(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 June 2017 (22.06.2017)

WIPO | PCT

(10) International Publication Number
WO 2017/106086 A1

(51) International Patent Classification:
C08G 18/48 (2006.01) *C09D 175/04* (2006.01)
C08G 18/66 (2006.01) *C08L 75/04* (2006.01)
C08G 18/76 (2006.01)

(21) International Application Number:
PCT/US2016/066118

(22) International Filing Date:
12 December 2016 (12.12.2016)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/267,984 16 December 2015 (16.12.2015) US

(71) Applicant: **DOW GLOBAL TECHNOLOGIES LLC** [US/US]; 2040 Dow Center, Midland, MI 48674 (US).

(72) Inventors: **WILLUMSTAD, Thomas P.**; 2301 North Brazosport Boulevard, Freeport, TX 77541 (US). **MOBLEY, Larry W.**; 1881 West Oak Parkway, Marietta, GA 30062 (US).

(74) Agent: **THEKDI, Amy**; The Dow Chemical Company, Intellectual Property, P. O. Box 1967, Midland, Michigan 48641-1967 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) Title: REPROCESSABLE POLYURETHANE TEXTILE BACKING

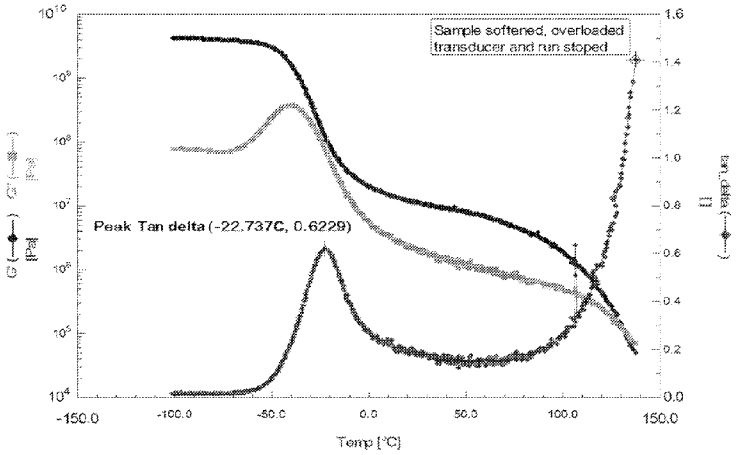


FIG. 1

(57) Abstract: A reprocessable polyurethane based textile backing includes a reaction product of a mixture including an isocyanate component, an isocyanate reactive component, and one or more fillers. The isocyanate component includes at least an isocyanate-terminated prepolymer or a modified polyisocyanate and the isocyanate component has a calculated isocyanate functionality from 1.9 to 2.1. The isocyanate-reactive component includes one or more low monol content polyether diols derived from propylene oxide and ethylene oxide and having a hydroxyl functionality from 1.97 to 2.00, one or more chain extenders, and one or more catalysts.

WO 2017/106086 A1

Reprocessable Polyurethane Textile Backing

Field

[0001] Embodiments relate to a reprocessable polyurethane based textile backing, compositions for forming the reprocessable polyurethane based textile backing, methods of forming the reprocessable polyurethane based textile backing, and methods of reprocessing the reprocessable polyurethane based textile backing.

Introduction

[0002] Hard backed carpet tiles made from flexible polyvinyl chloride and/or thermoplastic polyolefins may be melt processed and coated onto the back of carpet. These materials can also be thermally reprocessed at the end of product life, which reduces waste. However, the initial coating process for such materials can be complicated and/or expensive, e.g., because these materials necessitate the use of a high temperature extruder.

[0003] The use of polyurethane based hard backings for textiles, such as carpet, are discussed in, e.g., U.S. Patent No. 4,696,849. The hard backings may be made from reacting a liquid polyol/filler blend and a liquid isocyanate, such that use of a high temperature extruder is avoided. However, polyurethane based materials may not be readily reprocessable at the end of the product life. Accordingly, polyurethane based materials for use in hard backings for textiles are sought that allow for reprocessing, e.g., to form new carpet backings or other filled polyurethane materials.

Summary

[0004] Embodiments may be realized by providing a reprocessable polyurethane based textile backing that includes a reaction product of a mixture including an isocyanate component, an isocyanate reactive component, and one or more fillers. The isocyanate component includes at least an isocyanate-terminated prepolymer or a modified polyisocyanate and the isocyanate component has a calculated isocyanate functionality from 1.9 to 2.1. The isocyanate-reactive component includes one or more low monol content polyether diols derived from propylene oxide and ethylene oxide and having a hydroxyl functionality from 1.97 to 2.00, one or more chain extenders, and one or more catalysts.

Brief Description of the Drawings

[0005] FIG. 1 illustrates the dynamic mechanical analysis (DMA) results for Working Example 1.

[0006] FIG. 2 illustrates the DMA results for Comparative Example B.

Detailed Description

[0007] Polyurethanes are highly versatile materials with a broad array of applications and uses. Polyurethanes may be prepared as an one-component system or a two-component system. Whereas, the one-component system may be a preformed (pre-reacted) curable polyurethane based composition that is used to form a textile backing. The two-component system may be a composition in which separate components are combined immediately before forming textile backing or feed separately to form the textile backing. Both one-component and two-component polyurethane materials may be prepared by reacting an isocyanate material with an isocyanate-reactive material. For example, the polyurethane materials may be prepared by reacting an isocyanate component that includes one or more isocyanates, for which each isocyanate may be a polyisocyanate or an isocyanate-terminated prepolymer, with an isocyanate-reactive component that includes at least one material with an active hydrogen, such as a polyol. In exemplary embodiments, the isocyanate component and the isocyanate-reactive component may be separately dispensed onto a substrate to form a backing textile.

