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An agency of Industry Canada

CA 2950120 A1 2015/12/03

(21) 2 950 120

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(86) **Date de dépôt PCT/PCT Filing Date:** 2014/12/12
(87) **Date publication PCT/PCT Publication Date:** 2015/12/03
(85) **Entrée phase nationale/National Entry:** 2016/11/23
(86) **N° demande PCT/PCT Application No.:** RU 2014/000933
(87) **N° publication PCT/PCT Publication No.:** 2015/183131
(30) **Priorité/Priority:** 2014/05/29 (RU2014121932)

(51) **Cl.Int./Int.Cl.** ***C11D 3/04*** (2006.01), ***C11D 1/66*** (2006.01), ***C11D 3/06*** (2006.01), ***C11D 3/26*** (2006.01), ***C11D 3/37*** (2006.01)

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(54) **Titre : PRODUIT DE NETTOYAGE HYDROSOLUBLE**
(54) **Title: WATER-SOLUBLE DETERGENT**

(57) **Abrégé/Abstract:**
This invention relates to water-soluble detergents for cleaning various types of surfaces. The claimed cleaning agent contains a non-ionic surfactant, sodium polyacrylate and an active ingredient comprising inorganic alkali metal salts, namely sodium sulphate, monosubstituted sodium phosphate and disubstituted sodium phosphate, and carbamide, in specific amounts. An aqueous solution of the detergent is neutral in nature, can be reused and provides a high level of cleaning.

Abstract

(EN) This invention relates to water-soluble detergents for cleaning various types of surfaces. The claimed cleaning agent contains a non-ionic surfactant, sodium polyacrylate and an active component comprising inorganic alkali metal salts, namely sodium sulphate, monosubstituted sodium phosphate and disubstituted sodium phosphate, and carbamide, in specific amounts. An aqueous solution of the detergent is neutral in nature, can be reused and provides a high level of cleaning.

WATER-SOLUBLE DETERGENT

Field of the Invention

The present invention relates to chemistry; specifically, to water-soluble detergents for cleaning various types of surfaces from organic contaminants such as oil, oil products, lubricants, industrial and household grease and oils.

Prior Art

A whole wide range of water-soluble detergent compositions used as aqueous solutions for cleaning various surfaces from organic contaminants are known in the art today.

For example, the known detergent [RU2387704] comprising surfactants Neonol and Sintamide, caustic soda (caustic alkali), as well as an active component containing a mixture of inorganic salts, such as sodium metasilicate, liquid glass with silica module of 2.7, silicate with silica module of 4, sodium polyphosphate, soda ash (sodium carbonate), and sodium sulfate.

Said composition exhibits good cleaning power against organic contaminants, including contaminants wedged in hard-to-reach spots and hairline cracks.

However, in said composition, the emulsions formed after cleaning cannot be separated, and thus, the working solution cannot be reused.

Another major disadvantage of said composition is the relatively high content of active alkali agents therein (caustic soda and sodium carbonate), rendering its pH alkali, which has a negative impact on the environmental safety of the utilized composition.

Water-soluble detergents known for their high cleaning power and fast separation of the resulting emulsions, which make the separated aqueous phase available for reuse as a working solution, are known in the art [see, for example, RU2132367, RU2456340].

For example, the water-soluble detergent described in RU2456340 contains a mixture of non-ionic surfactants (Sintanol and OP-10), demulsifier, alkali, and an active component comprising a mixture of alkali salts: sodium carbonate, sodium phosphate, and ammonium sulfate.

Fast separation of the emulsion formed after cleaning is quickly achieved, and the separated aqueous phase can be reused as a working solution for cleaning contaminations.

Because of the relatively high alkali content in said composition, however, the pH of the aqueous solution is alkali, which negatively affects its environmental safety.

Another known water-soluble detergent [RU2132367] is chosen as the closest analog of the first, second, and third embodiments of the claimed invention.

Said composition comprises a non-ionic surfactant, polyelectrolyte (such as sodium

polyacrylate), and additionally, three types of active components, each of which comprising at least one alkali salt.

For example, the active component of said composition comprises sodium carbonate and carbamide.

The composition of said detergent comprising said active component is chosen as the closest analog to the first embodiment of the claimed invention.

Alternatively, the active component of said detergent may comprise sodium carbonate, sodium metasilicate, and carbamide.

The composition of said detergent comprising said active component is chosen as the closest analog to the second embodiment of the claimed invention.

Alternatively, the active component of said invention may comprise sodium carbonate and sodium metasilicate.

