

Nov. 19, 1968

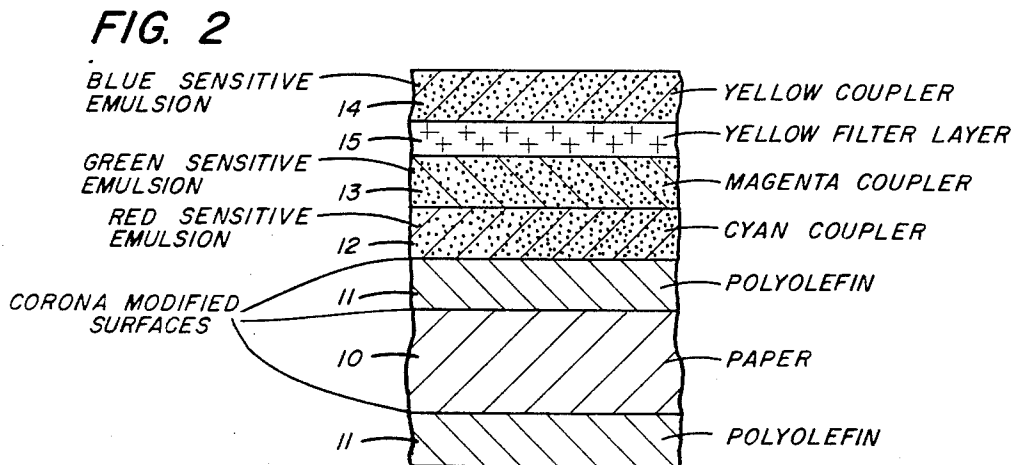
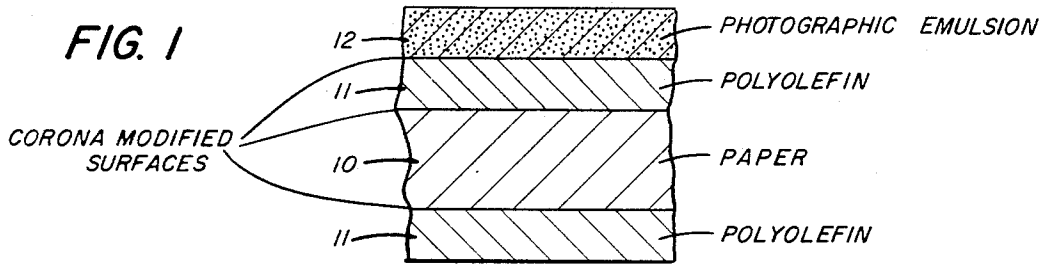
I. H. CRAWFORD ET AL

