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(54) **Paper-like polyester fiber printing sheet.**

(57) A paper-like polyester fiber sheet useful for printing comprises fine polyester staple fibers having a round cross-sectional profile with an average diameter of 1 to 20 μm and/or flat polyester staple fibers having a flat cross-sectional profile with an average minor axis length of 1 to 20 μm, and preferably, with a degree of flatness of 1/2 to 1/10. The resultant sheet has a weight of 25 to 80 g/m² and a bulk density of 0.40 to 0.70 g/cm³.

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PAPER-LIKE POLYESTER FIBER PRINTING SHEET

BACKGROUND OF THE INVENTION

(1) Title of the Invention

The present invention relates to a paper-like polyester fiber printing sheet. More particularly, the present invention relates to a paper-like polyester fiber printing sheet useful for commercial sheets, for example, labels and bar code sheets for commercial goods to be printed by a non-impact printer of an electrostatic recording machine, thermosensitive transcriber or ink-jetting or electrophotographic copying machine, for industrial sheets which are employed in industrial factories and may be brought into contact with water, oil or other liquids, and for other commercial sheets, for example, tickets and cards which are used in the open air, for example, for golf and skiing and are sometimes in contact with water or other liquids.

(2) Description of the Related Art

Japanese Unexamined Patent Publication Nos. 57-11209, 61-201099 and 61-282500 disclose paper-like synthetic fiber sheets comprising polyester staple fibers having a flat cross-sectional profile.

When conventional paper-like synthetic sheets which have been produced from synthetic polymer films are used for labels and bar code sheets for commercial goods and printed by a non-impact printer of a thermosensitive transcriber or electrophotographic copying machine, the following disadvantages have been found. That is, when the conventional printing sheet produced from the synthetic polymer film is printed or transcribed with ink or carbon toner, the printed ink or carbon toner images exhibit very slow rates of penetration into the sheet and a slow drying. If the printing operation is carried out at a high speed, sometimes the printed sheets are stained by not dry ink

or carbon toner. Accordingly, the conventional printing film sheet causes the printing procedure to exhibit a low productivity.

Also, when the labels or bar code sheets are produced by coating a conventional paper-like synthetic fiber sheet with a coating resin solution or emulsion by using a coating machine, a portion of the coating resin solution or emulsion permeates through the sheet from one side to the other side of the sheet. The permeated portion of the coating resin solution or emulsion stains a peripheral surface of a guide roll of the coating machine and thus causes an uneven coating. Also, a continuous coating operation over a long period of time becomes difficult or impossible and the resultant coated products exhibit an uneven and degraded quality.

The undesirable permeation of the coating resin solution or emulsion can be prevented by increasing the thickness or weight per unit area of the sheets. However, the thicker or weight-increased sheets exhibit an undesirably increased stiffness and resilience.

Therefore, when a label made of the weight-increased sheet and having a tacky adhesive layer is adhered onto a rough or curved surface of an article through the tacky adhesive layer, sometimes the adhered label tends to spontaneously peel from the surface of the article due to the increased resilience thereof. Also, the weight-increased sheet is costly.

Recently, there is a very strong demand for printing data, places of residence (addresses) and names on the sheet by using a high speed printing machine utilizing a laser beam and computer technology, at an extremely high speed of 10,000 lines/minute or more. However, almost none of the conventional paper sheets for labels, except for some types of synthetic polymer film sheets, are suitable for the high speed printing operation, because the high speed printing operation

produces a high temperature of about 200°C and the printing sheets are exposed to a high pressure.

It has been attempted to prepare paper-like printing sheets by coating nonwoven fiber sheets with a coating resin solution or emulsion. However, where the nonwoven fiber sheets have a weight of 80 g/m^2 or less, the coating resin solution emulsion permeates through the sheet from one side to the other side thereof and causes the same disadvantages as those mentioned above.