The composition of said detergent comprising said active component is chosen as the closest analog to the third embodiment of the claimed invention.

Said detergent exhibits high cleaning power against different organic contaminants, wherein due to the fast separation of the emulsion of said composition after use, the separated aqueous phase can be repeatedly reused as a cleaning solution.

However, although said composition does not contain any strong alkali agents, such as bases, as part of its composition, it comprises a large amount of sodium carbonate, which puts the pH of the aqueous solution in the alkali region. That makes said composition environmentally unsafe and thus, the resulting aqueous solutions of said composition need to be neutralized prior to their transfer to water treatment facilities.

Disclosure of the invention

The objective of the first, second, and third embodiments of the claimed invention is to improve the environmental safety of the detergent.

According to the first embodiment, said objective is achieved by creating a water-soluble detergent comprising a non-ionic surfactant, sodium polyacrylate, and an active component, which comprises an alkali salt and carbamide, wherein **according to the present invention**, said alkali salt of the active component comprises sodium sulfate, wherein said components are in the following weight ratio, %:

Non-ionic surfactant 2.7- 3.4

Sodium polyacrylate 0.1- 0.2

Sodium sulfate 86.0 – 88.6

Carbamide 8.6 -10.4.

According to the second embodiment, the set objective is achieved by creating a water-soluble detergent comprising a non-ionic surfactant, sodium polyacrylate, and an active component, which comprises a mixture of alkali salts and carbamide, wherein **according to the present invention,** said alkali salts of the active component comprise sodium sulfate, monosodium phosphate, and disodium phosphate, wherein said components are in the following weight ratio, %:

Non-ionic surfactant 0.5- 2.8

Sodium polyacrylate 0.1- 0.2

Sodium sulfate 55.0 – 70.0

Monosodium phosphate 7.0-12.0

Disodium phosphate 15.0-20.0

Carbamide 7.5- 10.0

According to the third embodiment, the set objective is achieved by creating a water-soluble detergent comprising a non-ionic surfactant, sodium polyacrylate, and an active component, which comprises a mixture of alkali salts and carbamide, wherein **according to the present invention,** said alkali salts of the active component comprise sodium sulfate, monosodium phosphate, and disodium phosphate, wherein said components are in the following weight ratio, %:

Non-ionic surfactant 5.0- 10.0

Sodium polyacrylate 0.1- 0.2

Sodium sulfate 60.0 – 80.0

Monosodium phosphate 5.0-15.0

Disodium phosphate 10.0-15.0

The compositions of the claimed water-soluble detergent according to the first, second, and third embodiments of the present invention were chosen by the inventors in the course of experimental studies. The inventors created a composition for a water-soluble detergent according to the first, second, and third embodiments of the invention, wherein the aqueous solution effectively removes organic contaminations from various types of surfaces, quickly separates into organic and aqueous phases, the latter can be reused to clean contaminants. The most important feature of the claimed detergent is that the pH of the aqueous solution of said detergent according to the first, second, and third embodiments of the invention is close to neutral.

The non-ionic surfactant in the composition of the water-soluble detergent according to the first, second, and third embodiments of the invention provides good surface wettability and a high solubilizing effect with respect to water insoluble hydrocarbon contaminants, while producing moderate foaming.

Said surfactant in the specified above ratios in the composition of the water-soluble detergent according to the first, second, and third embodiments of the invention delivers the desired cleaning power of the composition without forming a hard-to-break emulsion of the detergent in the cleaned product.

A non-ionic surfactant in the claimed concentration range makes the detergent universally effective towards a wide variety of hydrocarbons to be removed (from light oil products to heavy oil residues).

A compound containing a hydrophobic organic group and one hydrophilic residue, such as a condensation product of alkyl phenols or higher fatty alcohols from ethylene oxide, a condensation product of propylene glycol and ethylene oxide or propylene oxide, and other similar compounds can be used as a non-ionic surfactant according to the first, second, and third embodiments of the invention. Non-ionic surfactants, which could be easily biotreated, in particular, such as nonyl phenol ethylene oxide with 9 to 12 oxide groups (neonol), a mixture of ethoxylated monoalkyl phenols, based on propylene trimmers, or sintamides are the preferred surfactants.

Sodium polyacrylate in the amount of 0.1 to 0.2 wt. % in the composition of the detergent according to the first, second, and third embodiments of the invention creates a good emulsifying effect during cleaning and prevents resorption of the contaminants back onto the surface being cleaned, wherein at the separation stage of the resulting emulsion, sodium polyacrylate does not have any negative effect on the speed and completeness of separation of aqueous and organic phases.

