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Lauterbach et al.

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[54] **PAPER COATING LUBRICANTS AND COATED PAPER INCORPORATING SUCH**

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[58] **Field of Search** 428/342, 486, 488, 511, 428/512, 514, 533; 106/213, 214, 311

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[57] **ABSTRACT**

Oil-in-water type emulsions of long chain monohydric aliphatic alcohols containing from 16 to 30 carbon atoms per molecule, when added to conventional paper coating compositions, function as coating lubricants when such coating compositions are coated on paper. Paper coated therewith displays excellent performance and use characteristics compared to coated paper made with conventional lubricants. The emulsions have low viscosity, shear stability, and a solids content typically of from about 30 to 60 weight percent.

12 Claims, No Drawings

PAPER COATING LUBRICANTS AND COATED PAPER INCORPORATING SUCH

BACKGROUND OF THE INVENTION

The lubricants used in paper coating have traditionally consisted of the sodium, ammonium, or calcium salts of naturally occurring fatty acids, which contain, for the most part, from about 8 to 18 carbon atoms per molecule. These materials are mixed in solution or in dispersed form with paper coating compositions before the latter are applied to paper surfaces in coating operations. For example, calcium stearate is commercially available as an emulsion for direct addition to coating compositions.

When stable, fluid, and easily handled, the paper industry apparently prefers emulsions of water insoluble coating lubricants because of the ease of handling emulsions in paper coating operations, apparently primarily because they can be stored and then directly added with a minimum of labor to a paper coating composition before the same is used.

So far as is known, no one has ever heretofore employed long chain aliphatic monohydric alcohols containing from about 16 to 30 carbon atoms per molecule as coating lubricants in paper coating compositions. Moreover, it is believed that no one has ever heretofore prepared such alcohols in the form of aqueous oil in water type emulsion which can be directly mixed with conventional paper coating compositions in the manner desired by the paper coating industry for use in conventional paper coating processes and equipment. Such alcohols appear to display excellent performance characteristics as paper coating lubricants and also to have current economic advantages over the traditional paper coating lubricant materials previously used.

BRIEF SUMMARY OF THE INVENTION

In one aspect, the present invention is directed to an aqueous liquid emulsion comprising on a 100 weight percent total emulsion basis from about 40 to 70 weight percent of a continuous phase comprised of water and from about 30 to 60 weight percent of a discontinuous phase. The discontinuous phase is comprised initially on a total discontinuous phase basis of not more than about 99.8 weight percent of at least one monohydric aliphatic alcohol containing from 16 through 30 carbon atoms per molecule and from about 0.2 to 12 weight percent of surfactant. The discontinuous phase is in the physical form of discrete globules which typically fall in the size range from about 2 to 2000 microns.

In another aspect, the present invention relates to a method for making such emulsions. The method involves the steps of first warming the monohydric aliphatic alcohol to a temperature in the range of from about 65° to 100° C. sufficient to place such alcohol in a liquid state and then dissolving therein from about 0.2 to 12 weight percent (100 weight percent total solution basis) of the surfactant. Finally, one mixes, preferably in two controlled steps, the resulting solution with water to form the desired emulsion.

In still another aspect, the present invention relates to a paper coating composition of the type adapted for application to surface portions of a paper substrate member which contains as a lubricant in admixture therewith an aqueous emulsion as above described.

In yet another aspect, the present invention is directed to a paper coated with a coating composition in which has been incorporated, during the manufacture thereof, an aqueous liquid emulsion of monohydric aliphatic alcohol containing from 16 through 30 carbon atoms per molecule.

The use of such monohydric aliphatic alcohol in paper coatings provides flow modification for the coating during the coating process. Thus, in some coating compositions and in some coating procedures, such monohydric aliphatic alcohols desirably modify flow characteristics of the coating binder used in such compositions without adversely reducing product coating strength. In addition, such monohydric aliphatic alcohols act as a species of release agent in coating compositions in coating operations, as during the drying of a coating with a conventional drying roll where, during the early stages of drying, the surface, or skin, of the coating next to the drier surface does not stick thereto, and can be readily removed, as in normal continuous operations, while the layers or regions in such coating immediately below the surface thereof are still in a fluid state and are not dry; in this way, the coating during the important initial stages of drying is not disturbed. Furthermore, after a drying operation (however conducted), many coated papers are super-calendered, and in a super-calendering operation such monohydric aliphatic alcohols if present exhibit excellent friction reduction characteristics at the elevated temperatures and pressures characteristically employed during super-calendering.

