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(54) COMPOSITIONS AND METHODS FOR TREATING CLEANING SOLVENTS

ZUSAMMENSETZUNGEN UND VERFAHREN ZUR BEHANDLUNG VON REINIGUNGSFLÜSSIGKEITEN

COMPOSITIONS ET PROCEDES DE TRAITEMENT D'UN SOLVANT DE NETTOYAGE

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates generally to automotive, industrial, and commercial parts cleaning, and, more particularly, to improved formulations for increasing the effectiveness of cleaning solvents.

[0002] In industry today, there has been an increasing awareness of the importance of washing mechanical parts. In almost every repair, reconstruction, and rebuilding of motors, engines, and/or machines, it is necessary to clean oily, greasy, or otherwise dirty or contaminated parts before they can be repaired and reassembled. Further, in a number of cases, machining and refabricating operations, particularly those carried out on metal parts, leave residues or contaminants which are desirably cleaned before the part or component in question is reassembled or otherwise the subject of a completed operation.

[0003] In most cases, the kind of dirt and contamination which has accumulated on metal parts is that of an oily, greasy residue. In the case of automotive, truck, agricultural, and earth-moving construction machinery components, the parts in question gradually become covered with oil or grease that has leaked from the crankcases or gear housings of the machines, and these in turn attract dust, sand, dirt, and other constituents of the environment in which they work. Almost all oils and greases have the capability not only of attracting dust and dirt, but also, in effect, of acting as an adhesive for these and other contaminants.

[0004] Normally, for reasons of rust prevention, and particularly for reasons of solubility, such parts, being possessed of an oily, greasy residue, are best cleaned using hydrocarbon-based solvent systems rather than aqueous systems. The use of aqueous systems calls for using large quantities of water and requires emulsifying the oil and grease that is, in effect, serving as a dirt binder. Such cleaning, while effective if conducted properly, involves time-consuming washing/emulsification/saponification steps followed by rinsing and subsequent application of a corrosion inhibitor coating. In addition, disposing of oil-containing residues is sometimes subject to prohibition or regulation.

[0005] Accordingly, rather than pursue this method, most parts are simply washed in a hydrocarbon-based solvent that is compatible with the oils and greases in question, and which therefore serves to remove the dirt quite rapidly and effectively. This is particularly true when combined with a scrubbing or mechanical agitation action, i.e., brushing or dipping and agitating of parts, or both. Where the solvent is confined to a recirculating washer, the solvent need not be disposed of in violation of environmental regulations.

[0006] In connection with the use of hydrocarbon-based solvents, certain problems arise. These include environmental and fire hazard concerns, one consequence of which has been the increasing use of relatively high flash point solvents. In many cases, these solvents used have a flash point of 37,8°C (100°F) or above and are primarily aliphatic in nature with a certain aromatic constituent. Newer solvents, have a 65,6°C (150°F) or higher flash point and are predominantly or almost exclusively aliphatic.

[0007] Referring to the equipment used in parts washing, while simple dip tanks have been known to be used with some effectiveness, the most cost- and labor-effective method of small-scale parts washing, (i.e., that carried on in maintenance, repair, and rebuild shops and garages and industrial fabrication and assembly facilities of all sizes), has been to use parts washers which include a sink or the like positioned atop a reservoir of hydrocarbon-based solvent and wherein this solvent is circulated from the reservoir though a pump and directed over the parts being cleaned from a nozzle at the end of a conduit or the like. Parts washers usina such hydrocarbon-based solvents include those of the general type described in U.S. Patent 3,522,814, of which many hundreds of thousands have been sold and/or are in use.

[0008] Referring again to automotive, industrial, and commercial parts washing, when the cost of hydrocarbon-based solvent was very low and the regulatory atmosphere was somewhat lax, it was not uncommon to provide a rather crude filter to be used with such solvent and for the solvent to be changed by a route or serviceman every two to four weeks. The used solvent would be picked up by the route man, who then furnished a charge of new solvent for the parts washer. This cycle would commonly be repeated on a two to four week cycle or as needed.

[0009] When hydrocarbon-based solvent prices were low, this was an economical, common sense approach to parts washing problems. The combination of the relatively crude filter and simple gravity settling provided a gross separation of contaminants which was satisfactory for the times in question. Now, however, hydrocarbon-based solvent costs are much higher, and environmental regulations are such that it is much more desirable to ensure maximum use and reuse of a particular charge of solvent. However, this desirable state of affairs has not heretofore been able to be fully achieved in practice.

[0010] One characteristic of parts washer solvent that has been subjected to even comparatively few washing cycles is that the dirt entrained therein includes finely dispersed particles, many of which may be of sub-micrometre (submicron) size. While sand, gravel, metal filings, and the like cleaned from dirty or greasy parts rapidly settle out, a significant portion of the contaminants in solvent used for parts washing is comprised of very fine particles that are resistant to settling. As a result, while the solvent's cleaning effectiveness may not be impaired, due to the dispersed and unsettled contamination, it may be difficult to determine visually that the solvent can still be used effectively. Consequently, such solvent may be changed more often than needed.

[0011] If it were possible to achieve a greater separation of dirt and particles from the mass of solvent within a finite time, say fifteen minutes to one hour, the effectiveness and useful lifetime of much parts cleaning solvent would be greatly increased. It is possible that, by positioning the liquid pump inlet an appropriate distance from the bottom of the reservoir, if there were highly effective gravity separation of contaminants, the pump could continue to circulate comparatively clean solvent, while the case, the contaminants would continue to self-separate by gravity. Thus, the supernatant liquid within the reservoir would remain clean and be able to be used over a much longer period of time.

[0012] In speaking of reclamation of hydrocarbon solvents, being that the current regulatory atmosphere in some ways promotes this practice, when recycling of the hydrocarbon-based solvent used in parts cleaning is called for, i. e., by filtration, distillation of the solvent at a recycle center, and/or by various other commonly known methods, an economic price is extracted both for recycling very dirty solvent and also for distilling solvent that has sufficient solids suspended so as to be of reduced effectiveness in use as a cleaning material.

[0013] If it were the case that a greater separation of the dirt and particles in used or spent hydrocarbon-based solvent could be achieved, recycling would be simplified in that the major portion of the contaminants could be removed into a contaminant rich layer by physical separation, thus reducing the accumulation of sludge in the distillation phase of recycling. Heat transfer would be better and equipment damage would be minimized if the solvent that was ultimately recycled by distillation were cleaner when entering the distillation phase of recycling.

[0014] While it is not known with certainty all the reasons why the contaminants in parts cleaning hydrocarbon-based solvent are apparently so highly resistant to gravity separation, it is known that modern motor oil, cutting and machining fluids, and grease formulations include detergent/dispersant additives which form a part of the dirt and grime which accumulates on mechanical parts, both inside and outside sealed machine areas. The detergent/dispersant additives remaining in these oil, fluid, and grease residues may serve to suspend fine contaminants within the cleaning solvent and prevent their separation by gravity or filtration.

[0015] In any case, it would be considered extremely advantageous to provide at low cost a cleaning solvent that would provide much better particle separation from the majority of the liquid phase of parts cleaning solvent than is presently able to be achieved.

[0016] WO 91/19831 discloses compositions and methods for removal of grime, grease, oil and other contaminants from surfaces by employing cleaning compositions comprising cycloparaffins (e.g. cycloalkanes), branched paraffins, and at least about 0.1 wt. % of a nonionic or ionic surfactant. Ionic surfactants used include C_8-C_{18} fatty acid sulfonic acids or salts thereof, or alkyl benzene sulfonic acids or salts thereof where the alkyl group is preferably linear C_8-C_{18} alkyl, such as dodecylbenzene sulfonic acid or sodium salt thereof. In one example, a cleaning composition is prepared by mixing 1 vol.% (1.2wt.%) sodium dodecyl benzene sulfonate with 99 vol. % (98.8 wt.%) Conoco XP-15 (having a flash point of 150°F (65.6°C) and primarily comprising C_{11}-C_{13} cycloparaffins and C_{11}-C_{13} branched paraffins); the mixture is heated to 40°C and a grease-contaminated aluminium piece is then dipped for 5 min into the mixture with agitation to remove the grease.

[0017] US Patent 5,196,136 discloses a cleaning composition suitable for cleaning a substrate comprising (a) a liquid hydrocarbon; (b) a multiple ester additive $(RO)_m$-A-$(CO_2R^1)_n$ where A = alkane, R = H or alkyl carbonyl, R^1 = alkyl (e. g. in 5-50%); and (c) a compatibilizing agent such as a non-ionic surfactant. The hydrocarbon can be an aliphatic hydrocarbon liquid having a flashpoint greater than 140°F (60°C) and can be present in 50-95 %.

