

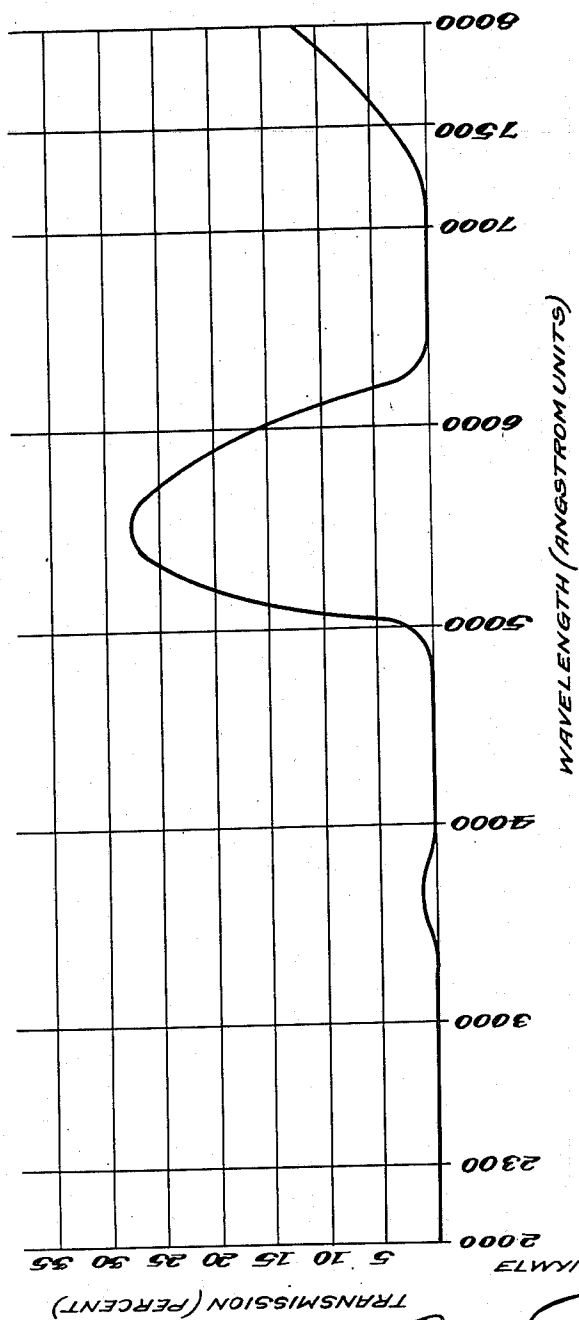
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SELECTED LIGHT TRANSMISSION AND PROTECTIVE MATERIALS

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SELECTED LIGHT TRANSMISSION AND
PROTECTIVE MATERIALS

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The present invention relates to selected light transmission and protective materials for general use and particularly to materials as may be used for packaging and protecting foods, plants and other products subject to deterioration by chemical change by light rays, and aims generally to improve existing materials of that type.

One of the primary objects of the invention is the provision of an improved material for processing foodstuffs and the like and which has the property of transmitting a selected short band of beneficial wave lengths of light, for example those wave lengths from 5000 to 6000 angstrom units together with an accompanying band of infra-red wave lengths lying above 7500 angstrom units.

More specifically, an object of the invention is the provision of a selected light transmission and protective material which may be incorporated in a stock normally permeable to light rays of some or all wave lengths from 2000 to 7500 angstrom units (for example paper stock), or applied as a coating or impregnant to transparent or semi-transparent materials, so that the finished materials will transmit selected beneficial wave lengths of light from 5000 to 6000 angstrom units while excluding or absorbing substantially all light from 6200 to 7500 angstrom units. I have found that these wave lengths of light, which I term the beneficial wave lengths, should have a transmission substantially in excess of the absorbed rays and preferably the transmission of wave lengths between 5400 and 5800 Å. is in excess of twenty (20) percent. These I find are particularly effective in promoting a desirable photochemical action on many commodities, especially when accompanied by a band of infra-red wave lengths of light of 7500 Å. or above. For best results with many commodities, I prefer that the percentage of transmission of wave lengths of 8000 Å. be not more than fifty percent of the transmitted wave lengths of 5400 to 5800 Å.

Another of the primary objects of the invention is the provision of a light protective material which will be substantially opaque to or absorbent of the harmful wave lengths of light between 2000 angstrom units to 5000 angstrom units.

More specifically, an object of the invention is the provision of a light protective material which may be incorporated in a stock normally permeable to some or all of light of wave lengths of 2000 to 5000 Å., or applied as a coating or impregnant to a normally transparent or semi-transparent material and which

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may be employed as a panel, screen, textile material package, container or wrapping, suitable for the protection of material in transit in the higher altitudes, for example air transport, where ultraviolet light of very low wave lengths is encountered, as well as the protection of human eyes in the presence of the shorter wave lengths of ultraviolet light.

