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COMPRESSION REFRIGERATION WORKING FLUID

William J. Huth, West Chester, Pa., assignor to Sun Oil Company, Philadelphia, Pa., a corporation of New Jersey

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This invention relates to an improved compression refrigeration working fluid comprising a halogenated hydrocarbon refrigerant, a mineral oil lubricant, and a minor amount of a polymerized styrene. It has been found that the addition of a polymerized styrene to a compression refrigeration working fluid lowers the temperature at which the working fluid can be successfully employed.

An important characteristic of refrigeration working fluids is the minimum temperature at which they may be successfully employed in compression refrigeration systems without plugging the systems. With the operation of refrigeration systems at lower and lower temperatures, the minimum operating temperature at which the working fluid can be used has often become the limiting or decisive characteristic affecting the choice of a suitable working fluid.

In accordance with the present invention, the minimum operating temperature of a compression refrigeration working fluid is lowered by incorporating in the working fluid a minor amount of a polymerized styrene. Refrigeration working fluids of this invention comprise a halogenated hydrocarbon refrigerant, a mineral oil lubricant and a minor amount of a polymerized styrene. The halogenated hydrocarbon refrigerant can be any of the halogenated hydrocarbon refrigerants conventionally used in the art in compression refrigeration systems. Examples of such refrigerants are dichlorodifluoromethane, dichloromonofluoromethane, monochlorodifluoromethane, trichloromonofluoromethane, 1,2-dichloro - 1,1,2,2 - tetrafluoroethane, 1,1,2-trichloro-1,2,2-trifluoroethane and the like.

The mineral oil lubricant which forms part of the novel working fluids of the invention can be any conventional compression refrigeration mineral oil lubricant. These oils usually have viscosities in the range of 75 to 600 SUS @ 100° F., low pour points, low floc points, and they do not vaporize at conditions in the refrigeration system.

The polymerized styrene which is used in the invention is preferably polystyrene, i.e., polyvinyl benzene or poly α-methyl styrene. Polyvinyltoluenes, polyvinylxylenes and other homologues and analogues of polystyrene can be used. Mixtures of polymerized styrenes can be employed. Poly α-methyl styrene has been found to be especially suitable in practice of the invention.

The polymers used in carrying out the invention are prepared in accordance with procedures which are known in the art. The polymers which are employed should be soluble in the compression refrigeration working fluid. The use of polymers which are normally viscous liquids is preferred. These polymers have average molecular weights in the range of about 200 to 7000. Normally solid polymers which are soluble in the working fluid can also be used. These polymers generally have molecular weight in the range of 7000 to 100,000 and preferably about 7000 to 35,000. The use of very high molecular weight infusible polymers should be avoided.

In carrying out the invention, the polymerized styrene is incorporated in the compression refrigeration working fluid in amount sufficient to lower the minimum temperature at which the working fluid can be employed. It is usually convenient to add the polymer to the lubricant which is used in the system although the polymer can be added to the refrigerant or to a mixture of the refrigerant and lubricant.

Several factors should be considered in determining the amount of polymerized styrene to be used in carrying out the invention. During operation of the refrigeration system, the polymerized styrene, being relatively nonvolatile, will largely remain in the compressor together with the lubricant. Since polymerized styrenes increase the viscosity of lubricants, the effect of the polymer additive on the viscosity of the lubricant should be considered in determining the amount of a particular polymer to be used in the invention. In general, the polymerized styrene should not be used in amount sufficient to increase the viscosity of the lubricant greatly above the upper lubricant viscosity specification for the particular refrigeration system. Generally, the upper lubricant viscosity limit is about 600 SUS @100° F.

Higher molecular weight polymerized styrenes increase lubricating oil viscosity to a somewhat greater extent than do lower molecular weight polymers. Accordingly, in carrying out the invention, relatively greater amounts of lower molecular weight polymerized styrenes can be used with a particular lubricant in a particular refrigeration system without increasing lubricant viscosity above the desired upper limit. In practice of the invention, suitable amounts of polymerized styrenes generally range from 5% to 20% by volume of the refrigeration lubricant. Amounts outside this range can, on occasion, be used.

The following illustrates the invention:

The minimum operating temperatures of working fluids were determined in a compression refrigeration testing apparatus which comprised a normal compression refrigeration system with an elongated capillary tube between the condenser and the evaporator. The working fluid in liquid phase passed through this capillary tube. External means were provided for regulating the temperature of the fluid passing through the capillary tube. The working fluids to be tested were circulated in this apparatus through the usual refrigeration cycle with the temperature of the capillary tube gradually being lowered until the working fluid plugged the capillary. Plugging of the capillary tube was evidenced by a sharp decrease in pressure on the suction side of the compressor. The lowest temperature at which a working fluid could be successfully employed in the test apparatus without plugging the apparatus was taken as the minimum operating temperature of that fluid.

A working fluid comprising "Freon 22" (monochlorodifluoromethane) and a mineral oil lubricant was tested in the above described apparatus. This working fluid was found to have a minimum operating temperature of +10° F.

Poly α-methyl styrene was incorporated in the mineral oil lubricant used above in amount of 10% by volume of the mineral oil lubricant. This addition of polymer increased the SUS viscosity @100° F. of the lubricant from about 464 to about 623. The poly α-methyl styrene used was a viscous liquid having average molecular weight in the range of 300–350, SUS viscosity @ 100° F. of 8500, SUS viscosity @ 210° F. of 77.4, and specific gravity d_4^{20} of 1.0324.

A second working fluid was formed comprising "Freon 22" and the mineral oil lubricant containing 10% by volume of the poly α-methyl styrene. This working fluid was tested in the above described testing apparatus, and the working fluid was found to have a minimum operating temperature of —20° F. Thus, the use of the poly α-methyl styrene in the working fluid lowered the temperature at which the working fluid could be employed by an increment of 30° F.

I claim:

1. Compression refrigeration working fluid consisting essentially of a halogenated hydrocarbon refrigerant, a mineral oil compression refrigeration lubricant, and from 5 to 20 percent by volume, based on said lubricant, of a soluble polymeric styrene, having average molecular weight in the range of 200 to 100,000.

2. Composition according to claim 1 wherein said polymeric styrene is a soluble poly α-methyl styrene.

3. Compression refrigeration working fluid consisting essentially of a halogenated hydrocarbon refrigerant, a mineral oil compression refrigeration lubricant, and from 5 to 20 percent by volume, based on said lubricant, of a soluble, viscous, liquid poly α-methyl styrene having average molecular weight in the range of 300–350, SUS viscosity at 100° F. of about 8500, SUS viscosity at 210° F. of about 77.4, and specific gravity d_4^{20} of about 1.0324.

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