3,411,908

PHOTOGRAPHIC PAPER BASE

Filed April 12, 1967

2 Sheets-Sheet 1



IRVIN H. CRAWFORD
WILLIAM L. JOHNSON
JOSEPH E. RATCLIFF
INVENTORS

BY *William L. Johnson*
W. H. M. Jewell

ATTORNEY & AGENT

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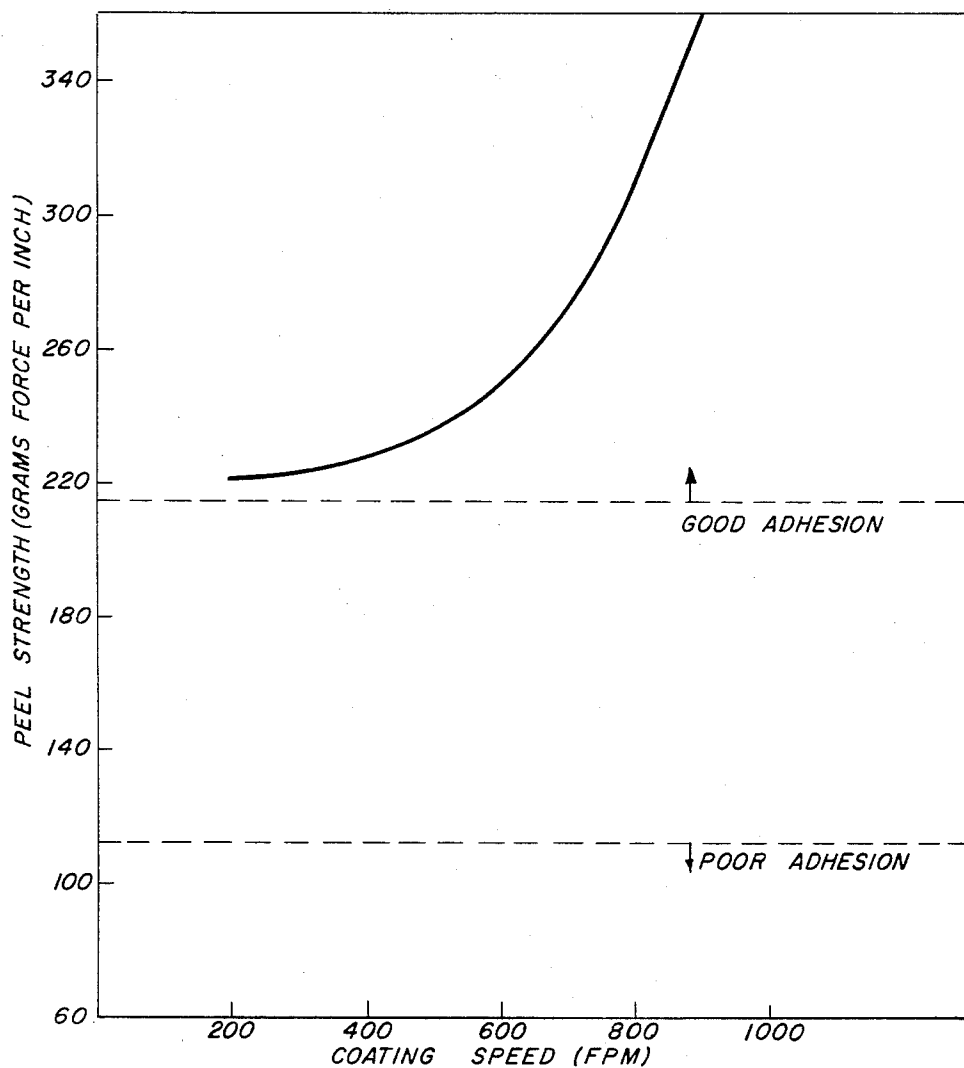


FIG. 3

IRVIN H. CRAWFORD
WILLIAM L. JOHNSON
JOSEPH E. RATCLIFF
INVENTORS

BY *Walter O. Johnson*
W. H. McJowell

ATTORNEY & AGENT

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3,411,908

PHOTOGRAPHIC PAPER BASE

Irvin H. Crawford, Rochester, N.Y., and William L. Johnson and Joseph E. Ratcliff, Kingsport, Tenn., assignors to Eastman Kodak Company, Rochester, N.Y., a corporation of New Jersey
Continuation-in-part of application Ser. No. 350,640, Mar. 10, 1964. This application Apr. 12, 1967, Ser. No. 630,261

12 Claims. (Cl. 96—74)

ABSTRACT OF THE DISCLOSURE

Photographic paper base is treated with corona discharge, and a polyolefin is extruded onto the paper. A photographic emulsion is then coated onto the polyolefin surface. The bond between the polyolefin and the paper is sufficient to resist the action of aqueous acid and alkaline photographic processing solutions.

This application is a continuation-in-part of Ratcliff et al., U.S. Patent application Ser. No. 350,640, filed Mar. 10, 1964, and now abandoned.

This invention relates to polyolefin coated photographic paper wherein the adhesion of the polyolefin layer to the paper is sufficient to strongly resist separation of the polyolefin layer from the paper either when the coated paper is dry or when the coated paper has been treated with aqueous photographic processing solutions including strongly acid and alkaline solutions

The coating of paper with polyolefins by extrusion from a hot melt is known in the art. In order to obtain satisfactory adhesion of the polyolefin to the paper it has been necessary to employ a combination of relatively low extrusion or coating speeds, high extrusion temperatures and high coating weights. Rapid coating speeds at reduced melt temperatures and reduced coating thickness have been produced by employing various chemical primers, such as polyethylene imine or organic titanates. However, chemical priming treatments are expensive, as are the purchase price and installation costs of equipment to coat the primer onto the paper. In addition, application of such primers requires wetting of the paper which in turn can make low wet strength paper stocks difficult to handle. In Werkman U.S. Patent 3,247,290 in order to obtain polyethylene coatings on paper having satisfactory adhesion, heat-seal properties etc. at coating speeds up to about 600 f.p.m., and to reduce the coating weight on paper from about 45 to 5 lbs. of polyethylene per ream (about 15 to 1.7 lbs./1,000 sq. ft.) it was necessary to blend a visbroken (heat degraded) polyethylene with a low density polyethylene and to extrude at temperatures between 400 and 700° F. Thus, at 350 ft./min. and 600° F. it was possible to obtain a coating of polyethylene of 10 lbs. polyethylene per ream (about 3.3 lbs./1,000 sq. ft.). In the invention described hereinafter the use of polyolefin blends containing such degraded polyolefins for coating photographic paper is not necessary.