The monohydric aliphatic alcohols used in this invention are generally compatible with the various coating binders used in paper coating compositions generally, though it appears that such alcohols are unusually compatible with starch and starch derivatives, which is a significant consideration because starch and starch derivatives are particularly well-known and well-used as coating binders in such compositions.

Typically, emulsions of this invention are water dilutable, but when the discontinuous phase is in the weight percentage range above indicated (which can be considered to approximate the total solids content of a given emulsion of this invention), these emulsions characteristically have a viscosity in the range from about 150 to 2000 centipoises (160 to 300 centipoises being now preferred). Also, these emulsions are generally compatible with conventional paper coating compositions, and, commonly, as with coating compositions using a starch or starch derivative as a coating binder, the change in coating composition viscosity is relatively small upon admixture therewith of such an emulsion of this invention. Furthermore, these emulsions are characteristically shear stable, as demonstrated, for example, by the fact that a sample of such an emulsion can be placed in a so-called Waring blender and subjected to operation of the blender for a period of, say, 1 minute, without any significant break-down of the emulsion.

DETAILED DESCRIPTION

The Emulsions and their Preparation

The emulsions are generally as characterized above. A presently preferred class of emulsions contains from about 42 to 55 weight percent solids (total discontinuous phase) and has discrete globules ranging from about 2 to 100 microns in average individual diameters.

The aliphatic monohydric alcohols used in this invention can be in any desired or readily available form. Pure materials may be used, but mixtures of various different such alcohols are commonly available commercially and are presently preferred.

One type of preferred alcohol mixture contains mainly aliphatic alcohols having from 20 through 28 carbon atoms per molecule, with one terminal hydroxyl group per molecule. One more preferred such mixture of this type comprises on a 100 weight percent total alcohol basis at least about 50 weight percent of an aliphatic monohydric alcohol containing 20 carbons per molecule with a terminal hydroxyl group and not more than about 35 weight percent of an aliphatic monohydric alcohol containing 22 carbon atoms per molecule with a terminal hydroxyl group.

If desired, one may use in combination with such an alcohol or alcohol mixture one or more paraffinic hydrocarbons, each having from 16 through 30 carbon atoms per molecule. In some use situations, such a mixture combination is advantageous because a given paraffinic hydrocarbon tends to have a lower melting point than its corresponding alcohol of the same molecular weight. Thus, such a mixture exerts a lubricating action over a wider (and, typically, lower temperature range) than is achievable using one alcohol, or even a mixture of alcohols, above. The quantity of paraffinic hydrocarbon employed in any given mixture in combination with the alcohol(s) on a total mixture basis can vary from a very small amount (e.g. 1 or 2 percent) up to large amounts (e.g. perhaps, 85 weight percent of a total mixture, but typically, if at least one paraffinic hydrocarbon is present, it is convenient to employ at least about 10 weight percent thereof (total mixture basis). When used, such a paraffinic hydrocarbon preferably contains mainly from about 20 through 28 carbon atoms per molecule.

One particularly preferred type of alcohol mixture for use in this invention is a candle-wax like material at room temperature which is comprised not only of an alcohol mixture but also a mixture of paraffinic hydrocarbons likewise containing from 16 through 30 carbon atoms per molecule. One such mixture is available commercially under the trade mark "Alfol 20 plus" from Shell Oil Company and reportedly contains about 70 weight percent of mixed alcohols and about 30 weight percent paraffinic hydrocarbons, while another such mixture is available commercially under the trademark "Epal C-20 plus" from Ethyl Corporation (see Examples below).

No particular criticality is associated with surfactant materials employed in the making of an emulsion. Surfactants should be soluble in the alcohol when the latter is in a melted form. Preferred surfactants presently are long chain alcohols and fatty acids which are believed (and there is no intent to be bound by theory herein) to be able to reduce the surface tension at the interface between suspended globules and water because of the solubility properties of their molecules. Anionic, cationic and nonionic surfactants may be used. One presently more preferred type of surfactant is an adduct of an alkyl phenol and ethylene oxide, such as those sold commercially by Shell Oil Company under its trademark "Neodol 25—9" and by Rohm and Haas Company under its trademark "Triton X-100" (see Examples below). Another presently more preferred type of surfactant comprises alkyl aryl sulfonates. Conveniently, one may employ surfactants having an HLB balance number of from about 2 to 40, although surfactants with higher and lower HLB balance numbers can work, depending upon conditions, equipment used for emulsion preparation, and the like. The chief function of a surfactant is as an aid to making a stable emulsion; however, using an ultrasonic emulsifier, one can sometimes emulsify the alcohols used in this invention with little or even no surfactant being used.