[0008] According to embodiments, a reprocessable polyurethane based textile backing is formed using a one or two-component system and the polyurethane based textile backing is reprocessable to form another polyurethane based substrate such as a second polyurethane based textile. For example, the reprocessable polyurethane based textile backing may form a carpet tile backing that, once separated from the carpet fibers and optionally pulverized into a powder, can be readily thermally reprocessed to form new carpet backing using a process such as compression molding (with or without elevated temperatures such as greater than 140 °C).

[0009] The reprocessable polyurethane based textile backing is the reaction product of a mixture including an isocyanate component and an isocyanate reactive component.

The isocyanate component includes at least an isocyanate-terminated prepolymer or a modified polyisocyanate. For example, the isocyanate component at a minimum includes an isocyanate-terminated prepolymer or a modified polyisocyanate, and may include one or more isocyanate-terminated prepolymers, one or more modified polyisocyanates, one or more other polyisocyanates, and/or combinations thereof. The isocyanate component is prepared so as to have a calculated isocyanate functionality from 1.9 to 2.1 (e.g., from 2.0 to 2.1, etc.) The isocyanate component may be included in an amount such that an isocyanate index of the mixture is from 85 to 125.

[0010] The isocyanate-reactive component includes one or more low monol content polyether diol that is both derived from propylene oxide and ethylene oxide and has an hydroxyl functionality from 1.97 to 2.00 (e.g., 1.98 to 2.00, etc.) For example, the low monol content polyether diol may be present in an amount from 15 wt% to 40 wt% (e.g., 15 wt% to 35 wt%, 15 wt% to 30 wt%, 20 wt% to 25 wt%, etc.), based on the total weight of the mixture. The isocyanate-reactive component further includes one or more chain extenders, one or more catalysts, and one or more fillers. The one or more chain extenders may be present in an amount from 1 wt% to 10 wt% (e.g., 1 wt% to 5 wt%, 1 wt% to 3 wt%, 1 wt% to 2 wt%), based on the total weight of the mixture. The one or more catalyst may be present in an amount less than 5 wt%, based on the total weight of the mixture, and may be present in an amount greater than 0.001 wt% of the total weight of the mixture. The one or more fillers may be present in an amount from 30 wt% to 75 wt% (e.g., 40 wt% to 75 wt%, 50 wt% to 75 wt%, 55 wt% to 75 wt%, 60 wt% to 70 wt%, 60 wt% to 65 wt%, etc.), based on the total weight of the mixture.

Isocyanate Component

[0011] The isocyanate component includes at least an isocyanate-terminated prepolymer or a modified polyisocyanate, and may optionally include one or more other polyisocyanates (modified or not modified). The isocyanate-terminated prepolymers are derived from polyisocyanates, as would be understood by one of ordinary skill in the art. By modified polyisocyanate, it is meant a polyisocyanate formed as a derivative of methane diphenyl diisocyanate (MDI) or toluene-diisocyanate (TDI). Examples of such modified polyisocyanates include a biuret modified MDI, an allophonate modified MDI, and a carbodiimide modified MDI.

[0012] For example, the isocyanate-terminated prepolymer may be formed by the reaction of another isocyanate component with another isocyanate-reactive component (both different and separate from the isocyanate-component and isocyanate-reactive component for forming the mixture), in which the isocyanate component is present in stoichiometric excess. Exemplary polyisocyanates for use in forming the isocyanate-terminated prepolymer and/or for inclusion in the isocyanate component, include aromatic, cycloaliphatic, and aliphatic polyisocyanates. For example, polyisocyanates known in the art may be used. Examples of polyisocyanates include the 4,4′-, 2,4′ and 2,2′-isomers of MDI, modifications, and blends thereof (e.g., polymeric or monomeric MDI blends), and 2,4- and 2,6- isomers of TDI (e.g., modifications, and blends thereof). Derivatives of any of the polyisocyanates that contain, e.g., biuret, urea, carbodiimide, allophonate, and/or isocyanurate groups, may be used.

[0013] The isocyanate component has calculated total isocyanate functionality from 1.9 to 2.1. As would be understood by a person of ordinary skill in the art, by calculated isocyanate functionality it is meant the isocyanate functionality is calculated based on the isocyanate functionality of each of the isocyanate-containing components in the isocyanate component and based on the weight of such components in the isocyanate component. Said in another way, the isocyanate functionality is calculated based on the weighted averages of each of the isocyanate group containing compounds in the isocyanate component, with respect to the total weight of the isocyanate component. The isocyanate component and/or each of the isocyanate group containing compounds in the isocyanate component may have a freezing point that is below 30 °C, e.g., so as to be a liquid near room temperature. For example, the isocyanate component may be in a liquid phase within the temperature range of 15 °C and 30 °C. In exemplary embodiments, the isocyanate component may include additional additives.

[0014] In exemplary embodiments, the isocyanate component includes from 20 wt% to 100 wt% (e.g., 30 wt% to 100 wt%, 50 wt% to 100 wt%, 70 wt% to 100 wt%, 80 wt% to 100 wt%, 90 wt% to 100 wt%, 95 wt% to 100 wt%, etc.) of one or more isocyanate-terminated prepolymers. The one or more isocyanate-terminated prepolymers may each have an isocyanate functionality from 2.0 to 2.1. The isocyanate component may include only isocyanate-terminated prepolymers that have an isocyanate functionality

from 2.0 to 2.1. The isocyanate-terminated prepolymer may have a free isocyanate group (NCO) content of 1 wt% to 35 wt% (e.g., 5 wt% to 30 wt%, 10 wt% to 30 wt%, 15 wt% to 30 wt%, 20 wt% to 30 wt%, 20 wt% to 25 wt%, etc.), based on the total weight of the prepolymer. The isocyanate component may include only one or more isocyanate-terminated prepolymers that are derived from MDI. The isocyanate component may exclude any additionally added isocyanate-terminated prepolymers that are derived from toluene diisocyanates. The isocyanate component may exclude any additionally added polymeric or modified diphenylmethylene diisocyanates and toluene diisocyanates.