One object of our invention is to provide a method for treating paper to render the surface thereof adherent to polyolefin coatings. Another object of our invention is to provide a method for treating paper substrates so that a polyolefin coating may be coated thereon at rapid coating speeds and as a thin film while maintaining good adhesion between the polyolefin coating and the paper substrate to render the paper particularly useful as a water-resistant photographic paper base. A further object of our invention is to provide a method for adhering polyolefin coatings to paper substrates which does not involve the use of chemical primers. Still another object of our invention

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is to provide photographic paper substrates having an adherent polyolefin coating thereon. Other objects of our invention will appear herein.

SUMMARY OF THE INVENTION

These and other objects of our invention are accomplished by subjecting photographic paper base to a corona discharge, and extruding a polyolefin coating thereon at speeds of about 100 to 1,500 f.p.m. and about 580–630° F. to obtain coatings as thin as 0.3 mil and of, for example 1.5–15 lbs. polyolefin/1,000 sq. ft. which can be expected to adhere firmly in the dry state or after wetting with aqueous photographic processing solutions for extended periods of time. The invention is especially useful in preparing photographic paper for color photography where a multiplicity of layers sensitive to different regions of the spectrum are coated on the polyolefin coated paper base and all layers adhere firmly to the paper support after treatment with aqueous acid and alkaline processing solutions. Thus, the type and degree of adhesion required is considerably different than required of many polyolefin coated papers which are not subjected to treatment with such acid and alkaline solutions. Moreover, photographic paper base has a very smooth surface required for coating uniform emulsion layers thereon and extruded polyolefins do not readily adhere. Accordingly, methods which have been used for adhering polyolefins to porous stocks such as milk carton stock, kraft paper, etc. are of little use. We have found that in accordance with our invention, polyolefin coatings may be applied at good coating speeds, using relatively low extrusion temperatures to obtain a thin layer on photographic paper substrates to provide a moisture resistant polyolefin coated paper having good adhesion between the polyolefin coating and the paper. Polyolefin coated paper prepared in accordance with our invention is inexpensive and does not require the use of chemical primers.

The accompanying drawings show in greatly enlarged cross-sectional view representative photographic elements of the invention. The broader aspects of the invention are illustrated in FIG. 1 wherein is shown a photographic paper support 10, the surfaces of which are modified by corona discharge, polyolefin layers 11 are adhered to these surfaces by extrusion and a photographic emulsion layer 12 is adhered to one of the polyolefin layers which was modified by corona discharge.

The specific embodiment of the invention shown in FIG. 2 is a multilayer photographic subtractive color paper wherein both surfaces of the photographic paper support 10 and of the upper polyolefin layer 11 are modified by corona discharge to adhere layer 11 to the paper and to adhere the superposed emulsion layers 12, 13 and 14 and filter layer 15 to the polyolefin layer 11.

FIG. 3 illustrates by means of a graph certain unexpected advantageous features of the invention obtainable by preparation of photographic paper base under conditions described in detail below.

The photographic paper base which is used in our invention is that well known in the art made, for example, by extensive jordaning of bleached sulfite paper stocks to the selected fiber length. The paper stock may comprise hard or soft wood fiber. The furnish to the paper machine preferably contains aluminum stearate and starch and usually resin size such as melamine-formaldehyde wet strength resin. A gelatin or starch tub size can be applied to the paper sheet before the calender and calendering is usually carried out at a high stock moisture content. Thereafter, the sheet is super-calendered using a series of steel and cotton rolls in the calender stack. The resultant stocks have very smooth surfaces and vary for example, from about 25 to 40 lbs./1,000 sq. ft. The

heavier stocks of about 38-42 lbs./1,000 sq. ft. are preferred for color products such as described in Example 7 below. It is smooth papers of this type to which thin layers of polyolefin extrusion will not readily adhere when coated at relatively high speeds and lower temperatures. However, when the surfaces of these papers are modified by corona discharge an improvement in the adhesion of the polyolefin to the paper is obtained beyond expectations. That is, polyethylene and polypropylene do not adhere nearly as well to other cellulosic surfaces having an equally smooth surface which have been bombarded to the same extent. For example, when cellulose esters such as acetate sheeting are bombarded, polyethylene extrusion will not adhere under the same extrusion conditions. Similarly, the adhesion of polyethylene extrusion to glassine paper comprising essentially pure cellulose, and which has been electron bombarded is not as good as to electron bombarded photographic paper base.

