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CLEANING METHOD

George T. Hittel, Midland, Mich., assignor to The Dow Chemical Company, Midland, Mich., a corporation of Delaware

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ABSTRACT OF THE DISCLOSURE

An improved method for cleaning articles fouled with dirt, grease, oil, fines, etc., accumulated during production which comprises heating the fouled article to about 160° F. and quenching the so-heated fouled article in methylene chloride.

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of my earlier filed copending application, Ser. No. 444,021, filed Mar. 30, 1965 for "Improved Cleaning Method," now abandoned.

BACKGROUND OF INVENTION

The rapid and efficient cleaning of articles which acmulate soil such as grease, fines, dirt, oil, etc., during manufacture or use is a problem which has plagued industry over the years. Numerous techniques have been employed with varying degrees of success. One of the more widely used techniques employed in today's manufacturing plants is vapor degreasing. Another is hot degreasing which often times employs sonic or vibratory techniques. Each has its drawbacks, in that the size of the articles to be cleaned often prohibits the use of these latter techniques and the vapor degreasing technique is often not effective alone. Some thirty years ago, Koch in his Patent 2,016,376, described a technique wherein a part to be cleaned was heated to above the boiling point of a solvent for the grease, oils, etc., which soiled the part, then dipped or quenched the soiled part into the solvent. The result was a rapid evolution of bubbles of vapor at the surface of the part which facilitated the removal of the fines while also dissolving the grease and oil. This technique seemed sound but never was accepted widely by industry. Part of the reason for the failure to obtain widespread acceptance may be found in the fact that in cleaning most metals by this technique, the surface is left with a light gray haze, which while readily removed by wiping must be removed for appearance's sake as well as to enable the part to be plated, painted, etc.

BRIEF DESCRIPTION OF INVENTION

The present invention comprises an improved method for cleaning an article soiled or fouled with grease, oil, dirt, fines, etc., in a solvent for said grease and oil by inducing boiling of the solvent at the surface of the articles while immersed in said solvent which consists of heating the article to at least about 160° F. for a time sufficient to provide the entire body of the article a heat content to maintain the surface temperature above abou 110° F. after immersion in methylene chloride for at least about 4 seconds. The method of heating is not critical and can be accomplished by introducing the article into a furnace, the field of an induction heating coil, infrared heat source, or the liquid or vapors of a material which will give up its heat to the article. A particularly satisfactory method for heating the article is to immerse the

article into the vapors of a chlorinated solvent which boils above about 160° F. or the liquid of such a solvent at or near its boiling point or a hydrocarbon liquid having a boiling point substantially above 160° F. such as mineral oil or the like. A preferred method of the present invention is to immerse the soiled article in a liquid solvent which contains from about 1 to 5 weight percent of an anionic detergent stable in the solvent and at temperatures up to 300°–400° F.

The quench period is not critical. The ebullient boiling usually substantially ceases in 4 to 40 seconds. The temperature of the quench liquid is not critical and can be maintained at from ambient temperature to near the boiling point of the methylene chloride.

The detergents employed in accordance with the present invention are commercially available materials which are compatible with solvents such as perchloroethylene, trichloroethylene and methyl chloroform and do not deteriorate under temperatures of 300°–400° F. Some readily available materials are the anionic phosphate ester-ethylene oxide adducts, the petroleum sulfonates, the alkylated chlorinated and unchlorinated diphenyloxide sulfonates, as well as the detergents employed in dry cleaning operations.

Water is not essential to the embodiment of the present invention which employs the detergent but has been found beneficial where it can be added without detrimental effect on the article. In most cases, 0.1 to 1 percent water has been found sufficient to impart the improved cleaning; however, as much as 5 weight percent may be employed in some instances.

Good results, removal of soil, grease, fines, etc., have been obtained when the article is heated to above 240° F. in perchloroethylene, mineral oil or in the field of an induction heating coil and the article is quenched in methylene chloride maintained at about 100° F. Exceptionally good results have been obtained when the fouled article is heated in perchloroethylene containing about 3 weight percent of a phosphate ester-ethylene oxide adduct detergent and up to 1 percent by weight water.

DETAILED DESCRIPTION OF INVENTION

In order to establish the advantages of the process of the present invention over the prior techniques, a series of experiments were run as follows:

Several ¾ inch rods about 2 inches long were buffed with a stearate based Al_2O_3 buffing compound to establish a gross, black irregular deposit on said rods and a highly polished surface. Rods of aluminum, magnesium, and steel were employed and after buffing were suspended below the surface of boiling (250° C.) perchloroethylene each in an individual container. At various intervals, the rods were removed for inspection. At the end of one hour, none of the rods was wholly free of accumulated buffing compound or accumulated dust.