[0018] US Patent 3,193,499 discloses a composition suitable for removing waxy deposits consisting essentially of an isoparaffinic hydrocarbon liquid containing substantially only isoparaffins, said liquid boiling at 335-475°F (168-246°C), and a small amount (e.g. 3.5-5.2%) of calcium petroleum sulphonate.

[0019] US Patent 4,407,707 discloses a process for removing finely divided solids from oils characterized as unconventional whole heavy crudes, heavy petroleum crude fractions and residua, syncrudes, syncrude fractions, and syncrude residua, particularly shale oil and shale oil fractions. The process comprises dispersing about 10-5000 parts, per million parts of oil by volume, of an admixture of surfactant and demulsifier within said oil; admixing with washwater and emulsifying; separating the emulsion into two phases and recovering the oil phase; followed by further water-washing, heating, emulsifying, coalescing, emulsion-separating, and oil-phase recovery steps. The surfactant comprises (A) an ethoxylated or propoxylated 1,4-sorbitan ester, and preferably also comprises (B) a substituted benzene monosulfonic acid. More preferably, the surfactant comprises (A), (B), and (C) a salt of a substituted benzene monosulfonic acid. The demulsifier comprises an alkoxylated phenol formaldehyde resin, substituted at a position para to the alkoxy group by a hydrocarbyl group (e.g. C_1-C_{30} alkyl including n-butyl, i-butyl and sec-butyl), wherein the alkoxylated resin must be ethoxylated or propoxylated or admixed ethoxylated/propoxylated.

[0020] In view of the failure of the prior art to provide a solvent composition or method that enhances particles settling, or which can be treated or employed so as to rejuvenate dirty parts washing solvent by separating contaminant particles from the body of the solvent, it is an object of the present invention to provide a method and/or composition which can alter or modify used or new parts washing solvent to restore its cleaning effectiveness.

[0021] The first aspect of the present invention provides a method of providing accelerated and enhanced settling of finely dispersed contaminants accumulating through use in a parts washing solvent, said parts washing solvent comprising not more than 20 percent aromatic solvent and the balance aliphatic and other solvents and said contaminants, said parts washing solvent having a flash point of at least 37.8°C (100°F); said method comprising treating said parts washing solvent with an additive composition to provide agglomeration and settling of contaminant particles creating turbidity in the parts washing solvent, said additive composition comprising at least one compound selected from the class consisting of aromatic, aliphatic and alkaryl sulfonic acids and sulfonic acid salts, and alkyl phenol formaldehyde resins modified so as to include alkoxy solubilizing groups forming a part thereof, and mixtures of said acids or acid salts and said resins, said treated solvent thus being capable of re-use for washing parts, said additive composition being added to the parts washing solvent in an amount to provide from 0.01 parts to 5 parts of said at least one compound per 100 parts of any solvent present after treatment.

[0022] The second aspect of the present invention provides a mineral spirits-based parts washing solvent composition, said composition comprising primarily aliphatic hydrocarbons and not more than 15 percent aromatic solvents, said composition having dispersed therein an additive composition adapted to accelerate settling of dispersed particles, said additive composition comprising an alkyl sulfonic acid and a mixture of alkoxylated lower-alkyl phenol-formaldehyde resins, wherein said lower-alkyl substituent is an alkyl substituent having from 4 to 11 carbon atoms, the alkyl sulfonic acid and the mixture of resins being present in a combined amount of from 0.01 up to 5.0 parts per 100 parts of solvent.

[0023] The third aspect of the present invention provides a method of cleaning parts using a parts washing solvent, said method including the steps of cleaning parts with a mass of parts washing solvent having a flashpoint of greater than 37.8°C (100°F) and comprising not more than 20% aromatic solvents and the remainder aliphatic and other solvents until said solvent suffers reduced visual clarity and attains a suspended particle concentration in excess of 500 ppm, and thereafter treating said solvent by a method as described in the first aspect of the present invention.

[0024] By use of the present invention, one or more of the following advantages may be achieved.

1. Providing a treatment which will restore the original ability of pre-treated solvent so as to cause separation of dirt and other contaminants therefrom.
2. Providing an enhanced solvent composition and/or method that greatly accelerates dirt and particle separation and which can be repeatedly used to clarify solvent which continues to be contaminated.
3. Providing a solvent additive that is physiologically benign and is effective in small concentrations.
4. Providing at least two separate treatments for a cleaning solvent, that may also be used in combination with each other, one being an enhanced solvent which will greatly accelerate particle settling during initial washing operations and another subsequent treatment which will enhance the settling rate of contaminants from solvent, whether enhanced or not, so as to extend solvent service life in use.
5. Providing a solvent additive which is able to be blended with parts cleaning solvents and that is economical and not environmentally objectionable.
6. Providing a solvent additive selected from the class consisting of aromatic, aliphatic and alkaryl sulfonic acids and sulfonic acid salts; alkyl phenol formaldehyde resins modified so as to include alkoxy solubilizing groups forming a part thereof, and mixtures of the above acids or acid salts and said resins.
7. Providing an additive which causes the cleaning solvent in which it is used to exhibit an accelerated settling and demulsification/ flocculation action to fine contaminant particles suspended within the body of said solvent.
8. Providing a method of cleaning parts using a cleaning solvent, which method comprises cleaning parts until a mass of solvent undergoes reduced visual clarity, and thereafter treating the solvent with an additive composition to clarify said solvent so as to extend its effective cleaning life.
9. Preferably a parts cleaning method which includes periodically adding a demulsifying agent to parts washer solvent which is becoming contaminated with fine suspended particles and, after continuing to use the solvent to the point of substantially reduced visual clarity, again clarifying the solvent by again adding the same additive composition.
10. Providing an additive which is effective to clarify cleaning solvent contaminated with fine suspended particles and which is effective in the presence of water and other additives for the solvent.
11. Providing an additive for a cleaning solvent which additive is compatible with solvent recirculating machinery including recirculating pumps and motors.
12. Providing a solvent additive which accelerates the settling of finely dispersed suspended particles in a manner which does not significantly increase the hazards of fire and toxicity presented by the solvent.
13. Providing an additive composition for cleaning solvent which is readily available and is not excessively costly in view of its advantages and performance characteristics.

DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

[0025] Inasmuch as one important object of the present invention is to provide a solvent which, when used in a parts cleaning or similar operation, will provide maximum settling out of particulate contaminants in the shortest possible time, with the object of effectively dividing a mass or volume of solvent into a relatively clear supernatant layer overlying a contaminant-rich lower layer of greatly decreased volume in relation to the volume of the supernatant layer, certain baseline criteria were established using existing cleaning solvent. For this purpose, and for providing the controls used in the examples referred to herein, several operations were conducted. Before referring in detail to these operations, a general description of them will be furnished.

[0026] The solvent used as a baseline and considered to be typical of contaminated parts washers solvent was taken from parts washing machines in the midwest periodically serviced by the assignee of this invention. Depending upon the duty cycle or the work load at any particular location, parts washers are serviced at varying intervals by picking up old, contaminated solvent and replacing it with new fresh solvent. The pickup intervals usually range from two to twelve weeks.

[0027] The solvent in many instances originally comprises a batch of 68 litres (18 US gallons) for a 114 litre (30 US gallon) parts washer unit of the type shown in U.S. Patent No. 3,522,814. In the course of servicing each individual parts washer, the residual dirty solvent therefrom is picked up by a serviceperson, and this solvent is ultimately all combined into a holding tank at a service center. Subsequently, such solvent batches are normally collected from the service centers and taken to a recycling center where recycling operations are performed on the solvent.

[0028] Thus, in a particular region of the country, the mass of recycled solvent resulting from periodic servicing tends to be of a generally uniform character, although each individual parts washer may be a source of used solvent which is quite different from that of another given individual parts washer. Customarily, the parts washers use a solvent which is primarily aliphatic but may contain up to 15 percent aromatic components, and has a flashpoint of 40.6°C (105°F) or higher or as solvent "SK-105". This is sometimes referred to herein, and in the charts and tables as a standard solvent. The aliphatic component usually is made up primarily of C_8-C_{13} alkanes. In other instances, to which reference will be made, a higher flashpoint solvent, such as a 99+ percent aliphatic solvent is provided, and this solvent has a flashpoint of 60-65.6°C (140°-150°F) or higher. The hydrocarbons are usually a mix of C_9-C_{15} alkanes. This solvent is sometimes referred to herein, and in the charts and tables as solvent "P-150".

