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(54) **Rhamnolipids with improved cleaning**

(57) A cleaning composition comprising mono-rhamnolipid and di-rhamnolipid, characterised in that the ratio of the total wt% of mono-rhamnolipid to the total wt% of di-rhamnolipid lies in the range 95:5 to 45:55.

**EP 2 410 039 A1**

**Description**TECHNICAL FIELD

5 **[0001]** This invention relates to cleaning compositions comprising rhamnolipid having components di-rhamnolipids and mono-rhamnolipids.

BACKGROUND

10 **[0002]** Rhamnolipids are a class of glycolipid. They are constructed of rhamnose combined with beta-hydroxy fatty acids. Rhamnose is a sugar. Fatty acids are ubiquitous in animals and plants. The carboxyl end of the fatty acid end is connected to the rhamnose. Rhamnolipids are compounds of only three common elements; carbon, hydrogen, and oxygen. They are a crystalline acid. Rhamnolipids may be produced by strains of the bacteria *Pseudomonas aeruginosa*. There are two major groups of rhamnolipids; mono-rhamnolipids and di-rhamnolipids.

15 **[0003]** Mono-rhamnolipids have a single rhamnose sugar ring. A typical mono-rhamnolipid produced by *P. aeruginosa* is L-rhamnosyl-β-hydroxydecanoyl-β-hydroxydecanoate (RhaC<sub>10</sub>C<sub>10</sub>). It may be referred to as Rha-C<sub>10</sub>-C<sub>10</sub>, with a formula of C<sub>26</sub>H<sub>48</sub>O<sub>9</sub>. Mono-rhamnolipids have a single rhamnose sugar ring. The IUPAC Name is 3-[3-[(2R,3R,4R,5R,6S)-3,4,5-trihydroxy-6-methyloxan-2-yl]oxydecanoyloxy]decanoic acid.

20 **[0004]** Di-rhamnolipids have two rhamnose sugar rings. A typical di-rhamnolipid is L-rhamnosyl-L-rhamnosyl-β-hydroxydecanoyl-β-hydroxydecanoate (Rha<sub>2</sub>C<sub>10</sub>C<sub>10</sub>). It may be referred to as Rha-Rha-C<sub>10</sub>-C<sub>10</sub>, with a formula of C<sub>32</sub>H<sub>58</sub>O<sub>13</sub>. The IUPAC name is 3-[3-[4,5-dihydroxy-6-methyl-3-(3,4,5-trihydroxy-6-methyloxan-2-yl)oxyoxan-2-yl]oxydecanoyloxy]decanoic acid.

25 **[0005]** In practice a variety of other minor components with different alkyl chain length combinations, depending upon carbon source and bacterial strain, exist in combination with the above more common rhamnolipids. The ratio of mono-rhamnolipid and di-rhamnolipid may be controlled by the production method. Some bacteria only produce mono-rhamnolipid, see US5767090: Example 1, some enzymes can convert mono-rhamnolipid to di-rhamnolipid.

30 **[0006]** In various publications mono-rhamnolipids have the notation Rha-, which may be abbreviated as Rh or RL2. Similarly di-rhamnolipids have the notation Rha-Rha or Rh-Rh- or RL1. For historical reasons "rhamnolipid 2" is a mono-rhamnolipid and "rhamnolipid 1" is a di-rhamnolipid. This leads to some ambiguity in the usage or "RL1" and "RL2" in the literature. Throughout this patent specification, we use the terms mono- and di-rhamnolipid in order to avoid this possible confusion. However, if abbreviations are used R1 is mono-rhamnolipid and R2 is di-rhamnolipid. For more information on the confusion of terminology in the prior art see the introduction to US 4814272.

**[0007]** The following rhamnolipids have been detected as produced by the following bacteria: (C12:1, C14:1 indicates fatty acyl chains with double bonds).