One now preferred class of emulsions of this invention comprises those wherein the discontinuous (or disperse) phase is initially comprised on a total 100% weight basis of from about 20 to 80 weight percent of a mixture of aliphatic monohydric alcohols each having from about 20 through 28 carbon atoms per molecule, from about 20 to 80 weight percent of a mixture of paraffinic hydrocarbons each having from about 20 through 28 carbon atoms per molecule, and from about 0.5 to 3 weight percent of such surfactant.

A presently preferred method of making an alcohol emulsion of this invention involves as a first step the warming of at least one monohydric aliphatic alcohol to a temperature in the range from about 40° to 100°C. sufficient to place such alcohol in a liquid state. Next, one dissolves in the so warmed such alcohol from about 0.2 to 12 weight percent (100 weight percent total solution basis) of a surfactant, such surfactant being characterized by having an HLB balance number in the range from about 2 to 40. Then, one mixes the resulting solution with water at a temperature similar to that of said solution and cools the mixture to ambient temperatures to form an emulsion wherein the continuous phase comprises initially from about 40 to 70 weight water and the discontinuous phase comprises initially from about 30 to 60 weight percent of said resulting solution in the physical form of globules. Preferably, afterwards, the product emulsion is passed through a homogenizer which functions, apparently, to further stabilize the emulsion, to decrease the average globule size, and to increase the viscosity thereof. Any conventional homogenizer apparatus may be employed, depending upon the scale of preparation, such as a laboratory hand operated Fisher homogenizer or a semi works size Manton-Gaulin homogenizer.

In mixing the alcohol/surfactant solution with water, either water may be added to the solution, or vice versa. Some sort of agitation is used as a part of mixing in order to break up the alcohol material into globules and produce the desired dispersion of the alcohol in water to make a product emulsion. In general, it is less expensive to add water to the solution than vice versa, since in so doing only one container at a time may be used for the entire preparation sequence.

A product emulsion is stable, characteristically. While as indicated above, the total concentration of non-aqueous materials in an emulsion can vary over a rather wide range, it is presently preferred to prepare the emulsion in the form of a system containing from about 40 to 65 weight percent total solids. In preparing an emulsion, it has been found that certain alcohols and alcohol mixtures can display, for reasons not presently known, a tendency to form water in oil emulsions rather than the desired oil in water emulsions, particularly at certain temperatures of the alcohol/surfactant solution approximately in the mid-region of the melting range of an alcohol mixture. The added water should preferably be near the temperature of the solution. Water in oil emulsions are not desired for purposes of the present invention since, when these systems be-

come adjusted to room temperature, they tend to form a solid material rather than a liquid material.

The Coating Compositions and their Preparation

Paper coating compositions are well known to the art and, as such, do not constitute part of the present invention. Such compositions are employed in many variations and types and it is difficult to generalize about the composition and preparation thereof. Typically, such a coating composition comprising in combination on a 100 weight percent total composition basis:

a. from about 20 to 65 weight percent total solids, and

b. from about 35 to 80 weight percent water.

Such total solids are comprised of coating binder and particulate pigment, and the weight ratio of coating binder to particulate pigment generally ranges from about 8:100 to 50:100.

To such a composition is added and mixed before such is coated upon a paper substrate in accord with the teachings of this invention at least one monohydric aliphatic alcohol containing from 16 through 30 carbon atoms per molecule, such alcohol being in the physical form of discrete globules whose average individual diameters fall in the range from about 2 to 2000 microns. The weight ratio of such alcohol to the particulate pigment ranges from about 0.2:100 to 3:100.

Preferably, the discrete globules are comprised initially on a total weight basis of not more than about 99.8 weight percent of such alcohol and from about 0.2 to 12 weight percent of surfactant, as when the globules are introduced into a coating composition through addition thereto of an emulsion of this invention as described herein.

Largely because of the high molecular weight of starch itself, it is common and often desirable to use a starch derivative which characteristically has a lower molecular weight than starch itself and thus can go into aqueous solution. The term modified starch is used herein in its conventional sense to refer to any of several water-soluble polymers derived from a starch (such as corn, potato, tapioca, etc.) by acetylation, chlorination, acid hydrolysis, enzymatic action, or the like. Such reactions produce starch acetates, esters, and esters in the form of stable and fluid solutions or films. Typical modified starches are "Staco M" a trademark of the Staley Products Co. and "Penford Gum 280" a trademark of Penick and Ford.

A starch dispersion or solution for use in a paper coating composition may be prepared on location by various treating/preparation procedures, such as that described in U.S. Pat. No. 3,211,564 to George E. Lauterbach.