The bombardment of the photographic paper base with corona discharge is carried out in apparatus such as described in Rothacker Patents U.S. 2,864,755 and 2,864,756 and Traver U.S. Patents 2,910,723 and 3,018,189. Advantageously, the paper substrate is subjected to a corona discharge of from about .1 to about 3.5 rfa. For illustration, a 60-cycle Lepel high frequency generator operating at 6 kva. at 440 volts giving an output of 2.5 RF amps can be used with several metal electrodes close to the paper at a point where the paper is passing over a metal roll coated with a dielectric material. Similarly, a metal roller may be used to support the web with the other electrode array being in planetary disposition equidistant from the surface of the metal roller and each being coated with a dielectric, at least on the surface nearest the metal roller.

The method we use to insure adequate adhesion of the polyethylene extrusion to paper is to extrude the melt onto the paper, just after the bombardment of the paper surface, at a temperature of about 580-640° F., preferably 580-630° F. and at about 100 to 1,500 f.p.m., preferably about 200 to 1,000 f.p.m. Under these conditions thin polyolefin coatings of about 0.3 to 2.0 mils thickness are obtainable which prevent photographic processing solutions from penetrating to the paper base. At temperatures much below 580° F. the extrusion will not adhere satisfactorily and the higher temperatures beyond about 630° F. are less preferred because of the tendency for decomposition of the polyolefin and a concomitant formation of insoluble particles in the coatings which appears as objectionable surface defects in the emulsion layers of the final light-sensitive product. Decomposition of the polyolefin can be materially reduced by the addition of antioxidants to the extrusion melt. Representative antioxidants are alkylated phenols, propylgallate, etc. Coatings speeds in the range beyond about 1,000 f.p.m. are less preferred since it is more difficult to obtain a thin uniform coating across the paper sheet even at the higher temperatures and poorer adhesion can be expected. The peel strength (or dry adhesion) of the polyolefin coatings to the paper is determined in an apparatus which measures the force in grams per inch width required to separate the polyolefin coating from the paper independent of the stiffness of the materials. This dry adhesion test will, in general, predict the wet adhesion of the polyolefin coatings; however, coatings appearing to adhere well dry may separate from the paper during the photographic processing cycles. Dry adhesion is also important to predict how well the polyolefin will adhere when different rolls of the paper are spliced together and fed through the sensitizing, slitting and winding photographic machinery. The wet adhesion of the photographic emulsions and of the polyolefin coating to the paper can be determined, for example, by processing the paper in a standard photographic processing cycle and observing the amount of edge penetration by the solutions and any

tendency for the layers to separate as the paper passes over rollers in the processing machine. Similarly, the polyolefin coatings which adhere well dry may separate from the paper base soon after coating an aqueous photographic emulsion thereon usually during the process of drying the emulsion.

The polyolefins used in our process include polyethylenes and polypropylenes. Useful polyethylenes have a density range of about 0.910 to 0.980 g./cc., their viscosity measured by Melt Index (ASTM D-1238, condition "E") can be about 2.0 to 20.0, preferably 3.0 to 12.0, decigrams per minute and they can be about 40 to 90% crystalline. Useful polypropylenes have a density range of about 0.900 to 0.910, their viscosity measured by Melt Flow Rate (ASTM D-1238, condition "L") can be about 10 to 90, preferably 40 to 90, decigrams per minute and they can be about 60 to 80% crystalline. The polyolefins are prepared by well-known methods of polymerization of ethylene and propylene using, for example, Zeigler catalyst. Blends of high density polyolefins and low density polyolefins (the latter originating from either initial polymerization of olefins to lower density, or by heat degradation of high density polymer) can be employed, but the latter are not required contrary to the process of U.S. 3,247,290. Other polyolefins which are useful are the polyallomers, i.e. copolymers of ethylene and propylene prepared, e.g. as described in the Hagemeyer U.S. Patent applications Ser. Nos. 505,227 filed Oct. 26, 1965, 516,783 and 516,677 filed Dec. 27, 1965. The required adhesion of the various polyolefins is effected by their extrusion onto the electron bombarded paper under the conditions given above. The polyolefin layers on which the emulsions are coated, preferably contain white pigment such as titanium oxide or barium sulfate to provide a white background for the photographic image formed in the emulsion layers. Well known optical brighteners can also be present in the polyolefin layer underlying the emulsion layers. The polyolefin or other polymer layer applied to the back of the paper base generally contains no pigment since it serves primarily as a waterproofing layer. However, dark pigments such as carbon can be present if an opaque base is required.