Sodium polyacrylate with 50,000-120,000 molecular weight in the composition of the detergent according to the first, second, and third embodiments of the invention is preferred.

Using the active components in any of the aforementioned quantities and qualitative compositions as part of the detergent according to the first, second, and third embodiments of the invention, in combination with the non-ionic surfactant and sodium polyacrylate within the aforementioned concentration range balanced the properties of the detergent in such a way that the pH of its aqueous solution became close to neutral (7.0-8.1).

According to the first embodiment of the present invention, said neutral pH is achieved by using sodium sulfate and carbamide in the aforementioned concentrations as part of the active component; according to the second embodiment - by using sodium sulfate, monosodium phosphate, disodium phosphate and carbamide, and according to the third embodiment - by using sodium sulfate, monosodium phosphate, and disodium phosphate.

None of said components are active alkali agents, while said mineral salts, namely sodium

sulfate and sodium phosphate (mono- and di-substituted) reduce the surface tension of the aqueous solution of the claimed detergent, which improves its cleaning power. Thus, even though said aqueous solution is not actively alkali, it exhibits high cleaning power against organic contaminants.

Additionally, owing to the selected qualitative and quantitative composition of the detergent, the emulsion formed after cleaning a surface from organic contaminants with the aqueous solution the detergent can quickly and completely separate, which means that the separated aqueous phase can be repeatedly reused in cleaning cycles.

Moreover, the constituents comprising the active component perform several additional functions. For example, as part of the active component according to the first and second embodiments of the present invention, carbamide enhances the demulsifying effect of the formed emulsion and raises the cloud point of the detergent solution, which expands the technological capacity of surface cleaning. As part of the active component's composition according to the second and third embodiments of the invention, sodium phosphates additionally function as corrosion inhibitors, which is important when cleaning metallic surfaces.

Moreover, even though said aqueous solution is not actively alkali, it exhibits high cleaning power against organic contaminants, wherein the emulsion formed after cleaning contaminants with said solution can quickly and fully separate; which creates an opportunity for multiple reusage of the separated aqueous phase in cleaning cycles, which, in turn, greatly reduces the volume of wastewater discharged in the industrial operations involving the claimed detergent.

Preferred embodiment of the invention

The detergent is prepared by simply mixing the components.

The detergent is a powder.

The detergent is used as an aqueous solution, which is prepared by dissolving the dry detergent in water in a 1 : (24- 48) ratio.

The first embodiment of the invention is demonstrated by the following examples.

Example 1.

A water-soluble detergent was prepared in the following composition wt. %:

Neonol AF9-12	2.3
Sodium polyacrylate, MW 50,000-120,000	0.1
Sodium sulfate	87.4
Carbamide	10.2.

The prepared mixture was dissolved in water in the 1:24 ratio.

The aqueous solution of the detergent was tested.

pH of the aqueous solution was determined on a HI 2214 pH-meter with a buffer solution.

pH was 7.2.

The cleaning power of the solution was determined by an established gasometrical method (see, for example, RU 2132267), based on the weight of the contamination left on the control metal plates, which had been coated with a hydrocarbon contaminant.

Cleaning efficiency was 95.4%.

The emulsion formed after cleaning was poured into a measuring cylinder and kept there until the organic phase fully separated from the aqueous phase. In 60 sec., the emulsion was clearly seen to be completely separated. To monitor the completeness of separation, residual contamination concentration of the aqueous phase was measured according to the industry standard OST 38013-78-85 "Determination of oil products content in wastewater".

Residual concentration was 0.2 mg/L.

Ten cleaning cycles were conducted; in each subsequent cycle, the aqueous phase separated from the organic phase in the previous cycle was used as the detergent solution. Notably, 10 test cycles later, the aforementioned performance indicators of the solution remained practically the same.

Example 2.

A water-soluble detergent was prepared in the following composition wt. %:

Sintamide-5	3.4
Sodium polyacrylate, MW 50,000-120,000	0.2
Sodium sulfate	86.0
Carbamide	10.4.

The prepared mixture was dissolved in water in the 1:24 ratio.

The aqueous solution of the detergent was tested as described in Example 1.

pH of the aqueous solution was determined on a HI 2214 pH-meter with a buffer solution.

pH was 7.1

Cleaning efficiency was 95.5%.

The aforementioned performance indicators of the solution remained practically the same after 15 test cycles.

The second embodiment of the invention is demonstrated by the following examples.

