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(54) Title: METALLIZED FILM-PAPER

(57) Abstract

A metallized plastic film-coated paper laminate for use as a decorative and packaging wrap and for reflective insulation. The metallized laminate comprises a paper sheet base layer, a thermoplastic polymer film extruded onto a surface of the paper layer, and a thin metallic layer deposited onto the free surface of the plastic film so that the plastic film is sandwiched between the metallic layer and the paper sheet. The resulting laminate has high strength and metallic brilliance at very low basis paper weight and may be used as a decorative wrap either alone or with overprinted indicia or designs.

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METALLIZED FILM PAPER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to metallized paper and more particularly to metallized paper having a thermoplastic film sandwiched between the metallic layer and the paper.

2. Description of the Prior Art

The prior art discloses methods of depositing a metallic layer onto paper.

Direct metallization of paper in a high vacuum metallization chamber is known. However, direct metallization has been found to have significant disadvantages. Particularly when one of the more useful metals, such as aluminum, is used in direct metallization of paper, the resulting product has a dull gray lustre instead of the desired metallic appearance. Also in direct metallization of paper, the resulting product has very poor barrier properties; namely, the product tends to be porous and permeable to water vapor, oxygen, and other gases. It has also been found necessary to degas the paper prior to the high vacuum metallization in order to release gases and water vapor which have been absorbed into the paper and which would adversely affect the metallization process if not removed.

In view of these disadvantages in direct metallization of paper, improvements such as coating the paper sheet with a solvent-based polymer coating or aqueous dispersion of resinous polymer prior to the metallization step have been described in the prior art. For example, an aqueous dispersion of resinous polymer used to coat a paper sheet is discussed in U.S. Patent 3,113,888. The aqueous dispersion of polymer is claimed to enhance the brilliance of the metallized surface and eliminate the need for degassing prior to metallization. However, coating by aqueous or solvent dispersion of high polymer requires that the coating and/or drying steps be carried out at specific temperatures and under stringent process control, adding significantly to the cost of the finished product. A metallized laminate having high tensile strength cannot be manufactured effectively by aqueous or solvent-based coating

methods for thin paper; e.g. paper having a basis weight less than 28 g/m^2. Furthermore, in order to obtain a suitable degree of brightness on paper, it has been necessary to apply one or more coatings to the surface of the paper, to obtain a glossy, smooth, non-porous surface. While it is theoretically possible to apply these coatings on a paper machine at the papermill level, in practice, these coatings are generally applied as a separate coating operation, adding additional cost to this substrate. Further, it has been difficult to apply suitable coatings to very lightweight porous tissues, these light tissues being weak and difficult to run through multistage converting operations without breaking. Vacuum metallizing is most often a batch process, and a web break during the metallizing process will cause delay times of 15-60 minutes to repair the break and bring the chamber down to the desired vacuum.

Applicants have determined that the disadvantages of direct metallization of paper or of metallization of aqueous polymer dispersion or solvent-coated paper can be overcome by extruding a thermoplastic film onto a fibrous material such as tissue, paper or cardboard prior to the vacuum metallizing step. Although processes for extruding a thermoplastic film onto a paper sheet, per se, are known, a substrate composed of thermoplastic film extruded onto paper has not been used heretofore as a substrate for metallizing to produce a laminate product having the desirable physical characteristics which applicants have achieved.

The extrusion of thermoplastic film onto the paper sheet prior to metallization is believed to be more economical than the water-based polymer dispersion method described in U.S. Patent 3,113,888 and can be more readily controlled than conventional solvent or water-based polymer coating techniques.

The product of the present invention exhibits excellent resistance to moisture vapor transmission, resistance to oxygen, grease and oil absorption, and has been found to have exceptional qualities of metallic smoothness and gloss.

Surprisingly, the product of the present invention exhibits significantly improved bursting strength, tensile strength, and high metallic brilliance heretofore unachievable for tissue thin paper; e.g., for paper having a basis weight less than about 28 g/m^2 and is a low-cost substitute for paper foil laminates such as gift wrap, labels, food wraps, decorative trims, and reflective insulating.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a decorative wrapping product having a layer on one side and a smooth, glossy metallic appearance on the other side.