[0029] In keeping with the invention, pickup of used solvent or incident to a service call occurs when users of the service encounter one of two conditions. One of these conditions results from a diminution in the effectiveness of the solvent for cleaning purposes when it becomes saturated, or nearly so, with solubilized contaminants such as oil, or suspended particles of grease and other components that are truly soluble in the solvent. In such a case, effective solvent action is no longer possible; the solvent has exhausted its potential as a cleaning agent and is no longer effective. In such a case, recyclinq is the only choice left.

[0030] However, a much more common case is that the solvent is too dirty and contaminated with suspended particulates to continue to be effective. This judgment is usually based on visual observation. Between the time operations are begun with a fresh batch of solvent and the time the service call is made, evaporative losses, contamination from dirt of all kinds, water, etc. occurs; and a gradual dirtying of solvent takes place. This is a natural incident to washing parts in the automotive industry, and/or in manufacturing, construction, agriculture or like industries wherein ferrous and non-ferrous metal mechanical parts are customarily cleaned using parts washer solvent (hereinafter generically referred to as "PWS") and cleaning equipment designed for this purpose.

[0031] The contaminated solvent received from a solvent collection and replacement service center was initially analyzed to provide a base-line or control for the various experiments referred to herein. One of the first steps performed was simply to pour a series of specimens or aliquot portions of used solvent into a graduated cylinder, a specially equipped drum, or the like and note the extent to which observable turbidity will spontaneously dissipate, i.e., whether and to what extent to which the solvent will separate spontaneously into two or more layers, one clean and one dirty.

[0032] Certain of these experiments are referred to in detail herein, but in summary, it was determined that a certain amount of contamination will settle by gravity within the first half hour after agitation. Thereafter, untreated contaminants tend to remain somewhat uniformly dispersed throughout the mass of solvent, and additional time does not result in material clarification of the solvent. The dispersion depends on a particle size, but in a wide range of sizes, certain particles appear to remain suspended indefinitely. Typically, the total suspended solids ("TSS") in used PWS requiring service were about 1,000-14,000 ppm in the supernatant layer, depending on the application. This is, in effect, an end point beyond which self-cleaning by gravity does not occur.

[0033] For purposes of the following discussions of the nature and effect of particle size in solvent classification, the particle size range of solid contaminants suspended in PWS was divided into seven groups, ranging from 70+ µm (microns) to 0.45 µm (microns), as is described later.

[0034] Regarding settlement rates generally, larger and more dense particles settle out more rapidly. Some particles are large and/or dense enough to settle without assistance in a finite time. Consequently, in a given specimen of solvent, as time passes, the concentration of suspended solids becomes somewhat less near the top of a column of such solvent. However, in general, with particles of 20µ and smaller, these settling rates are so slow that the solvent appears uniformly dirty to the naked eye, and it is the accelerated settling of these particles with which the present invention is primarily concerned.

[0035] Referring to another aspect of the present tests, inasmuch as it was desired to test the effectiveness of certain additives in accelerating the rate of settling, i.e., greatly enhancing the extent to which particulate materials would separate from a mass of solvent, another series of steps was carried out. These are a part of a process intended to recognize that solvent in a parts washer initially tends to become dirtied in the process of cleaning, after which the parts washer is not used for a given time, ranging from minutes up to days. The washer is thus used on an intermittent basis or duty cycle throughout the service interval, with additional dirt and contaminants continually finding their way into the solvent over a period of time.

[0036] Thus, a material that might be effective to create solids separation from a solvent should desirably be able to remain effective when a treated volume of solvent, already contaminated to a certain extent, is subsequently subjected to additional contamination. To simulate this condition, tests were performed wherein a given batch of solvent was divided into several aliquot portions. When the first aliquot portion was subjected to chemical additions to effect a clarifying or particulate settling action, the supernatant layer contained a greatly diminished level of contaminants. In order to determine the continuing effectiveness of such additives, more contaminants were added in a plurality of subsequent steps.

[0037] These subsequent evaluations of settling action were termed "cycles" and were initiated by taking additional individual aliquot portions of the original solvent batch and separating the bottom sediment, water, and other contaminants therefrom by centrifuging. After this "spin down" operation was conducted on each of several aliquots, the respective supernatant layers were discarded, and the individual remaining "spun down" contaminants were the concentrated contaminants that were then added successively to the supernatant of the original or first aliquot that had been treated with the modifying chemicals.

[0038] This, in effect, created a standard to determine how effective any particular solvent treatment could be in enhancing separation of contaminants subsequently placed into a given solvent batch. This closely approximates real life or field conditions wherein the solvent continues to be contaminated, while also being allowed period of non-use wherein settling can occur.

[0039] Referring again to certain general aspects of the present invention, it will be therefore appreciated that an advantageous solvent treatment will have the advantage of at least initiating, perhaps continuing contaminant separation, preferably at a relatively high rate. Additionally, a favorable product will be able to continue to provide layer formation and contaminant separation generally over a relatively extended period of time, including time during which clarifying chemicals are periodically added. Another aspect, which is equally important, in the visual appearance of the supernatant. This is because its appearance is often a controlling factor in determining when to initiate recycling.

[0040] Referring now generally to one aspect of the appearance matter, a number of tests were performed wherein a qualitative visual analysis of the effectiveness of different materials used to create settling can be demonstrated. Here, when a dirty solvent specimen taken from a service center and used as a control is placed in a transparent graduated cylinder, the control substance will typically be a dark grayish-black to brownish-black color with little visual clarity, and will remain turbid for an indefinite period of time. When additives used in accordance with the invention are placed in this solvent, an interface between an upper, clarified layer and a lower, contaminant rich layer appears, and this interface can be seen to move gradually downwardly until an equilibrium is approached or reached.

[0041] The height of the interface relative to the original column height at various times, the time required to reach equilibrium and the ultimate position of the interface can all be measured to determine these characteristics. As pointed out, where the solvent is recontaminated, this test is then periodically repeated or put through "cycles" to determine the residual effectiveness of the additive. This is done by adding contaminants and agitating the old, but treated solvent to which new contaminants only have been added.

[0042] According to the invention, it was found that a number of products were effective to promote contaminant settling in both pretreated solvent and in untreated solvent.

[0043] By "pretreated" is meant solvent which, in addition to its customary or conventional makeup of substantially all aliphatic hydrocarbons or of primarily hydrocarbons with up to 20% aromatic solvents, is meant a solvent that has had material of a different character added thereto to promote settlement or interface formation. In this connection, reference is made to copending application no. WO 9 601 915 filed 25.01. 1996.

[0044] Such pretreatment is of a type wherein polar solvents, including but not limited to C_8-C_{10} alcohols, diols, glycols, polyols, and glycol ethers are added to the hydrocarbon solvent. The addition of such chemicals makes it possible to maximize the effect of using treatment additives of the kind referred to herein. Thus, while the additive compositions described herein are effective in the absence of such pretreatment, they are advantageously also used with pretreated solvent. The additive compositions of the present invention may be used one or more times to enhance particle separation from used cleaning solvent.

[0045] As a matter of illustrating the nature of the problem encountered, and so as to distinguish it from liquid processing generally, five specimens of spent parts washer solvent were taken from tanks of collected, used solvent in one or more service centers. Hence, the exact composition of each of the specimens had come from a different source and was different. These are referred to respectively in Chart 1 as feed 1, feed 2, etc. A transparent cylinder was used and a specimen of each feed was agitated thoroughly and poured into the graduated cylinder. Thereafter, the particle size of the dispersed particles in the solution was analyzed. The size classifications are set forth in the following Table 1:

