably heated to drive off sufficient water to provide a solid barrier and to allow for possible cross-linking.

The precoating layer has a thickness which is typically quite thin. Suitably the thickness is about 0.005mm to 0.1mm when dry. The thickness is suitably controlled by the use of spray nozzles and spray pressure. The precoating layer is suitably placed directly on and against the back surface of the loop or fibre containing primary backing and is suitably applied in an amount to cover completely the loop backs and to lock in loops so that no mountains or valleys are evident. During processing the copolymers are suitably cured and crosslinked. The resulting precoated product is very flexible.

The floor covering may include a backing layer which imparts stability and free-laying properties to the floor covering.

Prior to applying the backing layer, it is possible to shear the carpet fibres if desired. Shearing is performed to cut the closed loop, tufted yarn on the face surface and to provide for the cut, tufted yarn to have the same general height as the height of the face wear surface fibres.

The backing layer may be formed from one or more layers of a thermoplastic polymer or other suitable backing material such as described above for the primary backing. In one embodiment the thermoplastic is a vinyl halide. A suitable vinyl halide is PVC (polyvinylchloride).

Other suitable backings include bitumen, atactic polypropylene, polyolefin, ethylene vinyl acetate copolymer, thermoplastic elastomers, polyurethanes, PVC/Latex, bitumen backed latex and polyurethane, polyamines, jute, urethane, polyvinylidine chloride, polyvinyl acetate, polyvinyl butyral, natural or synthetic rubber or polychloroprene. The backing layer may be in the form of a foam, sponge or solid. When in the form of a foam, the backing layer adds resilience and/or stability.

The backing layer can have a range of properties depending on the nature of polymers, plasticizers, stabilizers and fillers used. Suitable fillers include recycled glass, limestone or a combination thereof. The plasticizer may be a standard phthalate plasticizer such as DINP, DEHP, DOP, PEG 100, or PEG 200. A particularly preferred plasticizer is the combination of epoxide soybean oil and a castor oil derivative. A viscosity modifier such as an alcohol may be present as required to lower viscosity. A suitable viscosity modifier is ethanol. A suitable soybean plasticizer is an epoxidised soya bean oil such as Lankroflex E2307 (ESBO) AG available from Swift and Company Limited, 372 Wellington Road, Mulgrave, Victoria 3170, Australia. The castor oil derivative is suitably an acetic acid ester of monoglycerides made from fully hydrogenated castor oil such as Grindsted® Soft-n-Safe/C available from Danisco Emulsifiers.

A preferred backing layer is formed from a composition comprising recycled glass and the soybean oil/castor oil combination. This result is a more renewable and less fossil based product. In such a combination the composition may include up to about 60% thermoplastic (fossil origin)

The primary backing and backing layer or latex/precoating composition may include any one or more of flame or fire retardants, inert fillers such as limestone or barytes, calcium oxide, carbon-black, antibacterials, surfactants, defoamers, thickeners, dispersing agents, elastomers, antioxidants, colourants, hardeners, plasticizers, UV/heat stabilizers, viscosity modifiers, cross-linking agents and/or tackifiers.

The use of a plasticizer in combination with the thermoplastic resin provides the required flexibility, durability and hardness. The presence of a heat stabilizer stabilizes the thermoplastic and prevents thermal decomposition, a UV stabilizer stabilizes the thermoplastic preventing decomposition as a result of exposure to UV light, calcium oxide ensures any moisture is removed from the mixing process, calcium carbonate (limestone) acts as filler, increasing the volume of the thermoplastic compound mix at reduced cost and a viscosity modifier maintains viscosity to ensure that the mix remains well mixed and in suspension (slowing the dropping out of solids).

The floor covering may include one or more woven or non-woven layers of glass, fibreglass, polyester, Nylon® or polypropylene such as tissue, mesh, fleece or scrim sheet materials or a combination thereof in the primary backing and backing layer. The scrim material may be employed adjacent to the primary backing or closely adjacent thereto. Glass fibre or tissue materials may be employed within the thermoplastic backing layer to impart dimensional stability and improve laying properties of the carpet tile. Cushion layers for example, formed of foam may also be included.