35 **[0008]** Rhamnolipids produced by *P. aeruginosa* (mono-rhamnolipids):

Rha-C<sub>8</sub>-C<sub>10</sub>, Rha-C<sub>10</sub>-C<sub>8</sub>, Rha-C<sub>10</sub>-C<sub>10</sub>, Rha-C<sub>10</sub>-C<sub>12</sub>, Rha-C<sub>10</sub>-C<sub>12:1</sub>, Rha-C<sub>12</sub>-C<sub>10</sub>, Rha-C<sub>12:1</sub>-C<sub>10</sub> Rhamnolipids produced by *P. aeruginosa* (di-rhamnolipids):

40 Rha-Rha-C<sub>8</sub>-C<sub>10</sub>, Rha-Rha-C<sub>8</sub>-C<sub>12:1</sub>, Rha-Rha-C<sub>10</sub>-C<sub>8</sub>, Rha-Rha-C<sub>10</sub>-C<sub>10</sub>, Rha-Rha-C<sub>10</sub>-C<sub>12:1</sub>, Rha-Rha-C<sub>10</sub>-C<sub>12</sub>, Rha-Rha-C<sub>12</sub>-C<sub>10</sub>, Rha-Rha-C<sub>12:1</sub>-C<sub>12</sub>, Rha-Rha-C<sub>10</sub>-C<sub>14:1</sub>

Rhamnolipids produced by *P. aeruginosa* (unidentified as either mono- or di-rhamnolipids):

45 C<sub>8</sub>-C<sub>8</sub>, C<sub>8</sub>-C<sub>10</sub>, C<sub>10</sub>-C<sub>8</sub>, C<sub>8</sub>-C<sub>12:1</sub>, C<sub>12:1</sub>-C<sub>8</sub>, C<sub>10</sub>-C<sub>10</sub>, C<sub>12</sub>-C<sub>10</sub>, C<sub>12:1</sub>-C<sub>10</sub>, C<sub>12</sub>-C<sub>12</sub>, C<sub>12:1</sub>-C<sub>12</sub>, C<sub>14</sub>-C<sub>10</sub>, C<sub>14:1</sub>-C<sub>10</sub>, C<sub>14</sub>-C<sub>14</sub>.

Rhamnolipids produced by *P. chlororaphis* (mono-rhamnolipids only):

50 Rha-C<sub>10</sub>-C<sub>8</sub>, Rha-C<sub>10</sub>-C<sub>10</sub>, Rha-C<sub>12</sub>-C<sub>10</sub>, Rha-C<sub>12:1</sub>-C<sub>10</sub>, Rha-C<sub>12</sub>-C<sub>12</sub>, Rha-C<sub>12:1</sub>-C<sub>12</sub>, Rha-C<sub>14</sub>-C<sub>10</sub>, Rha-C<sub>14:1</sub>-C<sub>10</sub>.

Rhamnolipids produced by *Burkholdera pseudomallei* (di-rhamnolipids only):

55 Rha-Rha-C<sub>14</sub>-C<sub>14</sub>.

Rhamnolipids produced by *Burkholdera (Pseudomonas) plantarii* (di-rhamnolipids only): Rha-Rha-C<sub>14</sub>-C<sub>14</sub>.

**[0009]** Because rhamnolipids are produced in various chemical formulas, each with a different HLB, it is known that rhamnolipids can be produced or mixed to have a range of foaming properties.

**[0010]** Rhamnolipids are an anionic surfactant with both hydrophilic end and a lipophilic end. When their concentration increases to a certain level it is known that the rhamnolipids join together inside a liquid in a micelle.

**[0011]** It has been suggested that rhamnolipids with two shorter fatty acids are more active in reducing surface tension and as an emulsifier. Those rare rhamnolipids with a single fatty acid chain are not as effective.

**[0012]** The bacterium *Pseudomonas aeruginosa* is found naturally in soils, in water, and on plants. Metabolically, *P. aeruginosa* is chemoheterotrophic, generally aerobic, utilizing a wide range of organic compounds for sources of carbon and nitrogen.

**[0013]** There are over 100 strains of *P. aeruginosa* on file at the American Type Culture Collection (ATCC). There are also a number of strains that are only available to manufacturers of commercial Rhamnolipids. Additionally there are probably thousands of strains isolated by various research institutions around the world. Some work has gone into typing them into groups. Each strain has different characteristics including how much rhamnolipid is produced, which types of rhamnolipids are produced, what it metabolizes, and conditions in which it grows. Only a small percentage of the strains have been extensively studied.