The polyolefin layers applied to the paper base are very thin, e.g. about 0.3 to 4.0 mils thick as a result of the extrusion of from about 1.5 to 20 lbs. of polyolefin per 1,000 sq. ft. of paper surface under the mentioned conditions of temperature and speed.

The photosensitive layers which are coated onto the polyolefin coated papers are those well known in the art including, e.g. conventional silver halide emulsions containing, e.g. silver bromide, silver chloride, silver bromiodide and the like. The colloid vehicle is usually hydrophilic as in the case of gelatin. The emulsion layers which can be used for preparing multicolor photographic elements such as shown in FIG. 2 are well known in the art and include, for example, the above silver halides, gelatin and a dispersion of the appropriate color-forming compound, e.g. a coupler compound reactive with the oxidation product of a primary aromatic amino silver halide developing agent to form a dye image.

The method of dispersing representative cyan, magenta and yellow color-forming couplers in the emulsion layers is described in the Jelley et al. U.S. Patent 2,322,027 and elsewhere. Phenols and naphthols give cyan images, pyrazolones give magenta images and open chain reactive methylene compounds yield yellow images in the color developing process. The following are representative useful couplers:

Couplers producing cyan images

- 2-chloro-5-(N-n-valeryl-N-p-isopropylbenzylamino)-1-naphthol
- 2,4-dichloro-5-palmitylamino-1-naphthol
- 1-hydroxy-2-(N-p-sec. amylphenyl)naphthamide
- 2- α (p-tert. amylphenoxy)n-butylamino-5-methylphenol

2-(4''-tert. amyl-3'-phenoxybenzoylamino)-3,5-dimethyl-1-phenol

Couplers producing magenta images

2-cyanoacetyl coumarone-5-(N- γ -phenylpropyl)-p-tert. amylsulfonanilide

1-phenyl-3-(p-sec. amylbenzoylamino)-5-pyrazolone

1-(2',4',6'-trichlorophenyl)-3-[β -(2''',4'''-di-tert. amylphenoxy)-propionamido]-5-pyrazolone

1-(2',4',6'-tribromophenyl)-3-[β -(2''',4'''-di-tert. amylphenoxy)-propionamido]-5-pyrazolone

1-(2',5'-dichloro)-3-[3''-(4''-tert. amylphenoxy)benzamido]-5-pyrazolone

Couplers producing yellow images

N-(4-anisoylacetaminobenzenesulfonyl)-N-benzyl-m-toluidine

N-(4-benzoylacetaminobenzenesulfonyl)-N-n-amyl-p-toluidine

ω -Benzoyl-p-sec. amylacetanilide

α -(3-[α -(2,4-di-tert. amylphenoxy)butyramido]benzoyl)-2-methoxyacetanilide

Nonyl-p-benzoylacetaminobenzenesulfonate

It is these color processes which require the polyolefin extrusion to be very uniformly coated onto the photographic paper to prevent formation of coating defects in any one of the emulsion layers. The coating of the polyolefin onto paper under the conditions described above yields the desired quality of paper for this purpose. More particularly, in the mentioned color processes the multilayer color paper such as shown in FIG. 2 must be processed in a series of aqueous acid and alkaline solutions including strongly alkaline developing solution, acid stop bath, acid ferricyanide solution etc., followed by washing. In these processes the paper may be wet for as long as 60 minutes with the mentioned solutions and during this time the solutions tend to penetrate from the edge of the paper and tend to cause the polyolefin layer to separate from the paper. However, if the polyolefin layer is applied to the electron bombarded paper as prescribed above, this does not occur. The strong adhesion of the polyolefin to the paper is unique and appears to be due solely to the electron bombardment of the paper followed immediately by the polyolefin extrusion at the temperatures and speeds described above.