It is an important object of the present invention that the wrapping product exhibit improved bursting strength and tensile strength for a broad range of paper weights including very thin paper base layers.

It is a further object of the invention to provide a wrapping product that is flexible, yet strong, and which exhibits superior resistance to moisture vapor transmission, grease, oil and oxygen even for very thin paper base layers.

It has been determined that, when a thermoplastic material, preferably polyethylene or polypropylene, particularly low density polyethylene, is extruded onto one side of a paper sheet (base layer) thus forming a plastic paper substrate, the substrate may be exposed directly to conventional high vacuum metallization process to coat the exposed thermoplastic surface of the substrate with a thin metallic surface, preferably aluminum. The resulting product is a decorative wrap having a smooth, metallic lustre on one side and improved physical property characteristics.

Particularly the finished product exhibits the handling and flexibility of paper but yet has significantly improved bursting and tensile strength and a high metallic brilliance. The finished product also exhibits barrier properties; i.e., resistance to moisture vapor transmission, grease, and oxygen even for very thin paper base layers.

The significant increase in the bursting, tensile strengths and metallic brilliance achieved for a finished metallized paper product of very low basis weight was surprising and was not anticipated prior to applying the process of the invention.

The present invention thus results in a wrapping product which exhibits significantly improved strength and flexibility and high metallic brilliance for a broad range of thin paper thicknesses; e.g., for paper base layers typically between 17 g/m^2 and 32 g/m^2 basis weight including very thin

paper such as paper having a basis weight of less than about 28 g/m^2.

In the present invention, the reason for the high metallic brilliance achieved when depositing the metallic layer directly onto the exposed surface of the extruded plastic film is not fully understood. It is theorized that the high brilliance may be due to surface reaction occuring between the metal surface and the thin polymer film layer which may be enhancing the reflective properties of the film. Applicants also theorize that the surprising high metallic brilliance may be caused by microscopic craters or irregularities in the polymer surface which may result when using a highly polished chill roller after the extrusion step for very thin polymer layers, particularly between about 5.6 g/m^2 to 11 g/m^2. Development of such microscopic irregularities in the polymer surface when exposing very thin polymer layers to a highly polished chill roller followed by metallization was surprising. It is theorized that the irregularities in the polymer surface, contribute to the enhanced reflective properties of the polymer and consequently to that of the metallic layer thus markedly increasing the saleability of the product.

The product also exhibits barrier properties, such as resistance to moisture vapor transmission, oil, grease and oxygen absorption even at paper sheets having a basis weight as low as about 17 g/m^2 and for finished metallized products having a basis weight as low as 22.6 g/m^2.

The finished metallized product exhibits barrier properties at high, glossy metallic lustre and high tensile strength for paper sheets tissue thin; e.g., as low as even 17 g/m^2 basis weight paper. The process of the invention can also be practically utilized to achieve the above-enumerated desirable physical characteristics for heavier paper, for example, paper having a basis weight between about 17 g/m^2 to 50 g/m^2 and as high as 80 g/m^2 or even higher. The polymer film itself can have a basis weight as low as about 5.6 g/m^2 to 11 g/m^2 and up to 25 g/m^2 and the metallic layer about 5×10^{-2} g/m^2 when thin, lightweight paper of about 24 g/m^2 basis weight is used.

The base layer may be composed of fibrous material such as tissue, paper, cardboard or woven or nonwoven fabric. In addition to use as a gift wrap, the finished metallized product may be used as a packaging wrap or as a backing material, label or reflective insulator. The metallic layer may also be overprinted with indicia or designs or may be selectively removed to create such designs or indicia. The metallized product can also be laminated to heavier board or coated with pressure sensitive adhesive to form pressure sensitive labels.