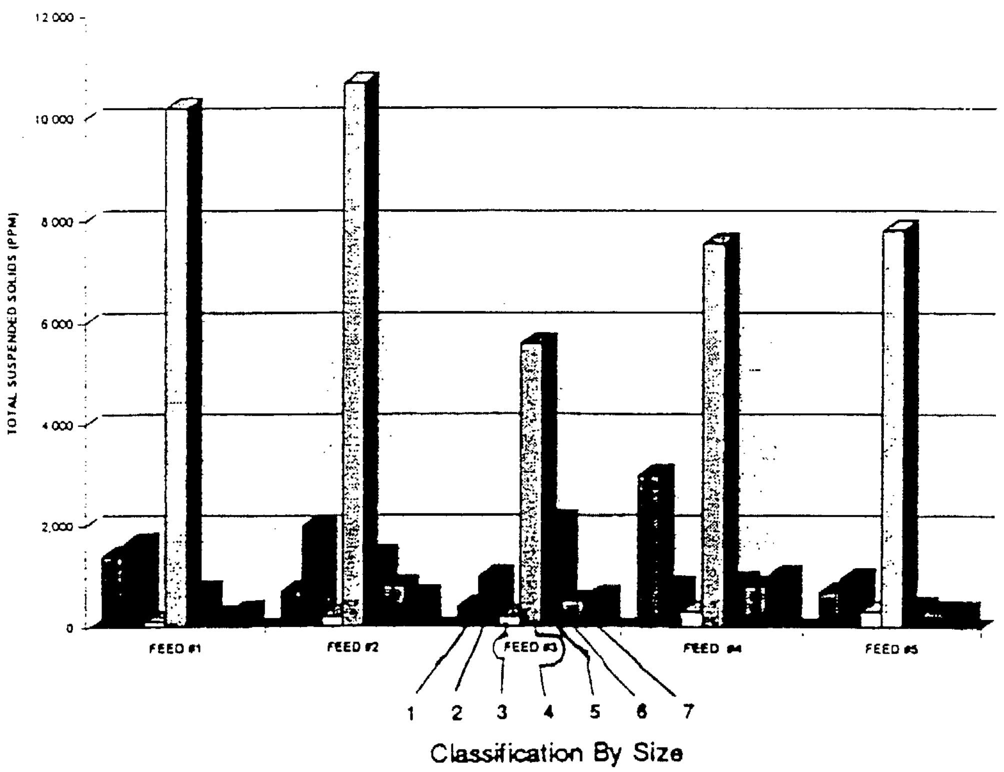
TABLE 1

SIZE CLASSIFICATION	PARTICLE SIZE RANGE
Class 1	70μ or larger
Class 2	30 - 70μ
Class 3	20 - 30μ
Class 4	10 - 20μ
Class 5	5 - 10μ
Class 6	1.2 - 5μ
Class 7	0.45 - 1.2μ

[0046] When each of the specimens was analyzed by the above successive filtration, the total suspended solids, expressed in parts per million (ppm) by weight, within each of the particle size classes was discovered to be as set forth in Chart 1.

CHART 1

PARTICLE SIZE DISTRIBUTION OF SOME REPRESENTATIVE SPENT PARTS WASHER SOLVENT



[0047] Here, it will be seen that the concentration of suspended solids in class 4, i.e., 10-20μ was much greater than the concentration of any other particle size range. In four of the feeds, there were between 7,500 and almost 11,000 ppm in class 4, i.e., the range of 10-20μ. In one specimen, feed 4, there were about 3,000 of the 70+ μm (micron) size particles (class 1), and in feeds 2 and 3, there were about 2,000 each of two different sizes, one being the 30-70 μm (micron) size (class 2) and the other comprising about 2,000 of the 5-10μ size (class 5). Thus, the particles sizes sought to be separated fell in greatest proportion within the 10-20 μm (micron) size (class 4), such size range containing anywhere from just more than 2 to over 5 times the content of any other size range.

[0048] Because of their larger particle size, particles greater than 20-30 μm (micron) size tend to settle somewhat rapidly by themselves and are therefore not either a significant contributor to the problem of dirty solvent nor do they require unusual treatments. However, those in the 10-20μ and smaller particle size range do require treatment because of their persistence in remaining suspended within the solvent. In Chart 1, therefore, in each set of feeds, the highest bar and the bars to the right thereof represent total suspended solids of the moderate and smaller sizes that require treatment according to the invention.

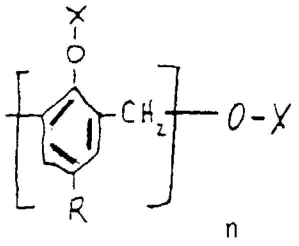
[0049] In summary, one aspect of the invention is to provide an additive composition and method which greatly facilitates spontaneous separation in untreated solvent, and in another aspect of the invention is the ability of separation-enhancing additives to cooperate with solvent compositions which have previously been treated with the alcohol/diol/glycol/polyol/glycol ether compositions referred to in the above copending application. Such products include, but are not limited to, 2-ethyl-1,3-hexanediol, diethylene glycol mono-butyl ether and propylene glycol and butyl ether.

[0050] In view of their purpose, the additives discussed herein and in the claims are sometimes referred to as "clarifying additives". The extent to which these clarifying additives can be used is set forth by way of illustration in the table set out below. Table 2, below, is a list of such additives, each assigned a legend for purposes of simplifying the following graphs and charts.

TABLE 2

LEGEND	CLARIFYING ADDITIVE
CA-1	A mixture of nonyl and butyl-substituted phenol-formaldehyde resins having plural ethoxy or propoxy groups. See illustration below.
CA-2	CA-1 plus an alkyl or aryl sulfonic acid or mixture.
CA-3	A mixture of petroleum naphtha, ammonium alkyl sulfonates and diethylene glycol mono-butyl ether. (DEGBE)
CA-4	A mixture of petroleum sulfonates, esterified polyols and CA-1.

[0051] In the foregoing, the structure of the main constituent of CA-1 is believed to comprise the following or a similar structure:



[0052] Where X = H, Ethoxy or Propoxy and R = C_3-C_{15} alkyl

[0053] In the preferred compositions, R is C_4-C_9; n is an integer of 1 or greater, and the molecular weight is usually from 500-10,000.

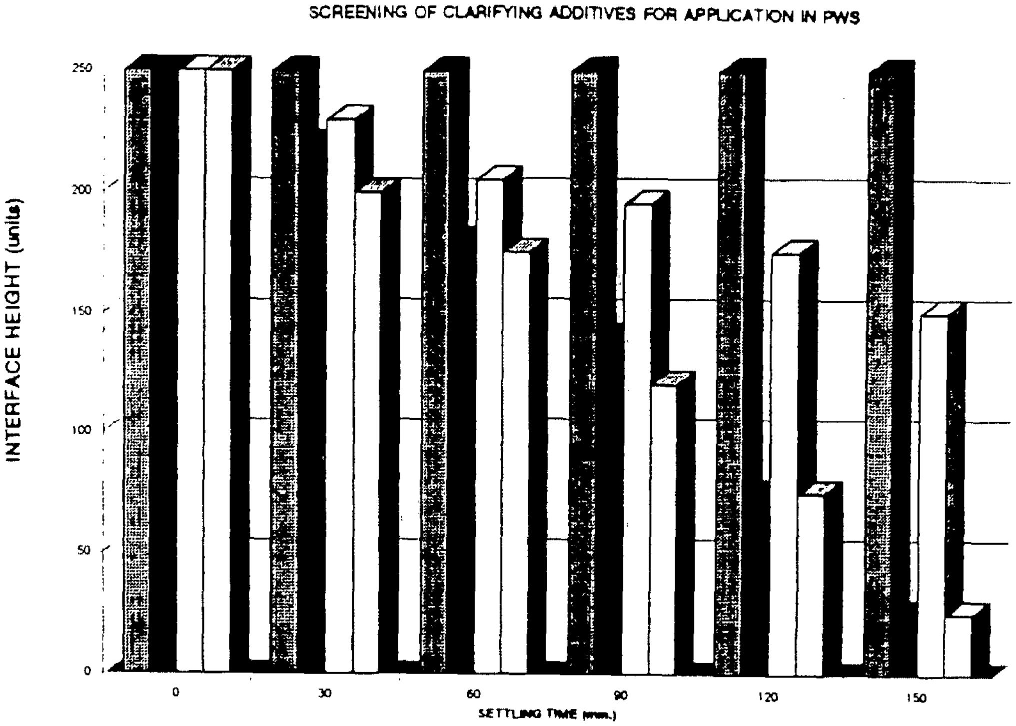
[0054] The foregoing materials were sometimes utilized by adding the same, either once or several times in sequence, to a solvent composition that had previously been treated with an alcohol/diol/polyol/glycol/glycol ether additive as those referred to above. In some instances, the presence of the clarifying additive augmented the desirable characteristics of the solvent treated with the other additive, especially when a limited amount of water was present in the composition. Thus, the additives referenced to herein were useful both with and without prior solvent treatment.

[0055] As reflected in the following materials, the clarifying additives were evaluated by various methods as set out below.

[0056] A preliminary screening was done using these additives with an SK-105 solvent, to determine whether such additives, with parts washer solvents, would develop an interface, and if so, where and to what extent after a given settling time. The solvent in these examples was not intentionally treated with any other composition.

[0057] Chart 2 shows the compositions and the results, with interface height in arbitrary units reflecting the height of a graduated cylinder on the vertical axis and settling time in minutes on the horizontal axis. Column 1 is the control; Column 2 is CA-4; Column 3 is CA-1; and Column 4 is CA-2.