The gelatin photographic emulsion layers do not strongly adhere to the polyolefin coatings on the paper and accordingly, it is preferred that the polyolefin surfaces be electron bombarded as described in Belgian Patent 631,169 granted May 15, 1965 to a contact angle of less than 76°.

The level of electron bombardment can be measured by the contact angle obtained when a drop of distilled water is placed on a level sample. By projecting the image of the drop and sample on a suitable screen using equipment such as the Contour Projector and measuring the angle of a line tangent to the drop image at the point the edge of the drop touches the sample, a contact angle is obtained which is referred to herein. The untreated polyethylene-coated paper gives a contact angle above 90°. The minimum electron bombardment needed for emulsion adhesion gives a contact angle of 75°. In the case of polypropylene the contact angle should be appreciably less for example, less than about 60° to obtain good adhesion of the gelatin emulsion layers.

Our invention will be further illustrated in the following examples.

EXAMPLE 1

A photographic paper base weighing about 27 lbs./1,000 sq. ft. containing an aluminum stearate size and tub sized with an unhardened gelatin solution was passed under a corona discharge generated by a 6 kva. Lepel

high frequency generator, at about 3 rfa. (radio frequency amperes) and immediately thereafter extrusion coated, at the rate of about 600 feet per minute, with a titanium dioxide pigmented medium density polyethylene at an extrusion temperature of 580–630° F. The dry adhesion of the polyolefin, which was extruded at about 1½ lbs./1,000 sq. ft., or at approximately .3 mil, was found to be excellent whereas a control, which did not employ the corona discharge treatment of the paper substrate, was found to have very poor adhesion between the polyolefin and the paper.

The polyethylene later was treated with the corona to a contact angle of less than 76° and a photographic paper type of gelatin silver halide emulsion coated thereon. The adherence of the layers was good when dry and also during the processing of the paper through a conventional photographic process including alkaline developer solution, acid fixing solution and washing.

EXAMPLE 2

The procedure of Example 1 was followed except that the paper employed was a 27 lb./1,000 sq. ft. paper stock containing a rosin size, a small amount of titanium dioxide and calender sized with a solution of gelatin and formaldehyde. The dry adhesion of the polyethylene to the substrate employing the corona discharge treatment was found to be excellent, whereas a control, which did not employ the corona discharge, had very poor adhesion between the polyolefin coating and the paper.

The layers of the sensitized paper also adhered well dry and upon processing in the above photographic processing solutions.

EXAMPLE 3

The papers described in Examples 1 and 2 were electron bombarded by subjecting the paper for 2 minutes to the corona discharge generated by 3 Central Scientific Company high frequency Tesla Coils (Catalog No. 80721) having a Nichrome wire attached to each coil and allowing the wires to serve as electrodes. After subjecting the substrates to the corona discharge, the samples were fed immediately into the nip of an extrusion coater at a speed such that 2 lbs./1,000 sq. ft. of a titanium dioxide pigmented polyethylene was applied at 580–630° F. The adhesion of the polyethylene to the substrate was found to be excellent, whereas in a control which did not employ corona treatment of the paper substrate, the adhesion of the polyethylene to the paper was found to be very poor.

A gelatin silver halide emulsion was applied to the corona-treated surface of the pigmented polyethylene as described in Example 1 and the layers of the product were found to adhere well dry and when wet with the photographic processing solutions.

A similar polyethylene coating is extruded onto the paper base under the same conditions from a blend of high density polyethylene and a thermally degraded low density polyethylene in the mentioned range of density and melt index. The polyethylene does not adhere satisfactorily except when the paper has been previously bombarded.

EXAMPLE 4

A blend of a high density polyethylene and a thermally degraded low density polyethylene in the mentioned range of density and melt index is extruded onto a paper base such as described in Example 1 in the mentioned range of temperature and speed. The polyethylene does not adhere satisfactorily except when the paper has previously been bombarded with the corona discharge.

Accordingly, it is considered that such polyethylene blends in general cannot be extruded to obtain satisfactory dry and wet adherence to photographic paper base at about 100 to 1,500 f.p.m. and about 580–630° F. unless the paper has previously been bombarded.