[0015] An isocyanate index for forming the reprocessable polyurethane based textile backing may be from 85 to 125 (e.g., from 90 to 120, from 90 to 115, from 95 to 110, from 100 to 105, etc.). By isocyanate index, it is meant a ratio of equivalents of isocyanate groups in the reaction mixture for forming the cured composition to the active hydrogen atoms in the reaction mixture for forming the cured composition, for forming the polyurethane polymers, multiplied by 100. Said in another way, the isocyanate index is the molar equivalent of isocyanate (NCO) groups divided by the total molar equivalent of isocyanate-reactive hydrogen atoms present in a formulation, multiplied by 100. As would be understood by a person of ordinary skill in the art, the isocyanate groups in the reaction mixture for forming the cured composition may be provided through the isocyanate component, and the active hydrogen atoms may be provided through the isocyanate-reactive component.

Isocyanate-Reactive Component

[0016] The isocyanate-reactive component includes one or more low monol content polyether diols derived from propylene oxide and ethylene oxide, and having a hydroxyl functionality from 1.97 to 2.00. By low monol content it is meant that the amount of monols is sufficiently low such that the measured hydroxyl functionality is close to 2.00, i.e., is from 1.97 to 2.00. As would be understood by a person of ordinary skill in the art, a nominal functionality of 2 for a diol is distinguishable from the actual measured functionality of the diol. In this regard, the actual measured functionality is affected by factors including the total monol content. By derived from propylene oxide and ethylene oxide it is meant that the low monol content polyether

diol is propylene oxide-ethylene oxide copolymer polyether polyol. For example the low monol content polyether diol may be an ethylene capped propoxylated polyether polyol. The low monol content polyether diol may be derived from greater than 20 wt% and less than 40 wt% of ethylene oxide, based on a total weight of the alkylene oxide content of the low monol content polyether diol. By alkylene oxide content it is meant the total alkylene oxides used to form the low monol content polyether diol.

[0017] The low monol content polyether diol may have a number average molecular weight from 1000 g/mol to 3000 g/mol (e.g., 1000 g/mol to 2500 g/mol, 1500 g/mol to 2000 g/mol, etc.) The low monol content polyether diol may have a high primary hydroxyl content. For example, the primary hydroxyl content may be greater than 50% (e.g., greater than 75 %, greater than 80 %, greater than 85 %, etc.), based on the total hydroxyl group content. The low monol content polyether diol may have a viscosity from 100 mPa*s to 325 mPa*s at 25 °C (e.g., from 200 to 325 mPa*s at 25 °C, from 250 to 325 mPa*s at 25 °C, etc.) The low monol content polyether diol may have a hydroxyl number from 58 mg KOH/g to 80 mg KOH/g (e.g., 58 mg KOH/g to 70 mg KOH/g, 58 mg KOH/g to 65 mg KOH/g, etc.)

[0018] Aside from the one or more low monol content polyether diols, the isocyanate-reactive component may exclude any additionally added polyols directly derived from ethylene oxide, propylene oxide, or a combination of ethylene oxide and propylene oxide. Further, the isocyanate-reactive component may exclude any additionally added polyether polyols directly derived from ethylene oxide, propylene oxide, butylene oxide, or combinations thereof. By directly derived it is meant that the polyol is directly formed using ethylene oxide, propylene oxide, or a combination thereto, and optionally using an initiator, as would be understood by a person of ordinary skill in the art. Similarly, the isocyanate-reactive component may exclude any polyols directly derived from butylene oxide. The isocyanate-reactive component may exclude any additionally added simple polyols that are composed of ethylene or propylene derived units, such as ethylene glycol, diethylene glycol, propylene glycol, and dipropylene glycol.

[0019] The isocyanate-reactive component may exclude any polyols that both have a hydroxyl functionality of less than 1.97 and are directly derived from ethylene oxide,

propylene oxide, or a combination of ethylene oxide and propylene oxide. The isocyanate-reactive component may exclude any polyols that both have a hydroxyl functionality greater than 2.00 and are directly derived from ethylene oxide, propylene oxide, or a combination of ethylene oxide and propylene oxide. Similarly, the isocyanate-reactive component may exclude any polyols that both have a hydroxyl functionality greater than 2.00 and are directly derived from butylene oxide.

[0020] The isocyanate-reactive component further includes one or more chain extenders and one or more catalysts. While the chain extenders and catalysts are described as included in the isocyanate-reactive component, the chain extenders and/or catalyst may be added to the mixture as separate components, e.g., separate from the one or more low monol content polyether diols, with one or more isocyanate-terminated prepolymers, with other additives, and/or as single components.

[0021] The one or more chain extenders may include one or more simple polyols. Exemplary simple polyols include butanediol, glycerin, ethylene glycol, diethylene glycol, propylene glycol, dipropylene glycol, hexanediol, sorbitol, and sucrose. In exemplary embodiments, the isocyanate-reactive component includes 1 wt% to 10 wt% (e.g., 1 wt% to 5 wt%, 1 wt% to 3 wt%, 1 wt% to 2 wt%) of butanediol. The isocyanate-reactive component may include only the butanediol, and exclude additionally added glycerin, ethylene glycol, diethylene glycol, propylene glycol, dipropylene glycol, hexanediol, sorbitol, and sucrose.

[0022] The one or more catalysts may include, e.g., tin and/or amine based catalysts. Exemplary of catalysts include tertiary amines, tin carboxylates, organotin compounds, tertiary phosphines, various metal chelates, and/or metal salts of strong acids (such as ferric chloride, stannic chloride, stannous chloride, antimony trichloride, bismuth nitrate, and bismuth chloride).

