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MOISTUREPROOF SHEET MATERIAL

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This invention relates to the art of moisture-proofing paper and other cellulosic sheet materials including transparent regenerated cellulose. More particularly, this invention relates to the production of a moistureproof glassine or a moistureproof, transparent regenerated cellulose wrapper, which can be used to wrap an article high in moisture content, such as bread, without developing the swelling, cockling, buckling, loss of gloss, and soginess, which is frequently characteristic of moistureproof glassine and Cellophane wrappers in such use at the present time.

A waxed glassine bread wrap is a good example of a moistureproof, cellulosic sheet material which suffers from shortcomings which this invention overcomes. It has long been desired to use waxed glassine as a bread wrap, because of the superior appearance and transparency of such a sheet as compared to other types of waxed paper. However, waxed glassine has never proven satisfactory for this purpose, primarily because it lacks stability on the package. It has very good initial appearance when used to wrap a loaf of bread, but after a period, varying usually from an hour to twenty-four hours, this good initial appearance is badly deteriorated. The sheet soon starts to cockle or becomes wavy in appearance, the swelling increase until the wrapper becomes loose and buckled, and finally soginess of the wrapper, with complete loss of gloss and marked loss of transparency, ultimately results. This type of failure does not occur in every case, but it occurs to a varying degree in a sufficiently large number of cases to make waxed glassine commercially unsatisfactory as a bread wrapper. Waxed glassine is also slightly deficient in heat-sealing strength for bread wrapping purposes, and this is a secondary and contributing cause for its lack of success in the bread wrapping field.

More recently, lacquered glassines and "hot melt" coated glassines have appeared on the market for bread wrapping purposes. These sheets have very good initial appearance and have better heat sealing properties than waxed glassine, but they also show the same difficulty as waxed glassine for bread wrapping purposes, namely, after a short period of time on the loaf, the initial good appearance of the package is lost, because the wrapper swells and cockles, and in some cases becomes soggy, with bad loss of gloss

and transparency. Moistureproof Cellophane shows a similar swelling and cockling when used as a bread wrap, but the perfect transparency of this wrap makes the cockling or waviness less noticeable than with a glassine wrapper. However, the swelling or expansion of a moistureproof Cellophane wrapper is frequently very noticeable, for it causes an excessively loose wrap which is objectionable.

We have discovered that in all these cases the basic cause of the difficulty is the inherent sensitivity of the base cellulosic sheet material to moisture. Swelling, cockling, buckling, soginess, and loss of gloss and transparency result from absorption of moisture, which gets entrapped within the coated base sheet, causing the sheet to change dimensionally, and this in turn leads to the other difficulties just enumerated. This moisture sensitivity is common to all types of paper to a varying extent, but it is much more marked and is a much more serious problem with glassine, than with other less highly beaten and less highly plasticized papers. Cellophane is also quite moisture sensitive and undergoes considerable dimensional changes with varying moisture content; it is about as poor as glassine in this respect.

We have further discovered that, in all these cases, this difficulty can be greatly reduced or entirely eliminated by coating one side of the base sheet with a coating which is more moisture vapor permeable than that which is used on the side next to the article, high in moisture content, which is being wrapped. For convenience of designation, we will hereinafter refer to these two sides of the base sheet or wrapper as the inside and outside surfaces respectively. By inside surface is meant the surface, which comes next to the bread or other product, high in moisture content, which is being wrapped, and by outside surface is meant the surface forming the outside of the package. The essence of this invention then resides in the use of a more moisture vapor permeable coating on the outside surface than on the inside surface of a cellulosic wrapping material, used to wrap a product high in moisture content such as bread.

In this way moisture from the contents of the package escapes through the outside coating of the sheet faster than it enters through the coat-

ing on the inside surface. Accordingly, moisture never accumulates or builds up within the base sheet and the swelling and other adverse effects already described, caused by this entrapped or absorbed moisture are thus eliminated. Such a sheet is stable indefinitely on a product, such as bread, whereas the same base sheet having coatings of the same moisture vapor permeability on the two sides usually loses its initial good appearance soon after the bread is wrapped. When a more moisture permeable coating is used on the outside surface, most of the moistureproofness of the wrap comes from the coating on the inside surface, the outside coating contributing only slightly to the overall moistureproofness of the wrap, and serving mainly to enhance the gloss and transparency, and for its heat sealing properties. Nevertheless, with the type coatings hereinafter described, adequate moistureproofness for bread wrapping and for most other purposes can be obtained from a highly moistureproof coating on only the inside surface of the wrap.

It is, therefore, an object of this invention to provide a moistureproof wrapper comprising a coated cellulosic sheet material which, when used to wrap a product high in moisture content such as bread, retains its initial good appearance, smoothness, flatness, and size during the life of the wrap.