EXAMPLE 5

A paper base was prepared as described in Example 1 except both sides of the paper base were bombarded and coated with polyethylene at about 590° F. and 200 f.p.m. in one pass down a machine provided with several bombardment stations and extrusion stations to obtain approximately 2 lbs. polyethylene/1,000 sq. ft. on each side of the paper. After sensitizing the polyethylene surface as described in Example 1, the dry and wet adhesion of all layers was found to be good.

The paper appears substantially as shown in cross-section in FIG. 1 wherein layer 10 represents the photographic paper base having corona-modified surfaces and polyethylene layers 11 adhered thereto and the photographic emulsion layer 12 adhered to one of the polyethylene surfaces.

EXAMPLE 6

A polyethylene-coated paper is prepared as described in Example 5 except substituting a crystalline polypropylene for the polyethylene and bombarding the polypropylene surface to a contact angle less than 54° before applying the photographic emulsion layer. The dry and wet adherence of the polypropylene to the paper and of the emulsion layers to the polypropylene is good.

EXAMPLE 7

A 40 lb./1,000 sq. ft. supercalendered paper base electron bombarded with the corona on each surface was coated with 7.5 lbs./1,000 sq. ft. of a medium density polyethylene, containing 10% titanium dioxide, by extrusion at 590° F. and 150 ft./min. on the face side and with 4.5 lbs./1,000 sq. ft. of a high density polyethylene containing no pigmentation by extrusion at 600° F. and 200 ft./min. on the wire side. A glossy chill roll was used on the face side to produce a glossy polyethylene surface. A matte chill roll was used on the wire side.

The polyethylene layer on the face side of the paper was bombarded to a contact angle less than 76° and thereafter red, green and blue light-sensitive gelatin silver halide emulsion layers containing respectively non-diffusing phenolic, pyrazolone and benzoyl acetanilide types of color couplers were coated upon the bombarded polyethylene surfaces. A yellow gelatin filter layer was interposed between the green and blue sensitive emulsion layers. The resulting paper is thus adapted to the production of subtractively colored images by the usual color development methods and appears substantially as shown in the cross-section in FIG. 2 of the drawings wherein layer 10 represents the photographic paper base, each surface of which has been modified with corona, and the polyethylene layers 11 coated thereon. On the corona-modified surface of one of layers 11 is adhered the red, green and blue-sensitive emulsion layers 12, 13 and 14 with the yellow filter layer 15 interposed between layers 13 and 14.

The dry adherence of the layers to the paper and to each other was very good. After exposure of the element to a color subject it was developed in a conventional alkaline photographic color developing solution containing a primary aromatic amino silver halide developing agent. Thereafter the silver image was bleached using an acid ferricyanide solution followed by fixing-out the silver salts with acid hypo solution followed by washing and drying in the usual manner. These processing steps are carried out by passing the paper through a series of tanks containing the solutions and over numerous rollers to the drying station. As a result, the wet adherence of the layers to the paper and to each other was found to be very good.

In preparing a color product such as described above, it may be desirable to apply medium density polyolefin to the face side of the paper, for example, about 5 to 12 lbs./1,000 sq. ft. and about 6 to 15 lbs. of high density polyolefin to the back of the paper, particularly to balance

the sheet for curl caused by sensitizing with the mentioned color emulsion layers.

EXAMPLE 8

A 27 lb./1,000 sq. ft. photographic paper base was bombarded as described in Example 1 at 6 kva. and 440 volts at output of 2.5 rfa., and high density polyethylene extruded on the paper at 200 f.p.m. and at temperatures of 560, 596 and 652° F. to obtain 10, 2 and 2 lbs. polyethylene/1,000 sq. ft. respectively. The adhesion of the polyethylene to the paper determined in a manner described above was good. However, coatings made under identical conditions on the same paper which had not been bombarded were found not to adhere satisfactorily. At the temperature of 652° F. fair dry adhesion of the polyethylene to the nonbombarded paper was obtained but when the paper was wet with aqueous photographic processing solutions, the adhesion was not considered to be satisfactory. Moreover, at this temperature decomposition of the polyethylene set in resulting in the formation of insoluble particles of polymer, carbon and the like in the melt which could be detected on the surface of the paper. Similar results are obtained at lower coating speeds of the order of 100 f.p.m. in absence of bombardment.

