Patented July 20, 1943 2,324,529

UNITED STATES PATENT OFFICE

2,324,529

MANUFACTURE OF PAPER AND BOARD

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No Drawing. Application June 5, 1939, Serial No. 277,453

4 Claims. (Cl. 8—115.6)

This invention relates to retarding the deterioration and the development of "off" and "cardboard" odors in paper and board and particularly in secondary stock board.

In the field of the secondary stock board made of crude and not too highly refined raw materials, the board after manufacture is readily subject to the development of objectionable odors that are transmitted to packaged compositions and particularly when used for the packaging of food products such as for eggs, whole wheat biscuits, cakes, cookies and other bakery goods, corn flakes, whole wheat flakes, bacon, and other meat products, butter, lard, margarine, ice cream, milk, etc.

Even though there is used an inner paper liner, the objectionable off odor penetrates the liner to contaminate the packaged composition and frequently renders it unsalable. Then develops what is known as "cardboard" or "papery" flavors in eggs, whole wheat biscuits, etc.

The problem is particularly serious in the utilization of pine stock, and pine board will, within a few days of manufacture and particularly if fresh stock is employed, develop very objectionable and readily penetratable off-odors.

An object of this invention is therefore the retardation of cardboard and papery off-odors and the substantial stabilization of papers and boards and particularly of pine stock boards.

A further object is to overcome the absorption of objectionable board odors into packaged organic food compositions, this being accomplished cheaply and simply.

Still further objects and advantages will appear from the more detailed description set forth below, it being understood, however, that this more detailed description is given by way of illustration and explanation only, and not by way of limitation, since various changes therein may be made by those skilled in the art without departing from the scope and spirit of the present invention.

In accordance with this invention, lecithin is applied to the surface of pine stock board, for example, at the calendar stacks and the board is then, following the application of the lecithin thereto, heated to an elevated temperature of over 180° F., and desirably to 212° F. and most preferably to 250° F. or over. Under the conditions of the heat treatment, the lecithin at the surface of the board becomes "activated" and develops marked stabilizing characteristics.

The higher the temperature to which the pine stock board, for example, is subjected after adding lecithin thereto, the greater is the stabilizing effect. It is not known as to how this stabilizing action occurs because it would normally be expected that an elevated temperature decreases rather than increases stability. It is believed, however, that some chemical action occurs whereby marked stabilization is effected.

The lecithin employed may be of any origin such as from crude corn germ oil, cottonseed oil, etc., and obtained by the segregation of the phosphatides from the crude oil. The lecithin may be in its crude unrefined state or more highly refined and substantially oil free.

The desirable method for the application of lecithin to the board is to place the lecithin in a finely divided powdery condition so that it may be readily stirred into an aqueous bath for application at the calendar stacks. This is accomplished by the use of a carrier such as starch, flour, sugar, powdered skim milk, charcoal, or similar material.

Where starch is employed as the carrier, for example, a mixture is made comprising from 50% to 98% by weight of the starch with the balance of lecithin, thoroughly admixing the lecithin in the powdered starch to obtain a powdery product and one that will readily mix with water even though the lecithin is itself not water soluble.

Where the lecithin is more highly refined and freer of associated oil, less of the starch or other carrier need be used to obtain the powdery combination.

The lecithin itself may not readily be applied to the surface of the board because of its insolubility in water so that if it were added to water for sizing on board, it would not become admixed therein so as to spread evenly upon the surface of the board. The lecithin may, however, be added to the water and the mixture homogenized or put through a colloid mill to obtain a dispersion of the lecithin in the water which may then be used as a sizing.

The lecithin is desirably present in the water used for sizing in an amount ranging from 0.3% to 10% against the weight of the water and other materials in the sizing bath, and good results are obtained by using as little as 2% of lecithin. Where a lecithin starch mixture is prepared, comprising, for example, 85% starch and 15% lecithin, that mixture may be added to the water tub at the calendar stacks in an amount of 8% to give desirable improvement to the manufactured board.

