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(54) Title: A HIGH RESILIENCE POLYURETHANE FLEXIBLE FOAM

(57) Abstract: The present invention relates to a process for preparation of a high resilience polyurethane flexible foam and the high resilience polyurethane flexible foam prepared by the process, and use of the high resilience polyurethane flexible foam in car seat cushion or pillow. The high resilience polyurethane flexible foam is made from a reaction system comprising components such as isocyanate and polyol, and at least one amino terminated long-chain chain-extender, a blowing agent and a catalyst. The reaction system of the foam of the present invention has a rapid aging and a short mold-release time, and the obtained foam has good elasticity, high comfort and satisfactory low odor.



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A HIGH RESILIENCE POLYURETHANE FLEXIBLE FOAM

Technical Field

The present invention relates to a process for preparation of a high resilience polyurethane flexible foam and the high resilience polyurethane flexible foam prepared by the process, and use of the high resilience polyurethane flexible foam in car seat cushion or pillow.

Background

It is known in the industry that the high resilience polyurethane flexible foam is widely used in sofa, pillow, automotive interior decoration, car seat cushion or pillow, and the like. However, with the rapid development of the economy, people have an increased demand for the comfort of cars and housewares. Up to date, while there are higher standards for the physical properties of polyurethane products, the automotive industry generally requires the polyurethane products with lower volatile organic compound (VOC) volatilization, low-atomization, and low odor. However, since in the polyurethane foam production process, it is necessary to use an amine catalyst, and the current amine catalysts with good performance such as bis(dimethylaminoethyl)ether, pentamethyldiethylenetriamine and dimethylcyclohexylamine have an unpleasant ammonia smell, which can cause discomfort to people who come in contact with them, and even affect people's health. Furthermore, the automotive industry standards in various countries apply the more and more stringent requirements on the VOC release and the unpleasant odor of the high resilience polyurethane flexible foam used in car seats.

In general, the organic volatiles and unpleasant odors emitted by the high resilience polyurethane flexible foam used in car seats are mainly derived from the trace amounts of chemical substances remained in isocyanate, polyether polyol, surfactant, catalyst, chain-extender/crosslinker as the raw materials for the polyurethane production, as well as the oxidation or thermal degradation products by-produced in the polyurethane formation reactions. With respect to the principal raw materials, the suppliers of main isocyanate and monomeric polyether have invested more optimized separation and purification equipments (activated carbon adsorption beds, ultra-efficient evaporators) in the factory production stage to achieve lower ppm levels of benzene-based (benzene, toluene, ethylbenzene, xylene, styrene) and aldehyde-based (formaldehyde, acetaldehyde, acrolein) volatile residues. Organosilicon surfactant producers have also introduced large molecular weight, sparingly volatile surfactants that are produced with cleaner purification and post-treatment processes. Polyurethane catalyst manufacturers have developed reactive polyurethane catalysts containing hydroxyl and/or amino substituent groups that can be reacted with isocyanates and immobilized in polyurethane macromolecular segments to reduce VOCs derived from the auxiliary agent for the polyurethane and the source of the odor unpleasant to the human body.

However, the catalytic and migratory abilities of these reactive catalysts will gradually lose during the polyurethane chemical reactions, which results in their higher use doses. Some others in the art have tried to use highly reactive small molecular amino (-NH₂) chain-extender/crosslinker to match or even replace the traditional small molecular diol/diol-amine or triol/triol-amine, and utilized the strong autocatalytic reactivity of the amino chain-extender/crosslinker itself to reduce the use of volatile and odor-rich tertiary amino catalyst. However, this kind of small molecular amino chain-extender/crosslinker will lead to the significantly increased hardness and close-cell content of the foam along with its increased use dose. How to reduce the odor is still a well-known problem in the art.

CN104130371A discloses a low-odor high-resilience sponge for seats of a passenger car, which is prepared from a composite material and a black material in a mass ratio of 100:55-60, wherein the composite material is composed of, by weight, 50-80 parts of polyether polyol, 20-50 parts of grafted polyether, 0.2-0.3 part of an amine catalyst, 0.2-0.5 part of an early-stage gel catalyst, 0.5-0.7 part of a later-stage gel catalyst, 3-4 parts of a blowing agent, 1 part of a crosslinker and 0.5-0.7 part of a stabilizing agent. It also discloses the low-odor high-resilience sponge for seats of a passenger car. The sponge for seats of a passenger car is prepared with the black material with low odor and hypotoxicity and the polyether composite material with low odor and hypotoxicity. The sponge has a smell standard grade of Grade 3.0 and a TVOC of 13.9µgC/g, and has the characteristics of low odor and high resilience, which is in line with the people's requirement to the sponge of automobile seats for environmental protection performance and mechanical properties.

US6051622A discloses a molded polyurethane seating foams exhibiting low resonant frequencies and low ball rebound are produced by reacting an isocyanate-terminated prepolymer prepared from a polyol component comprising in major part one or more low intrinsic unsaturation substantially polyoxypropylene polyols and/or polymer polyols with a blowing/chain extending stream comprising water and optionally amines and alkanolamines.

US20130059145A1 discloses a polyurethane floor which is in composite with 30wt% of fibre, and prepared from a system including isocyanate, water, polyol and the like.

Despite to the disclosures in the above publications, there is still an urgent need in the art for a high resilience polyurethane flexible foam with a short mold-release time, a good resilience ability, and a low odor.

Summary of the invention

According to one aspect, the present invention provides a process for preparation of a high resilience polyurethane flexible foam. It is prepared from a reaction system comprising the following components:

component A isocyanate;

component B, comprising:

a polyol;

a blowing agent;

a catalyst; and

at least one amino-terminated long-chain chain-extender having a functionality of 2-3, an amine value of 10-500 mg KOH/g, preferably 20-450 mg KOH/g, particularly preferably 28-350 mg KOH/g (test method according to ASTM D 2074-1992) and a weight-average molecular weight of 230-5000 g/mol, preferably 300-4000 g/mol, particularly preferably 350-3000 g/mol (test method according to GB/T 21863-2008).

For the process of the present invention, it is preferable that component A isocyanate comprises a mixture of poly-MDI, MDI (monomeric MDI) and TDI, preferably a mixture of poly-MDI, monomeric MDI and TDI. The mixture has a NCO content of 20-48wt%, preferably 25-45 wt%, particularly preferably 28-40 wt%. The NCO content is determined with GB/T 12009.4-2016. Preferably, said poly-MDI, and a mixture of MDI and TDI have a weight proportion of poly-MDI:MDI:TDI of 1-55:1-45:5-80, more preferably 1-55:10-30:20-80.

