

DESCRIPTION

Production method of aromatic polycarbonate

Technical Field

[0001]

The present invention relates to a production method of an aromatic polycarbonate by ester exchange reaction. More particularly, it relates to a production method of an aromatic polycarbonate, in which exchange frequency of a filter for filtering a raw material is reduced.

Background Art

[0002]

In recent years, a polycarbonate resin is widely used in OA parts, automobile parts, building materials and the like as engineering plastics having excellent mechanical properties such as impact resistance and additionally excellent heat resistance, transparency and the like. In particular, utilizing its properties such as impact resistance, transparency and the like, the polycarbonate resin is widely used in applications of an optical lens and a recording disc as optical materials and of a sheet, a bottle and the like.

[0003]

A so-called interfacial method using an aromatic diol such as a bisphenol compound, and phosgene as raw materials is industrialized as a production method of the aromatic polycarbonate.

However, this method involves the problems such that phosgene harmful to human body must be used, a solvent such as dichloromethane having high load to environment is required, and sodium chloride by-produced in large amount incorporates into a polymer.

On the other hand, a method in which an aromatic diol and carbonic diester are ester-exchanged in a molten state, and an aromatic polycarbonate is obtained while removing a low molecular weight material such as phenol by-produced is conventionally known as a so-called melt process. The melt process has the advantage that an aromatic polycarbonate can be produced without the above-described problems as in the interfacial method.

[0004]

By the way, the aromatic polycarbonate is used as an optical lens and a recoding disc as optical materials as described above. In particular, incorporation of foreign matters is a fatal problem in those applications.

A method of using an aromatic dihydroxy compound and a carbonic diester, from which foreign matters have been filtered and removed using a filter, is disclosed as a method of reducing foreign matters in an aromatic polycarbonate (for example, see Patent Document 1).

Furthermore, a method of mixing and melting an aromatic dihydroxy compound and a carbonic diester as raw materials and then filtering the melt using a filter which

has been subjected to specific treatment is disclosed (for example, see Patent Document 2).

Alternatively, a method of stipulating flow rate of a raw material liquid to be treated with a filter and a filtration area of the filter is disclosed (for example, see Patent Document 3).

[0005]

Patent Document 1: JP-A-5-239334

Patent Document 2: JP-A-2003-048975

Patent Document 3: JP-A-2002-256071

Disclosure of the Invention

Problems that the Invention is to Solve

[0006]

However, the filter for filtering raw materials gradually clogs with time. Therefore, in general when differential pressure before and after a filter reaches a certain level, the filter is replaced with a fresh filter or a cleaned filter.

However, an aromatic dihydroxy compound and a carbonic diester, used as raw materials of an aromatic polycarbonate by melt process, and a mixture of those each have a melting point greatly higher than room temperature, and as a result, there is the problem that exchange operation of a raw material filter involves large risk. To reduce exchange frequency of a filter, there is a method of increasing a filtration area per unit flow rate.

However, there is the problem that an apparatus is excessively large, resulting in further increasing risk of filter exchange operation.

The above-described problems become further serious by a slight amount of a precipitated catalyst when an ester exchange catalyst is contained in raw materials, and drastic resolution has been demanded.

[0007]

The invention has been made in view of the above-described problems in the prior art.

That is, the object of the invention is to provide a production method of an aromatic polycarbonate that can reduce exchange frequency of a filter for filtering raw materials.

Means for Resolving the Problems

[0008]

As a result of keen investigations to solve the above problems, the present inventors have found that when plural filters for filtering raw materials are used, exchange frequency of a filter can be reduced, and have completed the present invention based on such a finding.

[0009]

Thus, according to the invention, there is provided a method for producing an aromatic polycarbonate using an aromatic dihydroxy compound and a carbonic diester as raw materials, characterized in that the raw material in a

molten state is filtered using plural filters arranged in series, and then supplied to a reactor.

[0010]

The raw material is preferably a mixture of the aromatic dihydroxy compound and the carbonic diester, and the raw material preferably further contains an ester exchange catalyst.

When the filter has an opening at the upstream side of A μm and an opening at a downstream side of B μm , in at least one combination, it is preferred that A is larger than B ($A > B$), and it is further preferred that A is 8 or more at the most upstream side and B is 2 or less at the most downstream side.

It is preferred that at least three filters are present, and it is preferred that at least one filter of the filters is a pleat type filter.