**[0014]** Through evaluation and selection, strains of *P. aeruginosa* can be isolated to produce rhamnolipids at higher concentrations and more efficiently. Strains can also be selected to produce less byproduct and to metabolize different feedstock or pollutants. This production is greatly affected by the environment in which the bacterium is grown.

**[0015]** Various documents have proposed to use Rhamnolipids in detergent compositions.

US 2004/0152613 A1 (Ecover), also EP1445302, describe compositions including those having mixtures of Rhamnolipid surfactants and synthetic conventional surfactants, both in the micellar phase. From the footnotes to Tables 1-4 of this document it is said that the examples and comparative examples used JBR425, A 25% active material rhamnolipid from Jeneil, which is a 25% active liquid. The document does not give the ratio of mono-rhamnolipid: di-rhamnolipid. From para 0057, Fig 1 shows synergy between this Rhamnolipid and a C12-14 fatty alcohol sulphate (SLS). 5:1 SLS/Rhamnolipid was shown to have better detergency than 3:3 SLS/Rhamnolipid at the same total active level. According to paragraph 0036 alternative anionic surfactants may include C<sub>10-13</sub> linear alkylbenzene sulphonate. From Example 5 (the only one relating to laundry) it seems that the surfactant system was tested by adding it to a conventional laundry base powder comprising zeolite builder and other additives.

**[0016]** Wang et al "Engineering bacteria for production of rhamnolipid as an agent for enhanced oil recovery", Bio-technol. Bioeng., 98, 842-853, 2007 published an analysis of a Jeneil JBR425 sample dating from some time before 2007 (page 849). We also analysed a sample of JBR425 in early 2007 and our analysis showed a very different composition from that published by Wang. We obtained a ratio of mono-rhamnolipid to di-rhamnolipid of 30:70 whereas Wang's analysis seems to show that amount of mono-rhamnolipid was 45% and the amount of di-rhamnolipid was 55%. Our analysis is given in Table 1 below. Both analyses agree that there is more di-rhamnolipid than mono-rhamnolipid. We believe that the ratio is higher than 2:1.

**[0017]** For our analysis of this prior art Rhamnolipid a known amount of JBR425 was acidified to pH 3 using 12M HCl and placed in a refrigerator overnight. The supernatant was then extracted three times using a 2:1 mixture of Chloroform and Ethanol. The solvent was then removed by rotary evaporation and the isolated rhamnolipid mixture was then re-dissolved in methanol.

**[0018]** The process of separating and characterising the mixture was carried out using an HPLC connected to an Ion Trap Electrospray ionisation Mass Spectrometer. The mode of ionisation was in negative mode with a scanning range of 50-1200Da. The column used to separate was a Phenomenex luna C18 250 x 4.6mm 5 µm column. The mobile phase: water (mobile phase A) and acetonitrile (mobile phase B) were used to separate via a gradient of 60:40 (A:B) changing to 30:70 (A:B) over 30 minutes. The system was then held for 5 minutes before returning to the start conditions all at a flow rate of 0.5ml/min. The injection volume was 10 µl.

Table 1 - Analysis of JBR425 via HPLC/MS

| Rhamnolipid Congeners | m/z | %     |
|-----------------------|-----|-------|
| Di - C10-C8           | 621 | 1.6   |
| Di- C8-C10            | 621 | 1.3   |
| Di - C10-C10          | 649 | 67.4  |
| Di - C10-C12:1        | 675 | 0.78  |
| Di - C12:1-C10        | 675 | 0.016 |
| Di - C10-C12          | 677 | 3.18  |

(continued)

| Rhamnolipid Congeners | m/z | %     |
|-----------------------|-----|-------|
| Di - C12-C10          | 677 | 1.12  |
| Mono - C10-C8         | 475 | 0.63  |
| Mono - C8-C10         | 475 | 0.47  |
| Mono C10-C10          | 503 | 21.6  |
| Mono - C10-C12:1      | 529 | 0.69  |
| Mono -C12:1-C10       | 529 | 0.014 |
| Mono C10-C12          | 531 | 1.12  |
| Mono -C12-C10         | 531 | 0.023 |