A more particular object is to provide moistureproof glassine and Cellophane wrappers which combine the above objects with adequate moistureproofness and heat sealing strength for bread wrapping and most other purposes.

Still another object is to accomplish the above purposes by coating a cellulosic sheet material with a more moisture vapor permeable coating on one side than on the other, the side with the more moisture-permeable coating forming the outside surface of the package, when the sheet is used to wrap an article high in moisture content such as bread.

Other objects will appear from the following description and from the appended claims.

For the purpose of this specification and claims, a moistureproof coating is defined as one which, when applied to one side of a glassine paper at a coating weight not exceeding 3.0 lbs. per ream (2,880 sq. ft.), reduces the moisture vapor transmission to 500 grams or less per 10,000 square inches per 24 hours at a temperature of 85 degrees F. and at the relative humidity differential obtained by maintaining a relative humidity of 100% on the coated side of the sheet and a relative humidity of 15% on the uncoated side. Plain, uncoated glassine under these test conditions will transmit about 5,500 grams of water vapor per 24 hours per 10,000 square inches. It will be understood that this definition represents a minimum moistureproof value; compositions formulated according to the teachings of this invention, when applied to one side of a glassine paper, are capable in many cases of reducing the moisture vapor transmission value to 100, 50, 25, and even less grams of water vapor per 24 hours per 10,000 square inches, under the temperature and humidity conditions stated above. When a glassine paper is coated on both sides, the moisture loss value is ordinarily about one-half that obtained when one side only is coated, if the same composition at the same coating weight that is on the first side is applied to the second side.

The coated wrappers of this invention are preferably heat-sealable, at least for bread wrapping

purposes, since most bread is now wrapped on automatic wrapping machines that make both the bottom and end-seals by application of heat and pressure only. Heat-sealability is, therefore, desirable for some uses, but for many purposes is not necessary. This invention is not limited to heat sealing compositions, but covers broadly moistureproof wrappers which have coatings of differing moisture vapor permeabilities on the two sides, regardless of whether these coatings are or are not heat sealable. However, one of the preferred embodiments of this invention is a wrapper which combines moistureproofness, a differential moisture vapor permeability between the coatings on the two sides, and heat-sealing properties.

For the purpose of this specification and claims, heat-sealability is defined as follows:

By heat-sealable is meant that two strips of glassine paper, two inches in width, having a coating weight not exceeding 3.0 lbs. per side per ream, and sealed together by the application of heat and pressure in the manner described below, will require a force of at least 10 grams to pull them apart, when the end of one strip is attached to a device which indicates the pull, and the same end of the other strip is held in the hand and slowly pulled away until the bond is ruptured. The reading of the instrument for measuring the pull is recorded at this point, and the test repeated a number of times in order to get a good average value. For the purpose of this test, the seal is made by superposing the two strips of coated paper upon each other, so that the coated sides come together, placing them upon a smooth brass cylinder heated to a temperature between 200 and 450 degrees F., usually about 300 degrees F., and pressing them together and against the cylinder by means of a weighted strip of felt which is hung over the cylinder on top of the paper strips to be sealed. The weight of the felt strip is made 200 grams, and the time of contact with the heated brass cylinder is held at 3 seconds. In this way seals are made under conditions where temperature, pressure, and time of contact are all under control. It will be understood that the value 10 grams represents a minimum sealing strength value, which approximates that of waxed glassine under these same test conditions; coating compositions formulated in accordance with the teachings of this invention in many cases give seals withstanding 20, 40, 80, 100 grams and even greater pulls on a strip 2 inches wide. The sealing strength obtained with any given coating composition in this test depends to some extent upon the plasticizer and moisture content of the glassine paper; a soft, well humidified sheet gives generally higher values than a paper that is low in plasticizer and moisture content. The values given above refer to results obtained on a well plasticized sheet of glassine, having a sufficient moisture content for commercial wrapping purposes, this moisture content being in the range 3.5%-8%.

As has already been stated, this invention resides primarily in the use of a more moisture permeable coating on the outside surface than on the inside surface of a moistureproof cellulosic wrapping material, used to wrap a product high in moisture content, such as bread. It is also highly desirable that the inside coating be at least as flexible, and preferably more flexible, than the outside coating, so that its superior moistureproofness is retained under use conditions, where some flexing of the sheet due to

handling normally occurs. Moreover, slight variations in moisture content of the base sheet may cause slight dimensional changes in the paper before the safety-valve feature of the more permeable outside coating begins to operate, and these slight dimensional changes put a strain on the coating films which can cause small cracks or fissures to develop. Under these conditions, unless the inside coating is both more moisture-proof initially and also as flexible, small cracks or fissures may develop, which make it less moistureproof than the outside coating which may have been less moistureproof initially but more flexible. By a less moisture permeable coating on the inside surface, it will, therefore, be understood that we mean a coating which is not only less moisture vapor permeable initially, but also after flexing or crumpling the sheet.

