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(71) Applicant: UNILEVER NV
Burgemeester s'Jacobplein 1 P.O. Box 760
NL-3000 DK Rotterdam(NL)
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Applicant: UNILEVER PLC
Unilever House Blackfriars P.O. Box 68
London EC4P 4BQ(GB)
(84) GB

(72) Inventor: van Amerongen, Jacob
Clara Peeterslaan 5
NL-3723 PK Bilthoven(NL)
Inventor: van der Linden, Arie
Fazantenkamp 257
NL-3667 CM Maarssen(NL)

(74) Representative: Kan, Jacob Hendrik, Dr. et al
Unilever N.V. Patent Division P.O. Box 137
NL-3130 AC Vlaardingen(NL)

(54) Heavy duty washing process.

(57) A heavy duty process for laundering greasy stains from a fabric which comprises treating the fabric with an aqueous detergent composition comprising (a) 0.5 - 5 % by weight of a nonionic surfactant and (b) 1 - 10 % by weight of an apolar solvent in a ratio from less than 1 : 1 to 1 : 10. Preferably, the hot wash liquor is treated in a filtering step using microfilters to separate the organic solvent phase from the aqueous phase, which is then recycled.

DETERGENT COMPOSITIONS AND THEIR USE IN A HEAVY DUTY WASHING PROCESS

The present invention relates to detergent compositions and their use in a washing process, more in particular, an industrial heavy duty washing process for laundering greasy stains from a fabric.

It has always been difficult to obtain satisfactory results when washing heavily soiled articles such as overalls stained with grease or motor oil. Good results can be obtained using chlorinated hydrocarbons as solvent in a dry-cleaning process, although there is a tendency for the workwear to show some greying and to have a harsh feel. However, the use of chlorinated hydrocarbons is becoming more and more restricted for environmental reasons.

Furthermore, it has been described in the British patent specification 1,518,676 to remove oily stains from fabrics by means of a composition comprising a nonionic and an organic solvent in a weight ratio in the range of 1 : 1 to 100 : 1. In this process the soiled fabric is treated with an aqueous solution containing 0.01 to 2 % by weight of said composition at a temperature above the phase coalescence temperature. A draw-back of this process is the large amount of organic waste containing waste water.

It is an object of the present invention to provide improvements on the wash process as described in the British patent 1,518,676.

We have now found that one or more of these objects can be achieved by the process according to the present invention, which is characterized in that the soiled fabric is treated with an aqueous detergent composition comprising (a) 0.5 to 5 % by weight of a nonionic surfactant, (b) 1 to 10 % by weight of an apolar organic solvent, whereby the ratio of (a) to (b) is from less than 1 : 1 to 1 : 10, preferably from less than 1 : 1 to 1 : 5.

Suitable nonionic surfactants which may be used include the reaction products of compounds having a hydrophilic group and a reactive hydrogen atom, for example aliphatic alcohols, acids, amides or alkyl phenols with alkylene oxides, especially ethylene oxide either alone or in combination with propylene oxide and/or butylene oxide. Specific nonionic detergent compounds are alkyl (C_6-C_{22}) phenols-ethylene oxide condensates, the condensation products of aliphatic (C_8-C_{18}) primary or secondary linear or branched alcohols with ethylene oxide, and products made by condensation of ethylene oxide with the reaction products of propylene oxide and ethylenediamine. So-called "capped" nonionics are also suitable. Other suitable nonionic surfactants include long chain tertiary amine oxides, long chain tertiary phosphine oxides and dialkyl sulphoxides.

Preferably, the nonionic surfactant is an alkoxylated fatty alcohol, wherein the alcohol is a primary or secondary branched or linear alkanol having 10 to 16 carbon atoms. The alkoxy moiety consists of 3 to 10 ethoxy groups, propoxy groups and/or butoxy groups. The hydrophilic lipophilic balance (HLB) of the nonionic surfactant, defined as one fifth of the weight percentage of alkylene oxide in the nonionic, is chosen in the range of 10 to 14.

The apolar organic solvent may be an alkane, an alkanol, a low-EO nonionic, etc., or a mixture thereof. Suitable alkanols contain 6 to 18 carbon atoms. A low-EO nonionic is for the purpose of this invention defined as a fatty alcohol, alkoxylated with less than 3 ethoxy groups. The apolar organic solvent is preferably an aliphatic linear alkane or a mixture of alkanes having 8 to 16 carbon atoms, preferably 11 to 13 carbon atoms. An attractive commercially available solvent is kerosine.