**[0019]** US 5417879 A1 (Unilever) suggests a mixed micellar Glycolipid and lamellar surfactant composition, that can be either glycolipid, or not. Compositions are proposed for use at 0.5 to 50 g/l. Examples 1 and 2 used a Rhamnolipid material with n=10 i.e. C14, derived from *pseudomonas glumae*, the nutrient source used was glucose and glycerol. 1 g/l total surfactant was made up of mixtures of various ratios of rhamnolipid with synthetic nonionic surfactant (ethoxylated dodecyl alcohol) for example 1 and synthetic anionic surfactant (di C8 alkyl sulphosuccinates) for example 2. Triolein was removed with mixtures of Rhamnolipid and other surfactant from 100:0 to 0:100 in ratio increments of 20. The nonionic surfactant used with the Rhamnolipid in example 1 clearly outperformed the anionic used with it in example 2, at all ratios. Example 3, used a n=6 Rhamnolipid material (C10), called BioEm-LKP from Petrogen. The mono and di-Rhamnolipids are said to be present in equal weight ratio. Example 3 used this Rhamnolipid with nonionic surfactant. The results show poorer removal of triolein than was obtained with the Rhamnolipid of Example 1 (and 2).

**[0020]** Example 4 provides further data about combinations of nonionic surfactant and rhamnolipids. Two rhamnolipids are used: RL-BNS n=10 is probably the one used in example 1 (ratio mono-rhamnolipid: di-rhamnolipid not given). Table 5 shows that shorter chain length BioEm-LKP outperforms the RL-BNS on a weight for weight basis (more moles used) for EMPA 104 (Indian ink with olive oil on cotton polyester). However, on WFK20D (mixed particulates in sebum on cotton polyester) the longer chain material was superior (as it was in examples 1 and 3), despite being used at a lower molar concentration. It is not possible to determine from the information in this document if this could have been due to the ratio of mono:di rhamnolipids in the samples. There is no data for beef fat. Tests were all carried out using a 0.5g/l dried rhamnolipid/standard surfactant blend.

**[0021]** EP499434, Unilever, makes a very similar disclosure - See Examples 2, 3. Example 3 discloses that the rhamnolipid used is roughly 50:50 wt:wt mono to di rhamnolipid. The rhamnolipid was again not used with anionic surfactant.

**[0022]** From our analysis carried out in 2007 and from more recent analysis of commercially available Rhamnolipids from *pseudomonas aeruginosa*, where both mono- and di-rhamnolipids are produced, the mix is generally di-rhamnolipid (R2) dominated.

**[0023]** US5654192, (Institute Francaise du Petrole) uses a mixture of sulphosuccinate surfactant with di- and mono rhamnolipid (excess di-rhamnolipid) in Example 5.

**[0024]** DE19600743A discloses the use of mixtures of glycolipids (I) and surfactants (II) for the production of hand dish-washing detergents. Preferably, (I) are selected from rhamnose glucose sophorose trehalose and/or cellobiose lipids. (II) are anionic non-ionic and/or amphoteric or zwitterionic surfactants. The (I):(II) weight ratio is 10:90-90:10 and the total amount of (I) and (II) is 5-50 wt% of the detergent. Some examples used A1 (a 100% mono-rhamnolipid with only one carboxylate repeat). It was used with APG, SLES, SLS and betaine.

**[0025]** US 4814272 discloses specific ratios of mono- and di-rhamnolipids. Table 1 shows the influence of nutrient supply on the ratio of mono-rhamnolipid to di-rhamnolipid production for this strain of bacterium. Using glycerine the di-rhamnolipid predominates whereas using n-paraffin the amounts of mono-rhamnolipids are in the majority. Likewise, the incubation temperature affects the ratio, as shown in table 2. The rhamnolipids so produced are said to be suitable for tertiary flooding of petroleum deposits. Others have since commented that the mono carboxylate mono-rhamnolipids (III) disclosed in this document are ineffective surfactants. Example 1 makes equal weight ratio of mono-rhamnolipid and di-rhamnolipid. There is no suggestion that this equal ratio material is preferred or that it could be used in a detergent composition.

SUMMARY OF THE INVENTION

**[0026]** According to the present invention there is provided a detergent composition comprising mono-rhamnolipid and di-rhamnolipid and an optional co-surfactant wherein the weight ratio of mono-rhamnolipid to di-rhamnolipid lies in the range 95:5 to 45:55.