The moisture vapor permeability after flexing can be determined by making a moisture permeability test on both the plain, flat sheet, and on the same sheet after crumpling or folding in some standard fashion. We prefer to use a crumpling test, in which the test sheet of paper is crumpled in the palm of the hand before it is sealed over the open end of a moisture permeability cup. We have found that such a crumpled test can be made to give results of satisfactory reproducibility in the hands of a skilled operator, and this crumpled moisture vapor permeability value, when considered in relation to the initial, uncrumpled value, affords a good measure of the flexibility of the coating. For best results in the practice of this invention, the outside coating should preferably be more moisture permeable than the inside coating, both initially and after crumpling the test sheet.

Another test which we have found to be of value as an accelerated measure of the stability of the finished wrap, when used to wrap a product high in moisture content, such as bread, is the test which we have called the wet blotter test. In this test, a wet blotter is used to simulate a moist product, and the sheet to be tested is wrapped around this wet blotter with the inside surface toward the blotter, just as it would be used to wrap a loaf of bread, or other product high in moisture content. The wrapped blotter is placed on a flat surface, and the top or exposed surface observed over a period of time. We have found by experience that a sheet of moistureproof glassine, which does not become soggy, and which retains its initial gloss and transparency over a 24 hour period on this test will be entirely satisfactory as a bread wrap. Some slight cockling or waviness may occur in four hours or less under these severe and accelerated test conditions, but such a sheet is considered satisfactory and does not cause trouble in actual service. In making this test, the blotter should be wet with water at room temperature or slightly below, and the excess surface water removed before the wet blotter is used.

By use of the blotter test, and also by actual wrapping tests, we have found that the initial or uncrumpled moisture vapor permeability value of the outside coating may be 2 to 100 times that of the inside coating, but we prefer to use a coating on the outside which is 2-25 times more moisture permeable than the inside coating. In general, the stability of the wrap on a moist product increases as the ratio of the moisture vapor permeability values of the outside to inside coating increases, but there is a practical

upper limit for the outside coating which it is preferable not to exceed, for otherwise poor stability may sometimes result from moisture penetration into the base sheet from the air outside the package. This will not occur ordinarily, but it sometimes does occur under conditions of very high atmospheric humidity. The crumpled moisture vapor permeability values run much higher in all cases, even with very flexible coatings such as highly plasticized lacquers, and it is usually sufficient that the crumpled value for the outside coating be at least as high and preferably higher than that of the inside coating.

The principles of this invention may be practiced in many ways which will be readily apparent to those skilled in the art. To more clearly describe our invention, we will now give some specific examples, illustrating several ways in which the invention may be practiced, but it will be understood that these are illustrative only and not limitative, for many other ways of applying the broad principles here disclosed will occur to those skilled in the art.

Example 1

A well plasticized glassine (10-15% plasticizer based on the total weight of the sheet) and from 23-24 lbs. in basis wt. (2,880 sq. ft.) is coated on one side with the following latex emulsion:

60% solids latex	-----	volume	1
Water containing 3% by volume of strong ammonia (28% strength)	-----	volume	1
Glycerine	-----	cc. per gallon of latex	160

About .7 lb. of latex solids per ream (2,880 sq. ft.) is applied to one side of the glassine sheet by any convenient method as, for example, by use of a squeeze roll mechanism adapted to coat one side, the coating dried on a drum drier until the moisture content of the sheet is reduced to about 7% and the paper wound up.

The sheet is then waxed on both sides with an Asiatic paraffin having a melting point of 135-137 degrees F. by the A. S. T. M. method. A total of approximately 5½-6½ lbs. of wax per ream (2,880 sq. ft.) are applied to the two sides from a bath of the molten wax at about 160 degrees F., and the wax coating is then chilled by contact with cold rolls in such a manner that the coating develops the best gloss and transparency. This means that the cooling rolls are spaced at such a distance from the coating unit, and the speed of paper travel so adjusted that the wax just starts to solidify by air cooling at the time the cooling rolls are reached. The wax can be applied by any of the methods well known to the art of waxing paper, but we prefer the method of dipping the paper in the molten wax and removing the excess to the required wax weight by means of a rubber squeeze roll mechanism.

The finished paper is thus coated on one side with .7# of latex solids and about 3 lbs. of wax per ream, and on the other side with 3 lbs. of wax only per ream. The side coated with both latex and wax forms the inside surface of the finished wrap, and the side coated with wax only becomes the outside surface.

The molten wax coating fuses with the latex during the waxing operation resulting in a coating of much greater moistureproofness and flexibility than that of the straight wax coating on the other side. Thus the inside coating of

wax over latex gives an uncrumpled, moisture permeability test of 10-30, and a crumpled moisture permeability test of 150-300, whereas the corresponding values for the straight wax coating on the other side are 50-100 for the uncrumpled test, and 500-1000 for the crumpled test.