Example 3.

A water-soluble detergent was prepared in the following composition wt. %:

Neonol AF9-12	2.3
Sodium polyacrylate, MW 50,000-120,000	0.1

Sodium sulfate	60.2
Monosodium phosphate	10.2
Disodium phosphate	19.6
Carbamide	7.6

The prepared mixture was dissolved in water in the 1:24 ratio.

The aqueous solution of the detergent was tested as described in Example 1.

pH was 7.4

Cleaning efficiency was 97.5%.

The aforementioned performance indicators of the solution remained practically the same after 25 test cycles.

Example 4.

A water-soluble detergent was prepared in the following composition wt. %:

Sintamide-5	1.0
Sodium polyacrylate, MW 50,000-120,000	0.2
Sodium sulfate	68.5
Monosodium phosphate	7.2
Disodium phosphate	15.6
Carbamide	7.5

The prepared mixture was dissolved in water in the 1:24 ratio.

The aqueous solution of the detergent was tested as described in Example 1.

pH was 7.3

Cleaning efficiency was 97.0%.

The aforementioned performance indicators of the solution remained practically the same after 25 test cycles.

The third embodiment of the invention is demonstrated by the following examples:

Example 5.

A water-soluble detergent was prepared in the following composition wt. %:

Neonol AF9-12	10.0
Sodium polyacrylate, MW 50,000-120,000	0.2
Sodium sulfate	62.7
Monosodium phosphate	10.3
Disodium phosphate	16.8.

The prepared mixture was dissolved in water in the 1:24 ratio.

The aqueous solution of the detergent was tested as described in Example 1.

pH was 7.6.

Cleaning efficiency was 95.7%.

The aforementioned performance indicators of the solution remained practically the same after 20 test cycles.

Example 6.

A water-soluble detergent was prepared in the following composition wt. %:

Sintamide-5	5.2
Sodium polyacrylate, MW 50,000-120,000	0.1
Sodium sulfate	78.3
Monosodium phosphate	5.0
Disodium phosphate	11.4 .

The prepared mixture was dissolved in water in the 1:24 ratio.

The aqueous solution of the detergent was tested as described in Example 1.

pH was 7.5.

Cleaning efficiency was 96.5%.

The aforementioned performance indicators of the solution remained practically the same after 25 test cycles.

Industrial use

The present invention can be used for power cleaning of manufacturing and chemical equipment, bulk capacity tanks, tankers and trucks, as well as for washing rolled metal and metal shapes, in particular, prior to painting and plating thereof.

The invention can also be used for cleaning soil contaminated with oil products; and in particular, in emergency situations for cleaning spilled oil and oil products.

The advantage of the claimed detergent is that owing to the neutral character of the aqueous solution comprising the claimed detergent and because the aqueous solution of the detergent of the present invention can be reused in several cleaning cycles, the load on the ecosystem is greatly reduced.

Claims

1. A water-soluble detergent comprising a non-ionic surfactant, sodium polyacrylate, and an active component containing an inorganic metal salt and cabamide, wherein said inorganic alkali salt of the active component comprises sodium sulfate, wherein the detergent's components are present in the following wt.% ratio:

Non-ionic surfactant 2.7- 3.4
Sodium polyacrylate 0.1 - 0.2
Sodium sulfate 86.0 – 88.6
Carbamide 8.6 -10.4.

2. A water-soluble detergent comprising a non-ionic surfactant, sodium polyacrylate, and an active component containing a mixture of inorganic alkali salts and cabamide, wherein said inorganic alkali salts of the active component are sodium sulfate, monosodium phosphate, and disodium phosphate, wherein the detergent's components are in the following wt.%:

Non-ionic surfactant	0.5- 2.8
Sodium polyacrylate, MW 50,000-120,000	0.1-0.2
Sodium sulfate	55.0-70.0
Monosodium phosphate	7.0- 12.0
Disodium phosphate	15.0- 20.0
Carbamide	7.5 -10.0.

3. A water-soluble detergent comprising a non-ionic surfactant, sodium polyacrylate and an active component containing a mixture of inorganic alkali salts, wherein said inorganic alkali salts of the active component are sodium sulfate, monosodium sulfate, and disodium sulfate, wherein the detergent's components are in the following wt.%:

Non-ionic surfactant	5.0- 10.0
Sodium polyacrylate, MW 50,000-120,000	0.1-0.2
Sodium sulfate	60.0 – 80.0
Monosodium phosphate	5.0- 15.0
Disodium phosphate	10.0- 15.0