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(54) **Aqueous lubricant compositions**

(57) An aqueous lubricant composition, suitable for conveyor lubrication in the beverage or food industries, for example for lubricating the transport of glass, plastic, plastic impregnated or coated cardboard or metal beverage containers on a conveyor of stainless steel or nylon, comprises a combination of an amphoteric carbox-

ylate, preferably an alkyl amine carboxylate, and an imidazoline, the composition having a pH above 8 and being in the absence of any effective quantity of an anionic sulphonate surfactant. The composition gives an excellent drag coefficient, is compatible with printing inks and gives low stress cracking in PET containers.

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Description

[0001] This invention relates to aqueous lubricant compositions suitable for use in the beverage and food industries.

[0002] In the beverage and food industries product containers, such as bottles or cans, are commonly transported on continuously operating conveyors through unit operation stations, such as filling, closure or sealing stations. During transport between the stations, or at each operation, blockages of the containers on the conveyor can occur while the conveyor continues to move. To cope with these interruptions and resumptions in the movement of the containers reliably a low but appreciable sliding friction between the material of the containers and of the conveyor is required. It is usual to use a lubricant on the conveyor to achieve the required frictional characteristics. Additional functions of a lubricant are to provide control of microbiological growth and to provide detergency to remove spillages and other soils.

[0003] While the present invention has broad applicability to the conveyance of containers it is envisaged to be particularly applicable to the conveyance of glass, plastic, plastic impregnated or coated cardboard, or metal beverage containers on belt or chain conveyors of metal or plastic. When the container is of glass a stainless steel conveyor is often used whereas, when the container is of another material, for example of aluminium, or of polyethylene terephthalate (PET) or of polyethylene (PE) the conveyor may be of, for example, of nylon or of polypropylene or an acetal resin.

[0004] Lubricant compositions are also subject to requirements other than those relating purely to their frictional performance. Some lubricant compositions, for example those based on fatty acids, react with the hardness salts in water to deposit alkaline earth fatty acid salts on the conveyor and on the pipework used to deliver lubricant to the conveyor. This may be alleviated by ensuring that only soft water, for example containing hardness salts equivalent to below 5 ppm CaCO_3 , is used to make up the lubricant or by including an effective amount of a complexing agent, such as ethylene diamine tetra-acetic acid (EDTA), in the composition. Some lubricant compositions, for example those based on fatty amines, may tend to cause stress-cracking in the bases of plastic containers, such as PET containers, under conditions of internal pressurisation and/or warming. Using the lubricant compositions of the invention this effect may be reduced. Some lubricant compositions amongst the fatty acid-, fatty amine- and phosphate ester-based compositions have a deleterious effect on print and tend to cause the leaching of printing ink from a print display. Since it is common practice to preprint beverage cans this presents a considerable problem.

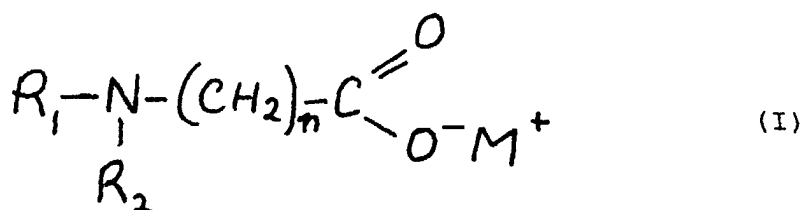
[0005] U.S. patent specification No. 5 747 431 describes an aqueous lubricant composition containing one or more of a specific range of cyclic imidazolines defined by general formula and an amount of an inorganic acid or a carboxylic acid having up to 6 carbon atoms, for example acetic acid, sufficient to render the cyclic imidazoline soluble in water. The quantity of the acid is typically from 0.05 to 10.5% by weight of the concentrate and, if required, additional acid is be added to bring the pH into the required region which is, preferably, from 3 to 8, more preferably from 3 to 6. At such a pH the imidazoline is solubilized by conversion to the acetate. Optionally, the lubricant composition may also contain an alkylamine carboxylate although this is exemplified in a quantity of only 0.6% wt/wt active raw material relative to 2.0% on an active basis, of the imidazoline.