For the process of the present invention, it is preferable that said polyol is selected from one or both of the following polyether polyols:

B1) a glycerol-initiated and EO-terminated long-chain polyether polyol (having a functionality of 3), a weight-average molecular weight of 4000-9000 g/mol, preferably 4500-8500 g/mol, particularly preferably 5000-8000 g/mol (test method according to GB/T 21863-2008), with a content of 50-85 pbw, preferably 60-85 pbw, particularly preferably 65-80 pbw, based on the mass of component B;

B2) a styrene-acrylonitrile graft-copolymerization modified polymeric polyol, having a functionality of 3, a weight-average molecular weight of 3000-9000 g/mol, preferably 3500-8500 g/mol, particularly preferably 4500-8000 g/mol (test method according to GB/T 21863-2008), with a content of 0-40 pbw, preferably 0-30 pbw, particularly preferably 5-20 pbw, based on the mass of component B.

Preferably, the said long-chain chain-extender is present in a content of 1-20 pbw, preferably

1-17 pbw, particularly preferably 2-15 pbw, based on the mass of component B.

Preferably, the said amino-terminated long-chain chain-extender is a polyether amine.

- 5 Preferably, the said long-chain polyether polyol has an EO content of 5-75 wt%, preferably 5-50 wt%, particularly preferably 10-20 wt%.

Preferably, the said component B comprises 2-5 pbw, preferably 2.5-4.5 pbw, particularly preferably 2.7-4 pbw of water, based on the mass of component B.

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The reaction system of the present invention preferably further comprises a surfactant, which is present in a content of 0.1-1 pbw, preferably 0.25-0.9 pbw, particularly preferably 0.35-0.8 pbw, based on the mass of component B.

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The reaction system of the present invention preferably further comprises at least one small-molecule chain-extender of alcohols, alcohol-amines or diamines, said small-molecule chain-extender is present in a content of 0.5-3.5 pbw, preferably 1-3 pbw, particularly preferably 1.25-2.75 pbw, based on the mass of component B.

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Said catalyst is, preferably but not limited to, tert-amine catalysts. Said amine catalysts are, preferably but not limited to, triethylamine, tributylamine, dimethylethanol-amine, bis-(dimethylaminoethyl)ether, triethylene diamine, N-ethylmorpholine, N,N,N',N'-tetramethylethylene diamine, pentamethyldiethylene triamine, dimethylaminopropylene diamine, N,N,N',N'-tetramethyldipropylene triamine or a mixture thereof and one, two or more of

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weak acid-modified products of said tert-amine catalysts.

For the process of the present invention, it is preferable that said foam has a mold-release time of <4 minutes, preferably <3.5 minutes.

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We have unexpectedly found through experiments that the amino-terminated long-chain chain-extender used in the present invention and the coordinating components thereof such as a polyether polyol, a catalyst, and a blowing agent are prepared into the foam, which not only has a short mold-release time and good physical properties (e.g. good elasticity, high comfort), but also possesses satisfactory low odor.

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The high resilience polyurethane flexible foam prepared by the process of the present invention can be widely used in the field of automobile decoration and daily household, including but not limited to car seat cushion or pillow, sofa, mattress, head pillow, office

chair cushion and the like.

According to another aspect, the present invention provides a high resilience polyurethane flexible foam prepared by the process of the present invention, wherein said foam is prepared by reaction of a reaction system comprising the following components:

component A isocyanate;

component B, comprising:

a polyol;

a blowing agent;

a catalyst; and

at least one amino-terminated long-chain chain-extender having a functionality of 2-3, an amine value of 10-500 mg KOH/g, preferably 20-450 mg KOH/g, particularly preferably 28-350 mg KOH/g (test method according to ASTM D 2074-1992), a weight-average molecular weight of 230-5000 g/mol, preferably 300-4000 g/mol, particularly preferably 350-3000 g/mol (test method according to GB/T 21863-2008).

Preferably, the component A isocyanate comprises a mixture of poly-MDI, MDI and TDI. The mixture has a NCO content of 20-48wt%, preferably 25-45 wt%, particularly preferably 28-40 wt%. The NCO content is determined with GB/T 12009.4-2016. Preferably, said poly-MDI, and a mixture of MDI and TDI have a weight proportion of poly-MDI:MDI:TDI of 1-55:1-45:5-80, more preferably 1-55:10-30:20-80.

Preferably, in the foam of the present invention, said polyol is selected from one or both of the following polyether polyols:

B1) a glycerol-initiated and EO-terminated long-chain polyether polyol having a functionality of 3, a weight-average molecular weight of 4000-9000 g/mol, preferably 4500-8500 g/mol, particularly preferably 5000-8000 g/mol, with a content of 50-85 pbw, preferably 60-85 pbw, particularly preferably 65-80 pbw, based on the mass of component B;
B2) a styrene-acrylonitrile graft-copolymerization modified polymeric polyol, having a functionality of 3, a weight-average molecular weight of 3000-9000 g/mol, preferably 3500-8500 g/mol, particularly preferably 4500-8000 g/mol, with a content of 0-40 pbw, preferably 0-30 pbw, particularly preferably 5-20 pbw, based on the mass of component B.

Preferably, said long-chain chain-extender is present in a content of 1-20 pbw, preferably 1-17 pbw, particularly preferably 2-15 pbw, based on the mass of component B.

Preferably, said amino-terminated long-chain chain-extender is a polyether amine.

Preferably, the said long-chain polyether polyol has an EO content of 5-75 wt%, preferably 5-50 wt%, particularly preferably 10-20 wt%.

Preferably, the said component B comprises 2-5 pbw, preferably 2.5-4.5 pbw, particularly preferably 2.7-4 pbw of water, based on the mass of component B.

The reaction system of the present invention preferably further comprises a surfactant, which is present in a content of 0.1-1 pbw, preferably 0.25-0.9 pbw, particularly preferably 0.35-0.8 pbw, based on the mass of component B.

The reaction system of the present invention preferably further comprises at least one small-molecule chain-extender of alcohols, alcohol-amines or diamines, said small-molecule chain-extender is present in a content of 0.5-3.5 pbw, preferably 1-3 pbw, particularly preferably 1.25-2.75 pbw, based on the mass of component B.

Said catalyst is, preferably but not limited to, tert-amine catalysts. Said amine catalysts are, preferably but not limited to, triethylamine, tributylamine, dimethylethanol-amine, bis-(dimethylaminoethyl)ether, triethylene diamine, N-ethylmorpholine, N,N,N',N'-tetramethylethylene diamine, pentamethyldiethylene triamine, dimethylaminopropylene diamine, N,N,N',N'-tetramethyldipropylene triamine or a mixture thereof and one, two or more of weak acid-modified products of said tert-amine catalysts.