On the other hand, it is preferred that flow velocity on at least one filter surface of the filters for the raw material in a molten state is from 1 to 20 m/hr, and it is further preferred to satisfy the conditions that (1) where the opening of the filter is less than 5 μm , the flow velocity on the filter surface of the raw material in a molten state is from 1 to 5 m/hr, and (2) where the opening of the filter is 5 μm or more, the flow velocity is from 5 to 20 m/hr.

Furthermore, it is preferred that a static mixer is

further arranged between a raw material preparation tank and a reactor, and raw materials are mixed using the static mixer, and it is preferred that an ester exchange catalyst is added to the raw materials between the raw material preparation tank and the reactor.

[0011]

That is, the gist of the invention resides in the following (1) to (11).

(1) A method for producing an aromatic polycarbonate using an aromatic dihydroxy compound and a carbonic diester as raw materials,

characterized in that the raw materials in a molten state is filtered using plural filters arranged in series, and then supplied to a reactor.

(2) The production method of an aromatic polycarbonate as described in (1), characterized in that the raw material is a mixture of the aromatic dihydroxy compound and the carbonic diester.

(3) The production method of an aromatic polycarbonate as described in (1) or (2), characterized in that an ester exchange catalyst is further added to the raw material, and the resulting mixture is filtered using the plural filters.

(4) The production method of an aromatic polycarbonate as described in any one of (1) to (3), characterized in that when the filter has an opening at the upstream side of A

μm and an opening at a downstream side of $B \mu\text{m}$, in at least one combination, A is larger than B ($A > B$).

(5) The production method of an aromatic polycarbonate as described in (4), characterized in that A is 8 or more at the most upstream side and B is 2 or less at the most downstream side.

[0012]

(6) The production method of an aromatic polycarbonate as described in any one of (1) to (5), characterized in that at least three filters are present.

(7) The production method of an aromatic polycarbonate as described in any one of (1) to (6), characterized in that at least one filter of the filters is a pleat type filter.

(8) The production method of an aromatic polycarbonate as described in any one of (1) to (7), characterized in that flow velocity on at least one filter surface of the filters for the raw material in a molten state is from 1 to 20 m/hr.

(9) The production method of an aromatic polycarbonate as described in (8), characterized in that the flow velocity on the filter surface of the raw material in a molten state is satisfied with the following conditions (1) and (2):

(1) when the opening of the filter is less than $5 \mu\text{m}$, the flow velocity is from 1 to 5 m/hr, and

(2) when the opening of the filter is $5 \mu\text{m}$ or more,

the flow velocity is from 5 to 20 m/hr.

(10) The production method of an aromatic polycarbonate as described in any one of (1) to (9), characterized in that a static mixer is further arranged between a raw material preparation tank and the reactor, and the raw materials are mixed using the static mixer

(11) The production method of an aromatic polycarbonate as described in any one of (1) to (10), characterized in that the ester exchange catalyst is added to the raw materials between the raw material preparation tank and the reactor.

Advantage of the Invention

[0013]

According to the present invention, in the production of an aromatic polycarbonate, exchange frequency of the filter for filtering raw materials can be reduced.

Brief Description of the Drawings

[0014]

[Fig. 1] Fig. 1 is a view showing one example of the production apparatus of an aromatic polycarbonate.

[Fig. 2] Fig. 2 is a view explaining one example of the constitution of a filter section.

Description of Reference Numerals and Signs

[0015]

1a-1 ... Supply port of diphenyl carbonate

1b ... Supply port of bisphenol A

2a ... First raw material preparation tank
2b ... Second raw material preparation tank
3a, 3b ... Anchor type stirring blade
4a ... Raw material feed pump
5a ... Catalyst supply port
6a ... First vertical reactor
6b ... Second vertical reactor
6c ... Third vertical reactor
7a, 7b, 7c, 10a ... Stirring blade
8a, 8b, 8c, 8d ... Distillation pipe
9a ... Fourth horizontal reactor
20, 20-1, 20-2 ... Filter section
21, 22, 23 ... Filter
24 ... Static mixer
81a, 81b, 81c, 81d ... Condenser
82a, 82b, 82c, 82d ... Pressure reducing device

Best Mode for Carrying Out the Invention

[0016]

The best mode for carrying out the invention (hereinafter, the embodiment of the invention) is described in detail below. The present invention is not limited to the following embodiments, and can carry out with various modifications within a scope of its gist. Further, the drawings used are to explain the present embodiment, and do not show the actual size.