In addition to improving the moistureproofness and flexibility, the latex undercoat also markedly increases the heat sealing strength of the inside coating, and of all seals where inside and outside coatings come together. In bread wrapping, on conventional bread wrapping machines, the end folds are so made that the outside surfaces largely come together and form most of the seals, but there are places where the inside surface comes into play, and the presence of the latex on the inside surface definitely exerts a reinforcing action and increases the overall strength of these end seals. The bottom seal on a bread package is formed by an inside and outside surface coming together, and here the latex very definitely contributes to the strength of the seal.

In general, the sealing strength of a waxed glassine is noticeably improved by increasing the softness of the sheet by adequate plasticizer and moisture content. We prefer to keep the moisture content of this finished sheet within limits of 5-7% of its finished weight, chiefly through control of the drying of the latex coating, but also by use of a steaming or water spraying treatment, if necessary, prior to waxing.

This is an example of a highly moistureproof and heat-sealable waxed glassine that is eminently suited for bread wrapping purposes. Compared to a straight waxed glassine, it is more moisture-proof, has stronger heat sealing properties, and is much more stable against cockling, buckling, sogginess, and loss of gloss and transparency, when bread is wrapped so that the latex-wax coating forms the inside surface of the package. On the wet blotter test already described, this sheet will show no cockling in 10 hours as against very definite cockling in less than 30 minutes for straight waxed glassine.

The use of the glycerine in the latex emulsion as given in this example is not essential, and very good results can be obtained with latex alone. However, we prefer to use a small amount of glycerine in the latex, for we have found that in some manner, the presence of this glycerine results in an improved blotter test, possibly because the glycerine possesses wetting properties that result in a smoother and more uniform latex coating.

Example 2

A well plasticized glassine (10-15% plasticizer content based on the total weight of the sheet) of 23-25 lbs. ream weight (2,880 sq. ft.) is coated on one side which becomes the inside surface of the finished wrap with the following nitrocellulose lacquer.

	Parts by weight
Du Pont #6326 heat sealing lacquer (45% total solids).....	100
Dibutyl phthalate.....	3.5
Asiatic paraffin (145 degrees F. M. P., A. S. T. M. method).....	0.9
Spermaceti.....	0.9
Thinner:	
85% ethyl acetate.....	63%
Toluene.....	27%
Alcohol.....	10%
	100%

The lacquer is applied by any convenient

method, such as by use, for example, of the Waldron reverse roll lacquer coating machine, which applies a smooth, uniform coating of lacquer which is desired. A coating weight of about 1.75 lbs. of lacquer solids per ream (2,880 sq. ft.) is applied to one side. It is preferable to slightly heat the lacquer, and to hold it at a temperature of about 110 degrees F. during the coating operation, to prevent the waxes from separating out of solution.

The lacquer is dried at a temperature of about 180-240 degrees F. by use of a steam heated drum drier or by means of a tower or tunnel drier through which hot air at 180-240 degrees F. is circulated. The drying time should be such that the volatile solvents are completely evaporated, and no trace of solvent odor remains in the sheet.

Before winding up, or in a separate operation, the sheet is rehumidified. This can be very conveniently accomplished by direct spraying of a fine mist of water against the sheet through fine nozzles calibrated to deliver the requisite amount of water. An amount of water sufficient to raise the moisture content of the sheet to 7-9% is applied at this point, and the paper wound up, and preferably let stand for about 24 hours in order to allow the moisture to diffuse uniformly through the sheet.

The opposite side of the sheet, which becomes the outside surface of the finished wrapper, is then coated with the following nitro-cellulose lacquer:

	Parts by weight
Du Pont #6326 heat sealing lacquer (45% total solids).....	100
Dibutyl phthalate.....	5
Asiatic paraffin (145 degrees F. M. P., A. S. T. M. method).....	0.90
Opal wax.....	1.35
Zinc stearate.....	1.12
Thinner:	
85% ethyl acetate.....	63%
Toluene.....	10%
Alcohol.....	27%
	100%

This lacquer is applied and dried in the same manner as the lacquer on the opposite side. The same coating weight of 1.75 lbs. of lacquer solids per ream (2,880 sq. ft.) is applied to this side also. If a drum drier is used, as we prefer to do, it is necessary to slightly roughen its surface as by rusting it, to prevent sticking of the lacquer on the first coated side to the drum surface. If this is done, no trouble of this kind will be encountered, and the drying efficiency is not noticeably impaired.

After drying this second lacquer coating, the finished coated sheet should have a moisture content of 4-7%, in order to have the proper softness and flexibility for the best folding and heat sealing properties when used on automatic bread wrapping machines.