In another series of experiments, similarly prepared rods were first heated under vacuum (27 inches) with an induction coil to 246° F. and then quenched in perchloroethylene, the gross smut and soil fell away leaving the rod with an overall light gray haze which could be readily wiped away with a cleansing tissue. The total time of immersion in the perchloroethylene was about 1 minute. The rods were too hot to handle comfortably.

In a still further series of experiments, steel and aluminum rods were similarly prepared, heated for five minutes in boiling perchloroethylene, then quenched into a container of toluene which was held just below its boiling point (221–230° F.). Upon visual inspection, it was observed that considerable buffing smut remained. Each rod was then reheated in the perchloroethylene for about 1 minute and then quenched, which procedure was repeated

three times. Even after this treatment, some smut was observable on the rod surface. Benzene was then substituted for the toluene and a new set of rods prepared, heated in boiling perchloroethylene for five minutes, quenched in the benzene. The results were not visibly different from that observed when using toluene. Three repeated heatings (1 minute in perchloroethylene) and quenching did, however, seem to improve the soil removal over that of the toluene.

The results of this series of tests indicate the general poor quality of cleaning of the prior techniques.

To further illustrate a commercial cleaning result when employing the techniques of the prior art, a series of ornate brass drawer pulls of yellow brass alloy and sand cast fabrication were buffed by the manufacturer with a proprietary buffing material. Several groups of these buffed pulls were boiled individually in one of the following solvents: perchloroethylene, 1,1,1-trichloroethane and trichloroethylene, while another group of pulls were boiled first in one then the other successively of the solvents. None of these treatments removed sufficient soil to permit the manufacturer to process with the next step in his processing.

The following examples are illustrative of the present invention.

EXAMPLE 1

Aluminum, steel and magnesium ¾ inch by 2 inch long rods were buffed with a commercial stearate base Al_2O_3 buffing compound which established a gross, black irregular deposit on the surface of the rods. Each rod was heated for five minutes in boiling perchloroethylene (250° F.) or hot mineral oil (300° F.) or under vacuum in the field of an induction heating coil (310° F.), then quenched in methylene chloride at room temperature. The results are tabulated below. In each instance, the soil (buffing compound) was removed prior to cessation of ebullient boiling in the methylene chloride. The rods appeared clean to visual observation but on wiping with soft tissue, there was evidence of a haze remaining. In comparison with the test results of the experiments above described, the cleaning was visually superior.

EXAMPLE 2

In another series of experiments, aluminum, steel and magnesium rods were prepared in a similar manner as that described in Example 1. The procedure of Example 1 was repeated employing various detergent compositions as set forth below in the perchloroethylene. The results of this series of experiments illustrate the improvement in cleaning when a detergent is employed.

Detergent	Wt. Percent	Results
Nonylphenol condensed with 9 moles ethylene oxide.	5	All smut removed—bright portions showing evidence of partial haze removal.
Alkylarylphosphate ester-ethylene oxide adduct.	3	All smut removed—bright surface with small hazy portions.
Alkylarylphosphate ester-ethylene oxide adduct 0.15% by weight added water.	3	All smut removed. All surfaces bright.

EXAMPLE 3

Ornate brass door pulls buffed by the manufacturer were heated in boiling perchloroethylene for 1½ minutes then submerged in methylene chloride. The pulls were clean with no film and were capable of handling by an ungloved hand.

EXAMPLE 4

To illustrate the necessity to heat the entire object to above the boiling point of the quench, flat aluminum strips were prepared by cutting a 1/32" x 1/32" groove in the 1 x 4 face, then buffing the surface with a commercial buffing compound. One strip was heated for one minute

in boiling perchloroethylene containing 5% by weight of a phosphate ester ethylene oxide adduct, while the other was immersed for 5 minutes in the same perchloroethylene composition. The strips were each quenched in methylene chloride. The strip heated for 1 minute, was clean but small deposits of buffing material was left in the groove. The strip heated for five minutes, was clean and free of any evidence of buffing material and was bright and free of haze.

EXAMPLE 5

A New Departure ball bearing #3205 comprising races and balls was purposely fouled with a mixture of lubricating oil, fine steel turnings, and sand to the point of immobility. It was then heated in perchloroethylene at the boil until it had reached the temperature of the heating medium (ca. 250° F.). It was quenched in methylene chloride and after boiling stopped it was inspected and found to be completely clean and free running by both standard visual and sonic examination. A second bearing was similarly handled and two cycles were required to restore like-new performance.