[0006] U.K. patent specification No. 2 285 630-A describes an aqueous lubricant composition containing an alkylamine dicarboxylate, a cyclic imidazoline and an alkyl sulphonate anionic surfactant, each defined by general formula.

[0007] The present invention, in its broadest aspect, is based on an aqueous lubricant composition comprising a combination of an amphoteric carboxylate with an imidazoline, the composition having a pH greater than 8, and on the finding that an unexpected degree of reduction in sliding friction obtainable by the use of such a composition, as well as certain other beneficial properties, in the absence of a content of any effective quantity of an anionic sulphonate surfactant, or of any other anionic surfactant. For example, any sulphonate or other anionic surfactant, if present, is preferably present in less than 0.2%, particularly preferably less than 0.15% by weight of the composition.

[0008] In defining the composition provided by the invention it is noted that cyclic imidazolines are believed to hydrolyse under some pH conditions with ring opening. The present invention encompasses both cyclic imidazolines and the chain compounds corresponding to the cyclic imidazoline hydrolysis products, whether the chain compounds are actually formed by the hydrolysis mechanism or not, or whether they are formed in situ in the lubricant composition or not and the term "hydrolysis product", used hereafter, is intended to encompass all of these alternative possibilities.

[0009] The present invention provides an aqueous lubricant composition comprising a combination of (a) one or more alkylamine monocarboxylates defined by the general formula (I)



wherein

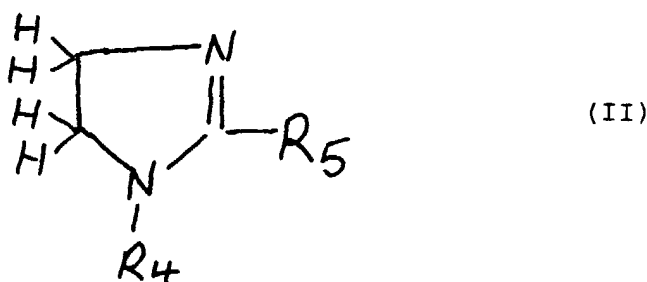
R₁ represents C₁ to C₂₄, preferably C₇ to C₂₄, alkyl- or C₁ to C₂₄, preferably C₇ to C₂₄, alkyl-[N-(CH₂)_{n'}]_m- wherein n, n' and m are the same or different and have values of at least 1, preferably from 1 to 5

R₂ represents H, C₁ to C₂₄ alkyl or C₁ to C₂₄ alkyl substituted by one or more hydroxyl or amine groups

M⁺ represents H⁺, Na⁺, K⁺ or (CH₂OH.CH₂)₃NH⁺

and (b)

one or more cyclic imidazolines defined by the general formula (II), and hydrolysis products thereof,

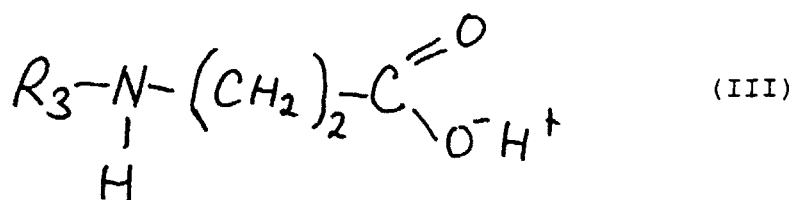


wherein

R₄ is -CH₂-CH₂-OH or -CH₂-CH₂-NH₂ or is an amide function

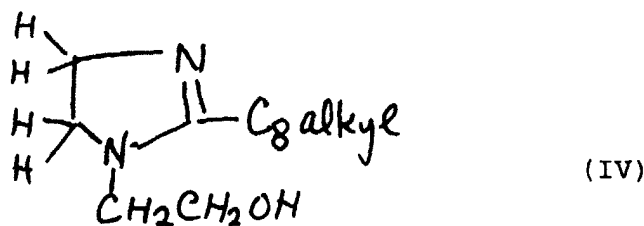
R₅ is an alkyl chain having a value of at least C₁, preferably from C₁ to C₃₀.

