

Description

As modern electronic circuit boards evolve toward increased circuit and component densities, thorough cleaning of the boards after soldering becomes more important. Current industrial processes for soldering electronic components to circuit boards involve coating the entire circuit side of the board with a flux and thereafter passing this coated side of the board over preheaters and through molten solder. The flux cleans the conductive metal parts and promotes adhesion of the solder. Commonly used fluxes consist, for the most part, of rosin used alone or with activating additives such as amine hydrochlorides or oxalic acid derivatives.

After soldering, which thermally degrades part of the rosin, the flux and flux residues are often removed from the board with an organic solvent. The requirements of such a solvent are stringent: a solvent should have a low boiling point, have low toxicity and exhibit high solvent power so that flux and flux residues can be removed without damage to the substrate being cleaned.

Flammability and solvent power characteristics can often be adjusted by preparing mixtures of solvents; mixtures, however, are often unsatisfactory because they fractionate to an undesirable degree if they are boiled. Such mixtures also fractionate during recovery, making it difficult to reuse a solvent mixture with the original composition without reformulation.

On the other hand, azeotropic mixtures, with their constant boiling and constant composition characteristics, have been found to be very useful. Azeotropic mixtures exhibit either a maximum or minimum boiling point and do not fractionate upon boiling. These characteristics are also important in the use of the solvent compositions to remove solder fluxes and flux residues from printed circuit boards. Preferential evaporation of the more volatile components of the solvent mixtures, which would be the case if they were not azeotropes, or azeotrope-like, would result in mixtures with changed compositions which may have less desirable properties, such as lower solvency for rosin fluxes, less inertness toward the circuit board electrical components and increased flammability. Azeotropes or azeotrope-like compositions are also desirable in vapor degreasing operations where redistilled material is usually used for final rinsing. Thus, the vapor defluxing as well as the degreasing system acts as a still. Unless the solvent composition exhibits a constant boiling point, i.e., is an azeotrope or is azeotrope-like, fractionation will occur and undesirable solvent distribution may act to upset the safety and effectiveness of the cleaning operation.

A number of fluorocarbon based azeotropic compositions have been discovered and in some cases used as solvents for the removal of solder fluxes and flux residues from printed circuit boards and for miscellaneous vapor degreasing applications. US-A-3,936,387 for example discloses azeotropic compositions of 1,2-dichloro-1-fluoroethane with methanol or ethanol.

Unfortunately, as recognized in the art, it is not possible to predict the formation of azeotropes and this obviously complicates the search for new azeotropic systems which have application in the field. Nevertheless, there is a constant effort in the art to discover new azeotropes or azeotrope-like systems which have desirable solvency characteristics and particularly a greater versatility of solvency power.

SUMMARY OF THE INVENTION

According to the present invention, an azeotrope or azeotrope-like composition has been discovered which consists of 94-98 weight percent 1,1-dichloro-1-fluoroethane and 2-6 weight percent methanol or 97-99 weight percent 1,1-dichloro-1-fluoroethane and 1-3 weight percent ethanol.

The present invention provides azeotropic compositions which are well suited for solvent cleaning applications.

DETAILED DESCRIPTION OF THE INVENTION

The compositions of the instant invention contain 1,1-dichloro-1-fluoroethane (CH_3CFC_2 , boiling point 32.2°C) which is known as HCFC-141b in the nomenclature conventional to the chlorofluorocarbon field.

By azeotrope or azeotrope-like composition is meant a constant boiling liquid admixture of two or more substances which admixture behaves like a single substance in that the vapor produced by partial evaporation or distillation has substantially the same composition as does the liquid, i.e., the admixture distills without a substantial change in composition. Constant boiling compositions characterized as azeotropes or azeotrope-like exhibit either a maximum or minimum boiling point as compared with that of nonazeotropic mixtures.

By effective amount is meant the amount of each component of the admixture of the instant invention which, when combined, results in the formation of the azeotrope or azeotrope-like composition of the instant invention.