[0017]

(Polycarbonate resin)

In the present invention, a polycarbonate resin is produced by melt polycondensation based on an ester exchange reaction between an aromatic dihydroxy compound and a carbonic diester.

A method of producing a polycarbonate resin by using an aromatic dihydroxy compound and a carbonic diester as raw materials, and continuously conducting melt polycondensation reaction in the presence of an ester exchange catalyst is described below.

[0018]

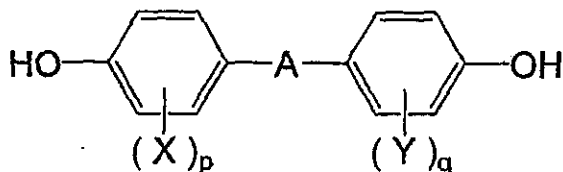
(Aromatic dihydroxy compound)

The aromatic dihydroxy compound used in the present embodiment includes a compound represented by the following general formula (1).

[0019]

[Chem. 1]

General Formula (1)



[0020]

In the general formula (1), A represents a single bond, a straight-chain, branched or cyclic divalent hydrocarbon group having from 1 to 10 carbon atoms which

may be substituted, or a divalent group represented by -O-, -S-, -CO- or -SO₂-. X and Y represent a halogen atom or a hydrocarbon group having from 1 to 6 carbon atoms. p and q are an integer of 0 to 2. X and Y, and p and q may be the same or different, respectively.

[0021]

Specific examples of the aromatic dihydroxy compound include bisphenols such as bis(4-hydroxydiphenyl)methane, 2,2-bis(4-hydroxyphenyl)propane, 2,2-bis(4-hydroxy-3-methylphenyl)propane, 2,2-bis(4-hydroxy-3-t-butylphenyl)propane, 2,2-bis(4-hydroxy-3,5-dimethylphenyl)propane, 2,2-bis(4-hydroxy-3,5-dibromophenyl)propane, 4,4-bis(4-hydroxyphenyl)heptane and 1,1-bis(4-hydroxyphenyl)cyclohexane; biphenols such as 4,4'-dihydroxybiphenyl and 3,3',5,5'-tetramethyl-4,4'-dihydroxybiphenyl; bis(4-hydroxyphenyl)sulfone, bis(4-hydroxyphenyl)sulfide, bis(4-hydroxyphenyl)ether, and bis(4-hydroxyphenyl)ketone.

Of those, 2,2-bis(4-hydroxyphenyl)propane (bisphenol A, hereinafter sometimes abbreviated as BPA) is preferable. Those aromatic dihydroxy compounds can be used alone or as mixtures of two or more thereof.

[0022]

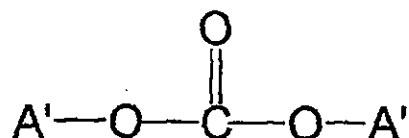
(Carbonic diester)

The carbonic diester used in the present embodiment includes a compound represented by the following general formula (2).

[0023]

[Chem. 2]

General Formula (2)



[0024]

In the general formula (2), A' represents a straight-chain, branched or cyclic monovalent hydrocarbon group having from 1 to 10 carbon atoms which may be substituted. Two A's may be the same or different.

Examples of the substituent on A' include a halogen atom, an alkyl group having from 1 to 10 carbon atoms, an alkoxy group having from 1 to 10 carbon atoms, a phenyl group, a phenoxy group, a vinyl group, a cyano group, an ester group, an amido group and an nitro group.

[0025]

Specific examples of the carbonic diester include diphenyl carbonate, a substituted diphenyl carbonate such as ditolyl carbonate; and a dialkyl carbonate such as dimethyl carbonate, diethyl carbonate and di-t-butyl carbonate.

Of those, diphenyl carbonate (hereinafter sometimes abbreviated as DPC) and a substituted diphenyl carbonate are preferable. Those carbonic diesters can be used alone or as mixtures of two or more thereof.

[0026]

The carbonic diester may be replaced by dicarboxylic acid or dicarboxylic ester in an amount of preferably 50 mol% or less, and more preferably 30 mol% or less.

The representative dicarboxylic acid or dicarboxylic ester include terephthalic acid, isophthalic acid, diphenyl terephthalate and diphenyl isophthalate. When replaced by such a dicarboxylic acid or dicarboxylic ester, a polyester carbonate is obtained.

