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AGENTS FOR REDUCING THE SURFACE TENSION OF LIQUIDS

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EX. NO.	THE CONTROL	LIFTING AGENT ADDED	LIFTING AGENT CONCENTRATION	SINKING TIME IN SECONDS	AVERAGE SINKING TIME
0	SODIUM DITERTIARY BUTYL NAPHTHALENE SULFONATE CONCENTRATION - 0.3 GRAMS PER LITER	NONE		64, 60, 65	63 SECONDS
1		CAMPHOR	0.8 GRAMS LITER	37, 37, 39, 39	38 SECONDS
2		DIISOBUTYL KETONE (cloudy saturated solution)	0.8 CC. LITER	36, 38, 39	38 SECONDS
3		1,1,3-TRIMETHYLCYCLO- HEXANONE -- 5	0.8 CC. LITER	39, 44, 41	41 SECONDS
4		METHYL n-AMYL KETONE	0.8 CC. LITER	43, 43, 43	43 SECONDS
5		ISOPHORONE	0.8 CC. LITER	51, 47, 48	49 SECONDS
6		METHYL n-BUTYL KETONE	0.8 CC. LITER	49, 52, 51	51 SECONDS
7		CYCLOHEXANONE	0.8 CC. LITER	54, 55, 52	54 SECONDS

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AGENT FOR REDUCING THE SURFACE
TENSION OF LIQUIDS

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8 Claims. (Cl. 252—353)

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My invention relates to agents for reducing the surface tension of liquids and more especially to the use of these compounds as lifting and dispersing agents to assist other surface active agents, such as wetting agents, detergents and other substances which promote wetting, penetration, swelling, frothing, and dispersing of materials by a solvent.

An object of my invention is the production of superior materials for effecting such changes by combining these assistants with other surface active materials. It has been found that the effect of such combinations is more than additive and substantially increase the wetting, penetrating, swelling, frothing and dispersing action of the solution, and otherwise improve the action of the materials with which they are associated.

The action of a wetting agent or any surface active compound is primarily due to adsorption. If a textile is immersed in a solution with wetting properties, the adsorbed air film on the surface is first displaced, due to the selective adsorption of wetting agent molecules. Wetting agents, and lifting agents, both reduce the surface tension of aqueous solutions. They do this because they have a limited solubility in water. The molecules of the surface active compound are literally squeezed out from the interior of the liquid to the surface. The effectiveness of a particular compound in reducing the surface tension depends on the orientation of the molecules at the interface, liquid-air, and the disrupting effect this orientation has on the forces between the water molecules at the interface. The best materials effectively reduce the surface tension of water to that of a hydrocarbon. The reduction of surface tension means that the liquid spreads easily and quickly over a large surface. Thus, when a fiber is immersed in a wetting agent solution, the air, then oil or wax, is displaced from the fiber due to the selective adsorption of the wetting agent molecules. The solution spreads quickly over the large surface of the fiber and the wetting agent acts as a bond between two substances that might not otherwise adhere to each other.

The action of a lifting agent, which is generally used in low concentrations where it would have little or no effect if used alone, is to introduce into the wetting agent solution another substance that will be preferentially adsorbed. It thus prolongs the time a solution may be used before exhaustion of the wetting agent. The lifting agent has a solvent action for oils and waxes and facilitates their removal from the fiber,

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where a fiber is acted upon. As some of the lifting agent remains on the fiber after removal from the solution, it promotes rewetting on immersion in water and promotes ease of handling in subsequent textile operations. In dyeing, the lifting agent has a great importance. It facilitates the dispersion of clumps and aggregates of color particles. It insures better solubility and the result obtained is better and of more even color.

Ketones can effect lowering of surface tension but when they are combined with efficient wetting agents and operate as lifting agents the mixture not only is more specific and effective than would be expected, but the lifting agent has a solvent action, as above explained, which makes it an excellent leveling agent for dye baths, and as above set forth, assists by remaining to some extent with the fiber in the future handling of the materials.

The lifting agents greatly increase the effectiveness of wetting agents, and other surface active compounds in many fields of use, such as the petroleum industry, metal processing, the paint industry, cleaners and cleaning compounds, the rubber industry, agriculture and cosmetics, textiles both natural and synthetic, to give but a few fields of use.