The floor covering may be prepared in any suitable manner. For example, a layer of thermoplastic may be applied/cast in a defined thickness onto the underside of the primary backing layer as a wet plastisol. The coated material is suitably leveled with a doctor blade which levels and smooths the thermoplastic layer and forces the thermoplastic layer into engagement with any glass scrim and the primary backing.

Alternatively, the backing layer may be preformed on a releasable support such as a fluorocarbon, glass fibre endless belt, Teflon® coated fibreglass belt or stainless steel support sheet through casting. The precoated primary backing layer is then laid into the liquid backing layer.

Following application of the backing layer, the carpet is suitably heated to fuse/gel and cure the thermoplastic, cooled and optionally cut into carpet tile sections. Heating may be by use of a heater, radiant panels or heating elements. The heating cures the thermoplastic material and for a tufted carpet, thereby locks back stitches in place, the primary backing is thereby bonded to the backing layer by fibres of the primary backing being embedded in the backing layer. The carpet tile may be heated to a curing temperature within the range of 50°C to 170°C, for example 90°C to 160°C, 100°C to 150°C or 140°C to 150°C. For example, for PVC, the plasticizer melts and begins diffusing into particles at 50°C, gelation begins at about 50°C and continues to about 130°C, at which point the particles swell and between 130°C and 170°C the gelation stage ends. At 91°C the polymer flows into a continuous mass.

A suitable apparatus for finishing the carpet tile may be an apparatus including a heater having a chamber to operate at a desired temperature and through which the primary backing and backing layers pass to be heated to provide for plastic deformation of the backing layer; a pair of press rollers to which the primary backing, backing and any additional cushion layers are delivered, after the primary and backing layers have been heated by the heater, to apply a force thereto to cause the layers to bond, and a controller operatively associated with the heater, the controller being configured to maintain the temperature within the chamber to provide for heating of the backing layer so that the backing layer is relatively deformed by the rollers to bond the layers.

During gelling or after gelling the carpet may be passed under an embossing roller which embosses the back of the carpet with indentations, corrugations or the like to form a friction-increasing surface (resisting movement and maintaining position when placed in situ) and assists in consolidating the layers into a unitary product. The consolidated carpet material may then be severed by suitable cutting means into appropriate length sections (for example into squares). The laminated construction may be cooled for example to about 105°C to allow removal of the construction from the support. The construction may then be passed through a heater and raised to about 100°C prior to being engaged by an embossing roller that embosses the thermoplastic layer.

In one embodiment, the backing layer is formed of a layer of thermoplastic such as PVC, a fibreglass scrim and a second thermoplastic layer such as PVC. The first layer of thermoplastic bonds the primary backing to the fibreglass layer, the thickness of the layer suitably being controlled by a doctor blade. The fibreglass layer is to ensure dimensional stability of the carpet tile. The second layer of thermoplastic glues the layers above it and provides the final backing of the carpet tile. The thickness of this layer is also suitably controlled by a doctor blade.

The backing layer may be applied to the primary backing in a continuous fashion to produce an indeterminate length of material which may be subsequently cut as desired to form the carpet tile.

The thickness of each layer may vary depending on whether a solid layer or foam layer is used. For example, the first PVC layer range is dependant on the weight of the PVC backing i.e., 2.64kg/m^2 would be two layers of 0.88mm, 2kg/m^2 would be two layers at 0.67mm, while 1.5kg/m^2 would be two layers at 0.5mm. The overall carpet thickness may suitably be between about 4 and 12 mm, for example about 6mm without foam backing and about 10mm with foam backing. The resulting floor covering is suitable for use as a floor covering for home and/or commercial use.

Installation of the carpet

In one embodiment, the underside of the carpet may be provided with an adhesive of the invention with a strippable protective layer attached thereto, where, in use the protective layer is stripped off and the floor covering applied to the floor surface and the adhesive allowed to cure. In another embodiment the adhesive of the invention is applied directly to the surface followed by positioning the carpet over the surface and allowing the adhesive to cure. The adhesive of the invention is suitably applied to the substrate suitably using a trowel. The adhesive has sufficient tack, peel strength and shear strength to maintain the tile against the floor during use but also allows carpet tiles to be replaced or rotated as desired. Volatile organic compound emissions may be reduced to 50µg/m^2/h which may be further reduced over time and balances at ambient VOC levels.