According to the foam of the present invention, preferably, said reaction is carried out in a mold, said foam has a shortest release time of <4 minutes, preferably <3.5 minutes.

The foam prepared by the process of the present invention has a density of, preferably 45-75 kg/m³, more preferably 45-55 kg/m³.

The foam prepared by the process of the present invention has a rebound resilience of preferably up to 55% or more.

Through experiments, surprisingly, we found that the amino-terminated long-chain chain-extender used in the present invention and the coordinating components thereof such as a polyether polyol, a catalyst, and a blowing agent are prepared into the foam, which not only has a short mold-release time and good physical properties (e.g. good elasticity, high comfort), but also possesses satisfactory low odor.

According to yet another aspect, the present invention provides use of the high resilience

polyurethane flexible foam of the present invention in car seat cushion or pillow.

According to a further aspect, the present invention provides a car seat cushion or pillow, which comprises the above-mentioned high resilience polyurethane flexible foam.

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Detailed Description of the invention

The following terms used in the present invention have the following definitions or explanations.

10 The term "pbw" refers to the mass fraction of each component of the polyurethane reaction system;

The term "functionality" refers to the value determined according to the following formula:

$$\text{Functionality} = \text{hydroxyl number} * \text{molecular weight} / 56100;$$

15 where the molecular weight is determined by GPC high performance liquid chromatography.

Components of the polyurethane reaction system

A) Polyisocyanate

Any organic polyisocyanate can be used to prepare the high resilience polyurethane flexible foam of the present invention, comprising aromatic, aliphatic and alicyclic polyisocyanate and a combination thereof. Said polyisocyanate can be represented by a general formula of $R(NCO)_n$, wherein R represents an aliphatic hydrocarbon group having 2 to 18 carbon atoms, an aromatic hydrocarbon group having 6 to 15 carbon atoms, an aromatic aliphatic hydrocarbon group having 8 to 15 carbon atoms, and $n=2-4$.

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The useful polyisocyanate comprises, preferably but not limited to, ethylene diisocyanate, tetramethylene 1,4-diisocyanate, hexamethylene diisocyanate(HDI), 1,12-diisocyanatododecane, cyclobutane-1,3-diisocyanate, cyclohexane-1,3-diisocyanate, cyclohexane-1,4-diisocyanate, 1-isocyanato-3,3,5-trimethyl-5-isocyanatomethylcyclohexane, hexahydrotoluene-2,4-diisocyanate, hexahydrobenzene-1,3-diisocyanate, hexahydrobenzene-1,4-diisocyanate, perhydro-diphenylmethane-2,4-diisocyanate, perhydro-diphenylmethane-4,4-diisocyanate, phenylene-1,3-diisocyanate, phenylene-1,4-diisocyanate, distyrene 1,4-diisocyanate, 3,3-dimethyl-4,4-diphenyldiisocyanate, toluene-2,4-diisocyanate (TDI), toluene-2,6-diisocyanate (TDI), diphenylmethane-2,4'-diisocyanate (MDI), diphenylmethane-2,2'-diisocyanate (MDI), diphenylmethane-4,4'-diisocyanate (MDI), diphenylmethane diisocyanate and/or a mixture of diphenylmethane diisocyanate homologs having more rings, polyphenylmethane polyisocyanate(poly-MDI), naphthylene-1,5-diisocyanate (NDI), isomers thereof, and any mixture formed from these and isomers thereof.

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The useful polyisocyanate further comprises an isocyanate obtained by modifying carbodiamines, allophanates or isocyanates, preferably but not limited to diphenylmethane diisocyanate, carbodiamine modified diphenylmethane diisocyanate, isomers thereof, and any mixture formed from these and isomers thereof.

When used in the present invention, the polyisocyanate comprises isocyanate dimer, trimer, tetramer or a combination thereof.

In the preferable example of the present invention, the isocyanate comprises poly-MDI, and a mixture of MDI and TDI. The mixture has a NCO content of 20-48wt%, preferably 25-45wt%, particularly preferably 28-40 wt%. The NCO content is measured by GB/T 12009.4-2016.

Preferably, said poly-MDI, and a mixture of MDI and TDI have a weight proportion of poly-MDI:MDI:TDI of 1-55:1-45:5-80, more preferably 1-55:10-30:20-80.

B) Polyol

The polyol of the present invention can be a polyether polyol, a polyester polyol, polycarbonate polyol and/or a mixture thereof.

The polyol of the present invention is preferably one or more polyether polyols, wherein at least one polyether polyol is an amine-initiated polyol. The polyether polyol has a functionality of 2-8, preferably 3-6, a hydroxyl value of 20-1200 KOH/g, preferably 20-800 mgKOH/g.

Said polyether polyol can be prepared by known processes, and usually is prepared from ethylene oxide or propylene oxide and ethylene glycol, 1,2-propylene glycol, 1,3-propylene glycol, diethylene glycol, glycerol, trimethylol propane, pentaerythritol, triethanol-amine, toluene diamine, sorbitol, sucrose, or any combination thereof as an initiator.

In addition, said polyether polyol can be prepared in presence of a catalyst through the reaction of at least one alkylene oxide containing an alkylene group of 2-4 carbon atoms and a compound containing 2-8, preferably but not limited to, 3-6 active hydrogen atoms or other reactive compounds.

The example of said catalyst includes alkali metal hydroxides such as sodium hydroxide, potassium hydroxide, or alkali metal alkoxides such as sodium methoxide, sodium ethoxide,

potassium ethoxide, or potassium isopropoxide.

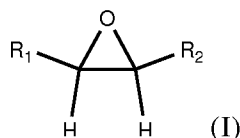
The useful alkylene oxide includes, preferably but not limited to, tetrahydrofuran, ethylene oxide, 1,2-propylene oxide, 1,2-butylene oxide, 2,3-butylene oxide, styrene oxide and any mixture thereof.

The useful active hydrogen-containing compound includes polyhydroxylated compound, preferably but not limited to, water, ethylene glycol, 1,2-propylene glycol, 1,3-propylene glycol, diethylene glycol, trimethylol propane, and any mixture thereof, more preferably polyols, in particular trihydric or higher polyol, e.g. glycerol, trimethylol propane, pentaerythritol, sorbitol and sucrose. The useful active hydrogen-containing compound further comprises, preferably but not limited to, organic dicarboxylic acids such as succinic acid, adipic acid, phthalic acid and terephthalic acid, or aromatic or aliphatic group-substituted diamines such as ethylene diamine, diethylene triamine, triethylene tetraamine, propylene diamine, butylene diamine, hexylene diamines or toluene diamine.

