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DEGREASING PROCESS

Wilbur H. Petering, Metuchen, and Adam G. Aitchison, Westfield, N. J., assignors to Westvaco Chlorine Products Corporation, New York, N. Y., a corporation of Delaware

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7 Claims. (Cl. 134—31)

This invention relates to an improvement in degreasing processes and other processes wherein chlorinated solvents are used as solvent media. It comprises particularly a method of degreasing articles with surfaces of a metal having a decomposing effect on chlorinated grease solvents, such as aluminum goods, wherein grease is removed from such a metal surface by a chlorinated solvent of a type normally subject to such decomposition, containing a minor amount of certain oxygen-containing organic compounds, advantageously organic oximes, which restrain such decomposition.

This application is a continuation-in-part of our co-pending application, Serial Number 386,544 filed April 2, 1941.

The removal of grease films from metal surfaces by the application of grease solvents has been widely practiced during recent years. Numerous solvents have been employed, and numerous variations of the degreasing procedure have been suggested. In one method of operating, the metal article to be degreased is brought into contact with the solvent in the liquid phase. This may be accomplished by immersing the article in a large body of the solvent, or by spraying the solvent on the surface of the article. In another common method of degreasing, known generally as vapor-phase degreasing, a body of solvent is maintained at the boiling point and in communication with a chamber adapted to contain a large body of the solvent vapor. The article to be degreased is brought into contact with this body of vapor, and causes condensation of the solvent on the greasy metal surface. The condensed solvent removes grease and oil from the metal surface and drips off, usually returning to the boiling body of the solvent. With it goes dirt, adhering to the greasy surface. This dirt often includes metal chips. In vapor-phase degreasers of this type, it is conventional to provide cooling coils or some equivalent arrangement near the top of the solvent vapor chamber to prevent or minimize the escape of vapors and loss of solvent from the system. Solvent condensed by such cooling coils is generally substantially uncontaminated by either grease or dirt, and is usually returned to a clean solvent reservoir, which, in many cases, is arranged to overflow into the solvent boiling compartment. In some cases, even when employing vapor-phase degreasing, the article to be degreased is preliminarily dipped in a body of liquid solvent. When hot solvent is employed for this purpose, there is sometimes a subsequent dip in cooler solvent, so that the article brought into

contact with the solvent vapor will have a sufficiently low temperature to cause the desired condensation of solvent on its surface in the vapor chamber.

As noted, numerous solvents have been employed in degreasing operations. Among these, solvents of the chlorinated hydrocarbon type, including both saturated compounds such as carbon tetrachloride, ethylene dichloride, et cetera, and unsaturated compounds such as trichlorethylene, perchlorethylene, et cetera, have been widely employed because of their high grease-solvent capacity and their low inflammability. Several of these chlorinated compounds are considered non-inflammable. Of the available solvents of this type, trichlorethylene is probably most widely used in degreasing. However, it is seldom used without the addition of some "stabilizer," adapted to prevent or retard its decomposition during storage and normal use. This so-called "normal" type of decomposition is promoted by light and oxygen. The action of light and oxygen is accelerated by heat. Several stabilizers are available and commonly used for the purpose of inhibiting this decomposition.

These previously known stabilizers are effective when present in minute amounts in preventing decomposition of trichlorethylene during storage and during the usual degreasing operations applied to ferrous metals and several other metals. However, when the metal to be degreased is aluminum or an aluminum alloy, it has been found that a different type of decomposition of the solvent is encountered, and that this type of decomposition may occur even in the presence of stabilizers which are effective in all other cases. This form of decomposition of chlorinated solvents in contact with metallic aluminum or its alloys is evidenced by a rapid rise in acidity (largely hydrochloric acid), by pronounced discoloration of the solvent, and, in the advanced stages of decomposition, by the formation of a tarry or gummy mass in the solvent.