**[0027]** The optional co-surfactant is preferably present at a level of at least 5 wt% and is more preferably synthetic anionic surfactant, most preferably linear alkyl benzene sulphonate. Especially with C12-14 alkyl chains. Preferably, the amount of synthetic anionic surfactant exceeds the total amount of Rhamnolipid. The total amount of surfactant in the composition desirably lies in the range 10 to 40 wt%.

**[0028]** The detergent composition preferably has less than 2 wt% builder and is more preferably unbuilder. That is, zeolite, phosphate or silicate builders are absent.

**[0029]** The detergent composition is preferably a liquid detergent composition and if citric acid builder is present, it is limited to a maximum level of 2 wt%. The composition is especially useful as a laundry detergent and may be used with advantage for washing in water with a low water hardness of less than 5°F. A process whereby the laundry and the composition are washed in presoftened water is particularly advantageously used with the compositions of the invention.

**[0030]** The rhamnolipids of the defined ratios are used to remove fatty soils from laundry, especially from cotton cloths. Removal of soils from cotton is of increasing concern because many of the sophisticated soil removal and soil release technologies included in modern laundry detergents work best on polyester cloths. Accordingly, it is advantageous to combine the detergent system of the present invention with a polyester soil release polymer.

**[0031]** Changing the relative amounts of mono and di rhamnolipids used in a detergent composition according to the invention leads to enhanced cleaning benefits and synergies with synthetic anionic surfactants. The best synergy is believed to occur with C12-14 alkyl benzene sulphonate synthetic anionic surfactant. This surfactant is commonly employed in laundry detergent compositions and is typically used with a nonionic surfactant, such as the ethoxylated nonionic surfactant used in US5417879. For environmental reasons it is desirable to eliminate this nonionic surfactant from the composition. The rhamnolipids with mono to di rhamnolipid ratio claimed provide a suitable substitute for the nonionic surfactant component, especially when used to remove fatty soils, e.g. from laundry and particularly when used to remove such fatty soils from cotton cloth. The compositions are suited to low wash temperatures and fast wash times, which support energy and time savings.

**[0032]** A preferred use of the compositions is for the removal of the fatty soil beef fat.

DETAILED DESCRIPTION OF THE INVENTION

**[0033]** A large proportion of biosurfactants are generated by the action of bacteria on renewable feedstocks and are increasingly becoming more and more viable options as sustainable replacements of current synthetic surfactants. Within the current portfolio of biosurfactants that are currently commercialised, Rhamnolipids, formed by the degradation of oils and fats by *Pseudomonas Aeg*, show poor cleaning benefits when used at concentrations of components generated by the bacterial breakdown process. However, when the main mono and di rhamnolipid components of the expressed rhamnolipids are extracted and rebled to produce blends not normally generated by bacterial sources they show enhanced performance. Moreover, by producing blends and mixing with either synthetic anionic surfactants further enhancement in detergency can be achieved.

**[0034]** The detergent composition may comprise other ingredients commonly found in laundry liquids.

**[0035]** The detergent composition may comprise other ingredients commonly found in laundry liquids. Especially polyester substantive soil release polymers, hydrotropes, opacifiers, colorants, perfumes, other enzymes, other surfactants, microcapsules of ingredients such as perfume or care additives, softeners, polymers for anti redeposition of soil, bleach, bleach activators and bleach catalysts, antioxidants, pH control agents and buffers, thickeners, external structurants for rheology modification, visual cues, either with or without functional ingredients embedded therein and other ingredients known to those skilled in the art. The composition is preferably a liquid and is advantageously packaged in either a multidose bottle or in a unit dose soluble pouch.

**[0036]** The invention will be further described with reference to the following non-limiting examples.

**EXAMPLES**Examples 1, 2, A and B

**[0037]** Table 3 shows the detergency data on stained woven cotton from four formulations containing biosurfactants. Examples 1 and 2 are according to the invention and Examples A and B are comparative for Jeneil and Jeneil LAS. Jeneil is the commercially available Rhamnolipid JBR425 with composition analysed to be that in table 1. All examples are systems composed of 0.5 gram per litre surfactant. Detailed compositions are given in Table 2.