The useful other reactive compound comprises ethanol-amine, diethanol-amine, methylethanol-amine, ethylethanol-amine, methyldiethanol-amine, ethyldiethanol-amine, triethanol-amine and ammonia.

Said polyether polyol prepared with an amine as the initiator comprises a compound obtained by reacting the amine as the initiator with an alkylene oxide compound.

As used in the present invention, the term "alkylene oxide compound" usually refers to a compound of the following general formula (I):



wherein R_1 and R_2 are independently selected from H, C_1 - C_6 straight and branched alkyl group and phenyl and substituted phenyl.

Preferably, R_1 and R_2 are independently selected from H, methyl, ethyl, propyl and phenyl.

The process for preparing the "alkylene oxide compound" is known to those skilled in the art, and it can be obtained, for example, by an oxidation reaction of an olefin compound.

Example of the alkylene oxide compound useful in the present invention includes but is not limited to ethylene oxide, 1,2-propylene oxide, 1,2-butylene oxide, 2,3-butylene oxide,

styrene oxide or a mixture thereof, particularly preferably a mixture of ethylene oxide and 1,2-propylene oxide.

When used in the present invention, the term "alkylene oxide compound" further comprises oxacycloalkanes, and the example thereof includes but is not limited to tetrahydrofuran and oxetane.

When used in the present invention, said "amine" refers to a compound containing a primary amino group, a second amino group, a tertiary amino group, or a combination thereof. The example of amine useful in the present invention includes but is not limited to triethanolamine, ethylene diamine, toluene diamine, diethylene triamine, triethylene tetraamine and derivatives thereof, preferably ethylene diamine, toluene diamine, particularly preferably toluene diamine.

Preferably, the polyether polyol of the present invention comprises a glycerol-initiated and EO-terminated long-chain polyether polyol having a functionality of 3, a weight-average molecular weight of 4000-9000 g/mol, preferably 4500-8500 g/mol, particularly preferably 5000-8000 g/mol, with a content of 50-85 pbw, preferably 60-85 pbw, particularly preferably 65-80 pbw. Said long-chain polyether polyol has an EO content of 5-75 wt%, preferably 5-50 wt%, particularly preferably 10-20 wt%.

Preferably, the polyol of the present invention further comprises a styrene-acrylonitrile graft-copolymerization modified polymeric polyol, having a functionality of 3, a weight-average molecular weight of 3000-9000 g/mol, preferably 3500-8500 g/mol, particularly preferably 4500-8000 g/mol, with a content of 0-40 pbw, preferably 0-30 pbw, particularly preferably 5-20 pbw, based on the mass of component B.

Vinyl polymer grafted polyether polyol is commonly known as "polymeric polyol" (Polyether Polyol) or as polyether (POP) polymeric polyol, and is obtained by free radical graft polymerization of general polyether polyols as basic polyether (generally general soft foam polyether triol, high active polyether), acrylonitrile and/or vinyl monomer such as styrene, methyl methacrylate, vinyl acetate, vinyl chloride and an initiator at about 100°C and under nitrogen protection.

Said polyester polyol is prepared by the reaction of dicarboxylic acid or dicarboxylic anhydride and polyol. Said dicarboxylic acid is preferably, but not limited to, an aliphatic carboxylic acid having 2-12 carbon atoms, for example, succinic acid, malonic acid, glutaric acid, adipic acid, suberic acid, azelaic acid, decanedioic acid, dodecylcarboxylic acid, maleic acid, fumaric acid, phthalic acid, isophthalic acid, terephthalic acid, and mixtures thereof. Said dicarboxylic anhydride is preferably,

but not limited to, phthalic anhydride, tetrachlorophthalic anhydride, maleic anhydride, and mixtures thereof. Said polyol is preferably, but not limited to, ethylene glycol, diethylene glycol, 1,2-propylene glycol, 1,3-propylene glycol, dipropylene glycol, 1,3-methylpropylene glycol, 1,4-butanediol, 1,5-pentanediol, 1,6-hexanediol, neopentyl glycol, 1,10-decanediol, glycerol, trimethylol propane or a mixture thereof. Said polyester polyol, further comprises a polyester polyol prepared from lactone. Said polyester polyol prepared from lactone is preferably, but not limited to, a polyester polyol prepared from ϵ -caprolactone.

Said polycarbonate polyol is preferably, but not limited to, polycarbonate diol. Said polycarbonate diol can be prepared by reacting a diol with a dihydrocarbyl or diaryl carbonate or phosgene. Said diol is preferably, but not limited to, 1,2-propylene glycol, 1,3-propylene glycol, 1,4-butanediol, 1,5-pentanediol, 1,6-hexanediol, diethylene glycol, 1,3,5-trioxacyclohexanediol or a mixture thereof. Said dihydrocarbyl or diaryl carbonate is preferably, but not limited to, diphenyl carbonate.

Blowing agent

The blowing agent of the present invention can be selected from various physical blowing agent or chemical blowing agent.

The useful blowing agent comprises water, halogenated hydrocarbons, hydrocarbon compounds and the like. The useful halogenated hydrocarbon preferably is pentafluorobutane, pentafluoropropane, monochlorotrifluoropropene, hexafluorobutene, HCFC-141b (monofluorodichloroethane), HFC-365mfc (pentafluorobutane), HFC-245fa (pentafluoropropane) or any mixture thereof. The useful hydrocarbon compound preferably comprises butane, pentane, cyclopentane (CP), hexane, cyclohexane, heptane and any mixture thereof.

The blowing agent of the present invention, preferably water, is present in a content of 2-5 pbw, preferably 2.5-4.5 pbw, particularly preferably 2.7-4 pbw, based on the mass of the component B.

Catalyst

The catalyst of the present invention preferably is a tert-amine catalyst. Said amine catalyst comprises but is not limited to triethylamine, tributylamine, dimethylethanol-amine, bis-(dimethylaminoethyl)ether, triethylene diamine, N-ethylmorpholine, N,N,N',N'-tetramethylethylene diamine, pentamethyldiethylene triamine, dimethylaminopropylene diamine, N,N,N',N'-tetramethyldipropylene triamine and one, two or more of weak acid-modified products of said tert-amine catalysts. The catalyst of the present invention is present in a content of preferably 0.20-4.00 pbw, based on the mass of the component B.