Various types of particulate pigments may be employed in a paper coating composition. A particularly common class of pigments for example, comprises inorganic pigments such as silicates, carbonates, aluminates, titanates, and the like. A typical pigment is 40 to 60 weight percent No. 2 coating clay, 20 to 40 weight percent No. 1 coating clay, and 10 to 30 weight percent calcium carbonate on a total 100% weight basis wherein the coating clay is Georgia kaolin clay.

Generally, as those skilled in the art well appreciate, a dispersant is used to disperse the particulate pigment in the aqueous phase of a coating composition. Typical dispersants include such materials as inorganic phosphate glass, a derivative of poly(acrylic acid), or the like.

In a special sense of the word, a dispersant may be regarded as a surfactant, but the term "dispersant" is used in this art in reference to the formation of a dispersed pigment system of the type found in coating compositions. A dispersant is usually not interchangeable with a surfactant in an emulsion of this invention and vice versa, but dispersants and surfactants are generally compatible with one another in a coating composition containing an alcohol in accordance with the teachings of this invention. A surfactant may be classified as a dispersant and, in fact, some so called dispersants may possibly be sometimes used as surfactants in the manufacture of emulsions of this invention, though such a surfactant has typically an HLB number within the range indicated above.

The coating composition itself is typically a colloidal dispersion of the pigment in water together with the coating binder. Coating compositions are typically formulated according to the type of end use printing applications intended for the paper coated therewith. Thus, a coating composition suitable for letter press coatings comprises

from about 40 to 65 weight percent total solids, and from about 35 to 60 weight percent water.

The total solids are comprised of coating binder, particulate pigment and alcohol, the weight ratio of binder to pigment ranges from about 15 to 20, and the weight ratio of alcohol to pigment ranges from about 0.2 to 3.

Similarly, a coating composition adapted to produce a product coating suitable for use in rotogravure printing comprises

from about 40 to 65 weight percent total solids and from about 35 to 60 weight percent water.

The total solids are comprised of coating binder, particulate pigment and alcohol, the weight ratio of binder to pigment from about 8:100 to 16:100, and the weight ratio of alcohol to pigment ranges from about 0.2:100 to 3:100.

Similarly, a coating composition adapted to produce a product coating suitable for use in offset printing comprises

from about 40 to 65 weight percent total solids, and from about 35 to 60 weight percent water.

The total solids are comprised of coating binder, particulate pigment and alcohol, the weight ratio of binder to pigment ranges from about 15:100 to 25:100, and the weight ratio of alcohol to pigment ranges from about 0.2:100 to 3:100.

For use in the paper trade for paper coating, the emulsion of this invention would be added as prepared to the coating composition, or to a mixture being prepared for use as a coating composition (sometimes termed a "finishing aid" for paper coating). The emulsion is a minor component in a coating composition being used for paper coating to prepare a printing surface. The emulsions are generally compatible with all paper coating compositions, although a slight viscosity increase may be noted in the paper coating composition after addition of a desired quantity of emulsion thereto.

Those skilled in the art will readily appreciate that a typical commercial coating composition may contain additional ingredients besides pigment, binder and lubricant. Thus, in addition, for example, such a composition can contain biocides, to control storage stability, dyes (typically blue or red) to control the tint of the white of the paper and to counteract yellowing. Also, there may be thickening agents, such as sodium aligi-

nates, or carboxy methyl cellulose, to interchange the rheology and the flow characteristics of a given coating color composition. In addition, offset coatings also contain a small amount (usually under 10 weight percent total coating composition basis) of an insolubilizing agent of some kind, particularly if the coating uses a starch binder or a protein binder.

Typically a coating composition viscosity varies with temperature and means of measuring, but roughly falls in the range from about 2000 to 7000 centipoises for a coating for a letterpress paper. For a rotogravure paper, this range would be the same for the same kind of equipment, but here the binder level would be much lower, typically about half that used for the letterpress paper coating.

The alcohols used in this invention can be branched and can have side chains. Such will affect the capacity of the alcohol to interact with a starch binder but not the capacity to react with, for example, a polyvinylacetate binder.

The Coated Papers and their Preparation

The coated papers produced from paper coating compositions containing an alcohol in accord with this invention comprise

a. a cellulosic, non-woven paper sheet member, and
b. a coating integral with at least one of the two opposed faces of said paper sheet member.