EXAMPLE 6

A commercial production line for cleaning drilled and honed cast fabricated stirring gear housings was modified by location, adjacent to an alkaline washer, of a two-tank cross rod degreaser which provided a continuous path for the housing to pass into a vapor zone of perchloroethylene, then over a baffle into a bath of liquid methylene chloride. Each zone had a heating means to provide in the first zone heat to generate vapors of the perchloroethylene and in the second zone sufficient heat to maintain the methylene chloride at just below its boiling point (ca. 100° F.). The gear housing entered the degreaser after being drilled and honed. The tests were conducted by directing 25 housings from the line into the rod degreaser, cleaning the same and thereafter washing and brushing by hand the cleaned housings to dislodge any dirt, etc., remaining after the passage through the cleaning processes. This dirt was collected and weighed. Twenty-five housings were taken from the alkaline cleaning bath and likewise washed and brushed to remove any dirt remaining. The dirt collected from each of the 25 housings was weighed. The average dirt remaining after cleaning by one of the processes is set forth below as an average for the 25 units cleaned by each process.

	Ave. grams dirt
Alkaline wash process	0.0184
Cleaning process of present process	0.0029

The same housings were then bearingized, each set cleaned with one of the processes, washed, brushed, the dirt collected, weighed and averaged. The results of such operations were:

	Ave. grams dirt
Alkaline wash process	0.0039
Degreasing process of present process	0.0026

The process of the present invention was then installed to process (clean) a part of the total production of housings after drilling and honing. The housings after being cleaned were further processed to prepare complete stirring gear assemblies. These assemblies were tested for porosity to fluids by subjecting the completed assembly to a pressure test. Many assemblies are found to be porous to the fluid. The discovery of the porosity at this point is expensive. Therefore, an ability to detect such porosity earlier would be beneficial. The number of alkaline cleaned assemblies passing the inspection after cleaning which failed during the testing was 427 out of 64,000. Only 152 out of 40,000 such porous housings were found on the test. The present process cleaned well enough to enable visual inspection, immediately after cleaning, to identify the highly porous housings which were passing inspection

after alkaline cleaning. This run demonstrates the superior cleaning of the present process.

In the same plant, a rack piston end plug assembly line vapor degreaser was likewise modified to incorporate the degreaser of the present system. The amount of dirt determined in the same manner aforementioned showed the following results.

	Vapor	Present invention
No plugs	174	174
Ave. grams dirt	0.00018	0.00009

The objects to be cleaned may be heated in any appropriate medium such as air, liquid, inert gas, or vacuum, for example, and accomplished by means of induction, radiation, convection, conduction, or resistance heating, for example.

An example of a ceramic object which may be cleaned in accordance with this invention are so-called "Pyroceram" bearings. Various glass objects may also be cleaned in accordance with this invention.

Examples of plastic objects which may be cleaned in accordance with this invention are phenolic gears and polyacetal parts, which are unaffected by perchloroethylene and methylene chloride, for example. Other plastic materials may be used if they are unaffected by the liquids used in practicing the method of the invention.

I claim:

1. An improved method of cleaning adhering materials from the surface of a metal object, comprising heating said object to a temperature of substantially about the boiling temperature of a first solvent selected from the

group consisting of perchloroethylene, trichloroethylene or methyl chloroform by immersing the object into the boiling liquid of the first solvent for a period sufficient to heat the object to about the boiling temperature of said first solvent, said first solvent containing about 1 to 5% by weight of an anionic detergent and approximately 0.1 to 1 percent by weight of water; immersing said object into methylene chloride which is heated at least near to its boiling temperature; and, removing said object from said methylene chloride after surface boiling has occurred on said object, the method resulting in the surface of the metal object being bright and free from gray haze.

References Cited

UNITED STATES PATENTS

2,016,376	10/1935	Koch	134—19
2,060,663	11/1936	Walt	134—19
2,118,480	5/1938	Somes	134—1
2,291,202	7/1942	Bassett et al.	134—19 XR
2,399,205	4/1946	Campbell	134—26
2,417,468	3/1947	Canziani et al.	134—19 XR
2,527,666	10/1950	Winter	134—1
2,635,063	4/1953	Dunlevy et al.	134—19 XR
2,653,115	9/1953	Drews et al.	134—19 XR
3,028,267	4/1962	Edhoffer et al.	134—105 XR
3,094,469	6/1963	Strauss et al.	134—30 XR

MORRIS O. WOLK, Primary Examiner

J. T. ZATARGA, Assistant Examiner

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