It is possible to "fingerprint", in effect, a constant boiling admixture, which may appear under varying guises depending on the conditions chosen, by any of several criteria:

- The composition can be defined as an azeotrope of A and B, since the very term "azeotrope" is at once both definitive and limitative, requiring that effective amounts of A and B form this unique composition of matter which is a constant boiling admixture.
- It is well known by those who are skilled in the art that at differing pressures, the composition of a given azeotrope will vary, at least to some degree, and changes in distillation pressures also change, at least to some degree, the distillation temperatures. Thus, an azeotrope of A and B represents a unique type of relationship but with a variable composition depending upon temperature and/or pressure. Therefore, compositional ranges, rather than fixed compositions, are often used to define azeotropes.
- Or, the composition can be defined as a particular weight percent relationship or mol percent relationship of A and B, while recognizing that such specific values point out only one particular such relationship and that, in actuality, a series of such relationships represented by A and B actually exist for a given azeotrope, varied by influence of distillative conditions of temperature and pressure.
- Or, recognizing that the azeotrope A and B does represent just such a series of relationships, the azeotropic series represented by A and B can be characterized by defining the composition as an azeotrope characterized by a boiling point at a given pressure, thus giving identifying characteristics without unduly limiting the scope of the invention by a specific numerical composition, which is limited by and is only as accurate as the analytical equipment available.

Binary mixtures of 94-98 weight percent HCFC-141b and 2-6 weight percent methanol are characterized as azeotropes or azeotrope-like in that mixtures within this range exhibit a substantially constant boiling point. Being substantially constant boiling, the mixtures do not tend to fractionate to any great extent upon evaporation. After evaporation, only a small difference exists between the composition of the vapor and the composition of the initial liquid phase. This difference is so small that the compositions of the vapor and liquid phases are considered substantially identical. Accordingly, any mixture within this range exhibits properties which are characteristic of a true binary azeotrope. The binary composition consisting of about 96.2 weight percent HCFC-141b and 3.8 weight percent methanol has been established, within the accuracy of the fractional distillation method, as a true binary azeotrope, boiling at about 30.0 °C at substantially atmospheric pressure

and is a preferred azeotrope or azeotrope-like composition of the instant invention.

Also, according to the instant invention, binary mixtures of 97-99 weight percent HCFC-141b and 1-3 weight percent ethanol are characterized as an azeotrope or azeotrope-like in that mixtures within this range exhibit a substantially constant boiling point. Being substantially constant boiling, the mixtures do not tend to fractionate to any great extent upon evaporation. After evaporation, only a small difference exists between the composition of the vapor and the composition of the initial liquid phase. This difference is so small that the compositions of the vapor and liquid phases are considered substantially identical. Accordingly, any mixture within this range exhibits properties which are characteristic of a true binary azeotrope. The binary composition consisting of about 98.6 weight percent HCFC-141b and 1.4 Weight percent ethanol has been established, within the accuracy of the fractional distillation method, as a true binary azeotrope, boiling at about 32 °C at substantially atmospheric pressure and is a preferred azeotrope or azeotrope-like composition of the instant invention.

The azeotrope of the present invention permits easy recovery and reuse of the solvent from vapor defluxing and degreasing operations because of its azeotropic nature. As an example, the azeotropic mixture of this invention can be used in cleaning processes such as is described in U.S. Patent No. 3,881,949, which is incorporated herein by reference.

The azeotropes of the instant invention can be prepared by any convenient method including mixing or combining, by other suitable methods, the desired amounts of the components. A preferred method is to weigh the desired amounts of each component and thereafter combine them in an appropriate container.

EXAMPLE 1

A distillation apparatus consisting of a flask and a total reflux condenser was used to determine the composition versus boiling temperature characteristics for these minimum boiling azeotropes, as follows: Pure HCFC-141b was placed in the flask and brought to boiling at atmospheric pressure and the temperatures of the boiling liquid and the vapor above the boiling liquid were recorded. Small quantities of the individual alcohol (methanol or ethanol) were added to the distillation apparatus. The distillation was allowed to re-equilibrate while boiling at total reflux for 30 minutes or less, and the temperatures of the boiling liquid and the vapor above the boiling liquid were noted for that particular mixture composition.