Efforts have been made heretofore to eliminate or minimize this type of decomposition by various special practices. In some instances, these practices have been partially successful, in that they have reduced formation of the above-mentioned tarry and gummy masses in the solvent, for example. However, when such results have been obtained, they have been accompanied by undesirable results of other types, such as increased acid development. It does not appear that prior to this invention there has been any satisfactory solution to the problem of decomposition encoun-

tered with the chlorinated solvents which are susceptible thereto, such as trichlorethylene, perchlorethylene, et cetera, when they are kept in contact with aluminum or its alloys having a decomposing influence at high temperatures.

The present invention is based on our discovery that this metal-induced decomposition of chlorinated solvents, with production of hydrochloric acid and other deleterious decomposition products, is prevented by the addition to the chlorinated hydrocarbon solvents of certain oxygen-containing organic compounds, such as organic oximes.

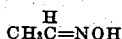
The organic oximes have many advantages for the present purposes. First, as a class, they are usually soluble in chlorinated hydrocarbons and are compatible with such solvents under service conditions. Under ordinary conditions they do not react with the chlorinated hydrocarbons to form sludge or other deleterious by-products. Likewise, the oximes do not attack metals. In other words, the organic oximes effectively stabilize chlorinated hydrocarbons against metal induced decomposition without any deleterious action, both during storage and under service conditions.

The following oximes are illustrative of the types that are effective in the practice of our invention:

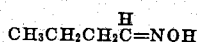
Formaldoxime



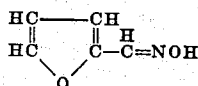
Acetaldoxime



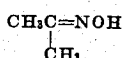
Butyraldoxime



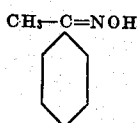
Furfuraldoxime



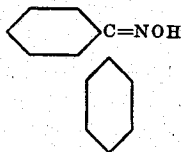
Acetoxime



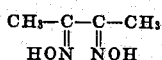
Acetophen(oxime)



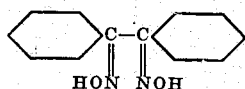
Benzophen(oxime)



Dimethylglyoxime



α Benzildioxime

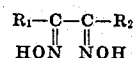


These oximes are derivatives of aldehydes and ketones and have the generic type formula



where R_1 is a hydrogen radical or an organic

radical such as an aliphatic, aryl, heterocyclic, or alicyclic group and R_2 is a hydrogen radical or an aliphatic, aryl, heterocyclic or alicyclic group. These radicals may be substituted with other substituents. For example, dioximes with the type formula



where R_1 and R_2 have the above meaning, may be used.

In the broad practice of our invention, we may employ a wide variety of oximes as noted above. These oxygen-containing compounds are generally employed in minor amounts, advantageously in the order of 1 per cent of the amount of chlorinated solvent by weight. However, as the effectiveness of these stabilizers varies to some extent with the type of compound employed, the particular percentage incorporated in the chlorinated hydrocarbon solvent may be varied to obtain the stabilization desired. Ordinarily it is advantageous to add definite molar percentages of the oximes to the chlorinated hydrocarbon solvents. However, for purposes of the present invention, the more oxime present, the more effective the composition in restraining this "metal-induced" decomposition. This seems to be true because these oxygen compounds unite chemically with the aluminum compounds that appear to cause the metal-induced decomposition and thus the more oxygen compound present the more stabilization obtained. For "metal-induced" decomposition claimed in this application it is generally advantageous to use about 1 mol of oxygen compound per 99 mols of chlorohydrocarbon. However, this amount may be increased with proportionately greater stabilization against metal-induced decomposition.

In the practice of our invention, many and various embodiments thereof may be employed. For instance, the chlorinated hydrocarbon solvent, in addition to the stabilizers described, may also contain one of the known stabilizers against normal decomposition, as previously mentioned, such as aralkyl ethers of hydroquinone, described in Pitman Patent 2,319,261.