**[0038]** The material used in Examples 1 and 2 below is 50% di-Rhamnolipid and 50% mono-Rhamnolipid (by weight).

Table 2 - Compositions: Examples 1, 2, A and B

| Ingredient                                                                                                                                                                                                          | Concentration % (100% solids basis) |         |         |         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|---------|---------|---------|
|                                                                                                                                                                                                                     | A                                   | B       | 1       | 2       |
| Mono-Rhamnolipid                                                                                                                                                                                                    | 9.24                                | 3.69    | 18.8    | 7.52    |
| Di-Rhamnolipid                                                                                                                                                                                                      | 28.36                               | 11.35   | 18.8    | 7.52    |
| LAS (as LAS acid)                                                                                                                                                                                                   | 0                                   | 22.56   | 0       | 22.56   |
| Total Surfactant (mixed)                                                                                                                                                                                            | 37.60                               | 37.60   | 37.60   | 37.60   |
| Sodium Hydroxide (to pH 8.2)                                                                                                                                                                                        | no                                  | yes     | no      | yes     |
| Glycerol                                                                                                                                                                                                            | 5.00                                | 5.00    | 5.00    | 5.00    |
| MPG                                                                                                                                                                                                                 | 9.00                                | 9.00    | 9.00    | 9.00    |
| TEA                                                                                                                                                                                                                 | 11.05                               | 11.05   | 11.05   | 11.05   |
| Citric Acid                                                                                                                                                                                                         | 1.71                                | 1.71    | 1.71    | 1.71    |
| Water                                                                                                                                                                                                               | Balance                             | Balance | Balance | Balance |
| Surfactant systems used - all at 0.5 g/l in wash<br>A = 100% Jeniel JBR 425<br>B = 40% Jeniel JBR 425, 60% LAS<br>1= 50/50 mono-rhamnolipid/di-rhamnolipid<br>2= 40% 50/50 mono-rhamnolipid/di-rhamnolipid, 60% LAS |                                     |         |         |         |

**[0039]** Total Surfactant levels used were calculated to deliver 0.5gpl in the wash. For a 20 ml dose of the compositions in Table 2, this amounts to 1.33 gram per litre of the full composition in a washing machine with a capacity of 15 litres. Washing was done for 30 min in Tergotometers at 25°C and 4°FH. Wash pH was circa 8. Cleaning results for several stains are shown in Table 3.

Table 3

| E.g. | Stain         | DR460 | StDev | E.g. | Stain         | DR460 | StDev |
|------|---------------|-------|-------|------|---------------|-------|-------|
| A    | LARD*         | 26.36 | 2.88  | 1    | LARD          | 34.70 | 2.00  |
| A    | Ragu          | 28.10 | 2.02  | 1    | Ragu          | 28.81 | 1.27  |
| A    | Green Curry   | 26.70 | 1.26  | 1    | Green Curry   | 26.61 | 3.30  |
| A    | Instant gravy | 30.50 | 1.94  | 1    | Instant gravy | 31.40 | 1.32  |
| B    | LARD          | 31.63 | 1.45  | 2    | LARD          | 33.86 | 1.30  |
| B    | Ragu          | 31.28 | 1.71  | 2    | Ragu          | 29.77 | 1.29  |
| B    | Green Curry   | 25.41 | 2.25  | 2    | Green Curry   | 27.26 | 1.43  |
| B    | Instant gravy | 30.61 | 0.81  | 2    | Instant gravy | 31.73 | 2.00  |

\*LARD is beef fat with a violet dye

**[0040]** The data for cleaning of Lard especially show enhanced cleaning with the 50/50 mono-rhamnolipid/di-rhamnolipid surfactant, when compared to combinations with LAS or with the commercially available Jeneil RBR425 Rhamnolipid with composition as analysed and given in table 1.

## Claims

1. A cleaning composition comprising mono-rhamnolipid and di-rhamnolipid, **characterised in that** the ratio of the total wt% of mono-rhamnolipid to the total wt% of di-rhamnolipid lies in the range 95:5 to 45:55.
2. A composition according to claim 1 comprising at least 1 wt%, preferably at least 5 wt%, even at least 10 wt%, rhamnolipid.