The finished sheet thus has a lacquer coating containing added plasticizer, spermaceti and paraffin on one surface, which forms the inside coating, and a similar lacquer coating containing added plasticizer, Opal wax, paraffin, and zinc stearate on the opposite side, which forms the outside coating. The lacquer coatings thus modified have the following moisture permeability values:

Inside lacquer coating: 30-60 uncrumpled, 200-300 crumpled.

Outside lacquer coating: 200-300 uncrumpled, 500-800 crumpled.

On the wet blotter test, with the inside coating

toward the blotter, this sheet will not become soggy or lose its initial gloss and transparency over a period of 24 hours or longer.

In the case of the preferred outside coating lacquer given in this example, we have added 5% dibutyl phthalate because this enhances the heat sealing properties without impairing any other necessary property. We have also added a small percentage of zinc stearate, which we have found improves the working properties of the coating on bread wrapping machines, in that it reduces the fouling of the hot sealing plates by the lacquer coating and eliminates the "drag" or frictional resistance of the paper on these sealing plates. The waxes used in this preferred outside lacquer were chosen so that the moisture vapor permeability value would fall in the desired range, and also with regard to their lack of odor, slip producing and "blocking" resistant properties. This last is quite important, for we have found that heat sealing lacquers which are sufficiently plasticized to have good heat sealing properties are susceptible to "blocking" unless a wax is made a part of the coating. By "blocking" is meant the sticking together of adjacent sheets in a roll under slightly elevated temperatures such as may occur in storage during the summer months.

In the case of the preferred inside coating lacquer given in this example, we used a combination of spermaceti and paraffin as the preferred wax because we obtained the best moistureproofness in this manner. We have also added 3.5% dibutyl phthalate because this measurably improved the moistureproofness and flexibility without impairing any other desirable property.

The resulting lacquered glassine makes an excellent bread wrap, having good moistureproofness, good heat-sealing and working properties on automatic bread wrapping machines, very good appearance, and very good stability on the loaf, which enables it to retain its good initial appearance throughout the useful life of the package.

The nitro-cellulose lacquer used in this example is a commercially available product sold under the designation #6326 moistureproof, heat-sealing lacquer by the Fabrics and Finishes Dept., E. I. du Pont de Nemours & Company, Parlin, N. J. It is sold by the manufacturer with the understanding that by the addition of 2-6% paraffin wax based on the solids, this lacquer can be made moistureproof. The exact composition of #6326 lacquer is not disclosed by the manufacturer, but it is manufactured and sold under U. S. Patent Reissue #16,803, U. S. Patent #1,826,696, and U. S. Patent 2,064,802, wherein the general composition and mode of preparation of this lacquer are fully described.

We have found that the moistureproofing properties of this lacquer can be varied over a wide range by substitution of other waxes for the paraffin. Thus, the waxes listed below were substituted in the following general formula:

	Parts by weight
Du Pont #6326 heat sealing lacquer (45% total solids)	100
Dibutyl phthalate	3.5
Thinner:	
85% ethyl acetate .. 63%	25
Toluol	
Alcohol	
100%	
Wax	1.8

These lacquers were applied to one side of a glassine paper at a coating weight of 1.75 lbs. of lacquer solids per ream and dried over a drum drier. When the following waxes were substituted in the above formula and the coated sheet tested for moisture vapor permeability, the following results were obtained.

Moisture vapor permeability values in grams loss per 10,000 sq. in. per 24 hours at 85 degrees F. under a relative humidity of 100% on coated side of sheet and 15% on the uncoated side

	Uncrumpled value	Crumpled value
No wax	2,750	2,991
Opal wax	2,834	2,900
Chinese insect wax	2,593	3,130
Nopco wax A	1,900	1,950
Japan wax	1,706	1,804
Carnauba	1,244	1,536
Cerese wax yellow	642	814
Candelilla	496	821
Barnsdall 165	443	854
Socony vacuum 2310 wax	414	854
Petrosene	374	695
Bleached montan wax	302	590
Asiatic paraffin, 155-57° F. M. P.	221	596
Refined bleached beeswax	176	506
Ceresine	140	381
Asiatic paraffin, 100-62° F. M. P.	137	376
Asiatic paraffin, 135-37° F. M. P.	98	282
Sinclair oil paraffin, 130-32° F. M. P.	87	376
Spermaceti	53	282
Spermaceti 50%	44	296
Asiatic paraffin 50%		

Opal wax is a hydrogenated castor oil manufactured and sold by E. I. du Pont de Nemours & Company, Wilmington, Delaware. Nopco Wax A is a synthetic wax manufactured and sold by National Products Company, Harrison, New Jersey. Cerese Wax Yellow, Socony Vacuum 2310 wax, and Petrosene are hydro-carbon amorphous or microcrystalline waxes manufactured and sold by the Socony Vacuum Oil Company, 26 Broadway, New York city. Barnsdall 165 is a hydro-carbon microcrystalline wax manufactured and sold by the Barnsdall Oil Company, Tulsa, Oklahoma.