When the nonwoven fiber sheet is pressed by means of a calender to decrease the bulk density of the sheet, the undesirable permeation of the coating resin solution or emulsion can be decreased. However, the pressed sheet exhibits a disadvantage such that the coating resin solution or emulsion cannot penetrate into the sheet, and therefore flows on the surface of the sheet. This phenomenon is found especially on a synthetic hydrophobic fiber sheet, for example, polyester fiber sheet, but not on natural pulp paper sheets, rayon sheets, polyamide fiber sheets and polyvinyl alcohol fiber sheets.

In order to prevent the undesirable permeation and flowing on the surface phenomena, it has been attempted to carry out the coating operation at a very low coating speed of 10 m/min or less, or to precoat the surface of the sheet with a size. However, these attempts cause an decreased productivity, and thus are not desirable.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a paper-like polyester fiber printing sheet which is free from an undesirable permeation of coating resin solution or emulsion and from staining with printing ink or carbon toner.

Another object of the present invention is to provide a paper-like polyester fiber printing sheet suitable for a high speed printing operation.

The above-mentioned objects can be attained by the paper-like polyester fiber printing sheet of the present invention which comprises 25% to 100% by weight of at least one type of principal polyester staple fiber selected from the group consisting of fine polyester fibers having a round cross-sectional profile with an average diameter of 1 to 20 μm, and flat polyester staple fibers having a flat cross-sectional profile with an average minor axis length of 1 to 20 μm, and 0 to 75% by weight of additional polyester staple fibers, and which has a weight of 25 to 80 g/m^2 and a bulk density of 0.40 to 0.70 g/cm^3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The paper-like polyester fiber sheet of the present invention is suitable for printing and comprises 25% to 100% by weight of at least one type of principal polyester staple fiber selected from fine polyester staple fibers having a round cross-sectional profile with an average diameter of 1 to 20 μm, and flat polyester staple fibers having a flat cross-sectional profile with an average minor axis length of 1 to 20 μm, and 0 to 75% by weight of additional regular polyester staple fibers.

When the fine polyester staple fibers are used as the principal fibers, if the average cross-sectional diameter is more than 20 μm, the resultant sheet will have a decreased fiber density, and thus a low bulk density of less than 0.4 g/cm^3, and therefore, will exhibit an undesirable permeation of a coating resin solution or emulsion and/or a printing ink.

Also, the production of the fine polyester staple fibers having an average cross-sectional diameter of less than 1 μm is difficult and costly, and therefore, is not industrially advantageous.

The fine polyester staple fibers usable for the present invention preferably have a denier of from 0.01 to 2.0 and a length of 1.0 to 30.0 mm. If the fine

fibers have a length of less than 1.0 mm, a sheet may have an unsatisfactory mechanical strength. Also, if the length of the fine fibers is more than 30.0 mm, it becomes difficult to produce a paper-like sheet having a uniform quality by means of a wet nonwoven fabric-forming method, because the long staple fibers cannot be evenly dispersed in water.

The flat polyester staple fibers have a flat cross-sectional profile having an average minor axis length of 1 to 20 μm.

If the average minor axis length is less than 1 μm, the resultant paper-like sheet undesirably allows a coating resin solution or emulsion and printing ink to easily permeate through the sheet. Also, if the average minor axis length is more than 20 μm the resultant sheet exhibits a film-like appearance and a high stiffness.

The flat polyester staple fibers usable for the present invention preferably have a degree of flatness (D_2/D_1), i.e., a ratio of a length of minor axis (D_2) to a length of major axis (D_1) of the flat cross-sectional profile of the fibers, of from 1/2 to 1/10. The length of the minor axis (D_2) is equal to a diameter of an inscribed circle of the flat cross-sectional profile. The length of the major axis (D_1) is equal to a diameter of a circumcircle of the flat cross-sectional profile.

When the degree of flatness is more than 1/2, it may be difficult to provide a paper-like sheet having a satisfactory resistance to the permeation of the coating resin and printing ink. Also, a degree of flatness of less than 1/10 may result in the formation of paper-like sheet having a film-like appearance and a high stiffness.