[0010] The preferred compounds within Formula (I) for use in the practice of the present invention are:



wherein R₃ is an alkyl fatty chain, preferably of coco-distribution.

[0011] The preferred compounds within Formula (II) for use in the practice of the present invention are:



10 and hydrolysis products thereof.

[0012] The lubricant compositions of the invention may be in the form of a concentrate, for example containing from 0.1% to 10% by weight, or up to the solubility limit, which may be up to 20% by weight or more, in total and on an active material basis, of the amphoteric alkyl carboxylate and the imidazoline. Such a concentrate is preferably, but not essentially, produced using naturally soft water, distilled water or softened water to maximise storage stability. For use the concentrate is further diluted, for example from 0.0005% to 5%, preferably at least 0.005%, preferably up to 2%, in total and on the same basis, of the same compounds. For this further dilution it is found that soft, medium or even hard water may be used. The relative molar proportion of the amphoteric alkyl carboxylate and the imidazoline is preferably from 10:90 to 90:10, particularly preferably from 60:40 to 40:60.

[0013] The lubricant compositions may contain other constituents, for example a hydrophilic organic co-solvent such as, for example butyl diglycol, monoethylene glycol or isopropyl alcohol, suitably in a concentration of from 1% to 10% by weight, a nonionic surfactant such as an alcohol alkoxylate, suitably in a concentration of 0.1% to 5% by weight and a biocide, suitably in a concentration of from 0.1% to 10% by weight. The cosolvent may be supplied by using the amphoteric carboxylate in the form of a solution thereof.

[0014] Preferably, to enhance solubility, the pH of the lubricant composition of the invention is controlled at a pH greater than 8.5 for example, desirably, greater than 9. It is preferred that the pH is below 11 and a pH range of from 9.5 to 10.5 is particularly preferred. At the pH levels envisaged by this invention the imidazoline is, surprisingly, solubilized in the presence of the alkylamine carboxylate. There is no reliance on salt formation to achieve solution in water.

[0015] The effectiveness of the lubricant compositions may be tested as follows.

30 Lubrication.

[0016] A number of glass bottles sufficient to give a load of 2000g are placed on a pilot conveyor fitted with a stainless steel track. The bottles are tethered to a force gauge capable of measuring the drag force in grams. Lubricant at a suitable concentration is sprayed onto the track and the track set in motion. Drag Coefficient (U) is calculated as Drag Force/2000 g. A coefficient of less than 0.15 represents good lubrication and higher values represent poor lubrication.

PET Compatibility.

[0017] Pressurised PET bottles are dipped into a sample of lubricant prediluted to use concentration (typically 1% by weight). After 10 minutes the bottles are removed and placed in an oven at a temperature of 38°C. After 72 hours at this temperature the bottles are removed and are examined visually for signs of stress cracking. A bottle similarly oven treated, which had not been contacted with the lubricant is used as a control.

Ink compatibility.

[0018] Samples of steel sheet printed with a representative ink are immersed in solutions of the lubricant having up to 10 times normal use concentration. The solutions are held at a temperature of 60°C for 30 minutes and the samples were then removed and examined visually for ink leaching.

[0019] Certain lubricant compositions according to the invention are now described with reference to the following examples but without any limitation of the scope of the invention thereto. Examples 1, 4 and 5 are according to the invention and Examples 2 and 3 are not according to the invention but are comparative therewith.

Examples 1-3.

[0020] The following compositions were made up by adding the other ingredients to the water and the compositions were tested for Drag Coefficient at a dilution of 1% by weight in tap water.

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Example No.	1	2	3
Distilled water	85	87	90
Butyl diglycol	2	2	2
Nonionic alcohol alkoxylate ^a	2	2	2
Amphoteric ^b	2.5	2.5	2.5
Biocide ^c	1.5	1.5	1.5
Imidazoline ^d	2	0	2
Amphoteric alkyl amine carboxylate ^e	5	5	0
pH	10	9	11
Drag Coefficient	0.075	0.1	0.15

Trade names/sources of constituents

^a Synperonic LFRA30 - ICI.