The single sheet of drawings is a table showing the increased efficiency of one wetting agent when mixed with the lifting agents.

A principal feature of the present invention resides in the discovery that ketones having 5 to 12 carbon atoms can be used effectively as assistants in conjunction with other materials with surface active properties, such as sodium alkyl sulfates, sodium oleate, sodium alkyl naphthalene sulfonates, etc. To show the importance of these ketones as assistants or lifting agents when used with other materials having surface active properties, below is given a procedure for a canvas disc wetting test, which procedure has been employed with a number of combinations of various ketones operating as lifting agents in admixture with certain agents for reducing the surface tension of liquids. The data given hereinafter show the remarkable results obtained by the use of these lifting agents in combination with these surface active materials.

Canvas disc wetting tests are employed to compare the wetting ability of various wetting materials. The following test was reported by Seyferth and Morgan in the American Dyestuff Reporter, 27, 525 (1938) and in Chemical Abstracts 32, 8789 (1938).

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The tests consists of measuring the sinking time of a 1" diameter, number 6 canvas disc in a known solution. Conditions of temperature, concentration of wetting agent, water hardness and pH are controlled. The canvas used in these tests was natural color and "unwaterproofed." All tests were made with discs cut from the same strip of cloth, to eliminate variations due to the canvas.

The solutions for the tests were made from a stock 1% solution. All were made with distilled water. The proper amount of concentrated solution was measured into a 500 cc. volumetric flask. An organic solvent, if any, was measured out and added. The mixture was then diluted with distilled water to 500 cc. This amount of the solution to be tested was placed in a 600 cc. beaker. A Gooch funnel 1½" in diameter and having a barrel 3" long is inverted in the solution and the whole is brought to the desired temperature, usually 25 degrees C. Working rapidly the Gooch funnel is removed, a canvas disc placed in the funnel which then is again inserted into the solution; at the same time a stop watch is started. The time recorded is that interval required for the disc to sink to touch the bottom of the beaker. After stirring the solution the test may be repeated for checks on the sinking time. To get consistent results it is necessary to insert the disc so that when it wets, one bubble of air comes off at a time from the same position near the edge of the disc. The data may be plotted on logarithmic paper; the points, when connected, give a straight line.

Seyferth and Morgan report the deviation from mean wetting time to be 9.4%.

The tests which are reported hereinafter were conducted by the procedure just above outlined.

The table in Figure 1 shows the results of the Seyferth and Morgan canvas disc wetting test on solutions containing ketones as lifting agents, together with a wetting agent. All solutions contained 0.3 gram per liter of sodium ditertiary butyl naphthalene sulfonate, as the wetting agent, made from an alkyl naphthalene fraction that had a boiling point of 185-195° C. at 5 mm. The concentration of the ketone lifting agent was in no case large enough by itself to cause sinking the canvas disc in less than a matter of hours. The wetting agent was sufficiently concentrated to cause sinking of the disc in an average of about 63 seconds. The temperature of all solutions during the test was 25° C.

Example 1

Camphor as a lifting agent-----	g. per liter--	0.8
Sodium ditertiary butyl naphthalene sulfonate as a wetting agent-----	g. per liter--	0.3

Example 2

Diisobutyl ketone as a lifting agent (cloudy sat. solution)...	cc. per liter--	0.8
Sodium ditertiary butyl naphthalene sulfonate as a wetting agent-----	g. per liter--	0.3

Example 3

1,1,3-trimethylcyclohexanone-5 as a lifting agent-----	cc. per liter--	0.8
Sodium ditertiary butyl naphthalene sulfonate as a wetting agent-----	g. per liter--	0.3

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Example 4

Methyl n-amyl ketone as a lifting agent-----	cc. per liter--	0.8
Sodium ditertiary butyl naphthalene sulfonate as a wetting agent-----	g. per liter--	0.3

Example 5

Isophorone as a lifting agent...	cc. per liter--	0.8
Sodium ditertiary butyl naphthalene sulfonate as a wetting agent-----	g. per liter--	0.3

Example 6

Methyl n-butyl ketone as a lifting agent-----	cc. per liter--	0.8
Sodium ditertiary butyl naphthalene sulfonate as a wetting agent-----	g. per liter--	0.3