CHART 2

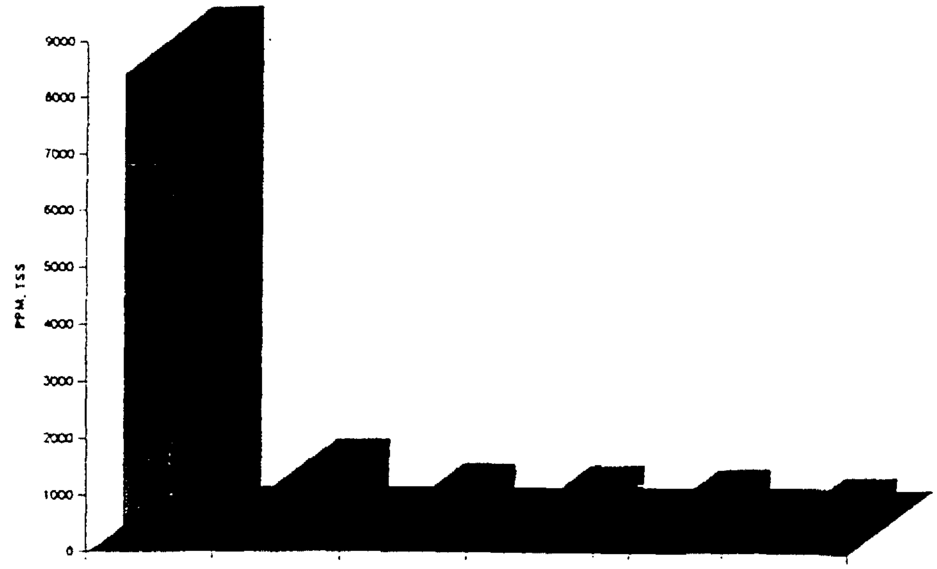


[0058] In these tests, all products were effective, with CA-2 and 4 showing the most promise.

[0059] Another test was administered to determine the total suspended solids content of the supernatant after 70 hours of settling. This is shown in Chart 3.

CHART 3

TSS CONTENT OF SUPERNATANTS OF SOME TREATED SAMPLES RELATIVE TO THE CONTROL AFTER 70 HOURS OF SETTLING



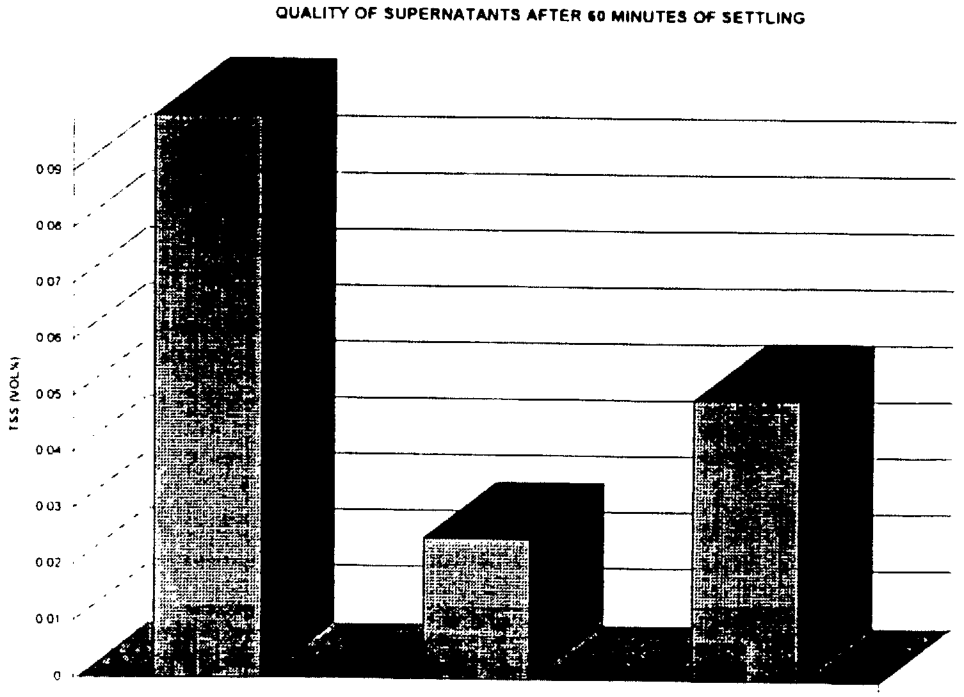
Total suspended solids appear on the vertical axis and the individual products appear in columns to the right as follows:

[0060] In the above chart, only suspended solids of 0.45μm (micron) and larger size are depicted. The left hand column is a control, expressed in terms of TSS, and showing the supernatant of an untreated, solvent. Column 2 shows solvent treated with 0.2 pph (parts per hundred) of CA-3 and 2 pph water. Column 3 is the same as column 2 except that the clarifying additive is CA-2. Column 4 is the same as columns 2 and 3 except that the clarifying agent is CA-1 and 2 pph of Al-1 is present. Column 5 is the same as column 2 except that no water is present. Column 6 is a solvent treated only with 2 pph each of Al-1 and water.

[0061] In these examples, although the active ingredient (Al1) proved most effective when used only with water, this was true only after a very extended (70 hrs.) time. The duration needed for separation, however, was so long that a much more rapid, even if less complete, separation was sought.

[0062] Therefore, the next set of tests, as reflected in Chart 4, shows the quality of the supernatant after only 60 minutes of settling. In Chart 4, The control is compared with a second column treated with CA-4, and a third column reflecting treatment with CA-1. The results range from 250 to 500 parts per million of total suspended solids after 60 minutes.

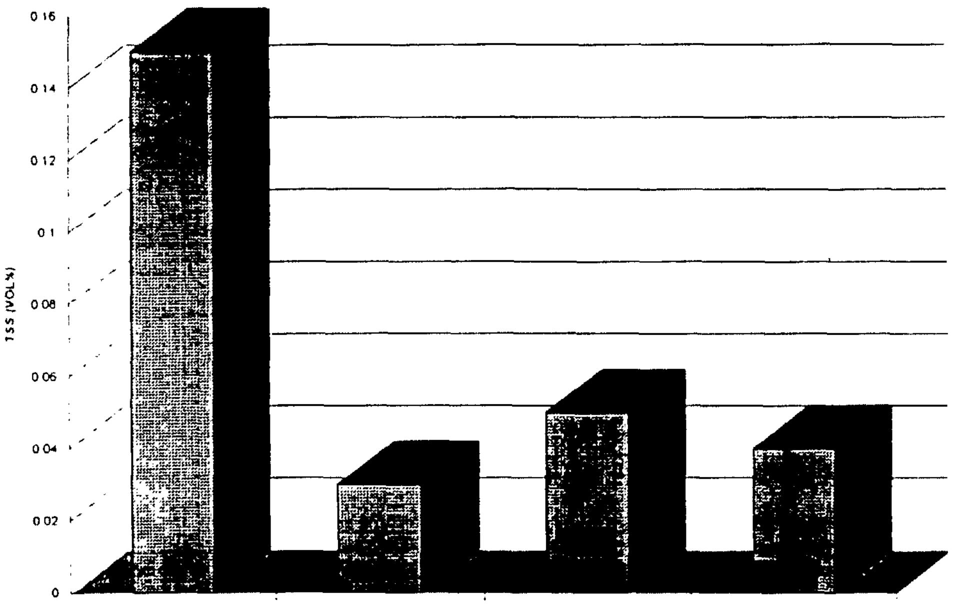
CHART 4



[0063] The following Chart 5 shows similar findings except that a longer settling time was permitted and the performance of CA-2 is reflected in the fourth column.