^b Amphoteric SBF - Rhone Poulenc.

^c Bioban CS 1135 - Angus Chemicals.

^d R5 (formula IV) - Lakeland Laboratories

^e Amphoran CP1 - Formula (III) with R3 = coco-, - Elf Atochem.

[0021] Example 1 used both the essential components of the invention, the imidazoline was absent from Example 2 and the amphoteric alkyl amine carboxylate was absent from Example 3. A synergic effect is apparent in the composition according to the invention from the results.

Examples 4-5.

[0022] The following compositions were made up and tested for Drag Coefficient at a dilution of 0.5% by weight in tap water.

Example No.	4	5
Distilled water	89	89
Nonionic alcohol alkoxylate ^f	0.5	0.5
Biocide ^g	4	4
Imidazoline ^h 80H (R5 = C8)	1.5	0
Imidazoline ^h 120H (R5 = C12)	0	1.5
Amphoteric alkyl amine carboxylate ^j	5	5
pH	10	10
Drag Coefficient	0.11	0.11
Trade names/sources of constituents		

^f Synperonic NCA810 - ICI

^g Emulcid - Thor Chemicals

^h Lakeland Laboratories

^j Amphoram

[0023] These Examples show no difference between the Imidazolines having chains of 8 and of 12 carbon atoms. This is surprising since the longer chain length (C₁₂ to C₁₈) has traditionally been preferred.

Variations in the Examples.

[0024] The Example 4 composition was further diluted to 1% in water containing 10ppm sulphate or 10ppm phosphate

ions. Both solutions remained clear overnight. This is in contrast to cationic lubricants, such as those based on fatty amines, which tend to become cloudy on standing as a result of the formation of insoluble sulphate or phosphate salts.

[0025] The Example 5 composition, further diluted to 1% by weight, was tested in waters ranging from 30 to 250 ppm CaCO₃ of hardness with no observable difference in Drag Coefficient. All the solutions remained clear despite the absence of a chelating agent.

Other tests.

[0026] Using the test methods given above lubricant compositions of the invention were found to be compatible with Can Print Pigments and PET.

[0027] Experiments were conducted using other surfactant acids including sarcosinates, phosphate esters, ether carboxylates and sulphonic acids. They are less effective in that either the formulations are not hard water stable, have poor lubrication or have poor stability. However, it is likely that stability could be improved by the use of suitable cosolvents or surfactants.

[0028] A solution containing 1.5% by weight of Imidazoline 80H and 98.5% by weight of butyl diglycol was made up. It was found to have a pH of 10.5 which is very close to the pH levels in the preceding Examples. This is taken to indicate that the imidazoline is present in a similar form in the Examples as in the present test.

Claims

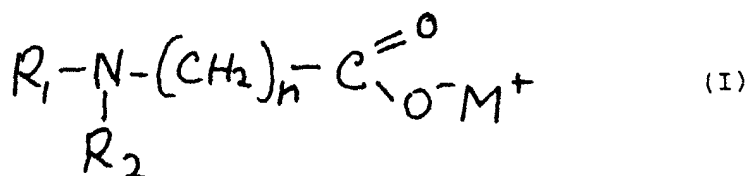
1. An aqueous lubricant composition, suitable for conveyor lubrication in the beverage or food industries, comprising a combination of an amphoteric carboxylate and an imidazoline, the composition having a pH above 8 and being in the absence of any effective quantity of an anionic sulphonate surfactant.