Other Additives

[0023] Various additives may be added to the mixture for forming the reprocessable polyurethane based textile backing, e.g., to adjust characteristics of the resultant backing. Additives known to those of ordinary skill in the art may be used. Additives may be added as part of the isocyanate component and/or the isocyanate-

reactive component. Exemplary additives include moisture scavengers, UV stabilizers, demolding agents, antifoaming agents, blowing agents, adhesion promoters, curatives, pH neutralizers, plasticizers, compatibilizers, flame retardants, flame suppressing agents, smoke suppressing agents, and/or pigments/dyes.

[0024] The mixture includes one or more fillers, e.g., functional fillers, silica based fillers, and/or mineral based fillers. Fillers may be present to provide desired rheological properties, mechanical reinforcement, chemical resistance, and/or reduce cost. The fillers may be added to the isocyanate-reactive component and/or the isocyanate component. Examples of fillers include calcium carbonate, talc, titanium dioxide, calcium oxide, silica, mica, wollastonite, fly ash, metal particles, alumina trihydrate, bentonite, kaolin, barytes, carbon black, graphite, high melting organic polymers, and/or reinforcements. In exemplary embodiments, the mixture includes 30 wt% to 75 wt% (e.g., 40 wt% to 75 wt%, 50 wt% to 75 wt%, 55 wt% to 75 wt%, 60 wt% to 70 wt%, 60 wt% to 65 wt%, etc.) of calcium carbonate.

[0025] One or more moisture scavenger may be added, e.g., may be added to the isocyanate-reactive component. If included, the one or more moisture scavengers may account for 1 wt% to 20 wt% (e.g., 1 wt% to 15 wt%, 1 wt% to 10 wt%, 1 wt% to 5 wt%, 1 wt% to 3 wt%, etc.) of the total weight of the mixture. Exemplary moisture scavengers include zeolites or molecular sieves, reactive silanes (such as vinyltrialkoxysilanes), and minerals (such as calcium oxide). One or more antifoaming agents may be added, e.g., may be added to the isocyanate-reactive component. If included, the antifoaming agent component may account for less than 5 wt% (e.g., less than 1 wt%, etc.) of the total weight of the mixture.

[0026] A plasticizer may be present. The plasticizer may enable higher filler loading, reduce cost, and/or reduce modulus. Examples of suitable plasticizers include liquid (at 25°C) esters of monocarboxylic acids and diesters of dicarboxylic acids having molecular weights of up to 300 g/mol. Pigment and/or dyes may be present, e.g., titanium dioxide and/or carbon black, may be used to impart color properties. Other additives include, e.g., UV stabilizers, antioxidants, and air release agents, which may be independently used depending on the desired characteristics.

[0027] Exemplary flame suppressing agents include dibromoneopentyl glycol, decabromodiphenyl oxide, tris(dichloropropyl)phosphate, polyammonium phosphate, beta-chloroethyl phosphonate ester, chloro-phosphate ester, and polymers and copolymers of vinyl chloride and vinylidene chloride.

Polyurethane Textile Backing

[0028] In preparing a polyurethane textile backing, an uncured polyurethane-forming composition, such as each of the components of the mixture according to embodiments, may be applied to one side of the textile and subsequently cured. The backing, if desired, may be formed into a layer and partially cured before contacted with the textile (e.g., with contact being made before the layer progressed to a tack-free state). Application of the polyurethane-forming composition may be performed in a manner which may affect sufficient penetration of the composition into the fibers of the textile so that a strong bond is formed upon curing. The coating weight of the backing may be from 1 to 300 (e.g., from 10 to 200, from 15 to 100, etc.) ounces per square yard. Curing may be achieved by heating the coated textile to 50 °C to 150 °C. Curing may be performed until a tack-free state is achieved for the backing. Heating coils, microwave heaters, infrared lamps, convection areas, and the like are suitable heating apparatuses that may be used for curing. The cured polyurethane textile backing may have a melting point from 130 °C to 200 °C (e.g., from 130 °C to 180 °C, from 130 °C to 160 °C, 140 °C to 160 °C, etc.), which is a desirable range to allow for reprocessing of the textile backing.

[0029] A wide variety of woven, knitted, and other textiles have a backing formed using the reprocessable polyurethane based textile backing, according to exemplary embodiments. The textile may include at least one backing material (a primary) and a pile or facing material, which is attached to the backing. Exemplary textiles include floor and wall coverings and carpet or carpet tiles. The carpet may include the reprocessable polyurethane based textile backing as the primary backing, to which a pile is attached (e.g., directly attached) to one side thereof. The pile may include yarns such as wool, nylon, polyester, acrylic, cotton, polypropylene, polyethylene, or blends thereof. These yarns may be woven or tufted through the primary backing, fusion

bonded or otherwise adhered thereto, knitted, or otherwise attached to the primary backing.

[0030] The textile may optionally include one or more secondary woven or nonwoven backings (e.g., formed from jute, polypropylene, polyethylene, nylon, polyester, and/or polyacrylate). The secondary backings may improve the dimensional stability of the textile. The reprocessable polyurethane based textile backing may be overcoated with other polymer layers, e.g., a frothed or foamed polyurethane cushion, a microcellular or noncellular polyurethane or rubber (natural or synthetic) backing, a scrim, or similar layer.

[0031] The reprocessable polyurethane based textile backing, according to exemplary embodiments, may be reprocessable such that a first plaque formed of the reaction product has an first tensile strength and a first percent elongation at break, measured according to ASTM D-1708, after the first plaque of the reaction product is pulverized into a powder and reprocessed using compression molding to form a second plaque, the second plaque has a second tensile strength and a second percent elongation a break, measured according to ASTM D-1708, and the second tensile strength shows retention of at least 40% of the first tensile strength and the second percent elongation at break shows retention of at least 40% of the first percent elongation at break. The first plaque may be formed using processing techniques known in the art for forming polyurethane products (such as elastomers or foams), such a reactive process (such as foaming process or a molding processing using an open mold) that involves the combination of an isocyanate component and an isocyanate reactive component to form polyurethane polymers. The resulting reaction mixture was poured into a standing mold (preheated to ca. 50 °C) and cured in an oven at 100 °C for 9 min. For example, the first plaque may be made using a process that is different from compression molding. The second plaque maybe made using a process, such a non-reactive process (e.g., an extruder type process, a compression molding process, etc.) where pre-formed polyurethane polymers are reprocessed.

