Examples of the other polyisocyanate include the above-described derivatives.

[0075]

These examples of the other polyisocyanates may be used singly or in combination of two or more. Preferably, araliphatic polyisocyanates and alicyclic polyisocyanates are used, more preferably, alicyclic polyisocyanates are used, and further preferably, methylenebis(cyclohexyl isocyanate) is used.

[0076]

When the other polyisocyanate (polyisocyanate excluding xylylene diisocyanate and hydrogenated xylylene diisocyanate) is blended, the xylylene diisocyanate content and the hydrogenated xylylene diisocyanate content (when they are used in combination, their total amount) relative to a total amount of the polyisocyanate component is, for example, 50 mass% or more, preferably 60 mass% or more, more preferably 80 mass% or more, and for example, 99 mass% or less.

[0077]

When the other polyisocyanate (polyisocyanate excluding xylylene diisocyanate and hydrogenated xylylene diisocyanate) is blended, for the polyisocyanate component, preferably, xylylene diisocyanate and bis(isocyanatocyclohexyl) methane are used in combination.

[0078]

By using xylylene diisocyanate and bis(isocyanatocyclohexyl) methane in combination, polyurethane dispersion that is excellently water dispersible and has a small average particle size can be produced without damaging gas barrier properties.

[0079]

When xylylene diisocyanate and bis(isocyanatocyclohexyl) methane are used in combination, for example, 60 parts by mass or more, preferably 70 parts by mass or more, more preferably 80 parts by mass or more, and for example, 95 parts by mass or less, preferably 93 parts by mass or less, more preferably 90 parts by mass or less of xylylene diisocyanate is blended relative to 100 parts by mass of a total amount of xylylene diisocyanate and bis(isocyanatocyclohexyl) methane. And for example, 5 parts by mass or more, preferably 7 parts by mass or more, more preferably 10 parts by mass or more, and for example, 40 parts by mass or less, preferably 30 parts by mass or less, more preferably 20 parts by mass or less of

[0256]

Thereafter, aging reaction was performed for 1 hour, methyl ethyl ketone and ion-exchange water were distilled off with an evaporator, and ion-exchange water was used to adjust the solid content to 25 mass%, thereby producing polyurethane dispersion 5 (PUD 5).

[0257]

The produced PUD 5 had a pH of 8.6, a viscosity of 15 mPa·s (25°C), and an average particle size of 62 nm measured by Coulter counter N5 (manufactured by Beckman Coulter, Inc.). The total of the urethane group concentration and the urea group concentration calculated by the amounts charged was 40.2 mass%.

[0258]

Synthesis Example 6 (Synthesis of polyurethane dispersion 6 (PUD 6))

67.7 g of Vestanat IPDI (3-isocyanatomethyl-3,5,5-trimethylcyclohexyl isocyanate, IPDI, manufactured by Evonic Corporation), 146.6 g of TAKELAC U-5620 (polyesterpolyol having a number average molecular weight of 2000, manufactured by Mitsui Chemicals, Inc.), 5.5 g of triethylene glycol, 10.8 g of dimethylolpropionic acid, and 79.6 g of acetonitrile as a solvent were mixed, and 0.03 g of tin octylate (Stanoct, manufactured by API Corporation) was added as a catalyst, and reaction was conducted in a nitrogen atmosphere at 65 to 70°C until the NCO% was 3.10% or less, thereby producing a transparent isocyanate group-terminated prepolymer reaction solution.

[0259]

Then, the produced reaction solution was cooled to 40°C, and thereafter, neutralized with 8.1 g of triethylamine.

[0260]

Then, the reaction solution was dispersed in 863.7 g of ion-exchange water with a homodisper, and an aqueous amine solution in which 11.3 g of 2-((2-aminoethyl) amino) ethanol was dissolved in 22.6 g of ion-exchange water was added thereto, thereby causing chain extension reaction.

[0261]

Thereafter, aging reaction was performed for 1 hour, acetonitrile and ion-exchange water were distilled off with an evaporator, and ion-exchange water was used to adjust the solid