Surfactant

In an embodiment of the present invention, the polyurethane reaction system of the present invention further comprises a surfactant, and said surfactant is, preferably but not limited to, an ethylene oxide derivative of organosilicon. Said surfactant is present in a content of 0.1-1 pbw, preferably 0.25-0.9 pbw, particularly preferably 0.35-0.8 pbw, based on the mass of the component B.

Chain-extender

The useful chain-extender according to the present invention is selected from low molecular weight and multiple functional alcohol or amine compounds containing hydroxyl or amino group. The commonly used alcohol chain-extender comprises 1,4-butane diol (BDO), 1,6-hexane diol, glycerin, trimethylol propane, diethylene glycol (DEG), triethylene glycol, neopentyl glycol (NPG), sorbitol, diethylaminoethanol (DEAE) and the like. The amine chain-extender comprises MOCA and a liquid MOCA obtained by modification with formaldehyde, ethylene diamines (EDA), N,N-dihydroxyl(diisopropyl)phenylamine (HPA) and the like. Hydroquinone bis(β -hydroxyethyl) ether (HQEE) is also included. It is well known by those skilled in the art that the chain-extender conventionally used in the polyurethane field is a small molecule alcohol containing two or more hydroxyl groups, compounds containing amino, imino group(s), or the ether alcohols, however the long-chain chain-extender, in particular the amino-terminated long-chain chain-extender, has not been tried for use.

The polyurethane reaction system of the present invention comprises at least one amino-terminated long-chain chain-extender. Preferably, said long-chain chain-extender has a functionality of 2-3, an amine value of 10-500 mg KOH/g, preferably 20-450 mg KOH/g, particularly preferably 28-350 mg KOH/g (test method according to ASTM D 2074-1992), a weight-average molecular weight of 230-5000g/mol, preferably 300-4000g/mol, particularly preferably 350-3000g/mol.

For the polyurethane reaction system of the present invention, it is preferable that said long-chain chain-extender is present in a content of 1-20 pbw, preferably 1-17 pbw, particularly preferably 2-15 pbw.

For the polyurethane reaction system of the present invention, it is preferable that said long-chain chain-extender is a polyether amine.

Polyether amines (Amine-Terminated Polyether, abbreviated as ATPE) are a class of polyolefin compounds having a soft polyether backbone and terminated with a primary

amino group or a secondary amino group. Their basic structure contains at least one polyalkylene glycol functional group, which is the key to influencing its properties. Polyalkylene glycols can increase the water solubility of polyether amine. It also affects the melting point and the viscosity of the polyether amine. Their structure variables comprise polyoxyethylenediamine, polyoxypropenediamine, polyoxyethylene/oxypropenediamine, polyoxypropenetriamine, polytetramethyleneetherdiamine, and the like. Most of these compounds are prepared from the corresponding polyether polyols as raw material by chemical treatment of the terminal hydroxyl groups. According to the structure of the hydrocarbon group attached to the terminal amino group, they can be divided into two types: aromatic and aliphatic. They are light yellow or colorless transparent liquid at room temperature, and have the advantages including low viscosity, low vapor pressure and high content of primary amine. They can be dissolved in solvents such as ethanol, aliphatic hydrocarbons, aromatic hydrocarbons, esters, ethylene glycol ethers, ketones and water. They are a class of polymers having a polyether structure as backbone and a terminal active functional group of amino group. Polyetheramines are obtained by the amination of polyethylene glycol, polypropylene glycol or ethylene glycol / propylene glycol copolymers under high temperature and high pressure. By selecting different polyoxyalkylene structures, a series of properties such as reactivity, toughness, viscosity, and hydrophilicity of the polyether amine can be adjusted, and the amino group provides the possibility of reacting polyether amine with various compounds.

Polyether amines can be used as high performance curing agent of epoxy resin to produce composite materials having high strength and high toughness, and are useful in coatings, decorations, cleaning agents and the like. It is well-known to those skilled in the art that in the field of polyurethane polyurea elastomers, polyether amines are involved in the polymerization as the main raw material. However, it has not been used as curing agent or chain-extender in the foaming system of high resilience polyurethane flexible foam.

In industrial production, polyether amines can generally be prepared by the aminolysis method and the leaving group method. The synthesis process of polyether amine includes batch and continuous processes. It is well known in the industry that the production process adopted by Huntsman Company is a continuous fixed-bed process that catalytically synthesizes polyether amines with a metal-on-support catalyst.

The polyurethane reaction system of the present invention preferably further comprises a small-molecule chain-extender selected from an alcohol, an alcohol-amine or a diamine, for example, one, two or more of 1,4-BD, DEOA, TEOA and DETDA. The small-molecule chain-extender is present in a content of 0.5-3.5 pbw, preferably 1-3 pbw, particularly

preferably 1.25-2.75 pbw, based on the mass of the component B.

A process for preparing a high resilience polyurethane flexible foam

According to the process for preparing the high resilience polyurethane flexible foam of the present invention, said foam is prepared by reacting a reaction system comprising the following components:

component A isocyanate;

component B, comprising:

a polyol;

a blowing agent;

a catalyst; and

at least one amino-terminated long-chain chain-extender having a functionality of 2-3, an amine value of 10-500 mg KOH/g, preferably 20-450 mg KOH/g, particularly preferably 28-350 mg KOH/g (test method according to ASTM D 2074-1992), a weight-average molecular weight of 230-5000g/mol, preferably 300-4000g/mol, particularly preferably 350-3000g/mol (test method according to GB/T 21863-2008).

Preferably, in the process of the present invention, said polyol is selected from one or both of the following polyether polyols:

B1) a glycerol-initiated and EO-terminated long-chain polyether polyol having a functionality of 3, a weight-average molecular weight of 4000-9000 g/mol, preferably 4500-8500 g/mol, particularly preferably 5000-8000 g/mol, with a content of 50-85 pbw, preferably 60-85 pbw, particularly preferably 65-80 pbw, based on the mass of component B;

B2) a styrene-acrylonitrile graft-copolymerization modified polymeric polyol, having a functionality of 3, a weight-average molecular weight of 3000-9000 g/mol, preferably 3500-8500 g/mol, particularly preferably 4500-8000 g/mol, with a content of 0-40 pbw, preferably 0-30 pbw, particularly preferably 5-20 pbw, based on the mass of component B.

Preferably, said long-chain chain-extender is present in a content of 1-20 pbw, preferably 1-17 pbw, particularly preferably 2-15 pbw, based on the mass of component B.