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3. A composition as claimed in any preceding claim further comprising at least 5 wt% of synthetic anionic (non-soap) surfactant.
- 5 4. A composition as claimed in any preceding claim in which the synthetic anionic surfactant comprises C<sub>12-14</sub> linear alkyl benzene sulphonate.
5. A composition according to any preceding claim comprising less than 2 wt% detergent builder
- 10 6. A composition according to any preceding claim that has more synthetic anionic surfactant than rhamnolipid.
7. A composition according to any preceding claim that is a laundry detergent liquid comprising from 10 to 50 wt% total surfactant.
- 15 8. A composition according to claim 6 comprising less than 2 wt% citric acid and/or citrate.
9. A laundry detergent according to any preceding claim, further comprising at least 0.5 wt% of a polyester substantive soil release polymer.
- 20 10. Use of a composition according to any one of claims 1 to 8 for washing in water with a water hardness of less than 5°F.
11. Use of a composition according to any one of claims 1 to 8 to remove fatty soils from laundry.
12. Use according to claim 10 wherein the fatty soils are removed from cotton cloth.
- 25 13. Use according to claim 10 or 11 wherein the fatty soil is beef fat.

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## EUROPEAN SEARCH REPORT

Application Number  
EP 10 17 0402

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                         |                                                     |                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-----------------------------------------------------|-----------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Citation of document with indication, where appropriate, of relevant passages           | Relevant to claim                                   | CLASSIFICATION OF THE APPLICATION (IPC) |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | EP 0 499 434 A1 (UNILEVER)<br>19 August 1992 (1992-08-19)<br>* example 3 *              | 1,2,4,8                                             | INV.<br>C11D1/06<br>C11D1/37            |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | EP 0 153 634 A2 (WINTERSHALL AG)<br>4 September 1985 (1985-09-04)<br>* examples 1-3,6 * | 1,2,8                                               |                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                         |                                                     | TECHNICAL FIELDS SEARCHED (IPC)         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                         |                                                     | C11D                                    |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                         |                                                     |                                         |
| Place of search<br>Munich                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                         | Date of completion of the search<br>17 January 2011 | Examiner<br>Hillebrecht, Dieter         |
| <p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone<br/>Y : particularly relevant if combined with another document of the same category<br/>A : technological background<br/>O : non-written disclosure<br/>P : intermediate document</p> <p>T : theory or principle underlying the invention<br/>E : earlier patent document, but published on, or after the filing date<br/>D : document cited in the application<br/>L : document cited for other reasons<br/>&amp; : member of the same patent family, corresponding document</p> |                                                                                         |                                                     |                                         |

1  
EPO FORM 1503 03.82 (P04C01)



**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 10 17 0402

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
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17-01-2011

| Patent document<br>cited in search report |    | Publication<br>date |    | Patent family<br>member(s) |  | Publication<br>date |
|-------------------------------------------|----|---------------------|----|----------------------------|--|---------------------|
| EP 0499434                                | A1 | 19-08-1992          | CA | 2060698 A1                 |  | 13-08-1992          |
|                                           |    |                     | DE | 69203473 D1                |  | 24-08-1995          |
|                                           |    |                     | DE | 69203473 T2                |  | 11-01-1996          |
|                                           |    |                     | ES | 2075608 T3                 |  | 01-10-1995          |
|                                           |    |                     | JP | 5059394 A                  |  | 09-03-1993          |
| -----                                     |    |                     |    |                            |  |                     |
| EP 0153634                                | A2 | 04-09-1985          | CA | 1247030 A1                 |  | 20-12-1988          |
|                                           |    |                     | DE | 3405664 A1                 |  | 05-09-1985          |
|                                           |    |                     | JP | 60188092 A                 |  | 25-09-1985          |
|                                           |    |                     | US | 4814272 A                  |  | 21-03-1989          |
| -----                                     |    |                     |    |                            |  |                     |

## REFERENCES CITED IN THE DESCRIPTION

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

### Patent documents cited in the description

- US 5767090 A [0005]
- US 4814272 A [0006] [0025]
- US 20040152613 A1 [0015]
- EP 1445302 A [0015]
- US 5417879 A1 [0019]
- EP 499434 A [0021]
- US 5654192 A [0023]
- DE 19600743 A [0024]
- US 5417879 A [0031]

### Non-patent literature cited in the description

- **WANG et al.** Engineering bacteria for production of rhamnolipid as an agent for enhanced oil recovery. *Biotechnol. Bioeng.*, 2007, vol. 98, 842-853 [0016]