The detergent composition of the invention may comprise other ingredients which are usual for washing processes such as builders, alkaline agents to maintain a pH value in the range of 8 to 13, preferably of 10 to 12. Bleaching agents, etc. may also be present.

The builder may be any material capable of reducing the level of free calcium ions in the wash liquor and will preferably at the same time provide other beneficial properties such as the generation of an alkaline pH or the suspension of soil removed from the fabric. The builders may be inorganic such as tripolyphosphates or zeolites, organic non-polymeric such as nitrilotriacetic acid, or organic polymeric such as copolymers of acrylic acid and maleic acid. The builder is preferably present in an amount of 0.25 to 2 % by weight of the composition.

In the process for laundering fabrics according to the present invention, the heavily soiled fabric is treated with the above mentioned detergent composition. The amount of detergent composition is relatively high, i.e. in the order of 0.5 to 5 kg per kg soiled fabric. Preferably, 1.5 to 2.5 kg per kg fabric is used. The process of the invention can be carried out in any suitable washing machine, such as a wash extractor or a tunnel washer.

The washing process may be preceded by a pre-rinse to remove loose dirt and soluble material. The actual wash process may comprise more than one wash cycle. It is preferably carried out at elevated temperatures. It was found to be particularly effective to first raise the temperature to above the so-called phase coalescence temperature, which is usually around 55 °C, and then cycle around this temperature at least two times. After a sufficiently long period to complete the washing action of the detergent composition, usually in the order of 10 minutes, the wash liquor is pumped off. After one or more rinse cycles, the wash load is removed for further processing.

According to a further aspect of the present invention, the used wash liquor containing suspended soil and emulgated grease and/or oil can be recycled instead of being pumped to the sewage system. The water of the pre-rinse and the first rinse cycle may be combined and treated in the same way.

Although it is particularly useful to apply the recycling step to a wash process involving the aqueous detergent compositions according to the invention, the recycling step can also be used in combination with similar aqueous detergent compositions having a different nonionic to solvent ratio. For example, the aqueous detergent composition may comprise (a) 0.5 - 5 % by weight of a nonionic surfactant and (b) 1 - 10 % by weight of an apolar organic solvent, whereby the ratio of (a) to (b) is 1 : 1 to 100 : 1.

It was found to be advantageous to dump the hot wash liquor from the process into a storage tank from which it is gradually pumped to a filtration unit comprising one or more microfilters. In this unit the wash liquor is continuously filtered under a pressure of approximately 0.5 - 3 bar. The unit is preferably operated in a cross-flow mode to avoid clogging of the filter. The aqueous phase containing virtually all of the water soluble components is separated from the phase containing the organic solvent, the suspended solid and the emulgated oil and/or grease, and can be recycled. The phase containing the oil and most of the organic apolar solvent can now be distilled to recover the organic solvent, or further treated to reduce the waste. Considerable savings in energy and chemicals can thus be achieved. The process is also advantageous from an environmental point of view because the amount of waste to be disposed off can be greatly reduced.

It is preferred to use hydrophilic microfilters in the present process. The aqueous phase passes through the filter and can be continuously recycled to the wash process. The retentate contains increasing amounts of oil and at a sufficiently high concentration the emulsion becomes unstable. Sometimes the emulsion will even break and a layer of oil will separate. After a certain amount of time, for instance at the end of a working day, the filtration process can be stopped and the retentate can be removed for distillation, disposal or further treatment. Preferably, the retentate has first been concentrated to a water content of 50 to 70 % by weight.

The microfilters to be used in the process of the invention can be made of any suitable material, provided that it is capable of withstanding elevated temperatures of up to 100 °C and highly alkaline wash liquors, having pH values of up to 14. It should thereby also retain its hydrophilic properties. We found that microfilters having a pore size of 50 - 1000 nm, preferably approximately 100 nm and made of a mixture of polyethersulphon and polyvinylpyrrolidon, are exceptionally suitable. The microfilters are preferably constructed of capillary tubes having an external diameter of 1 to 10 mm. Such filters are commercially available, for instance from X-flow, Enschede, The Netherlands.

The invention will now be further illustrated by means of the following non-limiting example.