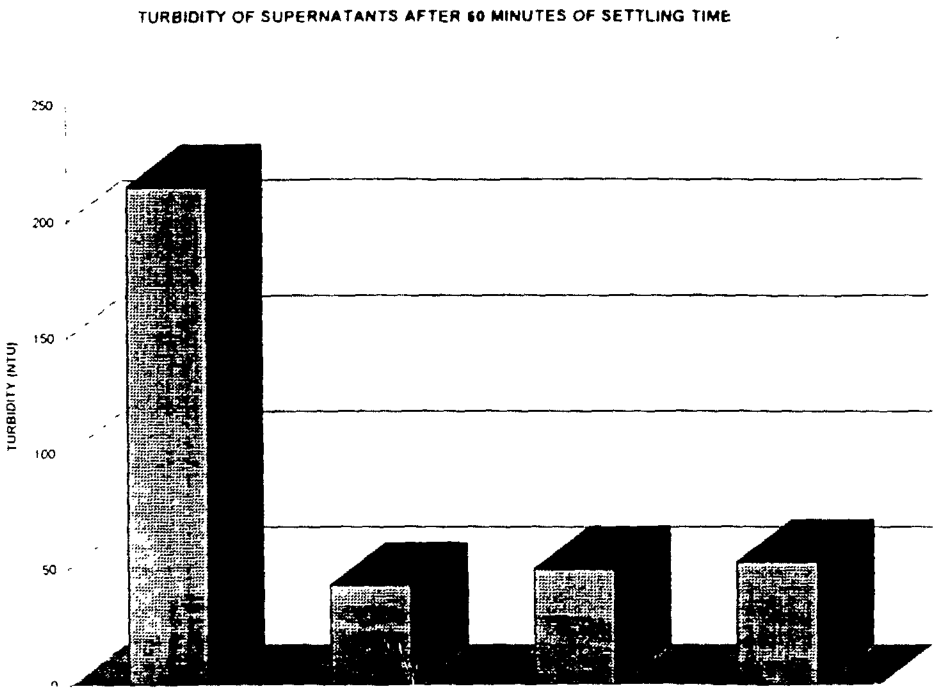
CHART 5

TSS AS A MEASURE OF THE QUALITY OF SUPERNATANTS IN ADDITIVE SCREENING



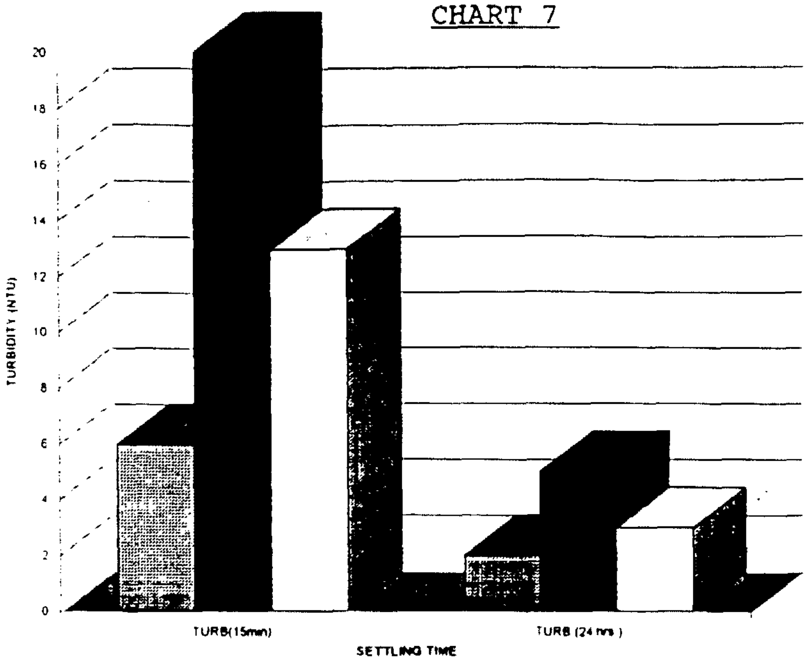
[0064] Chart 6 below, is similar to Chart 5 above, except that the clarity of the supernatant is expressed in terms of turbidity rather than total suspended solids. The first column is the control; the second column is the control after treatment with CA-4; the third column reflects treatment of the control with CA-1 and the fourth column is the control treated with CA-2. In these instances, the turbidity is expressed in units of NTU/5. Consequently, the readings are approximately five times higher than they would be according to the prior example, i.e., where turbidity units are NTU/25. If fully diluted, each of the specimens shown in this chart would equal or approach the 10 unit threshold for solvent that is clear enough to be considered a highly satisfactory product.

CHART 6



[0065] Chart 7, below, shows turbidity readings after fifteen minutes and 24 hours with a combination of the other treatment ingredients in different proportions. The left hand column shows a control with 2 parts CA-2, also treated with 2 parts each of 2-ethyl-1,3-hexanediol (hereinafter "EHD") and water; column 2 shows the same ingredients with 2 parts CA-2 but .5 part EHD and .5 part water. The third column shows a concentration of 2 parts CA-2 and 1 part each per hundred of solvent of EHD and water. It is clear that the turbidity varies with time and also that the order of effectiveness, is 2 parts, 1 part, and 1/2 part, respectively.

CHART 7



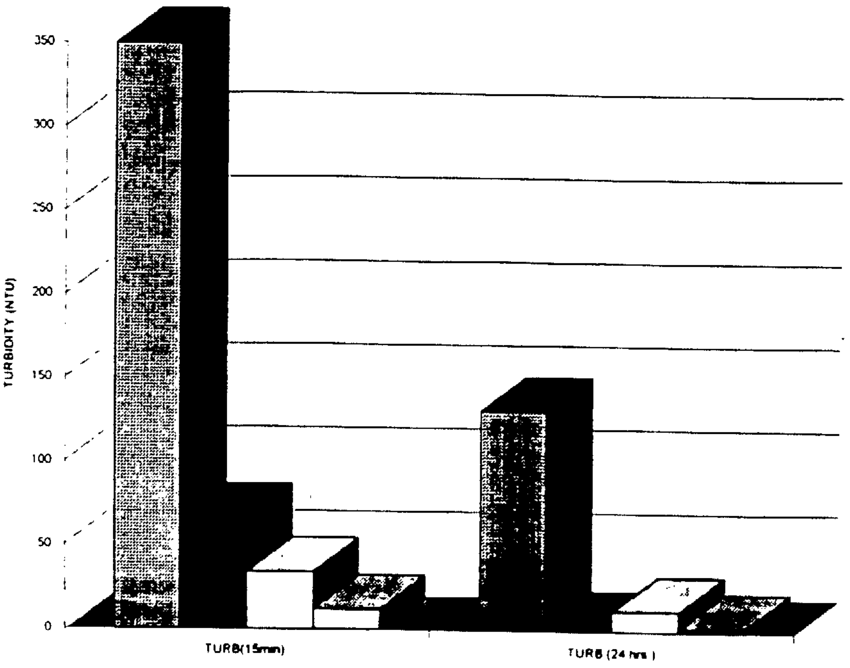
[0066] Chart 8, below, compares the turbidity of supernatants in a control sample and three other specimens after

15 minutes and after 24 hours. In each set of columns, the first column is the control and the second column represents the control treated with 0.2 pph of CA-1 and 2 pph of water. The third column shows a combination of the control treated with 0.2 pph of CA-1 and 2 parts each of EHD. The last column shows the control treated with 0.2 parts CA-1 and 2 parts each of EHD and water. This last composition, the one in column 4, is clearly the most effective. Given enough time, as is indicated by the 24 hour term of the second set of data, the 0.2 parts of CA-1 combined with EHD, in the absence of water is not as effective in the long run as is the control, CA-1 and some water.

[0067] In this connection, it will be realized that a certain amount of water may be unintentionally or transiently present in solvent but that the water is not dispersed therein, at least in the absence of additives. With the proper additives, including some of those which by nature attract water, an effective mixture can be provided.

CHART 8

TURBIDITY AS A MEASURE OF QUALITY OF SUPERNATANTS AFTER 15 MINUTES AND 24 HOURS O SETTLING TIME RESPECTIVELY



[0068] A number of other similar tests were performed on various combinations of the above active ingredients and clarifying additives. In this connection, it will be realized that, as commercially obtained, each of the clarifying additives includes its own diluent, the character and extent of which varies depending on the exact nature of the clarifying additive. In some instances, the compositions are referred to as from 50 to 75% "active" ingredients, meaning that the sulfonic acids, resins, etc. are present in 50 to 70% of the additive composition. Some ingredients are present in much smaller proportions of the additives as a whole.

[0069] Since it is impractical to perform measurements in the absence of such diluent, the proportions given here may not be totally exact with respect to the active components of the additives. The percentages given are those applicable to the products as they are normally packaged and handled. Accordingly, some latitude in the appended claims is also indicated. Actually, a clarifying additive may be present in very small proportions. Thus, if the effective portion of a clarifying additive comprises only 10 or 20% of the entire weight of such additive, then, when an amount such as 0.1 parts per hundred (pph) of additive is used on an overall basis, the actual concentration would be 10 times less. By way of example, where 0.1 pph equals 1,000 ppm, in the case of a 10% active material, benefit could be obtained at levels of 100 ppm and less.

[0070] From the foregoing, it will be seen that the present invention provides a highly advantageous manner of extending the life of washing solvent by a novel action of concentrating the solvent in a lower layer and leaving the supernatant layer of improved quality.

[0071] A very unusual and advantageous aspect of the present invention is that even after creating the ability to cause the solvent to separate into separate layers, one of which is very clear, the active ingredient nevertheless appears to be partitioned in large measure into the supernatant layer.