EXAMPLE 9

Photographic paper base both bombarded and not bombarded was coated with polyethylene as in Example 8, except at 615° F. and speeds of from 200 to 400 f.p.m. The polyethylene had good adhesion only to the paper which had been bombarded.

The same paper was coated with polyethylene at 630° F. and 200 to 600 f.p.m. to obtain good adhesion of the polyethylene only when the paper had been bombarded.

The same paper was coated with polyethylene at 640° F. and 200 to 900 f.p.m. with good adhesion obtained only with the paper which had been bombarded. FIG. 3 shows the unexpected result obtained by coating the polyethylene on the bombarded paper under these conditions. That is, as the speed was increased, the degree of adhesion increased sharply from about 220 to 360 grams force/in. in spite of the shorter time for the corona to activate the paper and for the hot polyethylene melt to penetrate the surface. The non-bombarded paper which had been coated with the polyethylene under the same conditions, that is, 640° F. and 200 to 900 f.p.m., did not possess satisfactory dry adherence of the polyethylene layer to the paper base. While it is less preferred to extrude polyethylene at temperatures much above 630° F. the difficulties encountered including tendency for the polyethylene to decompose can be overcome to a considerable extent by the incorporation of the mentioned antioxidants into the extrusion melt.

The invention has been described in considerable detail with particular reference to certain preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described hereinabove, and as defined in the appended claims.

We claim:

1. A process for preparing a photographic element which comprises modifying the surface of a smooth photographic paper base with a corona discharge, immediately extruding a thin layer of polyolefin onto the surface at a speed of about 200-900 f.p.m. and a temperature of from about 580-640° F. and coating a light-sensitive photographic emulsion layer on the polyolefin layer, the resulting adhesion of the polyolefin to the paper being sufficient to strongly resist separation of the polyolefin layer from the paper when the element is either dry or wet with photographic processing solutions.

2. The process of claim 1 wherein the surface of the polyolefin is also modified by a corona discharge to a contact angle of less than 76° and a light-sensitive gelatin

silver halide emulsion then coated upon the polyolefin surface.

3. The process of claim 1 wherein the polyolefin is polyethylene.

4. The process of claim 1 wherein the polyolefin is polypropylene.

5. The process of claim 1 wherein both surfaces of the paper are modified by corona discharge prior to extrusion of a thin layer of polyethylene onto each surface, modifying one of the polyethylene surfaces with corona discharge until a contact angle less than 76° is obtained and coating at least one gelatin silver halide emulsion layer onto the corona modified polyethylene surface.

6. The process of claim 5 wherein the corona modified polyethylene surface is coated with a plurality of differently sensitized gelatin silver halide emulsion layers adapted to the production of subtractively colored reproductions of a subject, the corona discharge modifications of the paper and polyethylene surface and conditions for coating the polyethylene layers on the paper, being such as to prevent separation of the emulsion layers from the polyethylene surface and separation of the polyethylene layers from the paper when the element is dry or wet with photographic processing solutions.

7. A photographic element comprising a smooth photographic paper base, at least one surface of the paper modified by corona discharge, a thin layer of polyolefin having been immediately extrusion adhered to the corona modified paper surface and a photographic emulsion layer adhered to the polyolefin surface, the resulting adhesion of the polyolefin to the paper surface being sufficient to strongly resist separation of the polyolefin from the paper when the element is dry or wet with aqueous photographic processing solutions.

8. The element of claim 7 wherein the surface of the polyolefin layer to which the emulsion layer is adhered comprises corona modified polyolefin.

9. The element of claim 7 wherein the polyolefin is polyethylene.

10. The element of claim 7 wherein the polyolefin layer is polyethylene which is adhered to corona modified surfaces of each side of the paper base and the photographic emulsion layer is adhered to the corona modified surface of one of the polyethylene layers.

11. The element of claim 10 wherein there is adhered to the corona modified polyethylene surface a plurality of differently sensitized gelatin silver halide emulsion layers adapted to the production of subtractively colored reproductions of a subject, the adhesion of emulsion layers to the polyethylene and the adhesion of the polyethylene layers to the paper being such as to prevent separation of the respective layers when the element is dry or wet with photographic processing solutions.

12. The element of claim 11 wherein the emulsion layers contain coupler compounds reactive with the oxidation product of a color developing agent to form a dye image in the emulsion layer.

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NORMAN G. TORCHIN, *Primary Examiner*.

R. H. SMITH, *Assistant Examiner*.