In both cases with each alcohol, when the mixture temperature reached the lowest value (temperature lower than the boiling points of either pure component), the temperature recorded was the boiling point of the true azeotrope at the azeotropic composition.

In order to verify the exact azeotropic compositions and temperatures, two mixtures of HCFC-141b and the individual alcohol (methanol or ethanol) were prepared with alcohol contents slightly higher and lower than the azeotropic composition. The mixtures were then boiled separately in a distillation apparatus consisting of a packed column which contained approximately 24 theoretical plates. Minimum boiling azeotropes were achieved with both mixtures at the top of the column for both systems. Head temperatures were corrected to 1,01 bar (760 mm Hg) pressure. Azeotropic compositions were determined by gas chromatography.

EXAMPLE 2

A single sided circuit board was coated with activated rosin flux and soldered by passing the board over a preheater to obtain a top side board temperature of approximately 93.3°C (200°F) and then through 260°C (500°F) molten solder. The soldered board was defluxed with an azeotropic mixture of 96.2 weight percent HCFC-141b and 3.8 weight percent methanol by suspending it, first, for three minutes in the boiling sump, then, one minute in the rinse sump, and, thereafter, for one minute in the solvent vapor above the boiling sump. The board thus cleaned had no visible residue remaining on it.

Claims

**Claims for the following Contracting States :
DE, FR, GB, IT, NL**

1. An azeotrope or azeotrope-like composition consisting of 94-98 weight percent 1,1-dichloro-1-fluoroethane and 6-2 weight percent methanol or 97-99 weight percent 1,1-dichloro-1-fluoroethane and 3-1 weight percent ethanol.
2. The azeotrope or azeotrope-like composition of Claim 1 wherein the composition is 96.2 weight percent 1,1-dichloro-1-fluoroethane and 3.8 weight percent methanol.
3. The azeotrope or azeotrope-like composition of Claim 2 wherein the composition has a boiling point of 30.0°C at substantially atmospheric pressure.
4. The azeotrope or azeotrope-like composition of Claim 1 wherein the composition is 98.6 weight

percent 1,1-dichloro-1-fluoroethane and 1.4 weight percent ethanol.

5. The azeotrope or azeotrope-like composition of Claim 4 wherein the composition has a boiling point of 32.0°C at substantially atmospheric pressure.
6. A process for cleaning a solid surface which comprises treating said surface with the azeotrope or azeotrope-like composition of Claim 1.
7. The process of Claim 6 wherein the solid surface is a printed circuit board contaminated with flux and flux residues.
8. The process of claim 6 wherein the solid surface is a metal.

Claims for the following Contracting State : ES

1. An azeotrope or azeotrope-like composition consisting of 94-98 weight percent 1,1-dichloro-1-fluoroethane and 6-2 weight percent methanol or 97-99 weight percent 1,1-dichloro-1-fluoroethane and 3-1 weight percent ethanol.
2. The azeotrope or azeotrope-like composition of Claim 1 wherein the composition is 96.2 weight percent 1,1-dichloro-1-fluoroethane and 3.8 weight percent methanol.
3. The azeotrope or azeotrope-like composition of Claim 2 wherein the composition has a boiling point of 30.0°C at substantially atmospheric pressure.
4. The azeotrope or azeotrope-like composition of Claim 1 wherein the composition is 98.6 weight percent 1,1-dichloro-1-fluoroethane and 1.4 weight percent ethanol.
5. The azeotrope or azeotrope-like composition of Claim 4 wherein the composition has a boiling point of 32.0°C at substantially atmospheric pressure.
6. A process for cleaning a solid surface which comprises treating said surface with the azeotrope or azeotrope-like composition of Claim 1.
7. The process of Claim 6 wherein the solid surface is a printed circuit board contaminated with flux and flux residues.

In both cases with each alcohol, when the mixture temperature reached the lowest value (temperature lower than the boiling points of either pure component), the temperature recorded was the boiling point of the true azeotrope at the azeotropic composition.