As will be seen from this tabulation of moisture vapor permeability data, a wide range of moisture loss values can be obtained by suitable choice of waxes, and this range can be made more continuous if desired by combining two or more individual waxes. By use of this data and with little further experiment, suitable inside and outside coating lacquers can be prepared having any desired moisture vapor permeability values within a wide range.

Example 3

A well plasticized glassine (10-15% plasticizer content based on weight of finished sheet) and from 23-25 lbs. in basis weight (2880 sq. ft.) is coated on one side with the following nitrocellulose lacquer.

	Parts by weight
Du Pont #6326 heat sealing lacquer (45% total solids)	100
Dibutyl phthalate	5.0
Asiatic paraffin, 145° F. M. P., A. S. T. M. method	.9
Spermaceti	.9
Thinner:	
85% ethyl acetate .. 63%	65.0
Toluene	
Alcohol	
100%	

This lacquer is applied and dried in the same manner as described in Example 2, only in this case a coating weight of 1.0 lb. of lacquer solids per ream (2,880 sq. ft.) is applied to one side.

After lacquering and drying, the sheet is rehumidified if necessary, by steaming or preferably by means of a fine water spray as described in Example 2; an amount of water being applied sufficient to bring the moisture content of the finished sheet within limits of 5-7% of its finished weight. After humidifying, the paper is wound up and preferably left stand 24 hours to allow the added moisture to uniformly diffuse through the sheet.

The sheet is then waxed on both sides in the same manner as described in Example 1. An Asiatic paraffin having a melting point of 135-137° F. by the A. S. T. M. method is preferred, and a wax weight totaling 5½-6½ lbs. per ream (2,880 sq. ft.) is applied to the two sides.

The finished sheet is thus coated on one side with a thin film of a highly moistureproof and flexible lacquer and a thicker coating of paraffin wax, and on the other side with a coating of paraffin wax alone. The side coated with both lacquer and wax forms the inside surface of the finished wrap, and the side coated with wax only becomes the outside surface.

The moistureproof lacquer coating on the inside surface has much better flexibility than a straight wax coating, resulting in a much better crumpled value, and the uncrumpled moisture permeability value is also better for the combined wax and lacquer coating on the inside surface as compared to the straight wax and lacquer coating on the other side. This results in a much better wet blotter test for this sheet with the inside surface toward the blotter than is given by a glassine waxed on both sides with about the same weight of wax. Thus, the sheet here described withstood the wet blotter test for 36 hours without developing soginess or loss of gloss or transparency, whereas a straight waxed glassine failed in about one hour.

Example 4

A well plasticized glassine is coated on one side with the same outside lacquer as was used in Example 2. This lacquer is applied, dried, and the sheet then humidified as described in Example 2. The coating weight is held to 1.75 lbs. of lacquer solids per ream (2,880 sq. ft.) on one side, which becomes the outside surface of the finished wrap.

The other side of the sheet is then coated with the following Pliolite lacquer.

	Per cent by weight
Pliolite	30
Commercial normal heptane (boiling range 192-212° F.)	70
	100

Pliolite is a resinified rubber manufactured and sold by the Goodyear Tire & Rubber Co., Akron, Ohio; it is described in detail by Thies and Clifford in "Industrial and Engineering Chemistry," vol. 26, page 123.

This Pliolite lacquer is applied and dried in the same manner as already described for nitrocellulose lacquers except that, since this Pliolite lacquer does not contain wax, it can be applied from a bath at ordinary temperatures. A coating weight of 1.6 lbs. of Pliolite solids per ream (2,880 sq. ft.) is applied to one side, which becomes the inside surface of the finished paper.

The order of coating the inside and outside

surfaces has been reversed in this case from that given in Example 2, simply to avoid sticking of the Pliolite coating to the drier drum during the coating of the second side. Pliolite is more thermoplastic than the nitrocellulose lacquer and cannot be brought into contact with the hot drier drum, as can the nitrocellulose lacquer film, without giving trouble from sticking. However, if a hot air tower or tunnel type drier is used, either the Pliolite or nitrocellulose lacquer coating may be applied first, and as good results obtained either way.

The finished sheet should preferably have a moisture content of 5-7%. The inside coating of Pliolite lacquer has the following moisture vapor permeability values: 15-30 uncrumpled and 100-200 crumpled. The outside lacquer has the moisture vapor permeability values already given in Example 2, namely, 200-300 uncrumpled and 500-800 crumpled.

Both coatings have excellent heat sealing properties and the finished sheet makes an excellent bread wrap, being very moistureproof, heat sealable, and having good working properties on commercial bread wrapping machines. The initial appearance of the wrap is very good, and it has excellent stability on the loaf, so that the good initial appearance of the sheet is retained throughout the useful life of the wrap.