2. A composition as claimed in claim 1 wherein the carboxylate is an amphoteric alkyl amine carboxylate.

3. A composition as claimed in claim 2 wherein the carboxylate is a monocarboxylate.

4. An aqueous lubricant composition, suitable for conveyor lubrication in the beverage or food industries, comprising a combination of

(a) one or more alkylamine monocarboxylates defined by the general formula (I)

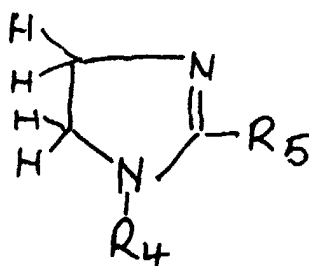


wherein

R₁ represents C₁ to C₂₄, preferably C₇ to C₂₄, alkyl- or C₁ to C₂₄, preferably C₇ to C₂₄, alkyl-[N-(CH₂)_n]_m- wherein n, n' and m are the same or different and have values of at least 1, preferably from 1 to 5.

R₂ represents H, C₁ to C₂₄ alkyl or C₁ to C₂₄ alkyl substituted by one or more hydroxyl or amine groups
M⁺ represents H⁺, Na⁺, K⁺ or (CH₂OH)₃NH⁺ and

(b) one or more cyclic imidazolines defined by the general formula (II), and hydrolysis products thereof,



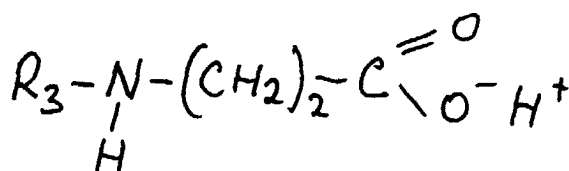
(II)

wherein

R₄ is -CH₂-CH₂-OH or -CH₂-CH₂-NH₂ or is an amide function
 R₅ is an alkyl chain having a value of at least C₁, preferably from C₁ to C₃₀.

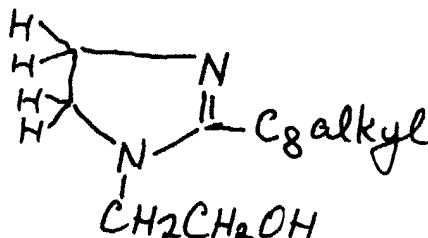
the composition having a pH above 8.

5. A composition as claimed in claim 4 wherein the one or more alkylamine monocarboxylates is as defined by formula (III)



(III)

6. A composition as claimed in claim 4 wherein the one or more imidazolines is as defined by formula (IV)



(IV)

and hydrolysis products thereof.

7. A composition as claimed in any preceding claim in the form of a concentrate containing from 0.1% by weight, to the solubility limit, in total and on an active material basis of the amphoteric carboxylate and the imidazoline.
8. A composition as claimed in any preceding claim in the form of a working solution containing from 0.0005% to 5% by weight, in total and on an active material basis, of the amphoteric carboxylate and the imidazoline.
9. A composition as claimed in any preceding claim containing the amphoteric carboxylate and the imidazoline in relative molar proportions of from 10:90 to 90:10.
10. A composition as claimed in any preceding claim having a pH greater than 8.5.
11. A composition as claimed in claim 10 having a pH from 9.5 to 10.5.
12. A composition as claimed in any preceding claim containing one or more of a hydrophilic organic co-solvent in a

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concentration of from 1% to 10% by weight, a nonionic surfactant in a concentration of 0.1% to 5% by weight and a biocide, in a concentration of from 0.1% to 10% by weight.

13. The use of a composition as claimed in any preceding claim in conveyor lubrication.

14. The use claimed in claim 13 wherein the conveyor is of stainless steel, polypropylene or an acetal resin and the containers to be conveyed are of glass, aluminium, steel, polyethylene terephthalate(PET), polyethylene(PE) or cardboard.



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EUROPEAN SEARCH REPORT

Application Number
EP 99 12 1643

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
D,X	US 5 747 431 A (GLOZBACH EBERHARD ET AL) 5 May 1998 (1998-05-05) * column 1, line 63 - column 2, line 18 * * column 3, line 38 - column 5, line 35; example 2 *	1-14	C10M173/02 //(C10M173/02, 133:06, 133:46), C10N40:00
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			C10M
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		21 February 2000	Rotsaert, L
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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

EP 99 12 1643

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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