Preferably, said long-chain chain-extender is a polyether amine.

Preferably, the said component B comprises 2-5 pbw, preferably 2.5-4.5 pbw, particularly preferably 2.7-4 pbw of water, based on the mass of component B.

The reaction system of the present invention preferably further comprises a surfactant, which is present in a content of 0.1-1 pbw, preferably 0.25-0.9 pbw, particularly preferably 0.35-0.8

pbw, based on the mass of component B.

The reaction system of the present invention preferably further comprises at least one small-molecule chain-extender of alcohols, alcohol-amines or diamines, said small-molecule chain-extender is present in a content of 0.5-3.5 pbw, preferably 1-3 pbw, particularly preferably 1.25-2.75 pbw, based on the mass of component B.

Preferably, said foam has a shortest release time of <4 minutes, preferably <3.5 minutes.

The high resilience polyurethane flexible foam of the present invention can be prepared using methods well known in the art. In one embodiment of the invention, the reaction components are mixed by a mixing head or the reaction components are mixed in a mixing chamber. The reaction mixture is then applied to a suitable closed mold and the foam expands to form a closed mold-sized foam.

The high resilience polyurethane flexible foam of the present invention can also be prepared by a molded foam process. The one-through feed process is usually used the molded foam process, in which the isocyanate component and the isocyanate-reactive component are mixed and injected into a mold, the mold is closed, the foam expands to fill the mold, and a high resilience polyurethane flexible foam having the shape and size of the mold is formed, and can be released with a shortest release time of <4 minutes, preferably <3.5 minutes.

A high resilience polyurethane flexible foam

The high resilience polyurethane flexible foam of the invention is prepared by aforementioned process of the invention.

The said foam has a density of, preferably 45-75 kg/m³, more preferably 45-55 kg/m³.

The said foam has a rebound resilience of preferably up to 55% or more.

Surprisingly, we found through experiments that the foam of the present invention, prepared from the reaction system containing the long-chain chain-extender and the coordinating components thereof such as an isocyanate, a polyether polyol, a catalyst, and a blowing agent, on one hand, reduces the mold-release time and increases the production efficiency, on the other hand, maintains the excellent physical properties of the high resilience polyurethane flexible foam (e.g. good elasticity, high comfort) and also lower the odor.

Use of the high resilience polyurethane flexible foam in manufacture of car seat cushion or pillow

The invention also provides the use of the above-mentioned high resilience polyurethane flexible foam in manufacture of car seat cushion or pillow.

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Car seat cushion or pillow

The car seat cushion or pillow of the present invention comprises the above-mentioned high resilience polyurethane flexible foam.

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Examples

The test methods in the examples are described as follows:

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The shortest release time refers to the shortest time period from a point when the polyurethane reaction system is introduced into the mold to a point after foaming when the foam can be released and taken out from the mold in a good condition, which is determined with smooth surface, integrity and no impressing indentation of the foam block released from the metal mold.

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TVOC Volatile Amount: The free foamed block obtained in a clean foaming cup is successively tightly wrapped with a food-grade tin foil and a food-grade PP film immediately after fully curing, and is sent on the next day to a third-party testing agency for a test of TVOC according to the test standard ISO12219-2:2012.

25

Raw material 1 - CHE-330N high active polyether polyol Mw=5000, f=3, hydroxyl value 33.5mgKOH/g, Jiangsu Changhua Polyurethane Technology Co., Ltd.

Raw material 2 - CHP-H45 polymeric polyol Mw=7800, f=3, hydroxyl value 21.5mgKOH/g, Jiangsu Changhua Polyurethane Technology Co., Ltd.

Raw material 3 - S-240 high active polyether Mw=5000, f=3, hydroxyl value 33.5mgKOH/g, Covestro Polymers (China) Co., Ltd.

30

Raw material 4 - Jefamine D230 polyether amine Mw=230, f=2, Huntsman Company

Raw material 5 - Jefamine D400 polyether amine Mw=400, f=2, Huntsman Company

Raw material 6 - Jefamine D2000 polyether amine Mw=2000, f=2, Huntsman Company

Raw material 7 - Jefamine T5000 polyether amine Mw=5000, f=3, Huntsman Company

Raw material 8 - B8715LF2 surfactant, EVONIK COMPANY

35

Raw material 9 - diethanol-amine chain-extender, DOW CHEMICALS

Raw material 10 - triethanol-amine crosslinker, Yadong Petrochemical (Yangzhou) Co., Ltd.

Raw material 11 - NIAx A-1 catalyst, Momentive company

Raw material 12 - NIAx A-33 catalyst, Momentive company

Raw material 13 - Desmodur MT-20, MDI/TDI/PMDI blend isocyanate, Covestro Polymers (China) Co., Ltd.

Preparation of the high resilience polyurethane flexible foam of the present invention

- 5 Firstly, the isocyanate-reactive component (i.e. component B, comprising: polyether polyol, blowing agent, surfactant, catalyst and any other non-isocyanate additives) was added a clean mixing tank and mixed with an impeller stirrer at a rotate speed of 1000rpm for 15 minutes. Then the isocyanate component A and the isocyanate-reactive component were respectively poured into the tanks A and B of the cleanly-washed high pressure foaming machine. At the set raw
- 10 material temperature, the components were mixed with the high-pressure impingement produced by the high-pressure foaming machine. The mixture was injected into a temperature-controlled mold and a clean foaming cup for the mold foaming and the free foaming respectively until the reactions were completed. The temperature of raw materials before the reaction was controlled at $23\pm 3^{\circ}\text{C}$.

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	Raw material No.	Comparative Example 1	Comparative Example 2	Example 1	Example 2	Example 3	Example 4
Isocyanate reaction component B	Raw material 1	78	78	74	69	63	58
	Raw material 2	15	15	15.6	15	14	15
	Raw material 3	2.7	2.7	3.0	3.0	4	4
	Raw material 4	/	/	1.0	/	/	/
	Raw material 5	/	/	/	1.0	/	/
	Raw material 6	/	/	/	6.0	15	17
	Raw material 8	0.75	0.75	0.65	0.6	0.6	0.6
	Raw material 9	1.55	1.55	1.65	1.5	1.5	1.5
	Raw material 10	0.35	0.35	/	0.2	/	/
	Raw material 11	0.08	0.12	0.08	0.08	0.08	0.08
	Raw material 12	0.48	0.65	0.37	0.32	0.25	0.35
	Water	3.30	3.30	3.30	3.30	3.30	3.30
	Raw material 13	52.5	52.5	54.0	54.5	55.5	54.5
Isocyanate component A							
Properties	Raw material Temperature	23±3°C					
	Foaming machine	High-pressure foaming machine					
	Mold temperature	60±2°C					
	Filling density, kg/m ³	53.0	53.0	53.0	53.0	53.0	53.0