The coating weight ranges from about 1.4 to 17 grams per square meter relative to the substrate paper sheet member, and the coating is comprised of coating binder, particulate pigment, and at least one monohydric aliphatic alcohol containing from 16 through 30 carbon atoms per molecule. The weight ratio of coating binder to particulate pigment ranges from about 8:100 to 50:100, and the weight ratio of alcohol to particulate pigment ranges from about 0.2:100 to 3:100.

Usually, owing to the manner of making, such a coated paper additionally contains a weight ratio of surfactant to particulate pigment ranging from about 0.004:100 to 0.36:100. Typically, though not necessarily, such a coated paper further contains a weight ratio of dispersant to particulate pigment of from about 0.5:100 to 1.5:100. Preferred alcohols and surfactants are as above described.

An alcohol-containing coated paper of this invention adapted for use in letter press printing and prepared from a suitable coating composition such as above described has a coating wherein the weight ratio of binder to pigment ranges from about 15:100 to 20:100, and the weight ratio of alcohol to pigment ranges from about 0.2:100 to 3:100.

An alcohol-containing coated paper of this invention adapted for use in rotogravure printing and prepared from a suitable coating composition such as above described has a coating wherein the weight ratio of binder to pigment ranges from about 8:100 to 16:100, and the weight ratio of alcohol to pigment ranges from about 0.2:100 to 3:100.

An alcohol-containing coated paper of this invention adapted for use in offset printing and prepared from a suitable coating composition such as above described has a coating wherein the weight ratio of binder to pigment ranges from about 15:100 to 25:100, and the weight ratio of alcohol to pigment ranges from about 0.2:100 to 3:100.

A typical coating apparatus would be a blade coater or a roll coater. Some coatings are run with an air knife, wherein one rolls paper through a suitable coating composition with an applicator roll, deposits on the paper surface an excess amount of coating composition which is then blown off with air from a slot going across the web. Relatively low air pressures and relatively high velocities are used. Material blown off the surface goes back into the coating composition reservoir. A chief advantage is a uniform film or coating which fills holes, etc. There are also other conventional coating techniques such as allowing water to strike a web (or soaking in) and, as it soaks into the paper, forming a filter cake of coating which is immobilized. Any convenient coating technique may be used. Variations in coating composition are made according to the type of coating apparatus employed as those skilled in the art will appreciate.

Paper stocks used for coating vary widely. A typical paper stock contains up to 50% by weight ground wood. Basis weight chosen depends upon whatever particular paper was being made at a given time, but typically ranges from about 28 to 45 pounds. Coating weight is about ⅛ total paper weight, typically, so that on the coated paper, coating weight is about 150% of the base paper weight.

Typically, coating thickness is not controlled by blade or the like. A coating composition is spread over a sheet and the film thickness is fairly well set by the coating machinery, and by the roughness of the paper. After coating, the layer is dried, typically at a temperature ranging up to typically not above about 212°F. The drier drums are heated to higher temperatures with steam internally, but drum temperatures are typically not above about 230° to 240° F. commercially.

A typical coating is applied to both sides of a paper. However, an example of a paper coating applied only on one side is label paper for tin cans and the like.

Typical procedure for coating on both sides can involve use of a roll coater when each side is simultaneously coated. However, on a blade coater, first one side, then the other is coated, as is the case with an air knife coater, with an intervening drying step between coating applications. The same coating composition can be used on both sides, but there may be some variation, as in the amount of binder and in the coating solids, depending, for example, on what the coat weight distribution from one side to the other is. The amount of alcohol lubricant used is generally constant for each side's coating composition.

After drying, a coating is calendered. Usually printing papers are super calendered. Calendering is done after both sides are coated, or coating is completed and dried; it is the last step in the coating procedure. The advantage of using an alcohol lubricant is particularly felt in super calendering. Super calendering is conventionally achieved by using a stack of alternately hard and soft rolls, as those skilled in the art well appreciate.

EMBODIMENTS

The present invention is further illustrated by reference to the following Examples. Those skilled in the art will appreciate that other and further embodiments are obvious and within the spirit and scope of this invention from the teachings of these present Examples taken with the accompanying Specification.