In order to verify the exact azeotropic compositions and temperatures, two mixtures of HCFC-141b and the individual alcohol (methanol or ethanol) were prepared with alcohol contents slightly higher and lower than the azeotropic composition. The mixtures were then boiled separately in a distillation apparatus consisting of a packed column which contained approximately 24 theoretical plates. Minimum boiling azeotropes were achieved with both mixtures at the top of the column for both systems. Head temperatures were corrected to 1,01 bar (760 mm Hg) pressure. Azeotropic compositions were determined by gas chromatography.

EXAMPLE 2

A single sided circuit board was coated with activated rosin flux and soldered by passing the board over a preheater to obtain a top side board temperature of approximately 93.3°C (200°F) and then through 260°C (500°F) molten solder. The soldered board was defluxed with an azeotropic mixture of 96.2 weight percent HCFC-141b and 3.8 weight percent methanol by suspending it, first, for three minutes in the boiling sump, then, one minute in the rinse sump, and, thereafter, for one minute in the solvent vapor above the boiling sump. The board thus cleaned had no visible residue remaining on it.

Claims

Claims for the following Contracting States :
DE, FR, GB, IT, NL

1. An azeotrope or azeotrope-like composition consisting of 94-98 weight percent 1,1-dichloro-1-fluoroethane and 6-2 weight percent methanol or 97-99 weight percent 1,1-dichloro-1-fluoroethane and 3-1 weight percent ethanol.
2. The azeotrope or azeotrope-like composition of Claim 1 wherein the composition is 96.2 weight percent 1,1-dichloro-1-fluoroethane and 3.8 weight percent methanol.
3. The azeotrope or azeotrope-like composition of Claim 2 wherein the composition has a boiling point of 30.0°C at substantially atmospheric pressure.
4. The azeotrope or azeotrope-like composition of Claim 1 wherein the composition is 98.6 weight

percent 1,1-dichloro-1-fluoroethane and 1.4 weight percent ethanol.

5. The azeotrope or azeotrope-like composition of Claim 4 wherein the composition has a boiling point of 32.0°C at substantially atmospheric pressure.
6. A process for cleaning a solid surface which comprises treating said surface with the azeotrope or azeotrope-like composition of Claim 1.
7. The process of Claim 6 wherein the solid surface is a printed circuit board contaminated with flux and flux residues.
8. The process of claim 6 wherein the solid surface is a metal.

Claims for the following Contracting State : ES

1. An azeotrope or azeotrope-like composition consisting of 94-98 weight percent 1,1-dichloro-1-fluoroethane and 6-2 weight percent methanol or 97-99 weight percent 1,1-dichloro-1-fluoroethane and 3-1 weight percent ethanol.
2. The azeotrope or azeotrope-like composition of Claim 1 wherein the composition is 96.2 weight percent 1,1-dichloro-1-fluoroethane and 3.8 weight percent methanol.
3. The azeotrope or azeotrope-like composition of Claim 2 wherein the composition has a boiling point of 30.0°C at substantially atmospheric pressure.
4. The azeotrope or azeotrope-like composition of Claim 1 wherein the composition is 98.6 weight percent 1,1-dichloro-1-fluoroethane and 1.4 weight percent ethanol.
5. The azeotrope or azeotrope-like composition of Claim 4 wherein the composition has a boiling point of 32.0°C at substantially atmospheric pressure.
6. A process for cleaning a solid surface which comprises treating said surface with the azeotrope or azeotrope-like composition of Claim 1.
7. The process of Claim 6 wherein the solid surface is a printed circuit board contaminated with flux and flux residues.



8. The process of claim 6 wherein the solid surface is a metal.
9. A process for preparing an azeotrope or azeotrope-like composition according to claim 1 comprising mixing or combining 94-98 weight percent 1,1-dichloro-1-fluoroethane and 6-2 weight percent methanol or 97-99 weight percent 1,1-dichloro-1-fluoroethane and 3-1 weight percent ethanol.