One specific advantage resulting from the addition of suitable oximes to chlorinated degreasing solvents, as described hereinabove, is that the presence of a minor amount of the oxime with the resulting decrease in metal-induced decomposition, permits operation of the degreasing equipment for a longer period without the necessity of shutting down to clean out accumulations in the boiling compartment. As previously noted, the reactions involved in this metal-induced decomposition are somewhat obscure. One explanation of these reactions is that the accumulation of non-volatile oils removed from the work during the degreasing operation, may raise the boiling point (or range) of the liquid in the boiling compartment of the degreaser to such an extent that reaction sets in between the chlorinated solvent and the finely divided aluminum or other metal which has also been washed off the work. This waste metal accumulating in the liquid solvent has large effective surface areas which are highly reactive, especially at the increased boiling temperature of the dirty solvent. It may be that the large metal surface catalyzes the decomposition, or it is possible that aluminum chloride forms at the surface of the metal and that this compound is the active decomposing agent.

Whatever the mechanism of the metal-induced decomposition, it has been necessary in the past to remove the accumulation of oily material and finely divided metal and metal compounds from the boiling compartment at frequent intervals. This involves additional labor, loss of production during the cleaning period, and loss of solvent. These difficulties are largely eliminated by operating in accordance with the present invention, and it has been found that a vapor-phase degreasing unit can be kept in operation when degreasing aluminum, for example, up to at least three times as long as was permissible heretofore, when suitable oxygen-containing organic compounds are added to the solvent, as described hereinabove.

Similar advantages are obtained in liquid-phase degreasing operations in which hot chlorinated solvents are employed.

In a specific example illustrative of a useful embodiment of the present invention, a degreasing solvent was prepared containing 99.0 parts by weight of stabilized trichlorethylene, and 1 part by weight of formaldoxime. This solvent was used in a vapor-phase degreasing operation of the type previously described for degreasing aluminum surfaces. No objectionable decomposition was encountered, even after continuing the operations without cleaning out the boiling compartment of the degreaser for considerably longer than had been possible before the use of the oxime in accordance with this invention.

These chlorinated solvents, such as trichlorethylene, containing minor amounts of organic oximes, are particularly adapted for use in degreasing aluminum and its alloys. Such solvents are also useful in degreasing other metals, including zinc and magnesium and their alloys as well as iron, steel, copper, et cetera.

While we have particularly described our invention hereinabove with respect to certain organic oximes, it will be obvious to the skilled in the art that the invention is not limited to the specific examples shown, but may be practiced

and embodied within the scope of the claims hereinafter made.

What we claim is:

1. As an improvement in degreasing surfaces of aluminum and its alloys with chlorinated hydrocarbon solvents normally subject to deterioration in the presence of aluminum, the improvement which comprises maintaining, in admixture with such chlorinated solvents, a minor amount of an organic oxime to inhibit such metal-induced decomposition thereof.

2. The method of claim 1, wherein said chlorinated hydrocarbon solvent is trichlorethylene.

3. The method of claim 1, wherein said chlorinated hydrocarbon solvent is perchlorethylene.

4. The improved process for degreasing surfaces of metals of the class consisting of aluminum and its alloys having a decomposing effect on chlorinated hydrocarbon grease solvents, which comprises establishing a body of grease solvent in communication with a space adapted to receive vapors therefrom, said solvent comprising a major proportion of chlorinated hydrocarbon solvent, normally subject to decomposition in the presence of such metal surfaces, and a minor proportion of an organic oxime having the property of restraining decomposition of such solvents in the presence of said metal surfaces, boiling said body of grease solvent and thereby maintaining a body of vapors thereof in said vapor space, contacting the metal surface to be degreased with said body of vapors and returning the solvent condensed by said metal to said boiling body of solvent, the amount of said oxime in said body of grease solvent being sufficient to inhibit metal-induced decomposition thereof.

5. The method of claim 4, wherein the chlorinated hydrocarbon solvent is trichlorethylene.

6. The method of claim 4, wherein the chlorinated hydrocarbon solvent is perchlorethylene.

7. The method of claim 4, wherein the oxime is formaldoxime.

WILBUR H. PETERING.
ADAM G. AITCHISON.