[0032] All parts and percentages are by weight unless otherwise indicated. All molecular weight values are based on number average molecular weight unless otherwise indicated.

Examples

[0033] Approximate properties, characters, parameters, etc., are provided below with respect to various working examples, comparative examples, and the materials used in the working and comparative examples.

[0034] The following materials are principally used for the isocyanate-reactive components and the isocyanate components shown in Table 1, below:

LM Diol	A polyether diol, having a relatively low monol content such that a hydroxyl functionality is greater than 1.97, a relatively high primary hydroxyl content, a number average molecular weight of 1800 g/mol, a viscosity of 300 mPa*s at 25 °C, a hydroxyl number of 61 mg KOH/g, and derived from greater than 20 wt% and less than 40 wt% of ethylene oxide and remainder of propylene oxide, based on the total alkylene oxide content (available from The Dow Chemical Company as VORANOL™ 223-060LM).
HM Diol	A polyether diol, having a relatively higher monol content compared to the LM Polyol such that a hydroxyl functionality is less than 1.97, a number average molecular weight of 2000 g/mol, a viscosity of 350 mPa*s at 25 °C, and a hydroxyl number of 56 mg KOH/g, (available from The Dow Chemical Company as VORANOL™ 222-056).
Triol	A polyether triol, having a high primary hydroxyl content, and a number average molecular weight of 4800 g/mol (available from The Dow Chemical Company as VORANOL™ 4701).
BDO	1,4-Butanediol as a chain extender (available from Sigma-Aldrich).

DEG	Diethylene glycol as a chain extender (available from Sigma-Aldrich).
DPG	Dipropylene glycol as a chain extender (available from Sigma-Aldrich).
Filler	Ground Calcium Carbonate (available from Imerys as CC-103®).
Sieve	Molecular sieve (available from UOP as UOP MOLSIV 5A Absorbent Powder).
Catalyst	A delayed action tertiary amine catalyst (available from Air Products as Polycat® SA-102).
Isocyanate 1	A diphenylmethylene diisocyanate, also referred to as MDI, based prepolymer derived from modified MDI, having a free NCO moiety content of 23.0 wt%, and an isocyanate functionality of 2.0 (available from The Dow Chemical Company as ISONATE™ 181).
Isocyanate 2	Polymeric MDI, having a free NCO moiety content of 31.8 wt%, and an isocyanate functionality of 2.3 (available from The Dow Chemical Company as PAPI™ 901).

[0035] Referring to Table1, initial plaques are prepared for each of Working Example 1 and Comparative Examples A, B, and C. To for the initial plaques the corresponding polyols, fillers, sieves, and catalysts are blended in a Flacktek speed mixing cup at 2100 rpm for a period of 1.5 minutes. As would be understood by a person of ordinary skill in the art, the catalyst may be present in a low amount based on the total weight, and the amount may be less than 0.1 wt% and greater than 0.001 wt%. Then, the resultant blended mixture composition is allowed to cool for a period of 30 minutes. Next, the corresponding isocyanates are added to the cooled blended mixture and blended in the Flacktek speed mixing cup at 2100 rpm for a period of 40 seconds to form a reaction mixture. Therefore, the reaction mixture is poured into a heated standing mold (heat to 50 °C to 60 °C) and cured in an oven heated to 100 °C for a

period of 10 minutes, and the resultant plaques are demolded after a period of cooling. After a period of 7 days, the initial tensile strength and percent elongation at break, shown in Table 1, are measured on the resultant plaques, according to ASTM D-1708.

[0036] Measured properties of the reprocessed are determined through first performing pulverizing and subsequent compression molding using the pulverized powders to form reprocessed plaques. In particular, from 15 grams to 40 grams of each of the resultant plaques are cut into small pieces (e.g., 0.25 cm x 0.25 cm x 0.25 cm) and then the small pieces are ground into a powder with a SPEX® SamplePrep 6870 Freezer Mill/Pulverizer. The resultant powders are then dried in a vacuum oven at 80 °C and 3 in. Hg. With respect to performing compression molding with the pulverized powders, either an 8.3 cm x 8.3 cm compression mold [0.14 cm thick] with 18-19 grams of the pulverized powder is used or a 5.7 cm x 5.7 cm compression mold [0.14 cm thick] with 9-9.5 grams of the pulverized powder is used.

[0037] For compression molding, the selected compression mold is placed on a piece of Teflon™ coated aluminum the material and the mold is topped with another piece of Teflon™ coated aluminum the material. Then, the structure is sandwiched between two steel plates and wrapped in foil. A press is preheated at 185 °C, then the wrapped structure is placed and heated without pressure for a period of 3 minutes and then pressed at ca. 4,000 lbs for an additional period of 3 minutes. Next, the pressure is increased to 20,000 lbs for a period of 6 minutes while maintaining the temperature at 185 °C. Then, the heat is turned off and the wrapped structure is cooled under pressure for an additional period of 6 minutes. Next, the wrapped structure is removed from the press and cooled on a bench top with steel plate for an additional period of 6 minutes at room temperature. Then, the inner mold is removed from the wrapped structure and allowed to further cool to room temperature before demolding the plaque. After a period of 7 days, the reprocessed tensile strength and percent elongation at break, shown in Table 1, are measured on the resultant plaques, according to ASTM D-1708.