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	Shortest release time, min		4.0	3.5	3.5	3.5	3.5	3.5	3.5
	Free bubble in a clean foam cup								
	TVOC (ISO12219-2:2012), ug/m ³		22500	26240	13700	14530	15100	15760	

It can be found from the results of the above experiments that, in general, the formulations with adding the long-chain chain-extender (for example, Examples 1, 2 and 3) may reduce the used amount of the catalyst and therefore reduce the release of TVOC, compared with the formulations without adding the long-chain chain-extender (for example, comparative Examples 1 and 2). Furthermore, it can be seen from the above table that the formulation of Comparative Example 1 had a longer mold-release time; the formulation of Comparative Example 2 had a relatively high catalyst content and thus achieved a relatively fast mold-release; however, it produced an increased TVOC release amount. For the formulation with the long-chain chain-extender, although the amount of catalyst was significantly reduced, unexpectedly, the mold-release time was reduced, and the TVOC release amount was largely reduced.

Although the present invention has been disclosed in the above preferred embodiments, it is not intended to limit the present invention. Any person skilled in the art can make various changes and modifications without departing from the spirit and scope of the present invention. Thus, the scope of protection shall be based on the scope of the patent claims.

Claims

1. A process for the production of high resilience polyurethane flexible foam by reaction of a reaction system comprising the following components:

5 component A, isocyanate;

component B, comprising:

a polyol;

a blowing agent;

a catalyst; and

10 at least one amino-terminated long-chain chain-extender having a functionality of 2-3, an amine value of 10-500 mg KOH/g, preferably 20-450 mg KOH/g, particularly preferably 28-350 mg KOH/g (test method according to ASTM D 2074-1992) and a weight-average molecular weight of 230-5000 g/mol, preferably 300-4000 g/mol, particularly preferably 350-3000 g/mol (test method according to GB/T 21863-2008).

15 2. The process according to claim 1, characterized in that said amino-terminated long-chain chain-extender is present in a content of 1-20 pbw, preferably 1-17 pbw, particularly preferably 2-15 pbw, based on the mass of component B.

20 3. The process according to claim 1 or 2, characterized in that said amino-terminated long-chain chain-extender is a polyether amine.

4. The process according to claim 1 or 2, characterized in that said reaction is carried out in a mold, said foam has a shortest release time of <4 minutes, preferably <3.5 minutes.

25 5. The process according to claim 1 or 2, characterized in that said polyol is selected from one or both of the following polyether polyols:

B1) a glycerol-initiated and EO-terminated long-chain polyether polyol, a weight-average molecular weight of 4000-9000 g/mol, preferably 4500-8500 g/mol, particularly preferably 5000-8000 g/mol (test method according to GB/T 21863-2008), with a content of 50-85 pbw, preferably 60-85 pbw, particularly preferably 65-80 pbw, based on the mass of component B;

30 B2) a styrene-acrylonitrile graft-copolymerization modified polymeric polyol, having a functionality of 3, a weight-average molecular weight of 3000-9000 g/mol, preferably 3500-8500 g/mol, particularly preferably 4500-8000 g/mol (test method according to GB/T 21863-2008), with a content of 0-40 pbw, preferably 0-30 pbw, particularly preferably 5-20 pbw, based on the mass of component B.

35 6. The process according to claim 1 or 2, characterized in that said component B further

comprises at least one small-molecule chain-extender of alcohols, alcohol-amines or diamines, said small-molecule chain-extender is present in a content of 0.5-3.5 pbw, preferably 1-3 pbw, particularly preferably 1.25-2.75 pbw, based on the mass of component B.

5

7. A high resilience polyurethane flexible foam prepared by the process of any of claims 1~6, wherein said foam is prepared by reacting a reaction system comprising the following components:

component A isocyanate;

10

component B, comprising:

a polyol;

a blowing agent;

a catalyst; and

at least one amino-terminated long-chain chain-extender having a functionality of 2-3,

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an amine value of 10-500 mg KOH/g, preferably 20-450 mg KOH/g, particularly preferably 28-350 mg KOH/g (test method according to ASTM D 2074-1992), a weight-average molecular weight of 230-5000 g/mol, preferably 300-4000 g/mol, particularly preferably 350-3000 g/mol (test method according to GB/T 21863-2008) .

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8. The high resilience polyurethane flexible foam according to claim 7, characterized in that said amino-terminated long-chain chain-extender is present in a content of 1-20 pbw, preferably 1-17 pbw, particularly preferably 2-15 pbw, based on the mass of component B.

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9. The high resilience polyurethane flexible foam according to claim 7, characterized in that said amino-terminated long-chain chain-extender is a polyether amine.

10. The high resilience polyurethane flexible foam according to any of claims 7-9, characterized in that the component A isocyanate comprises at least one isocyanate selected from the group consisting of poly-MDI, monomeric MDI and TDI, preferably a mixture of poly-MDI, monomeric MDI and TDI.

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11. The high resilience polyurethane flexible foam according to any of claims 7-9, characterized in that the said polyol is selected from one or both of the following polyether polyols B1) a glycerol-initiated and EO-terminated long-chain polyether polyol, a weight-average molecular weight of 4000-9000 g/mol, preferably 4500-8500 g/mol, particularly preferably 5000-8000 g/mol (test method according to GB/T 21863-2008), with a content of 50-85 pbw, preferably 60-85 pbw, particularly preferably 65-80 pbw, based on the mass of component B;

35

B2) a styrene-acrylonitrile graft-copolymerization modified polymeric polyol, having a functionality of 3, a weight-average molecular weight of 3000-9000 g/mol, preferably 3500-8500 g/mol, particularly preferably 4500-8000 g/mol (test method according to GB/T 21863-2008), with a content of 0-40 pbw, preferably 0-30 pbw, particularly preferably 5-20 pbw, based on the mass of component B.

12. The process according to any of claims 7-9, characterized in that said component B further comprises at least one small-molecule chain-extender of alcohols, alcohol-amines or diamines, said small-molecule chain-extender is present in a content of 0.5-3.5 pbw, preferably 1-3 pbw, particularly preferably 1.25-2.75 pbw, based on the mass of component B.

13. Use of the high resilience polyurethane flexible foam according to any of claims 1-7 in car seat cushion or pillow.

14. A car seat cushion or pillow, comprising the high resilience polyurethane flexible foam according to any of claims 1-7.