Patentansprüche

Patentansprüche für folgende Vertragsstaaten : DE, FR, GB, IT, NL

1. Azeotrope oder azeotropähnliche Zusammensetzung, bestehend aus 94 - 98 Gewichtsprozent 1,1-Dichlor-1-fluorethan und 6 - 2 Gewichtsprozent Methanol oder 97 - 99 Gewichtsprozent 1,1-Dichlor-1-fluorethan und 3 - 1 Gewichtsprozent Ethanol. 10
2. Azeotrope oder azeotropähnliche Zusammensetzung nach Anspruch 1, wobei die Zusammensetzung aus 96,2 Gewichtsprozent 1,1-Dichlor-1-fluorethan und 3,8 Gewichtsprozent Methanol besteht. 15
3. Azeotrope oder azeotropähnliche Zusammensetzung nach Anspruch 2, wobei die Zusammensetzung einen Siedepunkt von 30,0°C bei im wesentlichen atmosphärischem Druck besitzt. 20
4. Azeotrope oder azeotropähnliche Zusammensetzung nach Anspruch 1, wobei die Zusammensetzung aus 98,6 Gewichtsprozent 1,1-Dichlor-1-fluorethan und 1,4 Gewichtsprozent Ethanol besteht. 25
5. Azeotrope oder azeotropähnliche Zusammensetzung nach Anspruch 4, wobei die Zusammensetzung einen Siedepunkt von 32,0°C bei im wesentlichen atmosphärischem Druck besitzt. 30
6. Verfahren zur Reinigung einer festen Oberfläche, umfassend die Behandlung der genannten Oberfläche mit der azeotropen oder azeotropähnlichen Zusammensetzung nach Anspruch 1. 35
7. Verfahren nach Anspruch 6, bei welchem die feste Oberfläche ein gedruckter Schaltkreis ist, der mit Flußmittel oder mit Flußmittelrückständen verunreinigt ist. 40

8. Verfahren nach Anspruch 6, bei welchem die feste Oberfläche ein Metall ist.

Patentansprüche für folgenden Vertragsstaat : ES

1. Azeotrope oder azeotropähnliche Zusammensetzung, bestehend aus 94 - 98 Gewichtsprozent 1,1-Dichlor-1-fluorethan und 6 - 2 Gewichtsprozent Methanol oder 97 - 99 Gewichtsprozent 1,1-Dichlor-1-fluorethan und 3 - 1 Gewichtsprozent Ethanol. 10
2. Azeotrope oder azeotropähnliche Zusammensetzung nach Anspruch 1, wobei die Zusammensetzung aus 96,2 Gewichtsprozent 1,1-Dichlor-1-fluorethan und 3,8 Gewichtsprozent Methanol besteht. 15
3. Azeotrope oder azeotropähnliche Zusammensetzung nach Anspruch 2, wobei die Zusammensetzung einen Siedepunkt von 30,0°C bei im wesentlichen atmosphärischem Druck besitzt. 20
4. Azeotrope oder azeotropähnliche Zusammensetzung nach Anspruch 1, wobei die Zusammensetzung aus 98,6 Gewichtsprozent 1,1-Dichlor-1-fluorethan und 1,4 Gewichtsprozent Ethanol besteht. 25
5. Azeotrope oder azeotropähnliche Zusammensetzung nach Anspruch 4, wobei die Zusammensetzung einen Siedepunkt von 32,0°C bei im wesentlichen atmosphärischem Druck besitzt. 30
6. Verfahren zur Reinigung einer festen Oberfläche, umfassend die Behandlung der genannten Oberfläche mit der azeotropen oder azeotropähnlichen Zusammensetzung nach Anspruch 1. 35
7. Verfahren nach Anspruch 6, bei welchem die feste Oberfläche ein gedruckter Schaltkreis ist, der mit Flußmittel oder mit Flußmittelrückständen verunreinigt ist. 40
8. Verfahren nach Anspruch 6, bei welchem die feste Oberfläche ein Metall ist. 45
9. Verfahren zur Herstellung einer azeotropen oder azeotropähnlichen Zusammensetzung nach Anspruch 1, umfassend das Mischen oder Zusammenbringen von 94 - 98 Gewichtsprozent 1,1-Dichlor-1-fluorethan und 6 - 2 Gewichtsprozent Methanol oder 97 - 99 Gewichtsprozent 1,1-Dichlor-1-fluorethan und 3 - 1 Ge- 55



wichtsprozent Ethanol.