Still another of the primary objects of the invention is the provision of a selected light transmission and protective material that will not be active in promoting the growth of mold and like spores. I have found from experiment that growth in many molds is activated and promoted by selected bands of light of from 6300 to 7500 angstrom units. Accordingly, a more specific object of the invention is the provision of a selected light transmission and protective material which is substantially opaque to or absorbent of wave lengths of light between about 6300 Å. and 7500 Å.

A still further object of the invention is the provision of a light absorbent that may be combined with a lacquer and applied to normally transparent or semi-transparent materials.

An additional object of the invention is the provision of a light absorbent which may be combined with a laminant for paper, glassine, glass sheets, textiles, natural and synthetic rubber sheetings and transparent plastic materials and the like whereby a laminated material having the spectral characteristics described above is provided.

The term "light" as used herein refers not only to visible light (3800 to 7200 Å.) but also includes wave lengths of solar and artificial light of wave lengths between 2000 and 10,000 Å.

The above and other aims and advantages of the invention will be apparent to persons skilled in the art from a consideration of the following more detailed description and the accompanying drawing showing a spectrophotometric graph of a suitable material embodying the invention, and in which the abscissa indicates the wave lengths of light in angstrom units and the ordinate the percentage of light transmission through the material.

Generally my invention comprises a material that is normally permeable to some or substantially all light of wave lengths from 2000 to 8000 Å. and which has been rendered substantially opaque to or absorbent of wave lengths of light from 2000 to 5000 angstrom units with an ability to transmit selected wave lengths of light from 5000 to 6000 Å., with a peak transmission between 5400 to 5800 Å. By "substan-

tially opaque" or "substantially absorbent" I mean that it will not transmit over five (5) percent of those wave lengths to be absorbed. The infra-red wave lengths above 7500 Å. are not so harmful to most perishable merchandise but I prefer that the transmission of light at 8000 Å. not exceed fifty (50) percent of the selected transmitted wave lengths between 5200 and 5800 Å.

The invention may be embodied in a panel, glass optical structure, textile fabric, flexible wrapping of paper, cardboard stock, and the large variety of synthetic plastic materials such as synthetic rubber sheeting, normally transparent regenerated cellulose, or any of the well-known wrapping, packaging or structural materials, by incorporating with the material suitable light absorbents of such characteristics as to impart to the material spectrophotometric properties as illustrated in the drawing. The term "synthetic plastic materials" includes the varieties of synthetic resin such as the aceto-butyrates, phenolic, urea, vinyl, ethyl and cellulose, cellulose-acetate, polystyrene, methyl-methacrylate and others.

According to the invention, the base of the material, which may be paper, glassine, vegetable parchment, textile fabrics, cellulose derivative, synthetic rubber film or product, glass, synthetic plastic composition or other material wholly or partly permeable to light of wave lengths of from 2000 to 8000 angstrom units, is combined with a light absorbent material either as an impregnant, coating or ingredient mixed therewith to render said material selectively absorbent and transmissive of wave lengths of light according to the above stated characteristics.

The absorbents are preferably in the form of dyes and may be either water soluble or alcohol soluble, depending upon the nature of the material to be impregnated, coated or otherwise rendered transmissive to selected wave lengths of light according to the invention.

Example I

One water soluble dye mixture that is suitable for mixing with raw stock of a paper beater, may comprise—

95 parts of Hansa Yellow (Fast) TRD paste
5 parts Heliofen Blue (Fast) BWS

100 parts

The amount of such dye mixture that is to be added to the stock will vary considerably depending upon the nature of the raw stock. For example, considerably less dye mixture is required for unbleached paper stock than for bleached stock and other lighter or more transparent materials. In the above example Heliofen Blue is a phthalocyanine pigment and is preferred for its fastness to light as well as for its ability to absorb wave lengths of light in the region from 6300 to 7500 angstrom units.

Example II

A suitable alcohol soluble absorbent or dye mixture may comprise—

95 parts Metanil Yellow P concentrated (Fast)
in ethyl alcohol
4.5 parts Brilliant Blue (Fast) 6CB in ethyl
alcohol
.5 parts Migrosine SSB in ethyl alcohol

100 parts

It will be understood that the proportion of the several dyes may be varied slightly, depending upon the use of the material and also that the proportions of dye to the stock will vary considerably, depending upon the nature of the stock to be dyed. In the above example Metanil Yellow is an acid dye soluble in ethyl alcohol.

Such dyes may be incorporated and thoroughly mixed in the partly prepared stock, whether glassine, paper, regenerated cellulose, natural or synthetic rubber stock, resins or other synthetic plastic composition, prior to the sheeting or fabrication thereof, to provide a homogeneous material possessing the spectrophotometric characteristics shown in the drawing.