Abstract

The present invention relates to a process for preparation of a high resilience polyurethane flexible foam and the high resilience polyurethane flexible foam prepared by the process, and use of the high resilience polyurethane flexible foam in car seat cushion or pillow. The high resilience polyurethane flexible foam is made from a reaction system comprising components such as isocyanate and polyol, and at least one amino terminated long-chain chain-extender, a blowing agent and a catalyst. The reaction system of the foam of the present invention has a rapid aging and a short mold-release time, and the obtained foam has good elasticity, high comfort and satisfactory low odor.

Claims

1. A process for the production of high resilience polyurethane flexible foam by reaction of a reaction system comprising the following components:

5 component A, isocyanate;

component B, comprising:

a polyol;

a blowing agent;

a catalyst; and

10 at least one amino-terminated long-chain chain-extender having a functionality of 2-3, an amine value of 10-500 mg KOH/g, preferably 20-450 mg KOH/g, particularly preferably 28-350 mg KOH/g (test method according to ASTM D 2074-1992) and a weight-average molecular weight of 230-5000 g/mol, preferably 300-4000 g/mol, particularly preferably 350-3000 g/mol (test method according to GB/T 21863-2008).

15 2. The process according to claim 1, characterized in that said amino-terminated long-chain chain-extender is present in a content of 1-20 pbw, preferably 1-17 pbw, particularly preferably 2-15 pbw, based on the mass of component B.

20 3. The process according to claim 1 or 2, characterized in that said amino-terminated long-chain chain-extender is a polyether amine.

4. The process according to claim 1 or 2, characterized in that said reaction is carried out in a mold, said foam has a shortest release time of <4 minutes, preferably <3.5 minutes.

25 5. The process according to claim 1 or 2, characterized in that said polyol is selected from one or both of the following polyether polyols:

B1) a glycerol-initiated and EO-terminated long-chain polyether polyol, a weight-average molecular weight of 4000-9000 g/mol, preferably 4500-8500 g/mol, particularly preferably 5000-8000 g/mol (test method according to GB/T 21863-2008), with a content of 50-85 pbw, preferably 60-85 pbw, particularly preferably 65-80 pbw, based on the mass of component B;

30 B2) a styrene-acrylonitrile graft-copolymerization modified polymeric polyol, having a functionality of 3, a weight-average molecular weight of 3000-9000 g/mol, preferably 3500-8500 g/mol, particularly preferably 4500-8000 g/mol (test method according to GB/T 21863-2008), with a content of 0-40 pbw, preferably 0-30 pbw, particularly preferably 5-20 pbw, based on the mass of component B.

35 6. The process according to claim 1 or 2, characterized in that said component B further

comprises at least one small-molecule chain-extender of alcohols, alcohol-amines or diamines, said small-molecule chain-extender is present in a content of 0.5-3.5 pbw, preferably 1-3 pbw, particularly preferably 1.25-2.75 pbw, based on the mass of component B.

5

7. A high resilience polyurethane flexible foam prepared by the process of any of claims 1~6, wherein said foam is prepared by reacting a reaction system comprising the following components:

component A isocyanate;

10 component B, comprising:

a polyol;

a blowing agent;

a catalyst; and

at least one amino-terminated long-chain chain-extender having a functionality of 2-3,

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an amine value of 10-500 mg KOH/g, preferably 20-450 mg KOH/g, particularly preferably 28-350 mg KOH/g (test method according to ASTM D 2074-1992), a weight-average molecular weight of 230-5000 g/mol, preferably 300-4000 g/mol, particularly preferably 350-3000 g/mol (test method according to GB/T 21863-2008) .

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8. The high resilience polyurethane flexible foam according to claim 7, characterized in that said amino-terminated long-chain chain-extender is present in a content of 1-20 pbw, preferably 1-17 pbw, particularly preferably 2-15 pbw, based on the mass of component B.

25

9. The high resilience polyurethane flexible foam according to claim 7, characterized in that said amino-terminated long-chain chain-extender is a polyether amine.

10. The high resilience polyurethane flexible foam according to any of claims 7-9, characterized in that the component A isocyanate comprises at least one isocyanate selected from the group consisting of poly-MDI, monomeric MDI and TDI, preferably a mixture of poly-MDI, monomeric MDI and TDI.

30

11. The high resilience polyurethane flexible foam according to any of claims 7-9, characterized in that the said polyol is selected from one or both of the following polyether polyols B1) a glycerol-initiated and EO-terminated long-chain polyether polyol, a weight-average molecular weight of 4000-9000 g/mol, preferably 4500-8500 g/mol, particularly preferably 5000-8000 g/mol (test method according to GB/T 21863-2008), with a content of 50-85 pbw, preferably 60-85 pbw, particularly preferably 65-80 pbw, based on the mass of component B;

35

B2) a styrene-acrylonitrile graft-copolymerization modified polymeric polyol, having a functionality of 3, a weight-average molecular weight of 3000-9000 g/mol, preferably 3500-8500 g/mol, particularly preferably 4500-8000 g/mol (test method according to GB/T 21863-2008), with a content of 0-40 pbw, preferably 0-30 pbw, particularly preferably 5-20 pbw, based on the mass of component B.

12. The process according to any of claims 7-9, characterized in that said component B further comprises at least one small-molecule chain-extender of alcohols, alcohol-amines or diamines, said small-molecule chain-extender is present in a content of 0.5-3.5 pbw, preferably 1-3 pbw, particularly preferably 1.25-2.75 pbw, based on the mass of component B.

13. Use of the high resilience polyurethane flexible foam according to any of claims 1-7 in car seat cushion or pillow.

14. A car seat cushion or pillow, comprising the high resilience polyurethane flexible foam according to any of claims 1-7.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/066627

A. CLASSIFICATION OF SUBJECT MATTER

INV. C08G18/76 C08G18/48 C08G18/50 C08G18/32 C08G18/66
C08G18/63 C08G18/40 C08G18/18
ADD. C08G101/00

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

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 7 625 954 B2 (BASF AG [DE]) 1 December 2009 (2009-12-01) example 5 column 7, line 50 - column 8, line 66 example 15; table 1 column 6, line 21 - line 23 column 13, line 26 - line 30 -----	1-14
A	US 2007/287762 A1 (CASATI FRANCOIS M [CH] ET AL) 13 December 2007 (2007-12-13) paragraph [0098]; claim 3; example 12 paragraph [0081] paragraph [0055]; example 5 paragraph [0113] paragraph [0093] paragraph [0002] -----	1-14



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

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"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

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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