EXAMPLE

The following heavy duty wash process was carried out. 400 kg overalls, heavily soiled with motor oil and greasy stains were placed in a Milnor wash extractor. The load was pre-rinsed to remove any sand and other loose dirt. The rinse water could be disposed off directly to the sewage system, as it was not noticeably polluted. Subsequently, the wash load was treated for 10 minutes at a temperature of 60 °C with 1000 l of an aqueous detergent composition containing 3 % by weight paraffin (ex Shell), 1.5 % by weight of a nonionic mixture consisting of Dobanol 25-3 and 25-9 in a ratio of 1 : 2.5 (ex Shell), 0.45 % by weight sodium tripolyphosphate, 1.4 % by weight sodium metasilicate and 0.25 % by weight sodium hydroxide. The pH was adjusted to 11.8. After this first main wash, the hot wash liquor was pumped off to a thermally insulated waste water storage tank having a capacity of 5.5 m^3. The wash process was then repeated using the same amount of detergent composition, whereby no paraffin was used and the amount of nonionic was raised to 3 % by weight. Again, the hot wash liquor was transferred to the waste water storage tank. Thereafter, the was load as rinsed using 3.2 m^3 water. The rinsing was repeated twice, whereby only the water from the first rinse was pumped to the waste water storage tank. The amount of chemicals and solvent in the water of the second rinse was so low that it could be dumped to the sewage system. After drying, the wash load was inspected and it was found that and excellent cleaning result had been obtained, as substantially all greasy had been removed. The combined waste water in the waste water storage tank was continuously pumped to a thermally insulated circulation tank having a capacity of approximately 5 m^3. From this tank, the water was pumped under a pressure of 2 bar to a microfiltration unit equipped with hydrophilic microfilters made of a mixture of polyethersulphon and polyvinylpyrrolidon, having a pore size of 100 nm. The filters were obtained from X-flow, Enschede, The Netherlands. The total surface area of the unit was 50 m^2 and it had a maximum capacity of about 5000 l/hour. The filtration unit was operated in a cross-flow mode. The permeate contained water, nonionic and salts and was substantially free from organic solvent. It was pumped to a permeate storage tank having a capacity of about 5 m^3 from which it could be used again in the wash process. It proved to be advantageous to supplement the permeate with some of the detergent composition after each cycle, to compensate for the detergent components consumed in the wash cycle in removing the soil. The retentate was then fed to a distillation unit and the freshly distilled solvent was also used again in the was process. Overnight the liquor in the circulation tank was concentrated to a water content of approximately 50 % by weight, whereby gel formation was observed. This concentrate was finally disposed off.

Claims

1. Aqueous detergent composition comprising:
(a) 0.5 - 5 % by weight of a nonionic surfactant; and
(b) 1 - 10 % by weight of an apolar organic solvent; whereby the ratio of (a) to (b) is from less than 1 : 1 to 1 : 10.

2. Detergent composition according to Claim 1, wherein the nonionic surfactant is an alkoxylated fatty alcohol.

3. Detergent composition according to Claim 1, wherein the organic solvent is an aliphatic hydrocarbon having 8-16 carbon atoms.

4. Detergent composition according to Claim 1, wherein the organic solvent is an aliphatic hydrocarbon having 11-13 carbon atoms.

5. Detergent composition according to Claim 1, further comprising 0.25 to 2 % by weight of a detergency builder.

6. Detergent composition according to Claim 1, having a pH in the range of 8 to 13, preferably from 10 to 12.

7. Process for laundering greasy stains from a fabric which comprises treating the fabric with an aqueous detergent composition comprising:
(a) 0.5 - 5 % by weight of a nonionic surfactant; and
(b) 1 - 10 % by weight of an apolar organic solvent; whereby the ratio of (a) to (b) is from less than 1 : 1 to 1 : 10.

8. Process according to Claims 7, whereby the hot wash liquor is treated in a filtering step using microfilters to separate the organic solvent phase from the aqueous phase, which is then recycled.

9. Process for laundering greasy stains from a fabric which comprises treating the fabric with an aqueous detergent composition comprising:
(a) 0.5 - 5 % by weight of a nonionic surfactant; and
(b) 1 - 10 % by weight of an apolar organic solvent; whereby the ratio of (a) to (b) is 1 : 1 to 100 : 1, whereby the hot wash liquor is treated in a filtering step using microfilters to separate the organic solvent phase from the aqueous phase, which is then recycled.

10. Process according to any one of Claims 8 or 9, whereby the wash temperature is raised to above the phase coalescence temperature.

11. Process according to any one of Claims 8 or 9, whereby the filters are hydrophilic microfilters.

12. Process according to any one of Claims 8 or 9, whereby the filters are made of a mixture of polyethersulphon and polyvinylpyrrolidon, and have a pore size of 50 to 1000 nm, preferably of approximately 100 nm.