[0072] Consequently, when the lower layer is discarded prior to recycling, the water, sediment, and the like are disposed of but the active ingredient remains largely in the supernatant layer where it can serve to continue to create a cleaned supernatant layer area. Because of the manner in which parts washers are customarily used, this is an extremely, important solvent-prolonging process that is highly favorable to not only economics but also to planetary ecology.

[0073] It will thus be seen that the present invention provides improved solvent compositions and methods having a number of advantages and characteristics, including those pointed out herein and others which are inherent in the invention.

[0074] A number of examples having been set forth by way of example, it is believed that variations and modifications to the described forms of invention will occur to those skilled in the art and that such changes may be made without departing from the scope of the appended claims.

Claims

1. A method of providing accelerated and enhanced settling of finely dispersed contaminants accumulating through use in a parts washing solvent, said parts washing solvent comprising not more than 20 percent aromatic solvent and the balance aliphatic and other solvents and said contaminants, said parts washing solvent having a flash point of at least 37.8°C (100°F); said method comprising treating said parts washing solvent with an additive composition to provide agglomeration and settling of contaminant particles creating turbidity in the parts washing solvent, said additive composition comprising at least one compound selected from the class consisting of aromatic, aliphatic and alkaryl sulfonic acids and sulfonic acid salts, and alkyl phenol formaldehyde resins modified so as to include alkoxy solubilizing groups forming a part thereof, and mixtures of said acids or acid salts and said resins, said treated solvent thus being capable of re-use for washing parts, said additive composition being added to the parts washing solvent in an amount to provide from 0.01 parts to 5 parts of said at least one compound per 100 parts of any solvent present after treatment.

2. A method as claimed in claim 1, wherein said alkoxy solubilizing groups are propoxy solubilizing groups.

3. A method as claimed in claim 1, wherein said alkoxy solubilizing groups are ethoxy solubilizing groups.

4. A method as claimed in any one of the preceding claims, wherein said alkyl phenol formaldehyde resins include C_3-C_{13} alkyl groups on the phenol group of said phenol formaldehyde resins.

5. A method as claimed in claim 4, wherein said C_3-C_{13} groups comprise butyl groups.

6. A method as claimed in claim 4, wherein said C_3-C_{13} groups comprise nonyl groups.

7. A method as claimed in any one of the preceding claims, wherein said parts washing solvent comprises at least 98% aliphatic hydrocarbons.

8. A method as claimed in any one of the preceding claims, wherein said parts washing solvent has a flashpoint of at least 60°C (140°F).

9. A method as claimed in any one of the preceding claims, wherein the parts washing solvent additionally comprises one or more compounds for promoting settlement or interface formation including C_{8-10} alcohols, diols, glycols, polyols, and/or glycol ethers.

10. A method as claimed in claim 9, wherein the one or more compounds include 2-ethyl-1,3-hexanediol, diethylene glycol mono-butyl ether and/or butyl ether.

11. A method as claimed in any one of the preceding claims, wherein the additive composition includes esterified polyols and/or a diluent.

12. A mineral spirits-based parts washing solvent composition, said composition comprising primarily aliphatic hydrocarbons and not more than 15 percent aromatic solvents, said composition having dispersed therein an additive composition adapted to accelerate settling of dispersed particles, said additive composition comprising an alkyl sulfonic acid and a mixture of alkoxylated lower-alkyl phenol-formaldehyde resins, wherein said lower-alkyl substituent is an alkyl substituent having from 4 to 11 carbon atoms, the alkyl sulfonic acid and the mixture of resins being present in a combined amount of from 0.01 up to 5.0 parts per 100 parts of solvent.

13. A composition as claimed in claim 12 wherein said resins comprise alkoxylated butyl phenol-formaldehyde resins and alkoxylated nonyl phenol-formaldehyde resins.

14. A composition as claimed in claim 12 or 13 wherein said additive composition is selected from the class consisting of ethoxylated nonyl phenol-formaldehyde resins, propoxylated nonyl phenol-formaldehyde resins, ethoxylated butyl phenol-formaldehyde resins and propoxylated butyl phenol-formaldehyde resins, said alkyl sulfonic acid having an alkyl group of from 4 to 20 carbon atoms.

15. A composition as claimed in any one of claims 12 to 14 wherein the parts washing solvent is as defined in any one of claims 7 to 10.

16. A method of cleaning parts using a parts washing solvent, said method including the steps of cleaning parts with a mass of parts washing solvent having a flashpoint of greater than 37.8°C (100°F) and comprising not more than 20% aromatic solvents and the remainder aliphatic and other solvents until said solvent suffers reduced visual clarity and attains a suspended particle concentration in excess of 500 ppm, and thereafter treating said solvent by a method as defined in any one of claims 1 to 11.

17. A method as claimed in claim 16 which further includes the steps of again cleaning parts until the onset of said reduced visual clarity and again treating said solvent by a method as claimed in any one of claims 1 to 11.

Patentansprüche

1. Verfahren zum Vorsehen von beschleunigtem und verbessertem Absetzen fein dispergierter Kontaminanten, die sich durch Verwendung in einem Teilewaschlösemittel ansammeln, wobei genanntes Teilewaschlösemittel nicht mehr als 20 Prozent aromatisches Lösemittel und den Rest aliphatische und andere Lösemittel und genannte Kontaminanten umfaßt, wobei genanntes Teilewaschlösemittel einen Flammpunkt von mindestens 37,8°C (100°F) aufweist; wobei genanntes Verfahren die Behandlung genannten Teilewaschlösemittels mit einer Additivzusammensetzung zum Vorsehen von Agglomeration und Absetzen von Kontaminantenteilchen umfaßt, die Trübung in dem Teilewaschlösemittel hervorrufen, wobei genannte Additivzusammensetzung mindestens eine Verbindung umfaßt, die aus der Klasse ausgewählt wird, die aus aromatischen, aliphatischen und Alkarylsulfonsäuren und Sulfonsäuresalzen und dergestalt modifizierten Alkylphenol-Formaldehydharzen besteht, damit sie einen Teil davon bildende Alkoxylöslichmachende Gruppen einschließen und Gemische von genannten Säuren oder sauren Salzen und genannten Harzen, wobei behandeltes Lösemittel folglich in der Lage ist, zum Waschen von Teilen wiederverwendet zu werden, wobei genannte Additivzusammensetzung zu dem Teilewaschlösemittel in einer Menge zugefügt wird, um von 0,01 Teilen bis 5 Teilen genannter mindestens einer Verbindung pro 100 Teilen von jedwedem nach der Behandlung vorliegendem Lösemittel vorzusehen.

2. Verfahren nach Anspruch 1, worin genannte Alkoxylöslichmachende Gruppen Propoxy-löslichmachende Gruppen sind.

3. Verfahren nach Anspruch 1, worin genannte Alkoxylöslichmachende Gruppen Ethoxy-löslichmachende Gruppen sind.

4. Verfahren nach einem der vorangehenden Ansprüche, worin genannte Alkylphenol-Formaldehydharze C_3-C_{13}-Alkylgruppen an der Phenolgruppe von genannten Phenol-Formaldehydharzen einschließen.

5. Verfahren nach Anspruch 4, worin genannte C_3-C_{13}-Gruppen Butylgruppen umfassen.

6. Verfahren nach Anspruch 4, worin genannte C_3-C_{13}-Gruppen Nonylgruppen umfassen.

7. Verfahren nach einem der vorangehenden Ansprüche, worin genanntes Teilewaschlösemittel mindestens 98% aliphatische Kohlenwasserstoffe umfaßt.

8. Verfahren nach einem der vorangehenden Ansprüche, worin genanntes Teilewaschlösemittel einen Flammpunkt von mindestens 60°C (140°F) aufweist.

9. Verfahren nach einem der vorangehenden Ansprüche, worin das Teilewaschlösemittel zusätzlich eine Verbindung oder mehrere Verbindungen zum Fördern des Absetzens oder der Grenzflächenbildung, einschließlich C_{8-10}-Alkoholen, Diolen, Glycolen, Polyolen und/oder Glycolethern umfaßt.

10. Verfahren nach Anspruch 9, worin die eine Verbindung oder mehrere Verbindungen 2-Ethyl-1,3-hexandiol, Diethylenglycol-monobutylether und/oder Butylether einschließen.

11. Verfahren nach einem der vorangehenden Ansprüche, worin die Additivzusammensetzung veresterte Polyole und/oder ein Verdünnungsmittel einschließt.