The present invention will now be described with reference to the following examples which should not be construed as limiting on the present invention.

EXAMPLES

Example 1

An adhesive was prepared using the formulation as shown in the following Table:

Component	Amount (100wt%)
n-butylacrylate acrylic polymer (Tg - 42°C)	78.4
Water	14.4
48% zinc omadine	0.2
5% MIT/BIT biocide	0.3
Oil based defoamer	0.17
46% sodium hydroxide	0.07
14% alkali swellable thickener	6.4
Green pigment	0.06

The adhesive was prepared by adding the acrylic polymer to water in a suitable mixing vessel and stirring the mixture whilst adding the zinc omadine, biocide and defoamer in given water. 0.7wt% water and the sodium hydroxide were premixed and then added slowly to the mix followed by the alkali swellable thickener and the mixture stirred until smooth and uniform. The green pigment was added until fully dispersed, the resulting adhesive quality checked and passed through a 10 mesh filter.

The resulting adhesive had a viscosity of 15000 to 17000 (using a Brookfield Viscosity RVT spindle 5 at 20 rpm at 25°C) and total solids content of 44 to 46%. The pH of the formulation was 7.0 to 9.0 with a density (specific gravity) of 0.95 to 1.05 g/cm^3. The adhesive was a pressure sensitive adhesive with low tack.

Example 2

A study was undertaken to compare the emission rate of volatile organic compounds (2-ethyl-1-hexanol) using the adhesive of the invention compared with two commercial adhesives at pH 9, 10 and 11.

Four concrete core samples had the adhesive applied to the flat surface and these were placed separately into dishes containing water as a control, and water and CaOH at pH 9, 10 11. Each sample remained in this condition for four weeks while VOC monitoring was conducted throughout the period.

The results are shown in the following table:

	pH condition			
Adhesive	Control	pH 9	pH 10	pH 11
R656 Pressure Sensitive Adhesive (supplied by Intertac)	8.2	1	12	14
Ardex DPF0308 (supplied by Ardex)	20	21	23	22
Adhesive of Example 1	<1	<1	<1	<1

It can be seen from the table that the adhesive of the invention did not produce any emissions of 2-ethyl-1-hexanol whereas the conventional adhesives did produce 2-ethyl-1-hexanol in significant amounts. It was noted that the adhesive of Example 1 did give off some propanol in the first 15 minutes but this would not affect application of the carpet tile which is usually applied 15 to 20 minutes after the adhesive.

Example 3

The adhesive prepared in Example 1 was applied as a thin film to a concrete surface having a pH of 12 using a V1 or V2 notch trowel. A carpet tile was positioned on the adhesive and allowed to cure. No pungent odour was detected and the adhesive has sufficient shear strength and tack to maintain the carpet against the surface but was peelable from the surface.

Example 4

Samples of various conventional pressure sensitive adhesives manufactured in Australia, Europe and the US were obtained. 200ml of each were decanted into separate sealed containers and 50 ml of CaOH solution (pH11) was added to each. After 2 hours all of the samples displayed evidence of depolymerisation and all samples produced undesirable VOC's. It was determined at this point that further qualitative testing was required. Samples of Intertac pressure sensitive adhesive was supplied to CETEC Laboratories, to repeat the test and measure VOC.

Preliminary results showed emission rates while the adhesive was undergoing an alkaline hydrolysis reaction of 2800 ugm /m2/hr.

While the invention has been described with respect to a preferred embodiment, it will be understood that the invention is not limited to the preferred embodiment but is intended to cover various modifications and equivalent arrangements within the spirit and scope of the appended claims.

Claims

1. An alkaline hydrolysis resistant carpet adhesive comprising an n-butyl acrylate acrylic polymer.

2. The adhesive according to claim 1 wherein the n-butyl acrylate acrylic polymer is an aqueous dispersion of a thermoplastic acrylic polymer based on n-butylacrylate having a total solids content of about 60% and having a glass transition temperature of about -42°C.