Also, these dyes may be incorporated in the laminants or adhesives employed for laminating sheets of paper, glassine, regenerated cellulose and the like where it is desired to produce a laminated flexible wrapping or packaging material for laminating sheets of transparent plastic for aircraft and like windows and for laminating sheets or pieces of glass for antiglare windshield sections, and sun and light therapeutic eye lenses.

Example III

A suitable light absorbent coating suitable for application to normally transparent material such as window glass, glass containers, glass and transparent plastic panels, eyeglass lens, transparent thermoplastic sheets, natural and synthetic rubber sheets and articles, regenerated cellulose wrapping paper and textile fabric in sheet or web form may comprise an absorbent in a lacquer or resin vehicle. Such lacquer light-absorbents are preferably alcohol soluble and may comprise a mixture of the following ingredients:

6.68% Super Beckacite 2000 (Beck Kohler Co., Detroit, Mich.)
4.46% ethyl cellulose
17.42% ethyl alcohol
6.40% pentyl acetate
6.40% butyl alcohol
58.64% dye solutions of Example II

It will be understood that the amount of the dye solution that can be incorporated in the lacquer vehicle or coating will determine the transmission of the unabsorbed wave lengths of light, and hence the thickness of the coating may vary considerably for different uses. The term "dye" as used herein includes pigments as well as dyes.

Referring to the drawing, the dye incorporated material or dye coated material is preferably of such color density as to absorb substantially all, and at least 95% of the wave lengths of light between 2000 Å. and 5000 Å. From 5000 Å. the curve rises indicating a transmission of beneficial wave lengths of light from 5000 Å. to 6000 Å. I have found that the transmission of these wave lengths between 5400 and 5800 should be substantial as compared to the transmission of substantially absorbed wave lengths and with substantially complete absorption of red rays from 6300 to 7500 Å., this being the upper limit of visible light. The beneficial effect of the transmitted wave lengths from 5000 to 6000 Å. is enhanced by an accompanying transmission of wave lengths of light from 7500 to 8000 Å., but preferably, according to a preferred embodiment of the invention, the transmission of infra-red rays of 8000 Å. should not exceed 50 percent of the transmitted beneficial rays of wave lengths from 5400 to 5800 Å.

According to the embodiment of the invention the material may be a flexible wrapping or packaging material for foodstuffs and other commodities affected by light. For such use the material may comprise a single thickness or a laminated sheet of light absorbent containing paper, glassine, regenerated cellulose, synthetic rubber hydrohalide sheeting, or textile fabric. The absorbent may be incorporated as an ingredient mixed with the raw or partly prepared stock, as an impregnant or as a coating applied to one or both sides of the material, or as a laminant between laminated sheets thereof.

According to another embodiment of the invention, structural panels of normally transparent plastic or glass, eyeglass lenses, synthetic plastic and glass containers and receptacles may be coated on one or both sides with the absorbent containing lacquer as above described. Alternatively, when it is desired that such structures be formed of laminated materials, the laminant may form the absorbent carrier as above described. Such materials are particularly useful for windows, glass panels for food showcases, sun glasses, light bulbs, beverage and food containers and the like where the exclusion of certain rays and the transmission of selected other rays according to the invention is desirable.

According to a further embodiment of the invention, textile fabric and particularly woven cloth, may be rendered selectively absorbent and transmissive of wave lengths of light according to the invention by impregnating or coating the fabric with absorbents above described in Examples II and III. Such absorbents may be incorporated in a resinous or plastic carrier or vehicle which is applied to one or both sides of the textile fabrics, as may be desired. Such fabrics are especially useful in the manufacture of garments of various kinds for persons susceptible to burning by ultraviolet light, for use as packaging materials, tents and the like.

The characteristic feature of the invention of providing substantial opaqueness to or absorption of wave lengths of light from 2000 Å. to 5000 Å. is of great importance where the shorter wave lengths of ultraviolet light, estimated at approximately 2000 Å. and substantially below the range of visible light, are encountered. For example, in modern air transport lower wave lengths of the ultraviolet are encountered than nearer the earth's surface. For such use the commodity packaging and wrapping materials as well as the glass and plastic panels of the invention, which may be used as window lights of aircraft, are particularly desirable in protecting the cargo commodities as well as the passengers and personnel from the harmful effects of those lower wave lengths of ultraviolet light.

Furthermore, because of its ability to absorb substantially all wave lengths of light from 2000 to 5000 Å., the invention is of special value for use as visors and eye shields for welders and patients subjected to treatment by ultraviolet ray lamps, many of which lamps, as well as the welder's carbon arc, produce wave lengths of ultraviolet light as low as 2000 Å.