[0038] Dynamic mechanical analysis (DMA) is also performed on the compression molded plaques using an ARES controlled strain rheometer (TA instruments) equipped with dual cantilever fixtures for torsion testing, according to ASTM D-5279

[0039] Working Example 1, which includes the LM Diol, which is a diol having a relatively low monol content, is prepared according to the formulation in Table 1. Further, Comparative Example A is prepared using HM Diol, which is a diol having a relatively higher monol content. Comparative Example B is prepared using a higher isocyanate functionality (approximately 2.2 functionality) by adding both an isocyanate-terminated prepolymer and polyisocyanate, similar to as taught in U.S. Patent No. 6,171,678. Comparative Example C is prepared using the HM Diol with added Triol, similar to as taught in U.S. Patent No. 4,696,849.

[0040] **Table 1**

	Working Ex. 1	**Comp. Ex. A**	**Comp. Ex. B**	**Comp. Ex. C**
Formulation (wt%)				
LM Diol	23.4	--	23.4	--
HM Diol	--	23.4	--	16.0
Triol	--	--	--	7.0
BDO	1.8	1.8	--	--
DEG	--	--	2.4	--
DPG	--	--		2.4
Filler	61.3	61.3	61.3	61.9
Sieve	1.5	1.5	1.5	1.5
Catalyst	< 0.1	< 0.1	< 0.1	< 0.1
Isocyanate 1	12.0	12.0	5.5	11.2
Isocyanate 2	--	--	5.9	--
Formulation Properties				
Index	103	103	106	110
Total Calculated Isocyanate Functionality	2.0	2.0	2.2	2.0
Measured Properties				
Initial Tensile Strength (psi)	519	385	481	348
Reprocessed Tensile Strength (psi)	249	284	92	28
Initial Percent Elongation at break (%)	494	310	76	337
Reprocessed Percent Elongation at break (%)	301	16	39	117
Calculated Percent Retention of Elongation at break (%)	61	5	51	53

[0041] Referring to Table 1, it is seen that Working Example 1 provides significantly improved processability in relative to each of Comparative Examples A, B, and C. For example, Working Example 1 provides a high initial tensile strength and good retention of that tensile strength after reprocessing. Further, Working Example 1 provides a high initial percent elongation and a very good retention of percent elongation after reprocessing. Further, referring to FIG. 1, the DMA of Working

Example 1 suggests a melting point between 140 °C and 160 °C, which is within the desirable range to allow for reprocessing of the backing. Accordingly, Working Example 1 provides a polyurethane material that may be useable as an unitary backing for tufted or woven carpets, which backing can be melt reprocessed at the end of product life of the carpet. Upon such thermal reprocessing of the polyurethane material, the polyurethane material demonstrates a retention of at least 40% of both tensile strength and percent elongation at break.

[0042] Both of such properties show improvement relative to Comparative Example A, which uses the relatively higher monol content HM Diol instead of lower monol content LM Diol. Further, both of such properties show improvement relative to Comparative Example B, which formulation has a higher calculated total isocyanate functionality of 2.2, in comparison to Working Example 1, which formulation has a calculated total isocyanate functionality of less than 2.2. It is noted that standard polymeric MDI may have an isocyanate functionality as high as 2.7, such that it has been found that by lowing the total isocyanate functionality of an isocyanate component to less than 2.2, and even from 2.0 to 2.1, properties of a reprocessed polyurethane composition are improved. In addition, referring to FIG. 2, the DMA of Comparative Example B suggests a melting point would be above at least 200 °C.

[0043] Also both of such properties show improvement relate to Comparative Example C, which formulation which has both the HM Diol and a triol for increased hydroxyl functionality. Further, while Comparative Example C does demonstrate a good retention of percent elongation at break, the final reprocessed material is physically observed to be tacky and as possessing minimal dimensional stability or strength.

Listing of the Claims:

1. A reprocessable polyurethane based textile backing, comprising:

a reaction product of a mixture including an isocyanate component, an isocyanate-reactive component, and one or more fillers,

the isocyanate component includes at least an isocyanate-terminated prepolymer or a modified polyisocyanate, the isocyanate component having a calculated isocyanate functionality from 1.9 to 2.1.

the isocyanate-reactive component includes:

one or more low monol content polyether diols derived from propylene oxide and ethylene oxide, and having a hydroxyl functionality from 1.97 to 2.00,

one or more chain extenders, and

one or more catalysts.

2. The reprocessable polyurethane based textile backing as claimed in claim 1, wherein the isocyanate component only includes isocyanate-terminated prepolymers that are derived from diphenylmethylene diisocyanate, excludes any additionally added isocyanate-terminated prepolymers that are derived from toluene diisocyanates, and excludes any additionally added polymeric or modified diphenylmethylene diisocyanates and toluene diisocyanates.

3. The reprocessable polyurethane based textile backing as claimed in claim 1, wherein the isocyanate-reactive component excludes any additionally added polyols directly derived from ethylene oxide, propylene oxide, or a combination of ethylene oxide and propylene oxide.

4. The reprocessable polyurethane based textile backing as claimed in claim 1, wherein the isocyanate-reactive component excludes any polyols that both have a hydroxyl functionality of less than 1.97 and are directly derived from ethylene oxide, propylene oxide, or a combination of ethylene oxide and propylene oxide.

5. The reprocessable polyurethane based textile backing as claimed in claim 1, wherein the isocyanate-reactive component excludes any polyols that both have a hydroxyl functionality greater than 2.00 and are directly derived from ethylene oxide, propylene oxide, or a combination of ethylene oxide and propylene oxide.

6. The reprocessable polyurethane based textile backing as claimed in any one of claims 1 to 5, wherein the one or more low monol content polyether diols are derived from greater than 20 wt% and less than 40 wt% of ethylene oxide, based on a total weight of the alkylene oxide content of the low monol content polyether diols.

