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LUBRICATION OF REFRIGERATOR EQUIPMENT

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This invention relates to lubricating oils and more particularly to lubricating oils useful for the lubrication of refrigerators.

In electrical refrigerators and refrigerator equipment it is the common practice to admix the lubricant used to lubricate the inner moving parts of the equipment with the refrigerant or coolant used. This admixture is made in various proportions depending upon the type of equipment concerned.

It has long been recognized in the lubricating industry that one of the most troublesome problems in the lubricating of refrigeration equipment is the tendency for extremely small particles to separate out of the mixture as the temperature is lowered. These extremely small solid particles have a tendency to clog the fine orifices encountered in refrigerating equipment and prevent the flow of both lubricant and refrigerant. In fact, a standard test has been devised by those supplying lubricating oil to refrigerator equipment manufacturers known as the "floc point" determination. This test prescribes specific conditions under which a mixture of various proportions, such as 10% of the lubricating oil and 90% of the refrigerant used, is chilled. The temperature at which the flocculent precipitation occurs is called the "floc point."

The character of this flocculent precipitation is not exactly known. It has been definitely established, however, that this material is not a paraffin wax and that there is no appreciable connection between floc point and pour point of a lubricating oil. It has been found that the lowering of the floc point does not necessarily lower the point on the temperature scale at which the oil loses its properties of free flow due to the formation of interlocking wax crystals, in other words, does not lower the pour point. The formation of this precipitating material is believed to be due to some inner action between the refrigerant and the lubricating oil occurring only at temperatures below about 0° F.

It has now been found and is the subject of this invention that refrigerator oils having greatly reduced floc points may be prepared by combining with a base oil minor amounts of alkylated aryl borates.

The alkylated aryl borates used to form the improved refrigerating oils of this invention have the following general formula:

$$(RAr)_xH_yBO_3$$

wherein R is one or more straight chain alkyl radicals having 16 or more carbon atoms, Ar is an aryl nucleus, such as benzyl, bi-phenyl, alpha-naphthyl, etc., x is an integer from 1 to 3, and y is 0 to 2, $x+y$ being 3.

Preferred among the alkylated aryl borates covered by the formula above, and contemplated in the preferred embodiment of this invention, is a wax-alkylated phenyl borate which was prepared by alkylating phenol according to known procedures with chlorinated wax containing approximately 17.5% chlorine, using $AlCl_3$ as a catalyst. A wax of a chlorine content of from about 12% to 20% may also be used.

The resulting product was then reacted with H_3BO_3 in xylene solution and the resulting wax-alkylated phenyl borate was purified by filtering and then stripping off the xylene solvent. The product had a molecular weight of approximately 855 and a wax-phenol/H_3BO_3 ratio of approximately 1:1.

The lubricating oil base stock used in the formation of the refrigeration oils of this invention must be carefully selected. The selection of the base stock will depend to a certain extent upon the refrigerant which is to be used in conjunction with the lubricating oil. The highly refined Coastal stocks such as acid-treated, propane deasphalted and solvent dewaxed Coastal distillates having viscosities within the range of from 30 to 100 SUS at 210° F. may be used advantageously as a base oil and may be combined with any of the commonly used refrigerants such as methylchloride and those of the Freon type.

The invention will be more clearly explained by reference to the following:

Using as a base oil a blend of solvent extracted acid-treated naphthenic Coastal distillates having viscosities of 37 and 60 SUS at 210° F. a series of refrigerating oils were prepared. In this experiment various amounts of the preferred alkyl aryl borate, that is to say, wax alkylated phenyl borate were incorporated into the base oil blend.

These oils were subjected to the standard floc point test for a determination of the floc point. This test is conducted as follows:

1 ml. of the oil to be tested is placed in a special heavy glass tube. Dry air (dried using anhydrous $CaCl_2$) is then bubbled through the oil sample for at least one hour. The tube is then sealed by conventional methods and inserted in a cooling bath held at or below —20° F. Freon-12 is then charged to the tube in excess of 9 ml. (liquid) and the tube sealed, removed from the bath and allowed to warm up until a homogeneous solution of oil and liquid Freon-12 is obtained. Excess Freon-12 is then allowed to boil off until only 10 ml. total liquid (10% oil, 90% Freon) remain in the tube. The tube is then replaced in the cooling bath and cooled down in 5° F. decrements until the floc point is approached, at which time the bath is chilled in 2° F. decrements until a definite flocculent precipitation occurs. The point 2° F. above this temperature is denoted the floc point of the oil. The test may be run with other types of refrigerants or with different oil Freon ratios—10% oil is generally chosen because the amount of oil carried into the refrigeration evaporator by the refrigerant would seldom exceed 7% and on well-designed units only 2–3%. It has been established that the less oil used in the test the lower the floc point obtained.

TABLE I

Effect of wax-phenol borate on floc point of oil A[1]

Concentration of inhibitor:	Floc point, ° F.
None	—38
0.1 wt. percent	—56

[1] Oil A=Phenol treated and clay contacted distillate from Coastal naphthenic crude, vis. 150 SUS at 100° F., 41 SUS at 210° F.

The data presented in Table I above shows that inclusion of very minor amounts of wax phenol borate in refrigerator oil formulations depresses the floc point as much as 18°. It must be borne in mind that at these low temperatures even minor depressions of floc points

are very difficult to obtain and hence a depressant effect of 18° is considerable.

To summarize briefly this invention relates to the formation of an improved refrigerator oil which has been prepared by admixing with a highly refined Coastal distillate a minor amount, insufficient to increase the oxidation resistance of an alkyl aryl borate. In the preferred embodiment it is contemplated from from 0.001% to 0.4% by weight of wax phenyl borate will be combined with the base oil.

What is claimed is:

1. In the operation of refrigerator equipment employing a refrigerant and lubricant which are admixed at temperatures below about 0° F. resulting in flocculation of the refrigerant and lubricant, the improvement which comprises lubricating said equipment with a lubricating oil composition consisting essentially of a highly refined naphthenic Coastal Distillate having a viscosity of from 30 to 100 SUS at 210° F. containing combined therein a minor amount, sufficient to reduce the floc point, of an alkyl aryl borate having the general formula

$$(RAr)_xH_yBO^3$$

wherein R is an aliphatic hydrocarbon radical containing from 16 to 30 carbon atoms, Ar is an aryl group, x is an integer from 1 to 3, y is a number from 0 to 2 and $x+y=3$.

2. Method according to claim 1 wherein said alkyl aryl borate is wax phenyl borate.

3. Method according to claim 1 wherein said minor amount is in the range from 0.001% to 0.4% by weight based on the total lubricating oil composition.

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