Example 5

A sheet of regenerated cellulose, such as, for example, 300 gauge P. T. Cellophane, manufactured and sold by the Cellophane Division, E. I. du Pont de Nemours & Co., Buffalo, New York, is coated on one side, which becomes the inside surface of the wrap with the following nitrocellulose lacquer.

	Per cent by weight
Nitro cellulose (11.0-11.5% N content; 8-10 seconds viscosity)	7.47
Dicyclohexyl phthalate	4.48
Dibutyl phthalate	1.49
Dewaxed dammar resin	1.10
Asiatic paraffin, 145° F. M. P., A. S. T. M. method	.46
85% ethyl acetate	51.00
Toluol	25.50
Alcohol	8.50
	100.00

The lacquer is applied in any convenient manner, for example, by use of a Waldron reverse roll lacquer coating machine and dried on a drum drier at 180-240° F., or in a tower or tunnel drier through which a large volume of air at 180-240° F. is circulated. The lacquer is held at a slightly elevated temperature of about 100-110° F. to prevent the wax from separating out of solution, and a coating weight of 1.0 lb. of lacquer solids per ream is applied to one side. Before winding up, the sheet is passed through a steam chamber to restore its initial humidity, or it may be sprayed with a fine water mist, and if desired, a slight excess of water may be applied at this point, so that the finished sheet after the second lacquering operation has the desired moisture content of 6-8%.

After allowing the roll to stand long enough for the moisture to diffuse uniformly through the sheet, the second side, which becomes the out-

side surface of the finished wrap is then coated with the following nitro cellulose lacquer.

	Per cent by weight
Nitro-cellulose (11.0-11.5% N content; 8-11 seconds viscosity)-----	7.47
Dicyclohexyl phthalate-----	4.48
Dibutyl phthalate-----	1.49
Dewaxed dammar resin-----	1.10
Asiatic paraffin, 145° F. M. P., A. S. T. M. method-----	.15
Opal wax-----	.45
Zinc stearate-----	.30
85% ethyl acetate-----	50.74
Toluol-----	25.32
Alcohol-----	8.50
	100.00

This lacquer is applied and dried in the same manner as the lacquer coated on the other side, and the same coating weight of 1.0 lb. of lacquer solids per ream is applied. The coated sheet may be rehumidified, if necessary, after coating the second side by passing the web through a humidifying chamber which is maintained at a temperature of about 150° F., and at a relative humidity of about 50-75%.

The finished sheet thus has a lacquer coating containing a small amount of paraffin wax which imparts high moistureproofness on one side, which becomes the inside surface of the wrap, and the other side, which becomes the outside surface, is coated with the same lacquer containing small amounts of paraffin, opal wax, and zinc stearate. This latter combination of materials gives this coating a higher moisture vapor permeability value than the inside coating, and also imparts improved slip, better "blocking" resistance, and improved working properties on automatic wrapping machines.

The finished sheet is transparent, moisture-proof, heat-sealable, and when used to wrap a product such as bread with the inside surface toward the loaf, this sheet cockles less, shows less dimensional changes due to swelling, and in general maintains its initial appearance much better than the same sheet coated with a lacquer of the same moisture vapor permeability on the two sides.

Still other ways of practicing this invention will occur to those skilled in the art. Thus lacquers, quite similar to the nitro cellulose lacquers already disclosed, can be formulated using chlorinated rubber as the principal film forming material. A commercial grade of chlorinated rubber, known as Tornesite, is manufactured and sold by the Hercules Powder Co., Wilmington, Delaware. By using preferably the 125 centipoise viscosity grade of Tornesite, and combining it with such resins as ester gum, dammar, and hydrogenated ester gum, and with plasticizers such as dibutyl and diamyl phthalates, together with waxes, and dissolving all these materials in such a solvent as toluol, very satisfactory moisture-proofing and heat sealing lacquers can be obtained. By suitable choice of wax, as suggested by the data given in the table following Example 2, chlorinated rubber lacquer coatings of a wide range of moisture vapor permeability values may be readily formulated.

Likewise lacquers based on other cellulose derivatives such as the cellulose ethers, like ethyl and benzyl cellulose, and other cellulose esters, such as cellulose acetate and cellulose aceto-

butyrate, may be formulated to give coatings of varying degrees of moisture vapor permeating by use of different waxes such as those already disclosed. Other lacquers based on vinyl resins and methacrylate resins might also be used.

Or we might prefer to use a "hot melt" or molten coating composition instead of a lacquer. These can also be formulated to produce heat sealable coatings of varying degrees of moisture vapor permeability, and for many purposes have definite advantages over lacquers, being generally lower in cost due to the elimination of solvents.