12. Auf Lösungsbenzin basierende Teilewaschlösemittel-Zusammensetzung, wobei genannte Zusammensetzung primär aliphatische Kohlenwasserstoffe und nicht mehr als 15 Prozent aromatische Lösemittel umfaßt, wobei genannte Zusammensetzung eine Additivzusammensetzung darin dispergiert aufweist, die angepaßt ist, um das Absetzen dispergierter Teilchen zu beschleunigen, wobei genannte Additivzusammensetzung eine Alkylsulfonsäure und ein Gemisch aus alkoxylierten niederen Alkylphenol-Formaldehydharzen umfaßt, worin genannter niederer Alkylsubstituent ein Alkylsubstituent mit von 4 bis 11 Kohlenstoffatomen ist, wobei die Alkylsulfonsäure und das Gemisch aus Harzen in einer kombinierten Menge von 0,01 bis zu 5,0 Teilen pro 100 Teilen Lösemittel vorliegt.

13. Zusammensetzung nach Anspruch 12, worin genannte Harze alkoxylierte Butylphenol-Formaldehydharze und alkoxylierte Nonylphenol-Formaldehydharze umfassen.

14. Zusammensetzung nach Anspruch 12 oder 13, worin genannte Additivzusammensetzung aus der Klasse ausgewählt wird, die aus ethoxylierten Nonylphenol-Formaldehydharzen, propoxylierten Nonylphenol-Formaldehydharzen, ethoxylierten Butylphenol-Formaldehydharzen und propoxylierten Butylphenol-Formaldehydharzen bestehen, wobei genannte Alkylsulfonsäure eine Alkylgruppe von 4 bis 20 Kohlenstoffatomen aufweist.

15. Zusammensetzung nach einem der Ansprüche 12 bis 14, worin das Teilewaschlösemittel wie nach einem der Ansprüche 7 bis 10 definiert ist.

16. Verfahren zum Reinigen von Teilen unter Verwendung eines Teilewaschlösemittels, wobei genanntes Verfahren die Schritte der Reinigung von Teilen mit einer Masse von Teilewaschlösemittel mit einem Flammpunkt von größer als 37,8°C (100°F) aufweist und nicht mehr als 20% aromatische Lösemittel und den Rest aliphatische und andere Lösemittel umfaßt, bis genanntes Lösemittel eine reduzierte visuelle Klarheit erleidet und eine suspendierte Teilchenkonzentration von über 500 ppm erreicht und wobei genanntes Lösemittel danach anhand eines Verfahrens wie nach einem der Ansprüche 1 bis 11 definiert behandelt wird.

17. Verfahren nach Anspruch 16, das überdies die Schritte der erneuten Reinigung von Teilen, bis zum Beginn genannter reduzierter visueller Klarheit einschließt und wobei genanntes Lösemittel anhand eines Verfahrens nach einem der Ansprüche 1 bis 11 erneut behandelt wird.

Revendications

1. Procédé pour fournir une sédimentation accélérée et améliorée de contaminants finement dispersés s'accumulant par l'emploi dans un solvant de lavage de pièces, ledit solvant de lavage de pièces ne comprenant pas plus de 20 pour cent de solvant aromatique et la balance en solvants aliphatiques et autres et en lesdits contaminants, ledit solvant de lavage de pièces ayant un point d'éclair d'au moins 37,8°C (100°F); ledit procédé comprenant traiter ledit solvant de lavage de pièces avec une composition d'addition pour fournir l'agglomération et la sédimentation des particules de contaminants créant une turbidité dans le solvant de lavage de pièces, ladite composition d'addition comprenant au moins un composé sélectionné à partir de la classe consistant en acides aromatiques, aliphatiques et alcaryle sulfoniques et en sels d'acide sulfonique, et en résines formaldéhyde alkyle phénol modifiées de manière à inclure des groupes de solubilisation alcoxy formant une partie de celle-ci, et des mélanges desdits acides ou sels d'acide et desdites résines, ledit solvant traité étant ainsi capable d'être réutilisé pour laver des pièces, ladite composition d'addition étant ajoutée au solvant de lavage de pièces selon une quantité afin de fournir de 0,01 partie à 5 parties dudit au moins un composé pour 100 parties de tout solvant présent après le traitement.

2. Procédé tel que revendiqué dans la revendication 1, dans lequel lesdits groupes de solubilisation alcoxy sont des

groupes de solubilisation propoxy.

3. Procédé tel que revendiqué dans la revendication 1, dans lequel lesdits groupes de solubilisation alcoxy sont des groupes de solubilisation éthoxy.

4. Procédé tel que revendiqué dans l'une quelconque des revendications précédentes, dans lequel lesdites résines formaldéhyde alkyle phénol incluent des groupes alkyle C_3-C_{13} sur le groupe phénol desdites résines formaldéhyde phénol.

5. Procédé tel que revendiqué dans la revendication 4, dans lequel lesdits groupes C_3-C_{13} comprennent des groupes butyliques.

6. Procédé tel que revendiqué dans la revendication 4, dans lequel lesdits groupes C_3-C_{13} comprennent des groupes nonyliques.

7. Procédé tel que revendiqué dans l'une quelconque des revendications précédentes, dans lequel ledit solvant de lavage de pièces comprend au moins 98% d'hydrocarbures aliphatiques.

8. Procédé tel que revendiqué dans l'une quelconque des revendications précédentes, dans lequel ledit solvant de lavage de pièces a un point d'éclair d'au moins 60°C (140°F).

9. Procédé tel que revendiqué dans l'une quelconque des revendications précédentes, dans lequel le solvant de lavage de pièces comprend en outre un ou plusieurs composés pour favoriser la sédimentation ou la formation d'une interface incluant des alcools $C_{8\text{-}10}$, des diols, des glycols, des polyols et/ou des éthers glycoliques.

10. Procédé tel que revendiqué dans la revendication 9, dans lequel l'un ou les plusieurs composés incluent le 2-éthyle-1,3-hexanediol, l'éther mono-butylique de diéthylène-glycol et/ou l'éther butylique.

11. Procédé tel que revendiqué dans l'une quelconque des revendications précédentes, dans lequel la composition d'addition inclut des polyols estérifiés et/ou un diluant.

12. Composition de solvant de lavage de pièces à base d'alcools dénaturés, ladite composition comprenant essentiellement des hydrocarbures aliphatiques et pas plus de 15 pour cent de solvants aromatiques, ladite composition ayant une composition d'addition dispersée dans celle-ci adaptée pour accélérer la sédimentation de particules dispersées, ladite composition d'addition comprenant un acide alkyle sulfonique et un mélange de résines alkyle inférieur formaldéhyde phénol alcoxylées, dans lesquelles ledit substituant alkyle inférieur est un substituant alkyle ayant de 4 à 11 atomes de carbone, l'acide alkyle sulfonique et le mélange de résines étant présents selon une quantité combinée de 0,01 jusqu'à 5,0 parties pour 100 parties de solvant.

13. Composition telle que revendiquée dans la revendication 12, dans laquelle lesdites résines comprennent des résines formaldhéhyde butyle phénol alcoxylées et des résines formaldéhyde nonyle phénol alcoxylées.

14. Composition telle que revendiquée dans la revendication 12 ou 13, dans laquelle ladite composition d'addition est sélectionnée à partir de la classe consistant en résines formaldéhyde nonyle phénol éthoxylées, en résines formaldéhyde nonyle phénol propoxylées, en résines formaldéhyde butyle phénol éthoxylées et en résines formaldéhyde butyle phénol propoxylées, ledit acide alkyle sulfonique ayant un groupe alkyle de 4 à 20 atomes de carbone.

15. Composition telle que revendiquée dans l'une quelconque des revendications 12 à 14, dans laquelle le solvant de lavage de pièces est tel que défini dans l'une quelconque des revendications 7 à 10.

16. Procédé de nettoyage de pièces utilisant un solvant de lavage de pièces, ledit procédé incluant les étapes consistant à nettoyer des pièces avec une masse de solvant de lavage de pièces ayant un point d'éclair supérieur à 37,8°C (100°F) et ne comprenant pas plus de 20% de solvants aromatiques et le reste en solvants aliphatiques et autres jusqu'à ce que ledit solvant subisse un clarté visuelle réduite et atteigne une concentration de particules en suspension de plus de 500 ppm, et traiter ensuite ledit solvant par un procédé tel que défini dans l'une quelconque des revendications 1 à 11.

17. Procédé tel que revendiqué dans la revendication 16 qui inclut en outre les étapes consistant à nettoyer de nouveau des pièces jusqu'à l'apparition d'une clarté visuelle réduite et de traiter de nouveau ledit solvant par un procédé tel que revendiqué dans l'une quelconque des revendications 1 à 11.