Example I

Pine stock board after forming on the board making machine contained 70% total moisture. The board was passed through a trough containing 93% water and 7% of a starch lecithin mixture. The starch lecithin mixture was prepared by mixing thoroughly 1 part by weight of crude lecithin and 5 parts by weight of preboiled dried corn starch to obtain a powdery mixture with the lecithin thoroughly dispersed therethrough. The starch lecithin mixture was added to the water and the mixture agitated to hold the combination in suspension while the board passed through, it being estimated that 0.1% by weight of the lecithin adhered to the board (against the solids weight of the board). The treated board was then passed over heated rolls at a temperature of about 220° F. until dried. The board thus obtained was tested alongside of pine stock board similarly prepared but without the lecithin addition by allowing to remain exposed to the air at room temperature and in the dark. A distinct objectionable cardboard odor developed in the untreated board within 8 days whereas the treated board did not show the same objectionable characteristics until 15 days had elapsed.

The amount of lecithin to apply to the board may vary from 0.01% to 2% but generally less than 0.7% and desirably under 0.3% is applied.

The heating of the board after the addition thereto of the lecithin is important to obtain the desired results.

Example II

Waste paper stocks used in the manufacture of secondary grade stock board and containing about 60% total moisture were prepared by adding thereto and thoroughly mixing therein 0.25% against the solids weight of the board of a mixture comprising 75% lecithin extracted from corn germ oil and 25% powdered anhydrous dextrose. One sample of the stock thus prepared was heated under 28 pounds of steam pressure for 5 minutes. Another sample was heated under 18 pounds steam pressure for 5 minutes. Both lots were then dried in a vacuum oven at 60° C. The stocks thus prepared were placed into sealed glass bottles and observed for objectionable odor development at daily intervals. At the end of 12 days the stock which had been heated under 18 pounds pressure was off in odor whereas the stock that was heated under 28 pounds pressure remained in good condition for about 26 days.

Pine stock board develops off odors rapidly and the lecithin treatment described in accordance with this invention is particularly valuable for application to board made of pine stock and preferably to board made of pine stock which has not been aged or "seasoned" for any long period of time. For example, the lecithin treatment desirably applies to pine stock board which has been stored and held for less than a 5 month period prior to use.

The treatment described will very materially retard and in many cases prevent the objectionable off odors which so seriously depreciate the value of that board by contaminating products packaged in it even though the packaged product is not in intimate or direct contact with the board.

The lecithin is desirably prepared for addition to the paper or board stock as an oil emulsion and emulsifying agents other than starch or glucose may be used such as gum acacia, gum tragacanth, blackstrap molasses, etc.

Where the lecithin is emulsified in this manner, it may be put through a colloid mill or an emulsifying machine, in order to reduce the particle size of the lecithin to as small as possible, so that the lecithin will exert greater effectiveness when utilized in accordance with this invention.

The aqueous phase of such an emulsion may desirably include glucose, blackstrap molasses, dextrines or gums, and there may also be present in that aqueous phase boiled or unboiled starch.

Where a powdered mixture is prepared first comprising lecithin and starch, or lecithin and powdered anhydrous dextrose, sucrose or similar sugar, sufficient of the starch or sugar serving as the carrier should be utilized so that the finished combination including the lecithin is substantially in powdered form. In this way it may be more readily added to the size trough or used as a beater application in the manufacture of the board.

Desirable combinations for use are, for example, any of the following:

A. 98 parts of starch and 2 parts lecithin

B. 70 parts powdered anhydrous dextrose and 30 parts lecithin

C. 65 parts black strap molasses and 35 parts lecithin

D. 50 parts glucose, 25 parts starch, and 25 parts lecithin.

The cruder forms of lecithin are even more desirable to use in accordance with this invention than the more refined lecithins. For example, lecithin extracted from corn germ oil has been found to show greater effectiveness than highly refined lecithin. In addition, the lecithin extracted from crude corn germ and crude cottonseed oils appears to be even more effective than the lecithin extracted from other sources.

The effectiveness of the lecithin in retarding deterioration of pine stock board when particularly subjected to the elevated temperature is most unusual in view of the fact that lecithin is normally recognized as becoming substantially inactivated as an antioxidant when heated to a temperature in excess of 65° C., but in accordance with this invention, it has been observed that unless the high heat treatment is applied, the desired improvement in keeping quality is not obtained.

Where the lecithin is added to a petroleum oil or to paraffin or other wax used for sizing or impregnation in the paper or board, the desired effectiveness of the lecithin is not obtained and, in addition, moisture-proofness is very materially reduced.