[0027]

Those carboxylic diesters (including the above replaced dicarboxylic acid or dicarboxylic ester, and hereinafter the same) are used in an amount excess to the dihydroxy compound.

Specifically, the carboxylic diester is used in a molar ratio of preferably 1.01 or more and particularly preferably 1.02 or more, and preferably 1.30 or less and particularly preferably 1.20 or less, to the aromatic dihydroxy compound. Where the molar ratio is smaller than 1.01, terminal OH group of a polycarbonate resin obtained is increased, and thermal stability of the resin tends to deteriorate. Further, where the molar ratio is larger than 1.30, reaction rate of ester exchange lowers, and there is the tendency that it is difficult to produce a polycarbonate resin having the desired molecular weight. Additionally, the residual amount of carbonic diester in

the resin is increased, and this may result in odor at the time of molding or of a molded article, which is not preferred.

[0028]

(Ester exchange catalyst)

The ester exchange catalyst used in the present embodiment includes catalysts generally used in producing a polycarbonate by an ester exchange method, and is not particularly limited. In general, examples of the catalyst include basic compounds such as an alkali metal compound, a beryllium or magnesium compound, an alkaline earth metal compound, a basic boron compound, a basic phosphorus compound, a basic ammonium compound, and an amine compound.

Of those ester exchange catalysts, the alkali metal compound or the alkaline earth metal compound has large effect in the point of reducing exchange frequency of a filter for filtering raw materials, purposed in the present embodiment. Those ester exchange catalysts may be used alone or as mixtures of two or more thereof.

The ester exchange catalyst is used in a range of preferably 1×10^{-9} mol or more and particularly 1×10^{-7} mol or more, and preferably 1×10^{-1} mol or less and particularly preferably 1×10^{-2} mol or less, per mole of the aromatic dihydroxy compound.

[0029]

The alkali metal compound includes inorganic alkali metal compounds such as hydroxides, carbonates and hydrogen carbonate compounds of alkali metals; and organic alkali metal compounds such as salts of alkali metal with alcohols, phenols or organocarboxylic acids. Examples of the alkali metal include lithium, sodium, potassium, rubidium and cesium.

Of those alkali metal compounds, a cesium compound is preferred, and cesium carbonate, cesium hydrogen carbonate and cesium hydroxide are particularly preferred.

[0030]

Examples of the beryllium or magnesium compound and the alkaline earth metal compound include inorganic alkaline earth metal compounds such as hydroxides or carbonates of beryllium, magnesium and alkaline earth metals; and salts of those metals with alcohols, phenols and organocarboxylic acids. Examples of the alkaline earth metal include calcium, strontium and barium.

[0031]

Examples of the basic boron compound include a sodium salt, a potassium salt, a lithium salt, a calcium salt, a magnesium salt, a barium salt and a strontium salt of a boron compound. Examples of the boron compound include tetramethyl boron, tetraethyl boron, tetrapropyl boron, tetrabutyl boron, trimethylethyl boron, trimethylbenzyl boron, trimethylphenyl boron,

triethylmethyl boron, triethylbenzyl boron, triethylphenyl boron, tributylbenzyl boron, tributylphenyl boron, tetraphenyl boron, benzyltriphenyl boron, methyltriphenyl boron and butyltriphenyl boron.

[0032]

Examples of the basic phosphorus compound include trivalent phosphorus compounds such as triethylphosphine, tri-n-propylphosphine, triisopropylphosphine, tri-n-butylphosphine, triphenylphosphine and tributylphosphine; and quaternary phosphonium salts derived from those compounds.

[0033]

Examples of the basic ammonium compound include tetramethylammonium hydroxide, tetraethylammonium hydroxide, tetrapropylammonium hydroxide, tetrabutylammonium hydroxide, trimethylethylammonium hydroxide, trimethylbenzylammonium hydroxide, trimethylphenylammonium hydroxide, triethylmethylammonium hydroxide, triethylbenzylammonium hydroxide, triethylphenylammonium hydroxide, tributylbenzylammonium hydroxide, tributylphenylammonium hydroxide, tetraphenylammonium hydroxide, benzyltriphenylammonium hydroxide, methyltriphenylammonium hydroxide and butyltriphenylammonium hydroxide.

[0034]

Examples of the amine compound include 4-aminopyridine, 2-aminopyridine, N,N-dimethyl-4-amino-

pyridine, 4-diethylaminopyridine, 2-hydroxypyridine, 2-methoxypyridine, 4-methoxypyridine, 2-dimethylaminoimidazole, 2-methoxylimidazole, imidazole, 2-mercaptoimidazole, 2-methylimidazole and aminoquinoline.

[0035]

(Production method of aromatic polycarbonate)

A production method of an aromatic polycarbonate is described below.

The production of an aromatic polycarbonate is conducted by preparing a mixture containing an aromatic dihydroxy compound and a carbonic diester as raw materials (raw material preparation step) and subjecting the mixture of those compounds to a multi-stage polycondensation reaction in the presence of an ester exchange reaction catalyst under a molten state using plural reactors (polycondensation step). The reaction method may be any of a batchwise method, a continuous method, and a combination of a batchwise method and a continuous method. The continuous method is preferred from the standpoint of productivity and quality stability. In the case of the continuous method, the reactor used is generally constituted of a plurality of reactors arranged in series, and preferably, plural vertical reactors and the subsequent at least one horizontal reactor are used.

After the polycondensation step, a step of stopping a reaction and devolatilization removing unreacted raw

materials and reaction by-products in a polymerization reaction liquid, a step of adding a heat stabilizer, a release agent, a coloring material and the like, a step of shaping a polycarbonate resin into pellets having a given particle size, and the like may appropriately be added.

Each step of the production method is described below.

[0036]

(Raw material preparation step)

An aromatic dihydroxy compound and a carbonic diester used as raw materials of an aromatic polycarbonate are generally prepared as a molten mixture using a batchwise, semibatchwise or continuous stirring tank type apparatus in an atmosphere of an inert gas such as nitrogen or argon. For example, in the case of using bisphenol A as the aromatic dihydroxy compound and diphenyl carbonate as the carbonic diester, temperature of melt mixing is selected from a range of preferably 120°C or higher and particularly preferably 125°C or higher, and preferably 180°C or lower and particularly preferably 160°C or lower.

In this case, mixing proportions of the aromatic dihydroxy compound and the carbonic diester are adjusted such that the carbonic diester is excess, and are adjusted such that the carbonic diester is in a proportion of preferably 1.01 mol or more and particularly preferably

1.02 mol or more, and preferably 1.30 mol or less and particularly preferably 1.20 mol or less, per mole of the aromatic dihydroxy compound.

[0037]

(Polycondensation step)

Polycondensation by an ester exchange reaction between the aromatic dihydroxy compound and the carbonic diester is continuously conducted by multiple steps of generally 2 steps or more, and preferably from 3 to 7 steps.

Specific reaction conditions are that temperature is in a range of from 150 to 320°C, pressure is in a range of from normal pressures to 0.01 Torr (1.3 Pa), and an average residence time is in a range of from 5 to 150 minutes.

In each reactor in the case of conducting the polycondensation step by multiple steps, further high temperature and further high vacuum are generally set stepwise within the above reaction conditions in order to further effectively discharge phenol by-produced with the progress of the polycondensation reaction. It is preferred to set low temperature as possible and a short residence time as possible to prevent deterioration of quality such as hue of the polycarbonate obtained.

[0038]

In the case of conducting the polycondensation step

by multiple steps, preferably a plurality of vertical reactors and/or the subsequent at least one reactor having excellent thin film evaporation performance are provided, thereby increasing an average molecular weight of a polycarbonate resin. The reactors provided are generally 3 to 6, and preferably 4 to 5.

Examples of the reactor having excellent thin film evaporation performance include a thin film reactor, a centrifugal thin film evaporation reactor, a surface renewal type twin-screw kneading reactor, a twin-screw horizontal stirring reactor, a wet wall type reactor, a perforated plate type reactor which polymerizes while freely dropping, and a wire-equipped perforated plate type reactor which polymerizes while dropping along the wire.

[0039]

The ester exchange catalyst used in polycondensation of the aromatic dihydroxy compound and the carbonic diester is generally previously provided as an aqueous solution. Concentration of the catalyst aqueous solution is not particularly limited, and adjusted to an optional concentration according to solubility of a catalyst in water. Other solvent such as acetone, alcohol, toluene or phenol can be used in place of water.

Water used for dissolution of the catalyst is not particularly limited so long as kind and concentration of impurities contained are constant. In general, distilled

water, deionized water and the like are preferably used.

[0040]

(Production apparatus)

One example of the production method of an aromatic polycarbonate to which the present embodiment is applied is specifically described below based on the drawings.

Fig. 1 is a view showing one example of the production apparatus of an aromatic polycarbonate. In the production apparatus shown in Fig. 1, the aromatic polycarbonate is produced through a raw material preparation step of preparing an aromatic dihydroxy compound and a carbonic diester as raw materials, and a polycondensation step of subjecting those raw materials to polycondensation reaction in a molten state using a plurality of reactors.

Subsequently, pellets of the polycarbonate resin are formed through a step of stopping the reaction and devolatilization removing unreacted raw materials and reaction by-products in a molten reactant, a step of adding a heat stabilizer, a release agent, a coloring material and the like, and a step of forming the aromatic polycarbonate into pellets having a given particle size.

[0041]

In the raw material preparation step, a first raw material preparation tank 2a and a second raw material preparation tank 2b which are connected in series, and a

raw material supply pump 4a for supplying raw materials prepared to a polycondensation step are provided. The first raw material preparation tank 2a and the second raw material preparation tank 2b are provided with, for example, anchor type stirring blades 3a and 3b, respectively.

Diphenyl carbonate (hereinafter sometimes referred to as DPC) as a carbonic diester is supplied in a molten state to the first raw material preparation tank 2a from a DPC supply port 1a-1, and bisphenol A (hereinafter sometimes referred to as BPA) as an aromatic dihydroxy compound is supplied in a powder state to the first raw material preparation tank 2a from a BPA supply port 1b. The bisphenol A is dissolved in a molten diphenyl carbonate.

[0042]

In the production apparatus of an aromatic polycarbonate resin shown in Fig. 1, the DPC melt prepared at a given temperature under a nitrogen gas atmosphere and the BPA powder weighed under a nitrogen gas atmosphere are continuously supplied to the first raw material preparation tank 2a from the DPC supply port 1a-1 and the BPA supply port 1b, respectively. When liquid level of the first raw material preparation tank 2a exceeds the same height as the maximum height in a transfer piping, the raw material mixture is transferred to the second raw

material preparation tank 2b.

Next, the raw material mixture is continuously supplied to a first vertical reactor 6a through the raw material supply pump 4a. In this case, the molten raw material mixture is passed through a filter section 20 and filtered. Furthermore, a cesium carbonate aqueous solution as a catalyst is continuously supplied from a catalyst supply port 5a on the somewhere of the transfer pipe of the raw material mixture.

The filter section 20 is described in detail hereinafter.

[0043]

In the first vertical reactor 6a, polycondensation reaction is conducted under a nitrogen atmosphere such that the temperature is 220°C, the pressure is 13.33 kPa (100 Torr), the number of revolution of the stirring blade 7a is held to 160 rpm, and the liquid level is maintained constant such that the average residence time is from 60 to 120 minutes while distilling the by-produced phenol from a distillation pipe 8a. Next, the molten reactant discharged from the first vertical reactor 6a is continuously supplied to a second vertical reactor 6b, a third vertical reactor 6c and a fourth horizontal reactor 9a, successively, thereby the polycondensation reaction proceeds. Reaction conditions in each reactor are generally set such that high temperature, high vacuum and

low stirring speed are achieved with the progress of the polycondensation reaction. During the polycondensation reaction, the liquid level is controlled such that the average residence time in each reactor is, for example, about 60 minutes, and in each reactor, the by-produced phenol is distilled from the distillation pipes 8b, 8c and 8d.

[0044]

The filter section 20 is described in detail below.

Fig. 2 is a view explaining one example of the constitution of the filter section 20.

As shown Fig. 2, the filter section 20 is constituted of three filters 21, 22 and 23 connected in series.

When the filter has an opening at the upstream side of $A \mu\text{m}$ and an opening at a downstream side of $B \mu\text{m}$, in at least one combination, it is preferred that A is larger than B ($A > B$). Where this condition is satisfied, the filter is further difficult to clog, and reduction in exchange frequency of the filter can be promoted.

Furthermore, A and B are that A is preferably 8 or more and further preferably 10 or more at the most upstream side, and B is preferably 2 or less and further preferably 1 or less at the most downstream side. Where A and B are excessively fallen outside the range, there is the tendency that removal of foreign matters is deficient,

and the filter is liable to clog.

[0045]

The filter can use any type. Filter medium constituting the filter may be any of a metal wind, a laminated metal mesh, a metal non-woven fabric, a porous metal plate and the like. From the standpoint of filtration precision, the laminated metal mesh and the metal non-woven fabric are preferred, and above all, a type produced by sintering and fixing the metal non-woven fabric is preferred. The shape of the filter may be any type of a basket type, a disc type, a leaf disc type, a tube type, a flat cylinder type, a pleat cylinder type and the like. Above all, the pleat type is more preferred.

[0046]

Material of the filter is not particularly limited, and a metal-made filter, a resin-made filter, a ceramic-made filter and the like can be used. From the standpoints of heat resistance and reduction in coloration, a metal-made filter having an iron content of 80% or less is preferred. Above all, stainless steels such as SUS304, SUS316, SUS316L, SUS310S and the like are preferred.

[0047]

The opening described herein means a value of χ when $\beta\chi$ value represented by the following equation (1) measured according to ISO 16889 is 1,000.

$\beta\chi = (\text{number of particle at a primary side larger than}$

$\chi \text{ } \mu\text{m}) / (\text{number of particle at a secondary side larger than } \chi \text{ } \mu\text{m}) \dots\dots (1)$

The term "upstream" means a raw material preparation tank side to the direction that the raw material mixture flows, and the term "downstream" means a reactor side the direction that the raw material mixture flows.

[0048]

From points of productivity and filter life, it is preferred that flow velocity on the filter surface of the raw material in a molten state is from 1 to 20 m/hr. Where the flow velocity is too small, there is the tendency that facilities become too large, and where the flow velocity is too large, there is the tendency that the filter life becomes short.

In particular, where the opening of the filter is less than 5 μm , it is preferred that the flow velocity on the filter surface is from 1 to 5 m/hr, particularly from 2 to 3 m/hr, and where the opening of the filter is 5 μm or more, it is preferred that the flow velocity on the filter surface is from 5 to 20 m/hr, particularly from 6 to 10 m/hr.

The temperature of a raw material fluid in the case of passing through the filter in the present embodiment is not limited. However, where the temperature is too low, the raw material is solidified, and where it is too high, there is the defect such as thermal decomposition. For

this reason, the temperature is generally from 100 to 200°C, preferably from 120 to 180°C, and particularly preferably from 125 to 160°C.

[0049]

As shown in Fig. 2, a static mixer 24 is provided at the former part or the latter part, preferably at the former part, of three filters, but may not be provided.

Regarding the number of the filter, where one filter is used, the filter is frequently clogged by operation in a short period of time. Therefore, plural filters are used in the present embodiment, and preferably three or more filters are used. By employing this constitution, it becomes extremely difficult to cause clogging of the filter, and an excellent effect is exhibited such that reduction in exchange frequency of the filter is promoted.

In the present embodiment, a material that is filtered by the filter section 20 is a raw material mixture of an aromatic dihydroxy compound and a carbonic diester. However, those raw materials may be separately filtered and then mixed.

In the present embodiment, the addition position of a catalyst is not limited, and the catalyst may be added to any of the raw material preparation tank, between the raw material preparation tank and the reactor, and the reactor. However, from the standpoints of stabilization of addition amount and thermal stability of raw materials,

it is preferred that the catalyst is added between the raw material preparation tank and the reactor as shown in Fig. 1, and above all, it is preferred that the raw material mixture and the ester exchange catalyst are all mixed, and the resulting mixture is passed through the filter section 20 as shown in Fig. 1.

However, in the present embodiment, the position of the filter section is not limited to 20, and it is sufficient if only the raw materials in a molten state are filtered using plural filters arranged in series, and then supplied to the reactor.

Specifically, the filter section may be arranged to any position of 20-1, 20-2 and 20 in Fig. 1, and the arrangement position of the filter section may be plural. Alternatively, each filter of the filter section may be arranged on plural positions of 20-1, 20-2 and 20. However, from the standpoint that foreign matters are removed just before transferring to the reaction tank, it is preferred that at least one filter is arranged in 20.

Examples

[0050]

The present invention is described in more detail using the Examples. However, the invention is not limited to those Examples so far as it does not depart from its gist.

[0051]

(Example 1)

Bisphenol A as an aromatic dihydroxy compound and diphenyl carbonate as a carbonic diester were continuously supplied to a raw material preparation tank having a heat medium jacket and a heat medium coil therein, and in which the inner temperature is maintained at 150°C, so as to be diphenyl carbonate/bisphenol A=1.065 (mol/mol), followed by mixing and melting.

The raw material mixture was withdrawn from a piping located at the bottom of the raw material preparation tank. A cesium carbonate aqueous solution was added to the piping through a piping by controlling flow rate such that the aqueous solution is 0.5 μmol in terms of cesium carbonate per mole of the raw material bisphenol A, subsequently supplied to three filter units arranged in series through a piping equipped with a static mixer, and filtered. The respective filters have a structure that media prepared by sintering SUS316-made metal non-woven fabric are processed into a pleat type, and the openings are 10 μm , 5 μm and 1 μm in the order from the upstream side. In this case, flow velocity on the filter surface was 7 m/hr, 6 m/hr and 2 m/hr in the order from the upstream side. Continuous operation was carried out in this state for one year, but it was not reached to the differential pressure which is the standard for exchanging the filter.

[0052]

(Example 2)

Operation was conducted in the same manner as in Example 1 except that the flow velocity on the filter surface was set to be 28 m/hr, 10 m/hr and 6 m/hr in the order from the upstream side. When continuous operation was conducted in this state, it was reached to the differential pressure which is the standard for exchanging the filter after 30 days.

[0053]

(Comparative Example 1)

Operation was conducted in the same manner as in Example 1 except that only one filter having an opening of 1 μm was used. It was reached to the differential pressure which is the standard for exchanging the filter in two weeks, and therefore, the filter had to be exchanged.

[0054]

Thus, according to the production method of an aromatic polycarbonate described in detail in the present embodiment, exchange frequency of the filter for filtering raw materials can be reduced. As a result, excellent effects are exhibited such that degree of risk in the case of filter exchange and stop frequency of operation involved in filter exchange can be reduced, and an aromatic polycarbonate containing less foreign matters can

be obtained in a stable manner.

[0055]

While the invention has been described in detail and with reference to specific embodiments thereof, it will be apparent to one skilled in the art that various changes and modifications can be made therein without departing from the spirit and scope thereof.

This application is based on Japanese patent application (Patent Application No. 2007-087536) filed March 29, 2007, the entire contents thereof being hereby incorporated by reference.

Industrial Applicability

[0056]

According to the present invention, in the production of an aromatic polycarbonate, exchange frequency of the filter for filtering raw materials can be reduced. Therefore, the industrial value of the invention is remarkable.

CLAIMS

1. A method for producing an aromatic polycarbonate using an aromatic dihydroxy compound and a carbonic diester as raw materials, characterized in

that the raw materials in a molten state are filtered using plural filters arranged in series, and then supplied to a reactor,

that when the filter has an opening at the upstream side of A μm and an opening at a downstream side of B μm , in at least one combination, A is larger than B ($A > B$),

that flow velocity on at least one filter surface of the filters for the raw material in a molten state is from 1 to 20 m/hr, that the flow velocity on the filter surface of the raw material in a molten state is satisfied with the following conditions (1) and (2):

(1) when the opening of the filter is less than 5 μm , the flow velocity is from 1 to 5 m/hr, and

(2) when the opening of the filter is 5 μm or more, the flow velocity is from 5 to 20 m/hr, and

that A is 8 or more at the most upstream side and B is 2 or less at the most downstream side.

2. The production method of an aromatic polycarbonate as claimed in claim 1, characterized in that the raw material is a mixture of the aromatic dihydroxy compound and the carbonic diester.

3. The production method of an aromatic polycarbonate as claimed in claim 1 or 2, characterized in that an ester exchange

catalyst is further added to the raw material, and the resulting mixture is filtered using the plural filters.

4. The production method of an aromatic polycarbonate as claimed in claim 1 or 2, characterized in that at least three filters are present.

5. The production method of an aromatic polycarbonate as claimed in claim 1 or 2, characterized in that at least one filter of the filters is a pleat type filter.

6. The production method of an aromatic polycarbonate as claimed in claim 1 or 2, characterized in that a static mixer is further arranged between a raw material preparation tank and the reactor, and the raw materials are mixed using the static mixer.

7. The production method of an aromatic polycarbonate as claimed in claim 3, characterized in that a static mixer is further arranged between a raw material preparation tank and the reactor, and the raw materials are mixed using the static mixer.

8. The production method of an aromatic polycarbonate as claimed in claim 7, characterized in that the ester exchange catalyst is added to the raw materials between the raw material preparation tank and the reactor.