Revendications

Revendications pour les Etats contractants suivants : DE, FR, GB, IT, NL

1. Une composition azéotrope ou quasi-azéotrope composée de 94-98% en poids de 1,1-dichloro-1-fluoroéthane et de 6-2% en poids de méthanol, ou de 97-99% en poids de 1,1-dichloro-1-fluoroéthane et de 3-1% en poids d'éthanol. 5
2. La composition azéotrope ou quasi-azéotrope selon la revendication 1, dans laquelle la composition est de 96,25 en poids de 1,1-dichloro-1-fluoroéthane et de 3,8% en poids de méthanol. 10
3. La composition azéotrope ou quasi-azéotrope selon la revendication 2, dans laquelle la composition a un point d'ébullition de 30,0 °C sous substantiellement la pression atmosphérique. 15
4. La composition azéotrope ou quasi-azéotrope selon la revendication 1, dans laquelle la composition est de 98,6% en poids de 1,1-dichloro-1-fluoroéthane et de 1,4% en poids d'éthanol. 20
5. La composition azéotrope ou quasi-azéotrope selon la revendication 4, dans laquelle la composition a un point d'ébullition de 32,0 °C sous substantiellement la pression atmosphérique. 25
6. Un procédé pour nettoyer une surface solide qui comprend le traitement de ladite surface avec la composition azéotrope ou quasi-azéotrope de la revendication 1. 30
7. Le procédé de la revendication 6 dans lequel la surface solide est une plaquette de circuit imprimé contaminé par du flux et des résidus de flux. 35
8. Le procédé de la revendication 6 dans lequel la surface solide est un métal. 40

Revendications pour l'Etat contractant suivant : ES

1. Une composition azéotrope ou quasi-azéotrope composée de 94-98% en poids de 1,1-dichloro-1-fluoroéthane et de 6-2% en poids de méthanol, ou de 97-99% en poids de 1,1-dichloro-1-fluoroéthane et de 3-1% en poids d'éthanol. 50
2. La composition azéotrope ou quasi-azéotrope selon la revendication 1, dans laquelle la com- 55

position est de 96,2% en poids de 1,1-dichloro-1-fluoroéthane et de 3,8% en poids de méthanol.

3. La composition azéotrope ou quasi-azéotrope selon la revendication 2, dans laquelle la composition a un point d'ébullition de 30,0 °C sous substantiellement la pression atmosphérique. 5
4. La composition azéotrope ou quasi-azéotrope selon la revendication 1, dans laquelle la composition est de 98,6% en poids de 1,1-dichloro-1-fluoroéthane et de 1,4% en poids d'éthanol. 10
5. La composition azéotrope ou quasi-azéotrope selon la revendication 4, dans laquelle la composition a un point d'ébullition de 32,0 °C sous substantiellement la pression atmosphérique. 15
6. Un procédé pour nettoyer une surface solide qui comprend le traitement de ladite surface avec la composition azéotrope ou quasi-azéotrope de la revendication 1. 20
7. Le procédé de la revendication 6 dans lequel la surface solide est une plaquette de circuit imprimé contaminé par du flux et des résidus de flux. 25
8. Le procédé de la revendication 6 dans lequel la surface solide est un métal. 30
9. Un procédé pour préparer une composition azéotrope ou quasi-azéotrope, selon la revendication 1, comprenant le mélange ou la combinaison de 94-98% en poids de 1,1-dichloro-1-fluoroéthane et de 6-2% en poids de méthanol ou de 97-99% en poids de 1,1-dichloro-1-fluoroéthane et de 3-1% en poids d'éthanol. 35

