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AZEOTROPIC COMPOSITION

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This invention relates to an azeotropic composition and particularly to the azeotropic mixture of 1,1,2-trichloro-1,2,2-trifluoroethane and acetone.

Several of the chlorofluoromethanes and chlorofluoroethanes have attained widespread use as speciality solvents in recent years, particularly trichlorofluoromethane and trichlorotrifluoroethane. Both of these compounds are relatively low boiling liquids (CCl_3F, 23.8° C.; CCl_2FCClF_2, 47.6° C.), which are nontoxic and nonflammable, and which have satisfactory solvent power for greases, oils, waxes and the like. They have therefore found widespread use for cleaning electric motors, compressors, oxygen storage tanks, photographic film, lithographic plates, typewriters, instruments, gauges, sound tape, and as noncorrosive brines.

For certain solvent purposes however, the chlorofluoromethanes and chlorofluoroethanes have insufficient solvent power alone. This is particularly true in the electronic industry during the manufacture of "printed circuits." "Printed circuits" are well known in the electronics art; and consist of a circuit formed from a soft metal on a solid, nonconducting surface such as a reinforced phenolic resin. During manufacture, the solid surface is coated with the metal, the desired portion of metal is coated with an impervious coating, and the excess metal is removed by etching with a suitable acid. After the excess metal has been removed, it is necessary to remove the impervious coating because solder joints must be made to the "printed circuit" and these will not form if the coating is present. After the impervious coating is removed, the circuits are coated with a rosin flux to permit the joints to be soldered, with rosin flux must then be removed. The chlorofluoromethane and chlorofluoroethane solvents do not have sufficient solvent power to clean "printed circuits"; that is, to effectively remove the rosin flux.

It is an object of this invention to provide a novel azeotropic composition which has new and unusual properties. Another object is to provide an azeotropic composition which is valuable as a solvent, and particularly for cleaning printed circuits. A further object is to provide such a composition which is nonflammable and nontoxic, both in the liquid phase and in the vapor phase. Other objects are to provide new compositions of matter and to advance the art. Still other objects will appear hereinafter.

The above and other objects may be accomplished in accord with this invention which comprises an azeotropic composition consisting of about 87.5% by weight of 1,1,2-trichloro-1,2,2-trifluoroethane and about 12.5% by weight of acetone and boiling at 45° C. at 760 mm. pressure.

It has been found that 1,1,2-trichloro-1,2,2-trifluoroethane and acetone, when admixed in the above proportions, form an azeotrope which distillls at constant composition, the liquid phase and the vapor phase in equilibrium therewith having the same composition. Such mixture is nonflammable and nontoxic in both the liquid phase and the vapor phase. It is useful as a heat exchange medium and as a hydraulic fluid. It is particularly useful as a solvent for greases, oils, waxes, and the like, in cleaning electric motors, compressors, photographic film, oxygen storage tanks, lithographic plates, typewriters, precision instruments, gauges, sound tape,

cellulose acetate cloth and printed circuits. The 1,1,2-trichloro-1,2,2-trifluoroethane is not an effective solvent for cleaning printed circuits and cellulose acetate cloth. On the other hand, acetone seriously damages cellulose acetate cloth and causes softening, swelling and delamination of laminated boards used as the bases for printed circuits. It has been found that the small proportion of acetone present in the azeotrope with the 1,1,2-trichloro-1,2,2-trifluoroethane sufficiently modifies the solvent properties of both components so as to make the azeotrope an excellent solvent mixture for such purposes, and does not deleteriously affect cellulose acetate cloth or laminated boards for printed circuits.

Cellulose acetate cloth (acetate rayon) is unusually susceptible to damage by solvents, particularly acetone, but is not affected by 1,1,2-trichloro-1,2,2-trifluoroethane. Good dry cleaning solvents are difficut to obtain for this fabric. To test the effect of the above described azeotrope on cellulose acetate fabric, a piece of the fabric was immersed in the azeotrope overnight. It was then removed and dried. The fabric was completely unaffected. When a similar piece of fabric is allowed to stand in acetone overnight, it dissolves completely.