Where, however, the lecithin is added to the board without dissolving in the oil or paraffin and particularly where it is used as a sizing on the board, it will very materially improve the rate of penetration of the oil or paraffin subsequently applied and this is accomplished without materially reducing moisture-proofness. A more thoroughly oiled paper or board is obtained by pretreating the paper or board with lecithin so that such paper or board may be used much more readily for the wrapping of meats, poultry and similar products and particularly where they are to be placed in cold storage, or for other purposes where oiled and waxed papers and boards are normally employed. The increased paraffin or

paraffin oil penetration is of considerable importance in permitting minimum quantities of the oil or paraffin to be employed while getting maximum moisture proofness and retarding "freezer-burn" and dessication. As a less preferable alternative to adding the lecithin as a tub-sizing operation on the board or paper, the lecithin may be added in the beaters, provided that the paper or board is subsequently subjected to the elevated temperature of 180° F. to 212° F. and preferably to in excess of 220° F.

The lecithin may be added along with rosin, starches or other materials that are normally employed in the beaters and must be thoroughly admixed in the stock material in the beaters in order to obtain a thorough dispersion of the lecithin with the paper pulp material.

Although pine board stock is particularly to be treated in accordance with this invention, other boards may also be treated and also other papers, and particularly kraft, although greaseproof, sulphite, and similar papers may be treated in accordance with this invention as well.

Although lecithin may be employed for direct addition to the pine board, either as a tub-sizing or less preferably to the beaters, and such lecithin may be utilized without the co-addition of starch, sugar or similar material, it is most preferable for the lecithin to be added with sugar and considerably improved results will be obtained when the lecithin-sugar combination is used for addition to the paper stock before subjecting it to the elevated temperature as against adding lecithin alone or even as against a mixture comprising lecithin and starch.

Evample III

Pine board stock, containing approximately 60% moisture, was treated by adding thereto and thoroughly mixing therein the following materials:

A. 0.1% soya lecithin
B. 0.1% powdered anhydrous dextrose
C. A combination comprising 0.05% soya lecithin and 0.05% powdered anhydrous dextrose
D. No addition.

Each of the boards was heated to 220° F. for 10 minutes, and then placed in a vacuum oven at 160° F. until dried. The board stocks were then placed in sealed glass bottles and observed daily for aff odor developments.

Off odor observed after—

A	18 days
B	5 days
C	29 days
D	4 days

Other materials that may less preferably be employed for utilization particularly in retarding the development of off odors in pine board, include combinations of sugars or water-soluble carbohydrates, such as dextrins, with any one of the following groups:

A. Phospholipins, phosphoric acid and phosphates;
B. Polycarboxylic or hydroxy carboxy aliphatic acids, such as tartaric, citric, malic, succinic, lactic, glycollic, etc.;
C. Proteins, amino acids and amino-aryl compounds such as asparagine, tyrosine, aminophenols such as benzylaminophenol or their derivatives such as aminobenzyl-p-aminophenol, naphthylamine, and other aromatic amines;
D. Polyhydroxy-aryl compounds such as hydroquinone, pyrogallol, pyrocatechol, resorcinol, phloroglucinol, and other polyhydroxy phenols, guaiacol, eugenol, aromatic hydroxy aldehydes, the naphthols including alpha-naphthol, and substituted naphthols, tannic acid, etc.;
E. Other substituted aromatic compounds such as thymol.

Among the sugars that may be employed are included any of the mono-saccharides, di-saccharides or poly-saccharides that are in the water soluble class, such as dextrose, sucrose, lactose, mannose, fructose, crude or refined cane or beet sugars or mother liquors obtained from the refining of the sugars, etc. The combination may consist of from 25% to 95% by weight of the sugar against the weight of the other compound utilized in conjunction therewith, such as hydroquinone, tyrosine, etc.

Other materials that may be desirably employed for addition to paper or board stock, by themselves or in combination with other materials previously mentioned, and particularly to pine stock in an amount of under 2% include black strap molasses and the residues and mother liquors obtained from the refining of crude cane and crude beet sugars and less desirably the crude cane and beet sugars themselves.