Example 7

Cyclohexanone as a lifting agent-----	cc. per liter--	0.8
Sodium ditertiary butyl naphthalene sulfonate as a wetting agent-----	g. per liter--	0.3

Other examples of combinations which I have found to possess excellent properties are as follows:

Example 8

Sodium ditertiary butyl naphthalene sulfonate- 4 parts	1 g. per liter
Methyl n-amyl ketone- 6 parts	or less

Example 9

Sodium oleate----- 5 parts	1 g. per liter
Methyl n-amyl ketone- 5 parts	or less

Example 10

Sodium ditertiary butyl naphthalene sulfonate- 5 parts	1 g. per liter
Camphor ----- 1 part	or less
Alcohol, (methyl, ethyl isopropyl, etc.) ----- 4 parts	1 g. per liter or less

The use of alcohol is optional, but when added, the purpose is to produce a homogeneous mixture of the camphor and the wetting agent.

Example 11

Sodium ditertiary butyl naphthalene sulfonate- 4 parts	1 g. per liter
Isophorone ----- 6 parts	or less

Example 12

Sodium ditertiary butyl naphthalene sulfonate- 6 parts	1 g. per liter
Methyl propyl ketone- 4 parts	or less

Example 13

Sodium ditertiary butyl naphthalene sulfonate from a fraction boiling at 190-250° C. at 20 mm. and camphor in the ratio of 10:1----	g. per liter--	0.66
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Example 14

40% sodium ditertiary butyl naphthalene sulfonate from a fraction boiling at 190-250° C. at 20 mm. in methyl n-amyl ketone-----	cc. per liter--	1.25
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Example 15

50% sodium oleate in methyl-
n-amyl ketone----- cc. per liter- 1.38

Example 16

30% sodium ditertiary butyl
naphthalene sulfonate from
a fraction boiling at 190-
250° C. at 20 mm. in methyl
n-amyl ketone----- cc. per liter- 1.55

The addition of the ketone from 5-12 carbon atoms to any surface active substance has an effect on the activity of the latter which is considerably greater than that which would normally be exerted by calculation from the surface activity of the separate components. The solutions of the mixture have an increased activity as regards wetting, penetrating, detergent, frothing and dispersing action. As specific examples which do not limit the scope of my invention, the surface active material may differ as widely as soaps, sodium alkyl naphthalene sulfonates, and sodium alkyl sulfates.

Other combinations which come within the scope of this invention are the combination of my lifting agents with normal n-amyl ketone and sodium di-amyl naphthalene sulfonate.

Saturated water solutions of ketones may also be used alone for wetting purposes, and in this use they may be employed not as lifting agents in combination with a wetting agent, but as the principal surface active agent. The preferred material for such purposes is a ketone having from 5-12 carbon atoms, in the form of saturated water solutions.

I claim:

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1. A liquid, the surface activity of which has been changed, comprising a solution of an alkyl naphthalene sulfonate and a saturated aliphatic ketone selected from the group consisting of methyl-n-amyl ketone, diisobutyl ketone and methyl-n-butyl ketone.

2. A liquid, the surface activity of which has been changed, comprising a solution of a sodium alkyl naphthalene sulfonate and a saturated aliphatic ketone selected from the group consisting of methyl-n-amyl ketone, diisobutyl ketone and methyl-n-butyl ketone.

3. A liquid, the surface activity of which has been changed, comprising a solution of an alkyl naphthalene sulfonate and methyl-n-amyl ketone.

4. A liquid, the surface activity of which has been changed, comprising a solution of an alkyl naphthalene sulfonate and diisobutyl ketone.

5. A liquid, the surface activity of which has been changed, comprising a solution of an alkyl naphthalene sulfonate and methyl-n-butyl ketone.

6. A liquid, the surface activity of which has been changed, comprising a solution of a sodium alkyl naphthalene sulfonate and methyl-n-amyl ketone.

7. A liquid, the surface activity of which has been changed, comprising a solution of a sodium alkyl naphthalene sulfonate and diisobutyl ketone.

8. A liquid, the surface activity of which has been changed, comprising a solution of a sodium alkyl naphthalene sulfonate and methyl-n-butyl ketone.

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