The process of the invention has particular advantages over prior art methods as discussed in the foregoing description of the prior art. Furthermore, since thin lightweight paper can be used in applicants' process, an important additional advantage is realized in that more paper can be processed per batch run through conventional high vacuum metallizers resulting in increased productivity and considerable cost savings in time and labor. Also the use of very thin lightweight paper; e.g. basis weight as low as about 17 g/m^2 in addition to increasing productivity permits applicants to reduce material costs and realize additional savings in storage and shipping costs.

The present invention also has the advantage of not only obviating the need to apply solvent-based or aqueous dispersion coating to the paper prior to metallization but also a smooth, high metallic brilliance is obtained without application of a lacquer or other coating to the metallic surface after metallization as taught in conventional methods.

In sum, a finished wrapping or reflective insulator product having a high, metallic brilliance, excellent resistance to moisture, grease, oil and oxygen, and significantly improved bursting strength, tensile strength and flexibility surprisingly even for very thin tissue light paper, is achieved. The resulting product is an improved saleable product manufactured at considerable cost savings.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred metallized laminate sheet of the invention is comprised of a paper base layer sheet, a thermoplastic polymer film extruded onto the paper base layer, and a metallic layer deposited onto the free surface of the polymer film so that the polymer film is sandwiched between the metallic layer and the paper base layer. The base layer is preferably a paper or fibrous sheet but may also be of a woven or nonwoven fabric. The thermoplastic film preferably is polyethylene film, more preferably low density polyethylene film. Polypropylene film is also a preferred film but other extrudable thermoplastics are within the scope of the invention. For example, suitable thermoplastics may include polyolefins; vinyls such as polyvinyl chloride and polyvinylidene chloride; polyesters such as polyethylene terephthalate; styrenes such as polystyrene; and acrylates such as polymethylmethacrylate and nylon. The base layer may typically have a basis weight in the range between about 17 g/m^2 to 50 g/m^2 for thin to heavier weight paper or even cardboard having a basis weight of about 80 g/m^2 may be used. The base layer may have a basis weight of between about 17 to 32 g/m^2 for thin, light-weight paper. The polymer film may have a basis weight as low as about 5.6 g/m^2 to 11 g/m^2 and typically may be as high as about 25 g/m^2, and the metallic layer about 5×10^{-2} g/m^2 or having a resistance typically of about 2-4 ohm/cm^2.

In addition to use as a decorative wrapping paper, the product of the invention may be used as a packaging wrap, backing paper or to form labels or reflective sheets and rolls for insulation; for example, in building construction. The metallic layer may serve a number of functions. Principally, it has a decorative purpose, since it creates a brilliant metallic surface. Print coats may be applied to the surface of the metallic layer to enhance its printability, and the metallic layer may also be overprinted with indicia or designs. Alternatively, the metallic layer may be selectively removed in order to create such designs or indicia.

Test analysis of the physical property characteristics of the metallized laminate of the invention for a tissue thin paper base layer is presented in the example. As may be noted from inspection of the example, the metallized laminate exhibits significantly improved bursting strength, tensile strength and barrier properties and exhibits a high metallic brilliance.

The process of manufacture employs simply the steps of extruding the thermoplastic film uniformly onto a side of the paper base layer by use of conventional extrusion techniques to form a polymer film coated paper substrate; subjecting the polymer film coated paper substrate preferably to a chill rolling step employing highly polished chill rollers; and then passing the substrate to conventional high vacuum paper metallization equipment wherein a thin, metallic layer, preferably aluminum is deposited onto the free surface of the polymer film.

An example illustrative of the method of manufacture and physical property characteristics of the metallized laminate product is set forth as follows:

EXAMPLE I

A.M.G. bleached Kraft tissue having the following typical physical properties was used as the base layer:

Basis Weight:	21.4 g/m
Caliper:	1.3 mils
Tensile Strength:	
M.D. lbs./inch width (Machine Direction)	7
C.D. lbs./inch width (Cross Direction)	4
Moisture Vapor Transmission Rate	Negligible resistance to moisture vapor transmission

EXAMPLE I (CONTINUED)

Mullen Burst Strength lbs./In.^{2} (ASTM D774-67(1971))	7
Brightness (MgO = 100%)	Negligible

A polyethylene film was extruded onto this base layer tissue by use of extrusion coating methods for extruding a thermoplastic film onto a paper sheet to form a film coated paper substrate. The substrate was passed preferably through highly polished chrome chill rollers immediately after the extrusion of the film onto the paper sheet. The extruded polyethylene film layer had a basis weight of 5.8 g/m^2 and a density of 0.917 gm/cm^3 with a melt index of 12.0. The polyethylene-coated tissue was then subjected to a conventional high vacuum metallization, resulting in the deposition of enough aluminum to give a surface resistance of 2-4 ohms per square centimeter.