3. The adhesive according to claim 1 or 2 wherein the adhesive is in an aqueous formulation.

4. The adhesive according to any one of claims 1 to 3 wherein the n-butyl acrylate acrylic polymer is combined with a crosslinked acrylic polymer.

5. The adhesive according to claim 4 wherein the n-butyl acrylate acrylic polymer is combined with an APEO (alkyl phenol ethoxylate) free acid-containing acrylic emulsion copolymer.

6. The adhesive according to any one of claims 1 to 5 wherein the adhesive has a total solids content in the range of 44 to 46 wt%.

7. The adhesive according to any one of claims 1 to 6 including additional additives selected from fillers, thickeners, defoamers, antimicrobials, fungicides, biocides, pH adjusters/neutralising agents, tackifiers, surfactants, rheology modifiers, wetting agents, polymer blends and mixtures thereof.

8. The adhesive according to any one of claims 1 to 7 having a pH of from 7 to 10.

9. The adhesive according to any one of claims 1 to 8 having a viscosity within the range of 2000cps to 50000cps.

10. The adhesive according to any one of claims 1 to 9 having a density of 0.85 to 1.15g/cm^3 at 20°C.

11. A method of positioning a carpet on a surface comprising:

forming a film of the adhesive of any one of claims 1 to 10 on the surface or applying the adhesive to an underside of the carpet,

positioning the carpet on the surface; and

allowing the adhesive to cure to thereby from a releasable bond between the carpet and the surface.

12. The method of claim 11 wherein the surface is concrete or timber.

13. The method of claim 11 or 12 wherein the surface includes a sealer or an epoxy coating.

14. The method of claim 11, 12 or 13 wherein the surface has a pH above about 9.

15. The method of any one of claims 11 to 14 wherein the surface has a moisture content of 5wt% or above.

16. A carpet having an adhesive according to any one of claims 1 to 19 applied to an underside of the carpet and a releasable protective layer attached to the adhesive.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2011/001492

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

C09J 133/08 (2006.01)

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)

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)
EPODOC, WPI, INSPEC, CAPLUS, PCTFULL Keywords: butyl acrylate, polymer, acrylic acid, adhesive, glue, flooring, underlay, carpet, alkali, base, hydrolysis, resistant, glass transition, tg, CAS No. 25119-83-9, 9003-49-0, 141-32-2

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2009/0199965 A1 (WILDESON ET AL.) 13 August 2009 See [0022] – [0025], [0034], [0039], [0062], [0082] – [0084], [106]	1-16
X	US 6,409,860 B1 (FICKEISEN ET AL.) 25 June 2002 See col. 1 ln 34-62 and Example 1	1-16
X	Chemical Abstracts Accession No. 1996:593688 & JP 08-174773 A (NITTO DENKO CORP) 9 July 1996 See abstract	1-3, 11-16

☒ Further documents are listed in the continuation of Box C ☒ See patent family annex

* Special categories of cited documents:

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"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

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Date of the actual completion of the international search 27 February 2012	Date of mailing of the international search report 1 March 2012
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INTERNATIONAL SEARCH REPORT

International application No.	PCT/AU2011/001492

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Chemical Abstracts Accession No. 1996:73621 & JP 07-292335 A (SEKISUI CHEM CO LTD) 7 November 1995 See abstract	1, 3
X	JP 2003-096148 A (DAINIPPON INK & CHEM INC) 3 April 2003 Seen as a machine based English translation on the Patent Abstracts of Japan website See abstract , [0028], [0068], [0090], [0152], [0191], [0192]	1-10
X	CN 101712856 A (MINQIANG JIN) 26 May 2010 Seen as an English abstract on Espacenet See abstract	1, 3
X	US 4,036,673 A (MURPHY ET AL.) 19 July 1977 See Example 1, col. 6 ln. 10, col. 3 ln. 67, col. 3 ln. 20-50, Fig. 1	1, 3-7, 9-16

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2011/001492**

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	2009199965	AU	2007255490	CA	2653954	CN	101466781
		EP	2032638	JP	2009540034	KR	20090023676
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		DE	4404411	EP	0743965	FI	963133
		JP	H09508662	WO	9521884		
JP	2003096148	NONE					
CN	101712856	NONE					
US	4036673	CA	1053621				

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX