

Description

The present invention relates to novel hydrochlorofluorocarbon azeotropic or azeotropic-like mixtures which can be used as a chlorofluorocarbon alternative and which have excellent properties as a solvent and so on.

Chlorofluorocarbon compounds (hereinafter referred simply as CFCs) have little toxicity and are, in many cases, non-flammable and chemically stable. Various CFCs having different boiling points are available. By virtue of such properties, 1,1,2-trichloro-1,2,2-trifluoroethane (R113) is used as a solvent or a blowing agent; trichloromonofluoromethane (R11) is used as a blowing agent or a propellant; and dichlorodifluoromethane (R12) is used as a propellant or a refrigerant.

Chemically stable R11, R12 and R113 have long lifetime in the troposphere and reach the stratosphere, where they will be dissociated by solar radiation to release chlorine radicals, which initiate a chain reaction with ozone and deplete the ozone layer. Accordingly, the regulations for limiting the use of such conventional CFCs have been implemented. Therefore, a research has been actively conducted to develop a CFC alternative which scarcely depletes the ozone layer.

It is an object of the present invention to provide mixtures containing hydrochlorofluoropropanes having 3 carbon atoms, which have various excellent properties equal to conventional CFCs and which are useful as a CFC alternative.

A solvent consisting essentially of a hydrochlorofluoropropane of the formula I:



wherein $a+b+c=3$, $x+y+z=3$, $a+x \geq 1$, $b+y \geq 1$, and $0 \leq a, b, c, x, y, z \leq 3$, is described in the applicant's prior non-prepublished application EP-A-0 347 924.

The present invention provides a hydrochlorofluorocarbon azeotropic or azeotropic-like mixture as defined in the claims.

The mixture of the present invention is non-flammable or hardly flammable and may take a form of an azeotropic composition or an azeotropic-like composition. Particularly when used as a solvent, it provides properties equal or superior to conventional 1,1,2-trichlorotrifluoroethane (R113). Therefore, it is very useful as an alternative for R113. Further, no substantial change in the composition was observed when boiling or evaporating. Therefore, it may be used in the same manner as a conventional single CFC, whereby it has a merit in that no substantial change in the conventional technique is required.

The hydrochlorofluoropropanes to be employed in the azeotropic or azeotropic-like mixtures of the present invention are:

$\text{CF}_3\text{CF}_2\text{CHCl}_2$ (R225ca) and/or
 $\text{CCl}_1\text{F}_2\text{CF}_2\text{CHCl}_1\text{F}$ (R225cb)

Some halogenated hydrocarbons having a boiling point of from 20 to 85°C other than the hydrochlorofluoropropanes of the formula I, including chlorinated hydrocarbons, fluorinated hydrocarbons and brominated hydrocarbons having from 1 to 4 carbon atoms can be used in the mixtures of the invention.

The suitable chlorinated hydrocarbons having from 1 to 4 carbon atoms, include dichloromethane, trans-1,2-dichloroethylene, cis-1,2-dichloroethylene, 1-chloropropane and 2-chloro-2-methylpropane. The fluorinated hydrocarbons include 1,1,2-trichlorotrifluoroethane (R113), 1,1,2-trichloro-2,2-difluoroethane (R122), 1,1-dichloro-2,2,2-trifluoroethane (R123), 1,2-dichloro-1,1-difluoroethane (R132b), 1,2-dichloro-1-fluoroethane (R141) and 1,1-dichloro-1-fluoroethane (R141b). Likewise, the brominated hydrocarbons include 2-bromopropane.

Hydrocarbons having a boiling point of from 20 to 85°C which can be used in the mixtures of the invention, include aliphatic, alicyclic and aromatic hydrocarbons. Suitable hydrocarbons are cyclopentane, 2,2-dimethylbutane, 2-methylpentane and 2,3-dimethylbutane. Suitable hydrocarbons having from 5 to 8 carbon atoms may be a mixture obtained as a petroleum fraction and may preferably be a petroleum fraction containing as the main component at least one member selected from the group consisting of cyclopentane, 2,2-dimethylbutane, 2-methylpentane and 2,3-dimethylbutane.

The azeotropic or azeotropic-like composition of the mixture of the present invention may vary to an extent of $\pm 1.0\%$ by weight depending upon the purities of the compounds to be mixed or by the influence of measuring error.

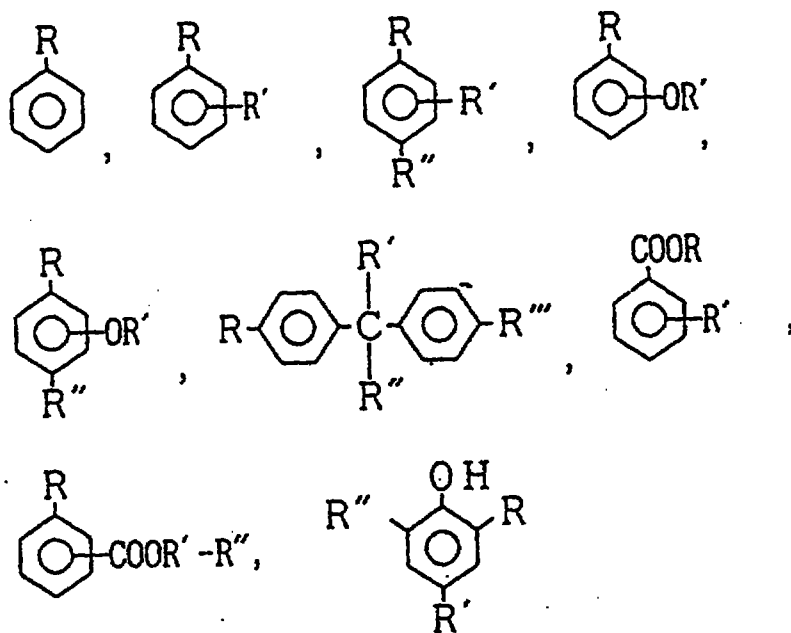
To the mixture of the present invention, other components may further be incorporated, as the case requires. For example, when the mixture is used as a solvent, it may contain at least one member selected from the group consisting of hydrocarbons such as neopentane, 3-methylpentane, neohexane, hexane, 3-methylhexane, heptane, isoheptane, 2,3-dimethylpentane, 2,4-dimethylpentane, octane, 2,2,3-trimethylpen-

tane, 2,2,4-trimethylpentane, cyclopentane, methylcyclohexane and ethylcyclohexane; chlorinated hydrocarbons such as 1,1,2-trichloroethane, 1,2-dichloroethane, trichloroethylene and tetrachloroethylene; chlorofluorinated hydrocarbons other than those of the present invention, such as 1,1-dichloro-2,3,3,3-tetrafluoropropene-1, trans-3-chloro-1,1,1,2,4,4,5,5,5-nonafluoropentene-2, cis-3-chloro-1,1,1,2,4,4,5,5,5-nonafluoropentene-2, 1,1,1,2,2,5,5,6,6,6-decafluorohexane and tetrachloro-1,2-difluoroethane; nitro compounds; phenols; amines; ethers; amylenes; esters; organic phosphites; epoxides; furans; alcohols; ketones; amides; and triazoles.

The content of such additional components in the mixture of the present invention is not particularly limited, but for the purpose of improving or controlling the solubility or obtaining a suitable boiling point or non-flammability, the content is usually from 0 to 50% by weight, preferably from 1 to 40% by weight. Preferably such incorporation will bring about an azeotropic or azeotropic-like composition. Further, to give the mixture a high level of stabilizing effect, it is effective to incorporate a stabilizer. The content of such additional components is usually from 1 ppm to 10% by weight, preferably from 10 ppm to 5% by weight. Further, the mixture of the present invention may further contain various cleaning assistants, surfactants, emulsifying agents or water.

As the nitro compounds, those represented by the formula $R-NO_2$ wherein R is a chain or cyclic hydrocarbon group having from 1 to 6 carbon atoms and containing a saturated or unsaturated bond, may be employed. Specifically, they include nitromethane, nitroethane, 1-nitropropane, 2-nitropropane and nitrobenzene. More preferred are nitromethane and nitroethane.

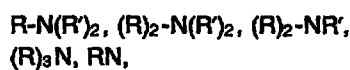
As the phenols, those represented by the following formulas are preferred:

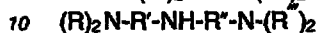
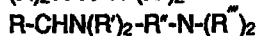
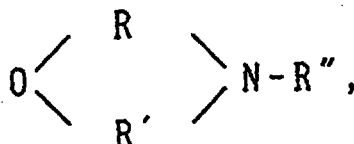


wherein each of R, R', R' and R'' is OH or a chain or cyclic hydrocarbon group having from 1 to 6 carbon atoms and containing a saturated or unsaturated bond.

Specifically, they include phenol, o-cresol, m-cresol, p-cresol, thymol, p-tert-butylphenol, tert-butylcatechol, catechol, isoeugenol, o-methoxyphenol, 4,4'-dihydroxyphenyl-2,2-propane, isoamyl salicylate, benzyl salicylate, methyl salicylate and 2,6-di-t-butyl-p-cresol. More preferred are phenol, 4,4-dihydroxyphenyl-2,2-propane and 2,6-di-t-butyl-p-cresol.

As the amines, those represented by the following formulas are preferred:

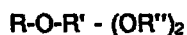
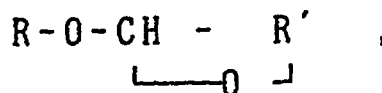
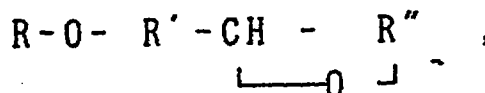
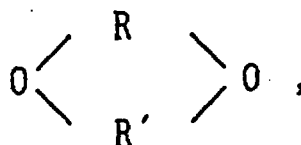




wherein each of R, R', R'' and R''' is a hydrogen atom or a chain or cyclic hydrocarbon group having from 1 to 8 carbon atoms and containing a saturated or unsaturated bond.

Specifically, they include pentylamine, hexylamine, diisopropylamine, diisobutylamine, di-n-propylamine, diallylamine, triethylamine, n-methylaniline, pyridine, picoline, morpholine, N-methylmorpholine, triallylamine, allylamine, α -methylbenzylamine, methylamine, dimethylamine, trimethylamine, ethylamine, diethylamine, propylamine, isopropylamine, sec-butylamine, tert-butylamine, dibutylamine, tributylamine, dipentylamine, tripentylamine, 2-ethylhexylamine, aniline, N,N-dimethylaniline, N,N-diethylaniline, ethylenediamine, propylenediamine, diethylenetriamine, tetraethylenepentamine, benzylamine, dibenzylamine, diphenylamine and diethylhydroxylamine. More preferred are diisopropylamine and diallylamine.

As the ethers, those represented by the following formulas are preferred:

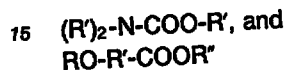
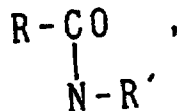


wherein each of R, R' and R'' is a chain or cyclic hydrocarbon group having from 1 to 10 carbon atoms and containing a saturated or unsaturated bond. Specifically, they include 1,4-dioxane, 1,2-butanediol, isopropyl ether, ethylene glycol monomethyl ether, diethylene glycol monomethyl ether, diethylene glycol monoethyl ether, dipropylene glycol methyl ether, ethyl isobutyl ether, ethyl isopentyl ether, ethyl naphthyl ether, ethyl vinyl ether, ethyl phenyl ether, anisole, anethole, ethyl propargyl ether, ethyl propyl ether, ethyl methyl ether, ethylene glycol, methyl glycidyl ether, ethylene glycol diethyl ether, ethylene glycol diphenyl ether, ethylene glycol dimethyl ether, ethylene glycol monophenyl ether, ethylene glycol monobutyl ether, ethylene glycol monobenzyl ether, dipentyl ether, allyl ethyl ether, diisopentyl ether, diallyl ether, butyl glycidyl ether, allyl glycidyl ether, dipropyl ether, ethyl glycidyl ether, vinyl glycidyl ether, dimethyl ether,

diethyl ether, di-n-propyl ether, dibutyl ether, 1,2-dimethoxyethane, trimethoxyethane, and triethoxyethane. More preferred are 1,4-dioxane, butyl glycidyl ether and 1,2-dimethoxyethane.

As the alylenes, α -allylene, β -allylene, γ -allylene, α -isoallylene and β -isoallylene are preferred. More preferred is β -allylene.

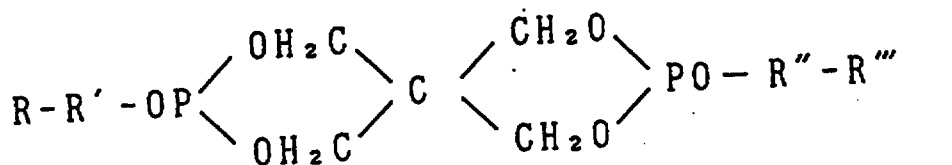
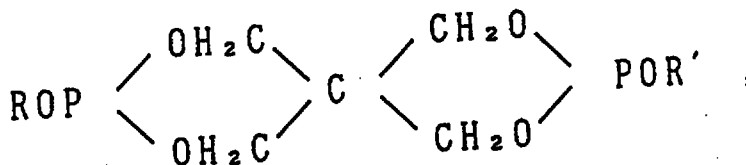
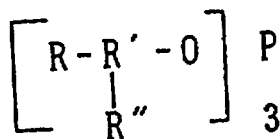
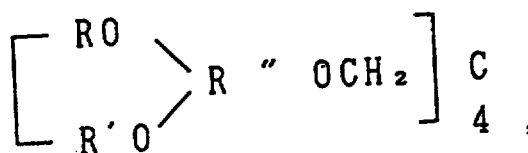
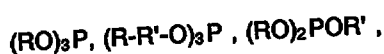
As the esters, those represented by the following formulas are preferred:



wherein each of R, R' and R'' is a hydrogen atom or a chain or cyclic hydrocarbon group having from 1 to 6 carbon atoms and containing a saturated or unsaturated bond.

Specifically, they include methyl acetate, ethyl acetate, propyl acetate, n-butyl acetate, isobutyl acetate, isopropyl acetate, ethyl acrylate, 2-hydroxyethyl methacrylate, methyl acrylate, butyl acrylate, phenyl acrylate, allyl acrylate, caprolactam, ethyl carbamate, methyl carbamate, and methyl salicylate. More preferred are methyl acetate and methyl salicylate.

As the organic phosphites, those represented by the following formula are preferred:



wherein each of R, R', R'' and R''' is a hydrogen atom or a saturated or unsaturated chain or cyclic hydrocarbon group having from 1 to 18 carbon atoms. Specifically, they include triphenolphosphite, tris(hydroxyphenyl)phosphite, triethylphosphite, tris(2-ethylhexyl)phosphite, tridecylphosphite, tributylphosphite, (nonylphenyl)phosphite, triethylphosphite, tris(2-ethylhexyl)phosphite, tridecylphosphite, tributylphosphite,

diphenylmono(2-ethylhexyl)phosphite, diphenylmonodecylphosphite, diphenylmonotridecylphosphite, dilaurylhydrogen phosphite, diphenylhydrogen phosphite, tetraphenyldipropylene glycol pentaerythritol tetraphosphite, triauryltrithiophosphite, bis(tridecyl)pentaerythritol diphosphite, bis(nonylphenyl)-pentaerythritol diphosphite, tristearyl phosphite, distearyl pentaerythritol diphosphite, and tris(2,4-di-tert-butylphenyl)phosphite. More preferred are triphenylphosphite and tributylphosphite.

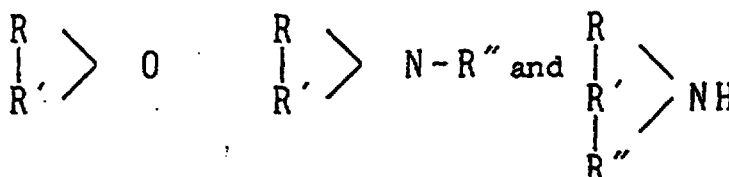
As the epoxides, those represented by the following formulas are preferred:

RO and XRO

wherein R is a saturated or unsaturated chain or cyclic hydrocarbon group having from 1 to 8 carbon atoms, and X is a halogen atom.

Specifically, they include 1,2-butylene oxide, epichlorohydrin, propylene oxide, 2,3-butylene oxide and styrene oxide. More preferred are 1,2-butylene oxide and epichlorohydrin.

As the furans, those represented by the following formulas are preferred:



wherein each of R, R' and R'' is a saturated or unsaturated hydrocarbon group having from 1 to 2 carbon atoms. Specifically they include tetrahydrofuran, n-methylpyrrole, 2-methylpyrrole and 3-methylpyrrole.

More preferred is N-methylpyrrole.

As the alcohols which are mainly used as stabilizers, those presented by the following formulas are preferred:

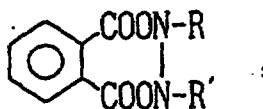
R-OH, NH₂-R-OH, R-O-R'-OH and R-R'-OH

wherein each of R and R' is a saturated or unsaturated chain or cyclic hydrocarbon group having from 1 to 6 carbon atoms.

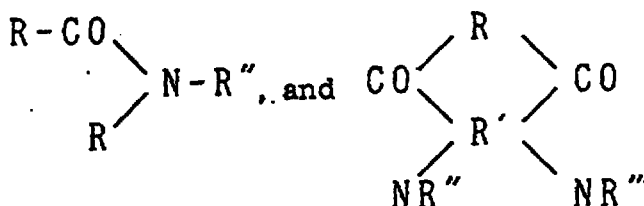
Specifically, they include, methanol, ethanol, sec-butanol, tert-butanol, allyl alcohol, benzyl alcohol, propanol, isopropanol, tert-amyl alcohol, 1-amino-2-propanol, propargyl alcohol, isobutanol, butanol, 3-methylpentyn-3-ol, 1-methoxy-2-propanol, 3-methyl-1-butyne-3-ol, 2-methyl-3-butyne-3-ol, pentyl alcohol, hexanol, heptanol and octanol. More preferred are sec-butanol and propargyl alcohol.

As the ketones and amides, those represented by the following formulas are preferred:

(R)₂CO, R-CO-R', (RNCO)₂.



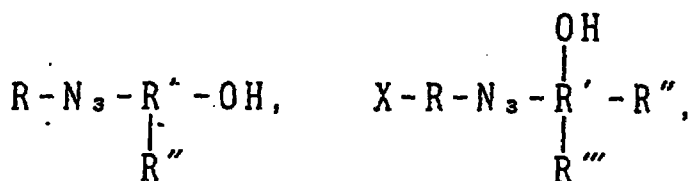
R-CO-NH-R', R-CON-(R')₂, (R)₂NCON(R')₂.



wherein each of R, R', R'' and R''' is a hydrogen atom or a saturated or unsaturated hydrocarbon group having from 1 to 4 carbon atoms. Specifically, they include acetone, methyl ethyl ketone, methyl isobutyl ketone, azodicarbonamide, maleic acid hydrazine, phthalic acid hydrazine, formamide, N-methylformamide, N,N-dimethylformamide, N-methylpropionamide, 2-pyrrolidone, N,N,N',N'-tetramethylurea and N-methylpyrrolidone. More preferred are methyl isobutyl ketone and 2-pyrrolidone.

As the triazoles, those presented by the following formulas are preferred:

R-N₃-R',



R-N₃-R'-N-R'',

wherein each of R, R', R'' and R''' is a hydrogen atom or a saturated or unsaturated chain or cyclic hydrocarbon group having from 1 to 16 carbon atoms, and X is a halogen atom.

Specifically, they include 2-(2-hydroxy-5'-methylphenyl)benzotriazole, 2-(2-hydroxy-3'-tert-butyl-5'-methylphenyl)-5-chlorobenzotriazole, 1,2,3-benzotriazole, and 1-[(N,N-bis-2-ethylhexyl)aminomethyl]-benzotriazole. More preferred is 1,2,3-benzotriazole.

The hydrochlorofluorocarbon azeotropic or azeotropic-like mixture of the present invention is useful for various purposes, for example, as a blowing agent and so on, like conventional CFCs. It is particularly useful as a solvent, since it provides a solvency equivalent or superior to conventional R113. Specific applications as the solvent include a removing agent for flux, grease, oil, wax or ink, a coating solvent, an extracting agent, a cleaning or water-removing agent for various articles made of glass, ceramics, plastic, rubber or metal, particularly for semiconductor devices, electronic components, electronic circuit boards, electrical devices, precision machine parts or optical lenses. Further, it is useful as a resist developer, a resist-removing agent or a buff polishing and cleaning agent. As a cleaning method, manual wiping, dipping, spraying, shaking, ultrasonic cleaning or vapor cleaning may be employed.

Now, the present invention will be described in further detail with reference to Examples. However, it should be understood that the present invention is by no means restricted by such specific Examples.

EXAMPLES 1 to 94

1,000 g of a mixture as identified in Table 1 was charged in a distillation flask, and using a packed distillation column which contained approximately 20 theoretical plates, distillation was conducted under atmospheric pressure. The fractions thereby obtained were measured by gas chromatography, whereby the presence of an azeotropic composition was found.

On the other hand, the azeotropic-like composition was obtained from the composition after repeating the evaporation and condensation of a mixture as identified in Table 1 for 3 days by an open system cleaning sump.

A SUS-304 test piece (25 mm x 30 mm x 2 mm in thickness) was immersed in machine oil (CQ-30, manufactured by Nippon Sekiyu K.K.) and then immersed in the azeotropic mixture of the present invention for 5 minutes. The results are shown in Table 1, wherein symbol A-⊙ indicates that the machine oil can be removed satisfactorily at the same level as R113.

A single sided printed circuit board (50 mm x 100 mm x 1.6 mm in thickness) was coated with a flux (Tamura F-AL-4, manufactured by Tamura Seisakusho) and heated at 200°C for 2 minutes in a convection oven. Then, it was immersed in the azeotropic mixture of the present invention for one minute. The results are shown in Table 1, in which symbol B-⊙ indicates that the flux can be removed satisfactorily at the same level as R113/ethanol = 96.2 wt%/3.8 wt%.

A glass plate (30 mm x 18 mm x 5 mm in thickness) was immersed in deionized water and then immersed in the azeotropic mixture of the present invention for 20 seconds for removal of water. The glass plate withdrawn, was immersed in dry methanol, whereby the removal of water was determined from the increase of the water content in methanol. The results are shown in Table 1, in which symbol C-⊙

indicates that the water can be removed satisfactorily at the same level as R113/methanol = 93.6 wt%/6.4 wt%.

Table 1

Exam- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
1	R225ca R141b	51.1 32	30 70	31	25 75	5-45 55-95	A-⊙
2	R225ca R113	51.1 47.6	40 60	44	42 58	22-62 38-78	A-⊙
3	R225ca R122	51.1 71.9	80 20	52	78 22	58-98 2-42	A-⊙
4	R225ca R132b	51.1 46.8	52 48	42	50 50	30-70 30-70	A-⊙
5	R225ca Dichloro- methane	51.1 39.8	50 50	34	47 53	27-67 33-73	B-⊙
6	R225cb R141b	56.1 32	20 80	32	16 84	1-36 64-99	A-⊙
7	R225cb Dichloro- methane	56.1 39.8	50 50	36	43 57	33-53 47-67	B-⊙
8	R225cb R132b	56.1 46.8	42 58	43	39 61	19-59 41-81	A-⊙
9	R225cb R122	56.1 71.9	80 20	55	78 22	58-98 2-42	A-⊙
10	R225cb R113	56.1 47.6	30 70	46	32 68	12-52 48-88	A-⊙

Table 1 (continued)

Exam- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
11	R225ca Cyclo- pentane	51.1 49.3	70 30	45	66 34	46-98 2-54	A-⊙
12	R225cb Cyclo- pentane	56.1 49.3	58 42	47	55 45	35-98 2-65	A-⊙
13	R225cb 2,2- dimethyl- butane	56.1 49.7	25 75	50	21 79	11-98 2-89	A-⊙
14	R225ca 2,2- dimethyl- butane	51.1 49.7	60 40	49	56 44	36-98 2-64	A-⊙

Table 1 (continued)

Exam- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
15	R225ca 2-bromo- propane	51.1 59.4	60 40	47	66 34	46-86 14-54	A-⊙
16	R225cb 2-bromo- propane	56.1 59.4	60 40	49	58 42	38-78 22-62	A-⊙
17	R225cb 2-methyl- pentane	56.1 60.3	90 10	-	- -	50-99 1-50	A-⊙

Table 1 (continued)

Exam- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
18	R225cb 2,3- dimethyl- butane	56.1 58.0	80 20	56	78 22	58-98 2-42	A-⊙
19	R225ca 2,3- dimethyl- butane	51.1 58.0	90 10	-	- -	85-99 1-15	A-⊙
20	R225ca trans- 1,2- dichloro- ethylene	51.1 47.7	60 40	44	57 43	37-77 23-63	A-⊙

Table 1 (continued)

Exam- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
21	R225cb trans- 1,2- dichloro- ethylene	56.1 47.7	50 50	46	47 53	27-67 33-73	A-⊙
22	R225ca cis-1,2- dichloro- ethylene	51.1 60.6	80 20	50	78 22	58-98 2-42	A-⊙

Table 1 (continued)

Exam- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
23	R225cb cis-1,2- dichloro- ethylene	56.1 60.6	70 30	53	69 31	59-79 21-41	A-⊙

Table 1 (continued)

Exam- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
66	R225ca R141	51.1 75.7	90 10	52	95 5	75-99 1-25	A-⊙
67	R225cb R141	56.1 75.7	90 10	56	89 11	69-99 1-31	A-⊙
24	R225ca Methanol	51.1 64.5	97 3	46	94.6 5.4	75-99 1-25	A-⊙ B-⊙ C-⊙
25	R225cb Ethanol	56.1 78.3	97 3	53.8	95.6 4.4	74-99.5 0.5-26	A-⊙ B-⊙ C-⊙
26	R225cb Iso- propanol	56.1 82.4	97 3	54.9	97.9 2.1	77-99 1-23	A-⊙ B-⊙ C-⊙
27	R225cb Methanol	56.1 64.5	95 5	47.2	93.3 6.7	74-99 1-26	A-⊙ B-⊙ C-⊙
28	R225ca R225cb Ethanol	51.1 56.1 78.3	90 5 5	50	94.8 2.7 2.5	14-98 1-85 1-16	A-⊙ B-⊙ C-⊙

Table 1 (continued)

Exam- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
29	R225ca R225cb Methanol	51.1 56.1 64.7	89 6 5	46	89.8 5.6 4.6	14-98 1-85 1-16	A-⊙ B-⊙ C-⊙
30	R225ca Ethanol	51.1 78.3	98.5 1.5	50	97.3 2.7	75-99.5 0.5-25	A-⊙ B-⊙ C-⊙
31	R225ca Iso- propanol	51.1 82.4	-	-	-	76-99 1-24	A-⊙ B-⊙ C-⊙
32	R225ca R113 Dichloro- methane	51.1 47.6 39.8	35 15 50	-	38 15 47	15-61 8-44 34-70	A-⊙ B-⊙
33	R225cb R113 R132b	56.1 47.6 46.8	25 35 40	-	26 35 39	6-37 22-52 27-51	A-⊙
34	R225ca R113 R132b	51.1 47.6 46.8	35 25 40	-	32 29 39	22-55 10-46 21-55	A-⊙
35	R225cb R113 Dichloro- methane	56.1 47.6 39.8	25 25 50	-	26 24 50	8-38 8-47 34-63	A-⊙ B-⊙

Table 1 (continued)

Exam- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
36	R225ca	51.1	40	-	41	28-52	A-⊙
	R113	47.6	20		22	7-39	B-⊙
	trans- 1,2- dichloro- ethylene	47.7	40		37	25-48	
37	R225ca	51.1	40	-	42	29-60	A-⊙
	R113	47.6	50		47	11-61	B-⊙
	2-bromo- propane	59.4	10		11	3-29	
38	R225ca	56.1	35	-	32	19-43	A-⊙
	R113	47.6	50		53	39-60	B-⊙
	cis-1,2- dichloro- ethylene	60.6	15		15	8-22	
39	R225ca	51.1	40	-	42	25-54	A-⊙
	R113	47.6	45		45	38-58	B-⊙
	cis-1,2- dichloro- ethylene	60.6	15		13	8-22	

Table 1 (continued)

Exam- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
40	R225cb	56.1	35	-	36	27-51	A-⊙
	R113	47.6	25		27	6-44	B-⊙
	trans- 1,2- dichloro- ethylene	47.7	40		37	29-48	
41	R225cb	56.1	35	-	34	22-43	A-⊙
	R113	47.6	55		56	38-68	B-⊙
	2-bromo- propane	59.4	10		10	3-26	
42	R225cb	56.1	35	-	34	20-53	A-⊙
	R113	47.6	55		55	8-72	
	Cyclo- pentane	49.3	10		11	1-40	
43	R225ca	51.1	40	-	41	28-65	A-⊙
	R113	47.6	50		52	13-68	
	Cyclo- pentane	49.3	10		7	2-35	

Table 1 (continued)

Exam- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
44	R225ca R113 1-chloro- propane	51.1 47.6 46.6	50 20 30	-	52 16 32	42-61 7-55 2-43	A-⊙ B-⊙
45	R225cb R113 1-chloro- propane	56.1 47.6 46.6	40 30 30	-	42 27 31	23-44 8-70 2-47	A-⊙ B-⊙
46	R225ca R113 2-chloro- 2-methyl- propane	51.1 47.6 50.7	45 50 5	-	40 55 5	28-56 12-64 2-32	A-⊙ B-⊙
47	R225cb R113 2-chloro- 2-methyl- propane	56.1 47.6 50.7	30 60 10	-	31 58 11	17-38 41-75 2-21	A-⊙ B-⊙

Table 1 (continued)

Exam- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
48	R225ca R225cb 2-methyl- pentane	51.1 56.1 60.3	90 5 5	-	90 7 3	36-97 1-51 1-16	A-⊙
49	R225ca R225cb 2,3- dimethyl- butane	51.1 56.1 58.0	85 10 5	-	88 8 4	6-94 1-83 1-26	A-⊙
50	R225ca R225cb 2-chloro- 2-methyl- propane	51.1 56.1 50.7	50 10 40	-	50 12 38	6-67 4-67 1-58	A-⊙ B-⊙
51	R225ca R225cb 1-chloro- propane	51.1 56.1 46.6	40 15 45	-	41 14 45	7-56 7-61 1-54	A-⊙ B-⊙
52	R225ca R225cb 2-bromo- propane	51.1 56.1 59.4	55 10 35	-	54 10 36	6-66 5-64 10-48	A-⊙ B-⊙
53	R225ca R225cb cis-1,2- dichloro- ethylene	51.1 56.1 60.6	60 10 30	-	58 12 30	6-70 4-74 10-38	A-⊙ B-⊙

Table 1 (continued)

Exam- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
54	R225ca R225cb trans- 1,2- dichloro- ethylene	51.1 56.1 47.7	40 15 45	-	42 13 45	8-57 6-54 10-59	A-⊙ B-⊙
55	R225ca R225cb R122	51.1 56.1 71.9	80 10 10	-	80 8 12	40-89 2-37 3-23	A-⊙ B-⊙
56	R225ca R225cb R141	51.1 56.1 75.7	80 10 10	-	84 8 8	44-92 2-41 1-17	A-⊙ B-⊙
57	R225ca R225cb R132b	51.1 56.1 46.8	35 10 55	-	36 11 53	6-44 4-44 44-73	A-⊙ B-⊙
58	R225ca R141b Dichloro- methane	56.1 32 39.8	25 65 10	-	20 67 13	8-31 36-88 3-38	A-⊙ B-⊙
59	R225ca R141b Dichloro- methane	51.1 32 39.8	30 60 10	-	26 62 12	8-41 32-84 3-31	A-⊙ B-⊙
60	R225ca R141b R123	51.1 32 27.1	15 5 80	-	12 7 81	6-33 2-33 44-86	A-⊙ B-⊙
61	R225ca R225cb R113	51.1 56.1 47.6	30 10 60	-	33 9 58	5-47 3-42 5-79	A-⊙

Table 1 (continued)

Exam- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
62	R225ca R225cb Dichloro- methane	51.1 56.1 39.8	25 21 55	-	25 21 54	9-49 8-39 5-70	A-⊙ B-⊙
63	R244ca R225cb 2-bromo- propane	54 56.1 59.4	20 40 40	-	21 42 37	5-58 7-66 5-54	A-⊙ B-⊙
64	R244ca R225cb cis-1,2- dichloro- ethylene	54 56.1 60.6	30 40 30	-	31 35 34	4-58 7-71 4-43	A-⊙ B-⊙
65	R244ca R225cb 1-chloro- propane	54 56.1 46.6	15 40 45	-	15 39 46	8-58 9-65 5-71	A-⊙ B-⊙
66	R244ca R225cb 2-chloro- 2-methyl- propane	54 56.1 50.7	20 30 50	-	22 32 46	7-55 8-56 5-74	A-⊙ B-⊙
67	R244ca R225cb 2,3- dimethyl- butane	54 56.1 58	60 20 20	-	62 20 18	29-87 6-68 2-29	A-⊙

Table 1 (continued)

Exam- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
68	R244ca	54	20	-	18	5-42	A-⊙
	R225cb	56.1	20		24	7-50	B-⊙
	R132b	46.8	60		58	41-80	
69	R244ca	54	30	-	30	5-55	A-⊙
	R225cb	56.1	25		26	8-57	B-⊙
	trans- 1,2- dichloro- ethylene	47.7	45		44	5-61	
70	R244ca	54	25	-	25	8-56	A-⊙
	R225cb	56.1	30		32	9-55	
	Cyclo- pentane	49.3	45		45	5-69	
71	R244ca	54	20	-	17	7-35	A-⊙
	R225cb	56.1	20		24	9-42	B-⊙
	Dichloro- methane	39.8	60		59	45-73	
72	R244ca	54	40	-	39	7-61	A-⊙
	R225ca	51.1	20		19	8-71	
	2,2- dimethyl- butane	49.7	40		42	5-72	
73	R244ca	54	10	-	12	5-41	A-⊙
	R225ca	51.1	30		34	9-48	B-⊙
	Dichloro- methane	39.8	60		54	40-73	
74	R244ca	54	10	-	9	2-37	A-⊙
	R225ca	51.1	40		40	7-50	B-⊙
	R132b	46.8	50		51	35-72	

Table 1 (continued)

Exam- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
75	R244ca R225ca R141	54 51.1 75.7	25 70 5	-	24 70 6	3-49 47-95 0.1-17	A-⊙ B-⊙
76	R244ca R225ca Cyclo- pentane	54 51.1 49.3	10 55 35	-	11 55 34	5-55 9-67 3-53	A-⊙
77	R244ca R225ca R122	54 51.1 71.9	20 70 10	-	21 70 9	3-59 36-93 1-22	A-⊙ B-⊙
78	R244ca R225ca trans- 1,2- dichloro- ethylene	54 51.1 47.7	10 50 40	-	11 47 42	3-69 8-78 3-54	A-⊙ B-⊙
79	R244ca R225ca cis-1,2- dichloro- ethylene	54 51.1 60.6	8 62 30	-	10 60 30	3-59 7-75 3-38	A-⊙ B-⊙
80	R244ca R225ca 2-bromo- propane	54 51.1 59.4	10 60 30	-	8 58 34	3-58 6-71 3-44	A-⊙ B-⊙
81	R244ca R225cb R141	54 56.1 75.7	45 45 10	-	47 47 6	22-86 6-72 1-21	A-⊙ B-⊙

Table 1 (continued)

Exam- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
82	R225ca R225cb Cyclo- pentane	51.1 56.1 49.3	50 10 40	-	48 15 37	10-88 8-70 3-58	A-⊙
83	R244ca R225cb R122	54 56.1 71.9	50 40 10	-	45 45 10	8-83 6-84 3-28	A-⊙ B-⊙
84	R244ca R225ca 2,3- dimethyl- butane	54 51.1 58	30 65 5	-	29 67 4	3-84 13-94 0.1-19	A-⊙
85	R244ca R225ca 1-chloro- propane	54 51.1 46.6	10 50 40	-	11 48 41	3-48 7-62 3-56	A-⊙ B-⊙
86	R244ca R225ca 2-chloro- 2-methyl- propane	54 51.1 50.7	10 60 30	-	10 54 36	3-56 6-72 3-54	A-⊙ B-⊙
87	R244ca R225cb 2,2- dimethyl- butane	54 56.1 49.7	45 10 45	-	42 14 44	7-76 8-62 3-73	A-⊙

Table 1 (continued)

Examp- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
88	R225ca R244ca Ethanol	51.1 54 78.3	-	-	-	50-80 10-40 1-10	A-⊙ B-⊙
89	R225cb R224ca Ethanol	56.1 54 78.3	-	-	-	40-80 10-50 1-10	A-⊙ B-⊙
90	R225ca R225cb R244ca Ethanol	51.1 56.1 54 78.3	-	-	-	5-99 3-99 1-69 1-35	A-⊙ B-⊙
91	R225ca R244ca Methanol	51.1 54 64.7	-	-	-	50-80 10-40 1-10	A-⊙ B-⊙
92	R225cb R244ca Methanol	56.1 54 64.7	-	-	-	40-80 10-50 1-10	A-⊙ B-⊙
93	R225ca R225cb R244ca Methanol	51.1 56.1 54 64.7	-	-	-	5-99 3-99 1-69 1-35	A-⊙ B-⊙

Table 1 (continued)

Examp- ples	Mixtures	B.P. (°C)	Charged composi- tion (wt%)	Boiling point of Azeo- trope (°C)	Azeo- tropic compo- sition (wt%)	Azeo- tropic- like compo- sition (wt%)	Test results
94	R225ca R225cb Iso- propanol	51.1 56.1 82.4	-	-	-	1-98 1-98 1-16	A-⊙ B-⊙

REFERENCE EXAMPLES

For the purpose of ascertaining the effects of the azeotropic-like mixture of the present invention for stabilization, the following test was applied to the mixture as identified in Table 2.

In accordance with JIS K1600, a metal test piece was placed in both the liquid phase portion and the gas phase portion of the stabilized mixture as identified in Table 2, and after 48 hours, the state of corrosion of the test piece was inspected. The results are shown in Table 2.

Azeotropic-like mixture

AA: R225ca/R225cb/methanol = 47 wt%/47 wt%/6 wt%

Stabilizer

NM: Nitromethane
 DIPA: Diisopropylamine
 Am: β -Amylene
 TPH: Triphenylphosphite
 DME: 1,2-Dimethoxyethane
 s-Bu: sec-Butanol
 ECH: Epichlorohydrin
 BHT: 2,6-Di-t-butyl-o-cresol
 BTA: 1,2,3-Benzotriazole
 PH: Phenol
 DO: 1,4-Dioxane
 MeA: Methyl acetate
 BO: 1,2-Buthyleneoxide
 MP: N-methylpyrrole
 MIBK: Methyl isobutyl ketone
 i-Bu: Isobutanol

Appearance of test piece

⊙: No corrosion
 ○: No substantial corrosion
 Δ: Corrosion slightly observed
 X: Substantial corrosion observed.

Table 2

Reference Examples	Stabilized mixture (wt%)	Corrosion of test piece		
		Fe	Cu	Ag
AA01	AA(99.5)/PH(0.5)	⊙	○	○
AA02	AA(99.5)/DIPA(0.5)	⊙	○	○
AA03	AA(99.5)/Am(0.5)	⊙	○	○
AA04	AA(99.5)/TPH(0.5)	⊙	○	○
AA05	AA(99.5)/MP(0.5)	⊙	○	○
AA06	AA(99.5)/BTA(0.5)	○	⊙	○
AA07	AA(99)/NM(1)	⊙	○	○
AA08	AA(99)/DO(1)	⊙	○	○
AA09	AA(99)/MeA(1)	⊙	○	○
AA10	AA(99)/BO(1)	⊙	○	○
AA11	AA(99)/DME(1)	⊙	○	○
AA12	AA(99)/s-Bu(1)	⊙	○	○
AA13	AA(99)/MIBK(1)	⊙	○	○
AA14	AA(99)/ECH(1)	⊙	○	○
AA15	AA(98.5)/NM(1)/BTA(0.5)	⊙	⊙	⊙
AA16	AA(97.5)/NM(1)/BO(1)/BHT(0.5)	⊙	⊙	○
AA17	AA(97)/NM(1)/BO(1)/BHT(0.5)/BTA(0.5)	⊙	⊙	⊙
AA18	AA(96)/NM(1)/BTA(0.5)/BO(1)/i-Bu(1)/BHT(0.5)	⊙	⊙	⊙
Comparative Example	AA(100)	⊙	Δ	Δ

The hydrochlorofluorocarbon azeotropic or azeotropic-like mixture of the present invention is non-flammable or hardly flammable and has excellent properties equal or superior to conventional CFCs. Further, the mixture shows no substantial change in the composition during boiling and evaporating, since it has an azeotropic composition or an azeotropic-like composition, and it can be used in the same manner as a conventional single CFC and thus has a merit that it requires no substantial change of the conventional technique. Further, it is excellent in the properties for dissolving and removing a flux or oil like R113 which is commonly used as a solvent, and thus it is useful as a cleaning agent which may be an alternative for R113.

Claims

1. A hydrochlorofluorocarbon azeotropic or azeotropic-like mixture comprising 3,3-dichloro-1,1,1,2,2-pentafluoropropane (R225ca) and at least one member selected from the group consisting of R141, R141b, R141b/dichloromethane, R141b/R123, R122, R132b, R113, R113/R132b, R113/dichloromethane, R113/2-bromopropane, cyclopentane, 2,2-dimethylbutane, 2-methylpentane, 2-bromopropane, 2,3-dimethylbutane, trans-1,2-dichloroethylene, cis-1,2-dichloroethylene, R113/cyclopentane, R113/1-chloropropane, R113/trans-1,2-dichloroethylene, R113/cis-1,2-dichloroethylene, R113/2-chloro-2-methylpropane.
2. A hydrochlorofluorocarbon azeotropic or azeotropic-like mixture, which comprises 1,3-dichloro-1,1,2,2,3-pentafluoropropane (R225cb) and at least one member selected from the group consisting of R141, R141b, R141b/dichloromethane, R122, R132b, R113, R113/R132b, R113/dichloromethane, cyclopentane, 2,2-dimethylbutane, 2-methylpentane, trans-1,2-dichloroethylene,



Table 2

Reference Examples	Stabilized mixture (wt%)	Corrosion of test piece		
		Fe	Cu	Ag
AA01	AA(99.5)/PH(0.5)	⊙	○	○
AA02	AA(99.5)/DIPA(0.5)	⊙	○	○
AA03	AA(99.5)/Am(0.5)	⊙	○	○
AA04	AA(99.5)/TPH(0.5)	⊙	○	○
AA05	AA(99.5)/MP(0.5)	⊙	○	○
AA06	AA(99.5)/BTA(0.5)	○	⊙	○
AA07	AA(99)/NM(1)	⊙	○	○
AA08	AA(99)/DO(1)	⊙	○	○
AA09	AA(99)/MeA(1)	⊙	○	○
AA10	AA(99)/BO(1)	⊙	○	○
AA11	AA(99)/DME(1)	⊙	○	○
AA12	AA(99)/s-Bu(1)	⊙	○	○
AA13	AA(99)/MIBK(1)	⊙	○	○
AA14	AA(99)/ECH(1)	⊙	○	○
AA15	AA(98.5)/NM(1)/BTA(0.5)	⊙	⊙	⊙
AA16	AA(97.5)/NM(1)/BO(1)/BHT(0.5)	⊙	⊙	○
AA17	AA(97)/NM(1)/BO(1)/BHT(0.5)/BTA(0.5)	⊙	⊙	⊙
AA18	AA(96)/NM(1)/BTA(0.5)/BO(1)/i-Bu(1)/BHT(0.5)	⊙	⊙	⊙
Comparative Example	AA(100)	⊙	△	△

The hydrochlorofluorocarbon azeotropic or azeotropic-like mixture of the present invention is non-flammable or hardly flammable and has excellent properties equal or superior to conventional CFCs. Further, the mixture shows no substantial change in the composition during boiling and evaporating, since it has an azeotropic composition or an azeotropic-like composition, and it can be used in the same manner as a conventional single CFC and thus has a merit that it requires no substantial change of the conventional technique. Further, it is excellent in the properties for dissolving and removing a flux or oil like R113 which is commonly used as a solvent, and thus it is useful as a cleaning agent which may be an alternative for R113.

Claims

1. A hydrochlorofluorocarbon azeotropic or azeotropic-like mixture comprising 3,3-dichloro-1,1,1,2,2-pentafluoropropane (R225ca) and at least one member selected from the group consisting of R141, R141b, R141b/dichloromethane, R141b/R123, R122, R132b, R113, R113/R132b, R113/dichloromethane, R113/2-bromopropane, cyclopentane, 2,2-dimethylbutane, 2-methylpentane, 2-bromopropane, 2,3-dimethylbutane, trans-1,2-dichloroethylene, cis-1,2-dichloroethylene, R113/cyclopentane, R113/1-chloropropane, R113/trans-1,2-dichloroethylene, R113/cis-1,2-dichloroethylene, R113/2-chloro-2-methylpropane.
2. A hydrochlorofluorocarbon azeotropic or azeotropic-like mixture, which comprises 1,3-dichloro-1,1,2,2,3-pentafluoropropane (R225cb) and at least one member selected from the group consisting of R141, R141b, R141b/dichloromethane, R122, R132b, R113, R113/R132b, R113/dichloromethane, cyclopentane, 2,2-dimethylbutane, 2-methylpentane, trans-1,2-dichloroethylene,



cis-1,2-dichloroethylene, 2,3-dimethylbutane, 2-bromopropane, R113/cyclopentane, R113/1-chloropropane, R113/trans-1,2-dichloroethylene, R113/cis-1,2-dichloroethylene, R113/2-bromopropane, R113/2-chloro-2-methylpropane.

- 5 3. A hydrochlorofluorocarbon azeotropic or azeotropic-like mixture which comprises R225ca, R225cb and at least one member selected from the group consisting of 2-methylpentane, 2,3-dimethylbutane, 2-chloro-2-methylpropane, 1-chloropropane, 2-bromopropane, cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, cyclopentane, R122, R141, R132b, R113, dichloromethane, methanol, ethanol and isopropanol.
- 10 4. An azeotropic composition comprising 47 % by weight R225ca and 53 % by weight dichloromethane.
- 15 5. An azeotropic composition comprising 43 % by weight R225cb and 57 % by weight dichloromethane.
6. An azeotropic composition comprising 94.6 % by weight R225ca and 5.4 % by weight methanol.
- 20 7. An azeotropic composition comprising 95.6 % by weight R225cb and 4.4 % by weight ethanol.
8. An azeotropic composition comprising 97.9 % by weight R225cb and 2.1 % by weight isopropanol.
- 25 9. An azeotropic composition comprising 93.3 % by weight R225cb and 6.7 % by weight methanol.
- 30 10. An azeotropic composition comprising 97.3 % by weight R225ca and 2.7 % by weight ethanol.

Patentansprüche

- 35 1. Azeotropes oder azeotropähnliches Chlorfluorkohlenwasserstoffgemisch, umfassend 3,3-Dichlor-1,1,1,2,2-pentafluorpropan (R225ca) und mindestens ein Mitglied, ausgewählt aus der Gruppe, bestehend aus R141, R141b, R141b/Dichlormethan, R141b/R123, R122, R132b, R113, R113/R132b, R113/Dichlormethan, R133/2-Bromopropan, Cyclopentan, 2,2-Dimethylbutan, 2-Methylpentan, 2-Bromopropan, 2,3-Dimethylbutan, trans-1,2-Dichlorethylen, cis-1,2-Dichlorethylen, R113/Cyclopentan, R113/1-Chlorpropan, R113/trans-1,2-Dichlorethylen, R113/cis-1,2-Dichlorethylen, R113/2-Chlor-2-methylpropan.
- 40 2. Azeotropes oder azeotropähnliches Chlorfluorkohlenwasserstoffgemisch, umfassend 1,3-Dichlor-1,1,2,2,3-pentafluorpropan (R225cb) und mindestens ein Mitglied, ausgewählt aus der Gruppe, bestehend aus R141, R141b, R141b/Dichlormethan, R122, R132b, R113, R113/R132b, R113/Dichlormethan, Cyclopentan, 2,2-Dimethylbutan, 2-Methylpentan, trans-1,2-Dichlorethylen, cis-1,2-Dichlorethylen, 2,3-Di-methylbutan, 2-Bromopropan, R113/Cyclopentan, R113/1-Chlorpropan, R113/trans-1,2-Dichlorethylen, R113/cis-1,2-Dichlorethylen, R113/2-Bromopropan, R113/2-Chlor-2-methylpropan.
- 45 3. Azeotropes oder azeotropähnliches Chlorfluorkohlenwasserstoffgemisch, umfassend R225ca, R225cb und mindestens ein Mitglied, ausgewählt aus der Gruppe, bestehend aus 2-Methylpentan, 2,3-Dimethylbutan, 2-Chlor-2-methylpropan, 1-Chlorpropan, 2-Bromopropan, cis-1,2-Dichlorethylen, trans-1,2-Dichlorethylen, Cyclopentan, R122, R141, R132b, R113, Dichlormethan, Methanol, Ethanol und Isopropanol.
- 50 4. Azeotrope Zusammensetzung, umfassend 47 Gew.-% R225ca und 53 Gew.-% Dichlormethan.
- 55 5. Azeotrope Zusammensetzung, umfassend 43 Gew.-% R225cb und 57 Gew.-% Dichlormethan.
6. Azeotrope Zusammensetzung, umfassend 94,6 Gew.-% R225ca und 5,4 Gew.-% Methanol.



7. Azeotrope Zusammensetzung, umfassend 95,6 Gew.-% R225cb und 4,4 Gew.-% Ethanol.
8. Azeotrope Zusammensetzung, umfassend 97,9 Gew.-% R225cb und 2,1 Gew.-% Isopropanol.
- 5 9. Azeotrope Zusammensetzung, umfassend 93,3 Gew.-% R225cb und 6,7 Gew.-% Methanol.
10. Azeotrope Zusammensetzung, umfassend 97,3 Gew.-% R225ca und 2,7 Gew.-% Ethanol.

Revendications

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1. Mélange azéotropique ou similaire à un mélange azéotropique d'hydrocarbures chlorofluorés, comportant du 3,3-dichloro-1,1,1,2,2-pentafluoropropane (R225ca) et au moins un élément choisi dans le groupe constitué de R141, R141b, R141b/dichlorométhane, R141b/R123, R122, R132b, R113, R113/R132b, R113/dichlorométhane, R113/2-bromopropane, cyclopentane, 2,2-diméthylbutane, 2-méthylpentane, 2-bromopropane, 2,3-diméthylbutane, trans-1,2-dichloroéthylène, cis-1,2-dichloroéthylène, R113/cyclopentane, R113/1-chloropropane, R113/trans-1,2-dichloroéthylène, R113/cis-1,2-dichloroéthylène, R113/2-chloro-2-méthylpropane.
- 15 2. Mélange azéotropique ou similaire à un mélange azéotropique d'hydrocarbures chlorofluorés comportant du 1,3-dichloro-1,1,2,2,3-pentafluoropropane (R225cb) et au moins un élément choisi dans le groupe constitué de R141, R141b, R141b/dichlorométhane, R122, R132b, R113, R113/R132b, R113/dichlorométhane, cyclopentane, 2,2-diméthylbutane, 2-méthylpentane, trans-1,2-dichloroéthylène, cis-1,2-dichloroéthylène, 2,3-diméthylbutane, 2-bromopropane, R113/cyclopentane, R113/1-chloropropane, R113/trans-1,2-dichloroéthylène, R113/cis-1,2-dichloroéthylène, R113/2-bromopropane, R113/2-chloro-2-méthylpropane.
- 20 3. Mélange azéotropique ou similaire à un mélange azéotropique d'hydrocarbures chlorofluorés, comportant R225ca, R225cb et au moins un élément choisi dans le groupe constitué de 2-méthylpentane, 2,3-diméthylbutane, 2-chloro-2-méthylpropane, 1-chloropropane, 2-bromopropane, cis-1,2-dichloroéthylène, trans-1,2-dichloroéthylène, cyclopentane, R122, R141, R132b, R113, dichlorométhane, méthanol, éthanol et isopropanol.
- 25 4. Composition azéotropique comportant 47% en poids de R225ca et 53% en poids de dichlorométhane.
- 30 5. Composition azéotropique comportant 43% en poids de R225cb et 57% en poids de dichlorométhane.
6. Composition azéotropique comportant 94,6% en poids de R225ca et 5,4% en poids de méthanol.
7. Composition azéotropique comportant 95,6% en poids de R225cb et 4,4% en poids d'éthanol.
- 40 8. Composition azéotropique comportant 97,9% en poids de R225cb et 2,1% en poids d'isopropanol.
9. Composition azéotropique comportant 93,3% en poids de R225cb et 6,7% en poids de méthanol.
- 45 10. Composition azéotropique comportant 97,3% en poids de R225ca et 2,7% en poids d'éthanol.

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