EXAMPLE 1

About 100 parts by weight of commercially available "Alfol 20 plus", a trademark of the Shell Oil Company

for its brand of mixed monohydric alcohols, is placed in a vessel and heated to a temperature sufficient to melt same. The melt temperature is about 57°–95° C. "Alfol 20 plus" is stated by the manufacturer to comprise about 70 weight percent mixed monohydric aliphatic alcohols containing from 20 through 28 carbon atoms per molecule and about 30 weight percent of mixed paraffinic hydrocarbons containing from 20 through 28 carbon atoms per molecule. The mixed monohydric aliphatic alcohol portion of this composition on a 100 weight percent total alcohol basis is said to comprise alcohol molecules each having a single terminal hydroxyl group and, further, having the following distribution of molecular weights:

number carbon atoms per molecule	estimated weight percent
C_{18} or lower	1 %
C_{20}	66%
C_{22}	24%
C_{24}	6%
C_{26}	2%
C_{28}	1%

To this melt is slowly added with stirring a total of about 4 parts by weight of a surfactant commercially available under the trade mark "Neodol 25-9" from Shell Oil Company. This surfactant is stated by the manufacturer to comprise an adduct of 1 mole of nonyl phenol with 9 moles of ethylene oxide. The surfactant dissolves in the melt to produce about a 4 weight percent solution thereof in the melt.

Then about 150 parts by weight of tap water at 57° C. is slowly added with vigorous stirring to this melt. After all the water is added, the resulting mixture is slowly cooled down to room temperature. In this cooling process, an oil in water type emulsion is produced.

More specifically, at the start of water addition, the temperature of the melt is around 57° C. and one cools with vigorous stirring to below 47° C. The emulsion in the beginning is of the water in oil type. As the emulsion passes through the melting range of the alcohol, the alcohol begins to crystalize. At this point the alcohol ceases to be in the continuous phase and the water in oil emulsion breaks. With vigorous stirring during this period the water phase becomes continuous, entrapping the alcohol and yeilding an oil in water emulsion. The product is an oil in water emulsion having a viscosity of approximately 100 centipoises. The continuous water phase comprises approximately 60% of the emulsion, while the discontinuous phase comprises approximately 40% of the emulsion. This emulsion is storage stable, but shows a slight tendency to form a water layer in its bottom portion while standing. This water layer readily mixes with the upper emulsion layer with stirring.

EXAMPLE 2

The emulsion prepared in the preceding example is passed through a laboratory hand homogenizer from Fisher Company to produce an emulsion in which the discontinuous phase is apparently comprised of globules of smaller average size than in the emulsion of example 1. This emulsion has a viscosity of about 400 centipoises and appears completely storage stable on standing.

When about 20 mililiters of this emulsion are passed through a Hercules Rheogram, it is found that the emulsion has shear stability over a wide range of shear forces.

EXAMPLES 3 AND 4

A paper coating composition is prepared having the following components:

"Ultragloss 90" clay	400	grams
"Stayco M" starch	70	grams
"Calgon" hexameter phosphate	0.8	grams
50 wt. % NaOH aq. soln.	1.6	grams
water (tap)	1154	grams

"Ultragloss 90" is a trademark of the Engelhard Minerals and Chemicals Company for its brand of Georgia kaolin clay. "Stayco M" is a trademark of the A. E. Staley Manufacturing Co. for one brand of modified starch.

This mixture is heated to 90° C. in a steam jacketed container with vigorous stirring for 15 minutes to cook the starch. Then the composition is divided into two equal portions and cooled.

To a first portion is added 3.6 grams of "Nopco C104", a trade mark of Nopco Industries for its brand of calcium stearate aqueous oil in water emulsion. To the second portion is added 5 grams of the emulsion of Example 2 above. Each resulting portion is then mixed for 5 minutes to produce a paper coating composition. The first resulting composition (containing "Nopco C 104") has a viscosity of 3,780 centipoises, and the second resulting composition (containing the alcohol emulsion of Example 2) has a viscosity of 2230 centipoises. The emulsion of Example 2 thickens only slightly the second portion but the Napco C 104 rather substantially thickens the first portion.

The reduced viscosity for the coating composition containing the emulsion of Example 2 (compared to the coating composition containing the emulsion of calcium stearate) indicates that one could use less modified starch in the coating composition containing the emulsion of Example [2 and thus improve the strength of the coating in a product coated sheet. Also, calcium stearate in such a coating composition tends to produce a coating of weaker strength relative to a coating made with alcohol therein because the calcium stearate apparently tends to weaken starch adhesive bonds.

The modification of starches used in making a coating composition (necessary to produce a water solution of starch having a predetermined, desired viscosity level) definitely tends to weaken the bonding capabilities of starch. In general, the more the modification, the more the reduction in bond strength. Thus, through the use of the alcohol emulsion of Example 2, one can use a starch which is less modified than by using, for example, an equivalent amount of a calcium stearate emulsion, and thereby increase the adhesive strength of the starch employed in a coating composition as well as the strength of a product coating.