7. The reprocessable polyurethane based textile backing as claimed any one of claims 1 to 6, wherein the one or more low monol content polyether diols have a viscosity from 100 mPa*s to 325 mPa*s at 25 °C.

8. The reprocessable polyurethane based textile backing as claimed any one of claims 1 to 7, wherein the one or more chain extenders includes butanediol.

9. The reprocessable polyurethane based textile backing as claimed any one of claims 1 to 8, wherein:

an isocyanate index is from 85 to 125,

the one or more low monol content polyether diols are present in an amount from 15 wt% to 40 wt%, based on a total weight of the mixture,

the one or more chain extenders are present in an amount from 1 wt% to 10 wt%, based on a total weight of the mixture,

the one or more catalyst are present in an amount less than 5 wt%, based on a total weight of the mixture, and

the one or more fillers are present in an amount from 30 wt% to 75 wt%, based on a total weight of the mixture.

10. The reprocessable polyurethane based textile backing as claimed any one of claims 1 to 9, wherein:

a first plaque formed of the reaction product has an first tensile strength and a first percent elongation at break, measured according to ASTM D-1708,

after the first plaque of the reaction product is pulverized into a powder and reprocessed using compression molding to form a second plaque, the second plaque has a second tensile strength and a second percent elongation a break, measured according to ASTM D-1708, and

the second tensile strength shows retention of at least 40% of the first tensile strength and the second percent elongation at break shows retention of at least 40% of the first percent elongation at break.

FIG. 1

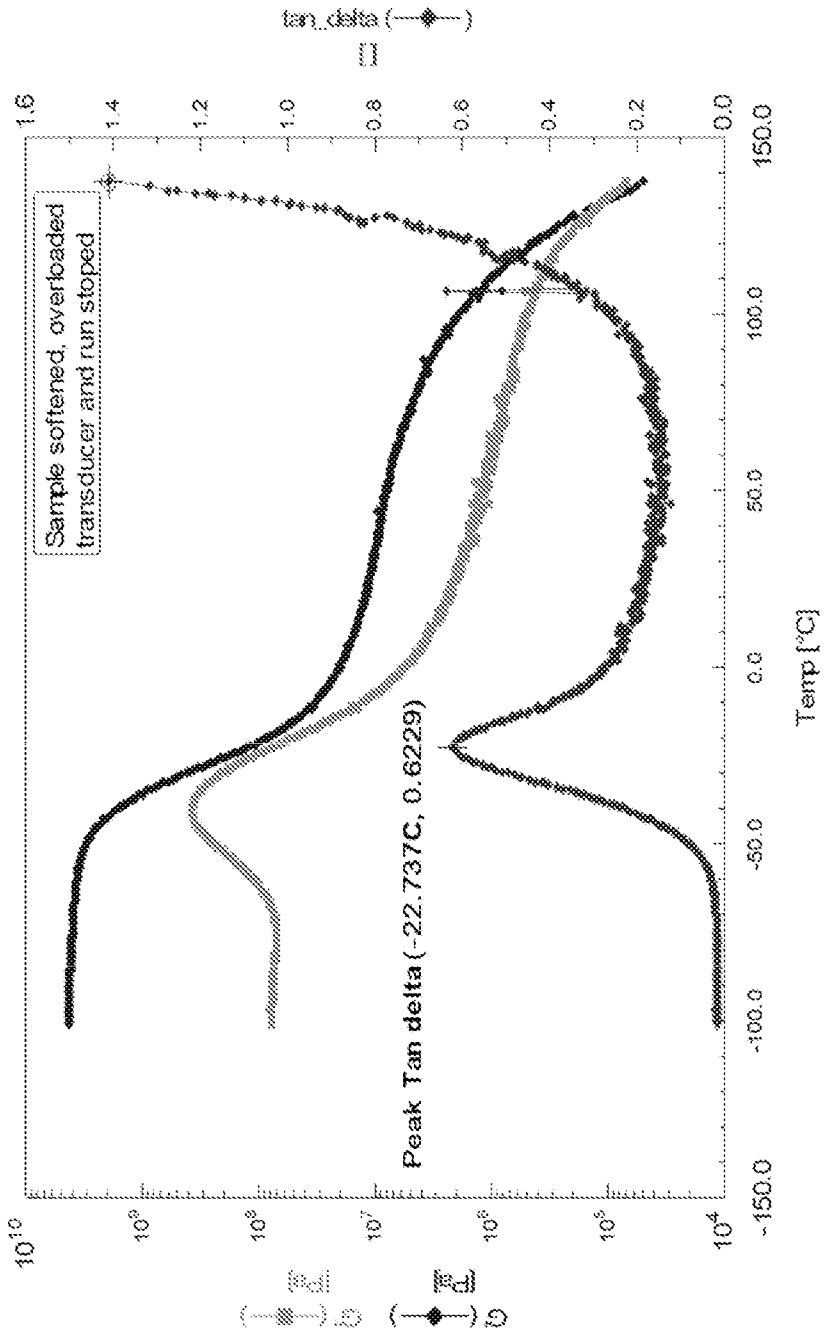
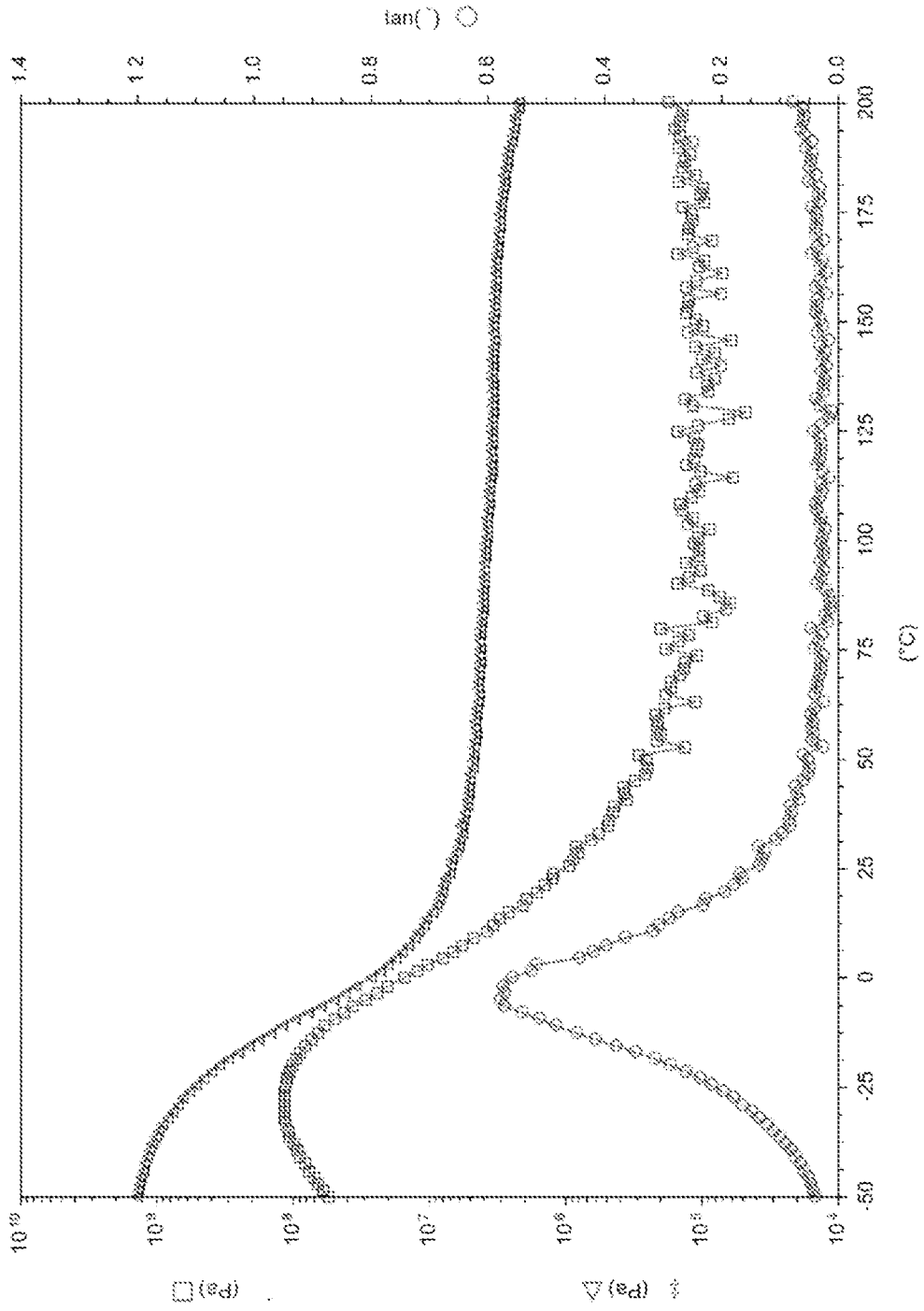