The feature of the invention in providing for transmission of selected beneficial wave lengths of light between 5000 and 6000 Å. is of great importance in connection with the packaging of foodstuffs and like commodities. The effect of these beneficial wave lengths accompanied by a limited band of infrared wave lengths from 7500

to 8000 Å. has the effect of increasing the sweetness and flavor of many fruits and vegetables, in some cases, to a greater extent than is found in tree or vine ripened fruit of the same species. For example, many comparative tests have been made of peaches, cantaloupe, grapefruit, oranges, lemons, tomatoes and similar commodities, ordinary wrapped specimens, tree or vine ripened specimens and specimens encased in wrapping materials of the present invention and in all cases the specimens processed by the materials of the invention possess a marked increase in sweetness and flavor. Without intending to be limited to any theory of photochemical reaction in the constituents of the fruit, it is believed that the transmission of the selected wave lengths between 5000 and 6200 angstrom units tends to increase the sugar content thereof, while the absorption of other wave lengths of light retard the formations of starches. Whatever the theory, a distinctly beneficial effect is noticeable when foodstuffs are packaged in materials of the present invention.

A still further advantage of the invention resides in substantially complete absorption of wave lengths of light from 6000 to 7500 Å., which wave lengths of light promote the growth of mold spores, particularly molds of the *Penicillium* and *Aspergillus* genera. Hence, the absorption of these wave lengths of light by the materials of the present invention provide for more complete protection of perishable and mold-forming commodities which is particularly advantageous in the packaging of many foodstuffs, for example peaches, citrus fruits, cheeses, meats and the like.

Furthermore, the invention is particularly advantageous in protecting many materials that are disintegrated by the action of light. For example, certain synthetic rubber packaging materials, such as synthetic rubber hydrohalide compositions, are frequently decomposed by strong light to such extent that they may impart an unfavorable flavor and odor to the products enclosed therein. Such decomposition is prevented by incorporating the absorbents of the invention in the material or by coating the material with a lacquer containing the absorbents herein described.

The present application is a continuation-in-part of my prior copending applications Serial No. 391,613, filed May 2, 1941 and Serial No. 446,295, filed June 8, 1942, both now abandoned.

Although I have mentioned certain particular types of material as embodiments of the invention and have cited several uses in which the invention is particularly advantageous, I wish it understood that these are intended as examples of illustration and not as words of limitation, as other embodiments and uses of the invention will be apparent to persons skilled in the art. The scope of the invention is best defined in the appended claims.

I claim:

1. A selected light transmission material comprising a base material normally transparent to wave lengths of ultraviolet, visible and infrared light; said material having incorporated directly therewith a soluble yellow dye light absorbent in sufficient amount to absorb ultraviolet and visible light below approximately 4900 angstrom units, but substantially transmit wave lengths of visible light and infrared light above 4900 A. U., and at least one other light absorbent absorptive of wave lengths of light between 6300 and 7500 angstrom units and selected from the group consisting of

a phthalocyanine and a soluble light-fast blue dye in sufficient amount to restrict transmission of wave lengths of visible light in the region between 6300 and 7500 angstrom units, the absorption properties of said combined dyes being such that in combination they substantially totally absorb wave lengths of light below 4900 angstrom units and substantially restrict transmission of wave lengths of light between 6300 and 7500 and the transmission properties of said combined dyes allowing transmission of visible light between 5000 and 6000 angstrom units.

2. A selected light transmission material as defined in claim 1 in which the first named light absorbent is a yellow dye selected from the group consisting of a water soluble dye and a spirit soluble dye.

3. A selected light transmission material as defined in claim 1 in which the second named light absorbent is a Heliogen phthalocyanine.

4. A selected light transmission material as defined in claim 1 in which the second named light absorbent is a brilliant light-fast blue dye.

5. A selected light transmission material as defined in claim 1 in which the base material is a sheet of paper stock and the light absorbents are water soluble dyes.

6. A selected light transmission material as defined in claim 1 in which the base material is a woven textile fabric impregnated with water soluble light absorbents.

7. A selected light transmission material as defined in claim 1 in which the base material is a woven textile fabric coated with a resinous coating in which the light absorbents are intimately mixed therein.

8. A selected light transmission material as defined in claim 1 in which the base material is of synthetic resinous material and the light absorbents are spirit soluble dyes.

9. A selected light transmission material as

defined in claim 1 in which the base material is of synthetic resinous material and the light absorbents are incorporated in a coating.

10. A selected light transmission material as defined in claim 1 in which the base material is a cellulose acetate and the light absorbents are spirit soluble dyes.

11. A selected light transmission material as defined in claim 1 in which the base material is methylmethacrylate.

12. A selected light transmitting material as defined in claim 1 in which the percentage of transmission of wave lengths of light at 7500 angstrom units is not more than approximately one-half of the percentage of peak transmission between 4900 and 6300 angstrom units.

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