The water and alcohol soluble extracts from the cereals and de-oiled or expressed seeds may also be utilized such as the concentrated water extract of finely divided dry milled maize, oats or barley, and also and less preferably of the seeds such as of peanut, cottonseed, sunflower seed, olives, etc., and preferably in their de-oiled or de-fatted condition and after the glyceride oil contained therein has been expressed or extracted therefrom. The water and alcohol soluble extracts of the de-oiled cereal germs may also be employed such as of de-oiled rice germ, corn germ, etc.

These materials may be employed in an amount ranging from 0.005% to 2% against the weight of and for addition to the pine board stock. In any event, it is important that the pine board stock be subjected to the elevated temperature in order to obtain the desired interaction whereby stabilization is secured.

Among the materials that may particularly be employed for addition to pine board stock before subjecting to the elevated temperature heating is tannic acid which appears to be unusual in having the property of becoming markedly increased in stabilizing effect when added to an oxidizable organic compound and particularly to a glyceride, essential or hydrocarbon oil-containing oxidizable organic compound and then subjected to an elevated temperature in the presence of that oxidizable organic compound, such increase in effectiveness being entirely out of proportion from what would be expected by comparison to similarly constituted materials. It is important, for example, for the tannic acid to be placed in contact with the pine board stock by sizing thereon or adding thereto and then the pine board stock subjected to the elevated temperature in order for the desired interaction to occur, whereby marked stabilization against the development of off odors takes place.

Although boards are particularly emphasized for treatment in accordance with this invention, textiles may similarly be sized in this manner and then heated and particularly where they

are subject to the development of off odors resulting from the components of those textiles being subject to rapid deterioration under conditions of storage.

In the treatment of pine stock board the board may be somewhat improved in keeping quality by subjecting the pulp to between 30 and 35 pounds steam pressure or more. Where less than 30 pounds steam pressure is applied to the pulp, the deteriorative changes occur with extreme rapidity but these changes can be somewhat reduced by subjecting the pulp to between 30 and 35 pounds steam pressure, this treatment being given to the entire pulp before the finished board is actually formed, and the pressures indicated is apparently critical in this regard.

The present application is a continuation in part of application, Serial No. 69,296 filed March 17, 1936.

The pine fiber board of this application, and as referred to in the claims, relates to the paper and paperboard made of pine stock base, particularly by the use of slash pine from which paper and paperboard of great susceptibility to oxidative deterioration and to the development of off-odors is obtained. The slash pine used in the manufacture of paper and paperboard becomes more readily subject to off-odors when it has not been aged or "seasoned" for a period of three to six months, and the process described herein is particularly of value for paper and paper board made from slash pine and other pine stock which has not been properly aged or "seasoned."

Having described my invention, what I claim is:

1. A process of treating a pine fiber board subject to oxidative deterioration which comprises passing the board through a trough containing an aqueous bath composed of about 93% water and 7% of a starch-lecithin mixture, said mixture consisting of about 1 part by weight of crude lecithin and about 5 parts by weight of starch, and then passing the board over heated rolls at an elevated temperature above 180° F. until dry, the final board containing about between 0.01% and 2% of lecithin.

2. A process of treating a paperboard subject to oxidative deterioration to render the same resistant to oxidative deterioration which comprises passing the board through a trough containing an aqueous bath composed of a major proportion of water and a minor proportion of a starch lecithin mixture, said mixture consisting of a minor proportion of lecithin and a major proportion of starch, and then passing the board over heated rolls at an elevated temperature above 180° F. until dry, the final board containing between about 0.01% and 2% of lecithin.

3. A process of treating a pine fibre board subject to oxidative deterioration to render the same resistant to oxidative deterioration which comprises passing the board through a trough containing an aqueous bath composed of a major proportion of water and a minor proportion of a starch lecithin mixture, said mixture consisting of a minor proportion of lecithin and a major proportion of starch, and then passing the board over heated rolls at an elevated temperature above 180° F. until dry, the final board containing between about 0.01% and 2% of lecithin.

4. A process of treating a pine fibre board subject to oxidative deterioration to render the same resistant to oxidative deterioration which comprises passing the board through a trough containing an aqueous bath composed of about 93% water and 7% of a starch lecithin mixture, said mixture consisting of a minor proportion of lecithin and a major proportion of starch, and then passing the board over heated rolls at an elevated temperature above 180° F. until dry, the final board containing between about 0.01% and 2% of lecithin.

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