EXAMPLES 5 AND 6

Each of the respective first and second paper coating compositions prepared above in Examples 3 and 4. Each coating is applied to Blandin Paper Company 29.5 pound base stock paper using a hand held rigid blade. A composition reservoir is associated with the blade and individual sheets of such stock paper are drawn beneath the blade edge and coated with compo-

sition from the reservoir. Two sheets are coated thusly with the first paper coating composition (the one containing calcium stearate) and three sheets are coated with the second paper coating composition (the one containing the alcohol). All sheets are dried with air in an oven for 10 minutes at 100°C. The dried coating weights are as follows:

Table I

	1st composition (containing Ca Stearate	2nd composition (containing alcohol)
first sheet	15.46 pounds/ream	14.31 pounds/ream
second sheet	15.31 pounds/ream	14.86 pounds/ream
third sheet	—	14.74 pounds/ream

All sheets are then cold (e.g. ambient temperature) calendered in the nip region between one steel roll and one so-called soft roll using a pressure of 600 pounds per linear inch, the apparatus comprising a conventional laboratory-type super calendar apparatus. Each sheet is passed between the rollers with the steel roll adjacent the coated paper sheet surface. Before the first passage and after each passage (except for the third and fifth passage for each sheet) each sheet is subjected to a 75° angle gloss meter reading using a standard gloss meter. The readings are as follows:

Table II

Sheet* type	sample no.	Number of passes through calendering apparatus 0 (initial)	1	2	4	6
1	1	15.2	57.1	65.0	73.3	77.5
1	2	14.0	55.2	63.2	70.6	72.1
2	1	15.6	59.0	67.5	71.7	74.5
2	2	16.1	59.2	67.0	70.9	73.2
2	3	15.9	61.2	70.3	76.0	73.5

*Sheet type 1 are sheets coated with first composition (containing calcium stearate) while sheet type 2 are sheets coated with second composition (containing alcohol). Sample numbers refer to same sample sheets as shown in Table I above.

Following the last pass between the calendering rolls, the brightness of each sheet is measured using a standard General Electric Company brightness meter by which the reflectivity of each sheet is compared to a reference standard in accord with the standard TAPPI test procedure for brightness measurement. The readings are as follows:

Table III

Sheet* type	sample No.	Brightness Value
1	1	69.0
1	2	69.0
2	1	69.6
2	2	69.2
2	3	69.0

*see footnote for Table II above

The test results given above show that the brightness of the alcohol containing sheets is slightly better than that of the calcium stearate containing sheets. The alcohol functions as a lubricant because the sheet coating gloss generally improves of the sheet coatings containing the alcohol with each successive passage through the calender stack (as is the case with sheets whose coating contains calcium stearate). The sheets with the alcohol containing coating appear to have coatings with greater strength than the sheets with the calcium stearate containing coating.

EXAMPLE 7

The procedure of Example 1 is repeated except that in place of the "Alfol 20 plus" there is employed "Epal C-20 plus" which is a trade mark of the Ethyl Corporation for its brand of mixed monohydric aliphatic alcohols blended with paraffinic hydrocarbons, the molecules of this mixture apparently falling in the C_{16} to C_{28} range. Reportedly, this mixture is comprised of 63 weight percent mixed alcohols and 37 weight percent paraffinic hydrocarbons. This product emulsion is storage stable, but shows a slight tendency to form a water layer in its bottom portion while standing. This water layer readily mixes with the upper emulsion layer with stirring. This emulsion has a viscosity of about 100 centipoises.

EXAMPLE 8

The procedure of Example 2 is repeated except that the emulsion of Example 7 is employed in place of the emulsion of Example 1. The discontinuous phase of the product emulsion is apparently comprised of globules of smaller average size than in the emulsion of Example 7. The product emulsion has a viscosity of about 400 centipoises and appears completely storage stable on standing. When the emulsion is tested in a Hercules Rheogram, it is found that the emulsion has shear stability over a wide range of shear forces.

EXAMPLE 9

To a coating composition prepared as described in Example 3 and 4 is added 5 grams of the emulsion of Example 8 followed by stirring for about 5 minutes. The product composition shows a small increase in viscosity.

EXAMPLE 10

When a coated and calendered paper is prepared as described in Example 5 and 6 using the coating composition of Example 9, it is found that the coating is lubricated and displays excellent coating strength and brightness characteristics.

EXAMPLE 11

The procedure of Example 1 is repeated except that in place of the "Alfol 20 plus" there is employed a substantially pure C_{20} monohydric aliphatic alcohol having a terminal hydroxyl group. The product emulsion is then passed through a homogenizer in the manner taught by Example 12. The resulting emulsion is storage stable on standing, has a viscosity less than about 1000, and displays excellent shear stability.