After completion of the metallizing step, the metallized laminate product had the following typical physical properties:

Basis Weight:	27.2 g/m^2
Caliper:	1.4 mils
Tensile Strength:	
M.D. lbs.inch width (Machine Direction)	8.4
C.D. lbs./inch width (Cross Direction)	6.2
Mullen Burst Strength lbs./In^2 (ASTM D 774-67 (1971)	9.0
Moisture Vapor Transmission Rate (Gms/100 In^2/24 hours)	2.8
Brightness: (MgO = 100%)	61.5%

Although a tissue thin paper base layer was used, the metallized laminate had the handling properties and flexibility of paper but yet significantly improved bursting strength and tensile strength for its low basis weight. The

metallized laminate also exhibited exceptionally high metallic brilliance. After the metallization step, the laminate product is suitable for use directly as a decorative or packaging wrap or as a reflective insulator. However, the laminate product may be subjected to additional processing wherein print coats, commonly available from ink manufacturers, may be applied to the surface of the aluminum to enhance its printability.

The metallized laminate can be subjected to other processing, depending on the desired end use; for example, the metallized product can be laminated to heavier board, or coated with pressure sensitive adhesive to form pressure sensitive labels.

While the present invention has been described with reference to specific preferred embodiments, it should be appreciated that variations are possible without departing from the scope of the invention. Therefore, the invention is not intended to be limited by the description in the specification but only by the language of the claims and equivalents thereof.

CLAIMS

1. A laminate comprising a base member,

a thermoplastic polymer layer extruded upon said base member, and

a metallized layer deposited upon the extruded thermoplastic polymer.

2. A laminate as defined in claim 1 wherein said thermoplastic polymer layer constitutes a single continuous film.

3. A laminate as defined in claim 2 wherein said polymer film has a basis weight in the range between about 5.6 g/m^2 and 25 g/m^2.

4. A laminate as defined in claim 1 wherein said polymer is polyethylene.

5. A laminate as defined in claim 4 wherein said polyethylene has a density less than high density polyethylene.

6. A laminate as defined in claim 1 wherein the thermoplastic polymer film is selected from the group consisting of polyethylene, polypropylene, polyvinylchloride, polyvinylidene chloride, polyethylene terephthalate, polystyrene, and polymethylmethacrylate.

7. A laminate as defined in claim 1 wherein the base member is a sheet having a basis weight of between about 17 g/m^2 to about 80 g/m^2.

8. A laminate as defined in claim 1 wherein the metallized layer is vapor deposited upon the extruded thermoplastic polymer.

9. A process of manufacturing the product of claim 1, comprising the steps of extruding a thermoplastic polymer layer upon a base member, and vapor depositing a metallized layer upon the thermoplastic polymer layer.

10. The process of claim 9 further including the step of impressing the thermoplastic polymer layer with a chilled roller before metallization.

INTERNATIONAL SEARCH REPORT

International Application No PCT/US82/00314

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

U.S. 428/31, 246, 285, 458, 461 427/250

IPC[3] B32B 15/02, 15/08

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
U.S.	428/31, 219, 246, 248, 285, 286, 342, 458, 461, 463; 427/250, 404, 411

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
X	US,A 3113888 Published 10 December 1963,	1-10
A	US,A 3887640 Published 3 June 1975, Diaz et al.	1-10

* Special categories of cited documents: [15]

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"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention

"X" document of particular relevance

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
28 June 1982	16 JUL 1982
International Searching Authority [1]	**Signature of Authorized Officer [20]**
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