The azeotrope of this invention has several advantages over the solvents heretofore employed for cleaning printed circuits. Trichloroethylene, tetrachloroethylene, and methyl chloroform, are unstable and require stabilizers, whereas the azeotropic composition of this invention does not. The azeotropic composition of this invention is more effective as a solvent for such purposes than trichloroethylene and tetrachloroethylene. Inhibited methyl chloroform (containing dioxane as a stabilizer) is too strong a solvent and attacks the backing of the printed circuits. Isopropyl alcohol-toluene blends are flammable and irritating. The azeotropic mixture of 1,1,2-trichloro-1,2,2-trifluoroethane and acetone does not suffer from any of these defects.

The azeotropic composition of this invention was obtained during the distillation of two kilograms of a mixture containing 82.5% by weight of 1,1,2-trichloro-1,2,2-trifluoroethane and 17.5% by weight of acetone through a 1 inch x 38 inch column packed with ⅛ inch glass helices at a reflux ratio of 10/1 and a take off of 1 ml./min. The first fraction obtained was 1594.3 grams of the azeotrope containing 87.5% by weight of 1,1,2-trichloro-1,2,2-trifluoroethane and 12.5% by weight of acetone and having a boiling point of 45.0° C. at 760 mm. pressure. At this point, there was insufficient 1,1,2-trichloro-1,2,2-trifluoroethane remaining to maintain the azeotrope and nonazeotropic mixtures, containing much larger concentrations of acetone, distilled (160.7 grams).

Printed circuit boards are usually prepared by impregnating glass cloth, nylon, or paper laminates with a phenol-formaldehyde resin or an epoxy resin. Printed circuits are prepared by a variety of methods. In a typical procedure, the board consists originally of a phenolic resin impregnated base to which is bonded a sheet of copper, 2 to 4 mils thick, covering one surface of the board. The desired circuit is drawn on the copper with an asphalt based ink, using the silk screen method. The excess copper is then removed by etching with a ferric chloride-hydrochloric acid bath, sometimes containing ammonium chloride, leaving on the board the copper that is covered by the ink. After washing off the etch solution, the asphalt ink is removed by cleaning with the azeotropic composition of this invention in an ultrasonic bath (some mechanical scrubbing is often used). The entire surface of the board is coated with a rosin flux and dried. The electronic components (resistors, capacitors, etc.) are then added at the proper places for soldering to the circuit. The board is then passed over a molten solder bath, contacting the desired joints with the

molten metal, whereby the soldering is effected. After cooling, the excess rosin flux remaining on the board must be removed since, if present in the final assembly, it will lead to corrosion, poor electrical resistance and other deleterious properties.

The board is cleaned by placing it in an ultrasonic bath operating at about 32 kilocycles per second and at about 25° C., where it remains for one minute. If 1,1,2-trichloro-1,2,2-trifluoroethane is used alone as the solvent in the bath, it has no effect on the rosin flux. If trichloroethylene is used as the solvent in the bath, about 5% to about 50% of the flux remains after the treatment. If the same cleaning operation is repeated on another circuit board using the azeotropic mixture of 1,1,2-trichloro-1,2,2-trifluoroethane and acetone as the solvent the rosin flux is completely removed. Neither the 1,1,2-trichloro-1,2,2-trifluoroethane, nor the azeotropic mixture has any effect on the board which constitutes the backing of the printed circuit.

It will be understood that the preceding detailed description of the use of the azeotropic composition of this invention in cleaning printed circuits and cellulose acetate cloth is given for illustrative purposes solely, that this invention is not restricted to such specific embodiments and that other techniques may be employed. Also,

the azeotropic composition can be used for other purposes as indicated in the general description.

From the preceding description, it will be apparent that this invention provides a novel azeotropic composition which has unusual properties and which is useful for a wide variety of purposes. Accordingly, it will be apparent that this invention constitutes a valuable contribution to and advance in the art.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

An azeotropic composition consisting of about 87.5% by weight of 1,1,2-trichloro-1,2,2-trifluoroethane and about 12.5% by weight of acetone and boiling at 45° C. and 760 mm. pressure.

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