EXAMPLE 12

The emulsion of Example 11 is added to a coating composition in the manner prepared and taught by Examples 3 and 4, and the product composition shows some increase in viscosity.

EXAMPLE 13

The coating composition of Example 12 is coated on paper as taught by Example 10 and the paper is similarly then dried and calendered. The product paper has a lubricated coating and displays excellent coating strength and brightness characteristics.

EXAMPLE 14

Examples 1 and 2 are repeated in sequence except that the solids level in the product emulsion is increased to 55 weight percent. The product emulsion is storage stable, water dilutable, and shear stable.

EXAMPLE 15

Examples 1 and 2 are repeated in sequence except that in place of "Neodol 25-9" there is employed sodium lauryl sulfate. The product emulsion is storage stable, water dilutable, and shear stable.

EXAMPLE 16

Examples 1 and 2 are repeated in sequence except that in place of "Neodol 25-9" there is employed "Triton X-100", a trade mark of the Rohm and Haas Company for its adduct of one mole of octyl phenol with 10 moles of ethylene oxide. The product emulsion is storage stable, water dilutable, and shear stable.

We claim:

1. A coated paper comprising

a. a cellulosic, non-woven paper sheet member, and

b. a coating integral with at least one of the two opposed faces of said paper sheet member,

c. said coating comprising from about 1.4 to 17 grams per square meter relative to said paper sheet member,

d. said coating being further comprised of coating binder, particulate pigment, and at least one monohydric aliphatic alcohol containing from 16 through 30 carbon atoms per molecule, the weight ratio of said coating binder to said particulate pigment ranging from about 8:100 to 50:100, and the weight ratio of said alcohol to said particulate pigment ranging from about 0.2:100 to 3:100.

2. The coated paper of claim **1** wherein said coating additionally contains a weight ratio of surfactant to said particulate pigment of from about 0.004:100 to 0.36:100.

3. The coated paper of claim **1** wherein such alcohol comprises a mixture of alcohols each having from about 20 through 28 carbon atoms per molecule.

4. The coated paper of claim **1** wherein such alcohol comprises on a 100 weight percent total alcohol basis at least about 50 weight percent of an aliphatic monohydric alcohol containing 20 carbon atoms per molecule with terminal hydroxly group and not more than about 35 weight percent of an aliphatic monohydric alcohol containing 22 carbon atoms per molecule with a terminal hydroxyl group.

5. A coated paper comprising

a. a cellulosic, non-woven paper sheet member, and

b. a coating integral with at least one of the two opposed faces of said paper sheet member,

c. said coating comprising from about 1.4 to 17 grams per square meter relative to said paper sheet member,

d. said coating being further comprised of coating binder, particulate pigment and a lubricant composition, the weight ratio of said coating binder to said particulate pigment ranging from about 8:100 to 50:100, and the weight ratio of said lubricant composition to said particulate pigment ranging from about 0.2:100 to 3:100,

e. said lubricant composition comprising from about 1 to 85 weight percent of at leasat one paraffinic hydrocarbon containing from 16 through 30 carbon atoms per molecule with the balance up to 100 weight percent thereof being at least one monohydric aliphatic alcohol containing from 16 through 30 carbon atoms per molecule.

6. The coated paper of claim **2** wherein said surfactant is an adduct of nonyl phenol with ethylene oxide.

7. The coated paper of claim **6** wherein said surfactant comprises about one mole of nonyl phenol and about 9 moles of ethylene oxide.

8. The coated paper of claim **1** wherein said coating binder is selected from the group consisting of starch, starch derivative, polyvinyl alcohol, polyvinyl acetate, butadiene/styrene latices, acrylic polymers, casein, and soy proteins.

9. The coated paper of claim **1** wherein said coating binder is starch or a starch derivative.

10. A coated paper of claim **1** adapted for use in letter press printing where, in said coating, the weight ratio of said binder to said pigment ranges from about 15:100 to 20:100 and the weight ratio of said alcohol to said pigment ranges from about 0.2:100 to 3:100.

11. A coated paper of claim **1** adapted for use in rotogravure where, in said coating, the weight ratio of said binder to said pigment ranges from about 8:100 to 16:100 and the weight ratio of said alcohol to said pigment ranges from about 25:100 to 1.5:100.

12. A coated paper of claim **1** adapted for use in offset printing, where, in said coating, the weight ratio of said binder to said pigment ranges from about 15:100 to 25:100 and the weight ratio of said alcohol to said pigment ranges from about 0.2:100 to 3:100.

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