tan_delta
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
150.0
100.0
50.0
0.0
-50.0
-100.0
-150.0
Temp [°C]
Sample softened, overloaded transducer and run stoped
Peak Tan delta (-22.737C, 0.6229)
10^{10}
10^{9}
10^{8}
10^{7}
10^{6}
10^{5}
10^{4}
G''
G'

FIG. 2


tan( ) ○
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
200
175
150
125
100
75
50
25
0
-25
-50
(°C)
□ (E'a)
▽ (E"a)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/066118

A. CLASSIFICATION OF SUBJECT MATTER
INV. C08G18/48 C08G18/66 C08G18/76 C09D175/04 C08L75/04
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 C09D C08L B32B D06N

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 2003/114627 A1 (HOLESCHOVSKY ULRICH B [US] ET AL) 19 June 2003 (2003-06-19) claims 1-29; examples 1-8; table 1	1-10
X	US 4 696 849 A (MOBLEY LARRY W [US] ET AL) 29 September 1987 (1987-09-29) Polyol A; column 7, lines 29-47; claim 1; examples 4-6; table 1	1-10
A	WO 2004/035910 A1 (DOW GLOBAL TECHNOLOGIES INC [US]; JENKINES RANDALL C [US]; FIEST JACK) 29 April 2004 (2004-04-29) claim 1	1-10

☐ Further documents are listed in the continuation of Box C.

☒ 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
31 March 2017	10/04/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Scheuer, Sylvie

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2016/066118

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2003114627 A1	19-06-2003	AU 4779899 A	07-02-2000
		US 6171678 B1	09-01-2001
		US 2003114627 A1	19-06-2003
		WO 0004223 A1	27-01-2000
US 4696849 A	29-09-1987	AR 242602 A1	30-04-1993
		AU 576096 B2	11-08-1988
		BR 8606874 A	03-11-1987
		CA 1297614 C	17-03-1992
		CN 86106969 A	09-09-1987
		DK 444186 A	17-03-1987
		EP 0238619 A1	30-09-1987
		ES 2000397 A6	16-02-1988
		JP H0448806 B2	07-08-1992
		JP H01250477 A	05-10-1989
		JP S62502048 A	13-08-1987
		US 4696849 A	29-09-1987
		WO 8701656 A1	26-03-1987
WO 2004035910 A1	29-04-2004	AT 461315 T	15-04-2010
		AU 2003279259 A1	04-05-2004
		BR 0314889 A	02-08-2005
		CA 2502894 A1	29-04-2004
		EP 1554425 A1	20-07-2005
		ES 2342827 T3	15-07-2010
		TW 200420795 A	16-10-2004
		US 2007043128 A1	22-02-2007
		WO 2004035910 A1	29-04-2004