Sometimes it is also possible to accomplish the purposes of this invention by using a lower coating weight of the same coating on the outside surface than on the inside surface, and in this way obtain a difference in the moisture vapor permeability values of the coatings on the two sides. This is not a generally satisfactory method, but it can sometimes be used particularly with "hot melts," and such a method of obtaining a difference in the moisture permeability of the coatings on the two sides comes within the scope of this invention.

It should be stated that in order to obtain the full benefits from the principles here disclosed, it is important that the coatings, particularly the inside coating, be applied as smoothly, and as uniformly as possible. Ridges, scratches, and any discontinuities in the coatings should be avoided as far as practicable, for otherwise localized diffusion of moisture through these areas will cause localized swelling effects, which will tend to defeat the purposes of this invention. Even so, however, the use of a more moisture permeable coating on the outside surface will offset to some degree the harmful effects of such imperfections in the inside coating, and make the effects definitely less noticeable than if coatings of the same moisture permeabilities were used on the two sides. Thus, by use of the principles here disclosed, absolute perfection in the coating process, although desirable, is not as essential as when coatings of the same moisture vapor permeability are used on the two sides.

In accordance with the patent statutes, we have described the principles of our invention, and while we have endeavored to set forth the best embodiments thereof, we desire to have it understood that these are only illustrative of a means of carrying out our invention, and that obvious changes may be made within the scope of the following claims without departing from the spirit of our invention.

We claim:

1. As an article of manufacture, a moisture-proof and heat sealable wrap suitable for articles high in moisture content, comprising a glassine paper coated on the inside surface with an undercoat of .3 to 1.2 lb. of latex solids per 2,880 sq. ft. ream and a top coat of paraffin wax, and on the outside surface with a coating of only paraffin wax.

2. As an article of manufacture, a moisture-proof and heat sealable wrap suitable for articles high in moisture content, comprising a glassine paper coated on the inside surface with an undercoat of .3 to 1.2 lb. of latex solids per 2,880 sq. ft. ream and a top coat of paraffin wax, and on the outside surface with a coating of only paraffin wax, the total wax weight on the two sides ranging from 3 to 7 lbs. per 2,880 sq. ft. ream.

3. As an article of manufacture, a moisture-proof and heat sealable wrap suitable for articles

high in moisture content, comprising a glassine paper coated on the inside surface with an undercoat of .3 to 1.2 lbs. of latex solids containing a small amount of glycerine, per 2,880 sq. ft. ream, and a top coat of paraffin wax, and on the outside surface with a coating of only paraffin wax.

4. As an article of manufacture, a moisture-proof and heat sealable wrap suitable for articles high in moisture content, comprising a glassine paper coated on the inside surface with a undercoat of .3 to 1.2 lbs. of latex solids, containing a small amount of glycerine, per 2,880 sq. ft. ream and a top coat of paraffin wax, and on the outside surface with a coating of only paraffin wax, the total wax weight on the two sides ranging from 3 to 7 lbs. per 2,880 sq. ft. ream.

5. As an article of manufacture, a moisture-proof and heat sealable wrap suitable for articles high in moisture content, comprising a cellulose base sheet selected from the class consisting of paper and regenerated cellulose coated on the inside surface with an under coat of .3 to 1.2 pounds of latex solids per 2,880 sq. ft. ream and a top coat of paraffin wax, and on the outside surface with a coating of only paraffin wax.

6. As an article of manufacture, a moisture-proof and heat sealable wrap suitable for articles high in moisture content, comprising a cellulose base sheet selected from the class consisting of paper and regenerated cellulose, coated on the

inside surface with an under coat of .3 to 1.2 pounds of latex solids per 2,880 sq. ft. ream and a top coat of paraffin wax, and on the outside surface with a coating of only paraffin wax, the total wax weight on the two sides ranging from 3 to 7 pounds per 2,880 sq. ft. ream.

7. As an article of manufacture, a moisture-proof and heat sealable wrap suitable for articles high in moisture content, comprising a cellulose base sheet selected from the class consisting of paper and regenerated cellulose, coated on the inside surface with an under coat of .3 to 1.2 pounds of latex solids containing a small amount of glycerine per 2,880 sq. ft. ream, and a top coat of paraffin wax, and on the outside surface with a coating of only paraffin wax.

8. As an article of manufacture, a moisture-proof and heat sealable wrap suitable for articles high in moisture content, consisting of a cellulose base sheet selected from the class comprising paper and regenerated cellulose, coated on the inside surface with an under coat of .3 to 1.2 pounds of latex solids containing a small amount of glycerine per 2,880 sq. ft. ream, and a top coat of paraffin wax, and on the outside surface with a coating of only paraffin wax, the total wax weight on the two sides ranging from 3 to 7 pounds per 2,880 sq. ft. ream.

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