The additional polyester staple fibers to be blended with the fine polyester fibers and/or the flat polyester fibers preferably have an average denier of 0.1 to 20 and a length of 1 to 30mm.

The principal polyester staple fibers are in a

content of 25% to 100% by weight. If the content of the principal polyester staple fibers is less than 25% by weight, the resultant sheet will exhibit an undesirably high permeability of the coating resin and the printing ink.

The paper-like sheet of the present invention must have a weight of 25 to 80 g/m^2, preferably, 30 to 60 g/m^2 and a bulk density of 0.40 to 0.70 g/cm^3, preferably, 0.45 to 0.65 g/cm^3.

A weight of less than 25 g/cm^2 will result in an undesirably increased permeability of the coating resin and printing ink through the resultant sheet. This increased permeability will cause the rollers in the coating machine to be stained with the permeated coating resin and the resultant sheet will have a decreased coating evenness. Therefore, it becomes difficult or impossible to continuously carry out the coating operation over a long period of time.

Also, a weight of more than 80 g/m^2 will cause the resultant sheet to exhibit an unsatisfactory softness and touch.

A bulk density of less than 0.40 g/cm^3 causes the resultant sheet to exhibit an undesirably increased permeability of the coating resin therethrough. Also, a bulk density of more than 0.70 g/cm^3 causes the resultant sheet to exhibit a poor penetration of a coating resin thereinto and, therefore, the coating resin applied to the sheet surface tends to flow on the surface. Due to the above-mentioned phenomenon, it is difficult to evenly coat the resultant sheet with the coating resin.

When the flat polyester staple fibers and the additional regular polyester staple fibers are used together, it is preferable to blend 45% to 70% by weight of the flat fibers with 30% to 55% by weight of the weight of the additional staple fibers.

The additional fibers preferably have a bire-

fringence of from 0.005 to 0.05.

The principal and additional polyester staple fibers respectively comprise, independently from each other, polyethylene terephthalate homopolymers and copolymers. The copolymer may contain 5-sodium sulfoisophthalate as a copolymerization component.

The paper-like sheet of the present invention can be produced from an aqueous dispersion of the principal polyester staple fibers or a blend of the principal polyester staple fibers with the additional polyester staple fibers by means of a wet paper-forming machine, for example, a cylinder, short net or wire paper-forming machine.

A paper-like sheet may be formed from a single layer of the staple fibers or two or more layers of the staple fibers may be laminated together.

The resultant sheet is pressed or calendered by means of a pair of calendering metal rolls or a combination of a calendering metal roll with a cotton roll. In this calendering process, the calendering metal rolls preferably have a temperature of 160°C to 235°C, more preferably, 200 to 230°C. Also, the calendering process is preferably carried out under a linear pressure of 5 to 100 kg/cm.

The weight of the sheet per unit can be adjusted to a desired level of between 25 and 80 g/m^2 by controlling the amount of fibers to be supplied from a head box to a paper-forming net of the paper-forming machine, and by regulating the speed of the paper-forming net.

The bulk density of the paper-like sheet can be adjusted to a desired level of between 0.40 and 0.70 g/cm^3 by controlling the calendering temperature, pressure, and speed.

The paper-like sheet of the present invention is advantageous in the following features.

(1) Although the sheet has a small weight of from 25 to 80 g/m^2, the sheet can prevent an undesirably

permeation of coating resin therethrough and an undesirable flow of the coating resin on the sheet surface.

(2) The above-mentioned feature (1) allows the coating procedure to be continuously carried out over a long period of time, and the resulted coated sheet exhibits an excellent evenness.

(3) The sheet has a smooth surface having excellent printing and writing properties.

(4) The sheet has a more appropriate softness than that of a conventional film-based sheet and can be coated with a greater amount of a coating resin than used for the conventional sheet. Therefore, the coating layer formed on the sheet can contain a greater amount of white pigment, for example, talc or titanium dioxide, than the conventional sheet. Accordingly, the sheet of the present invention has an enhanced opaqueness and covering-up property.

The present invention will be further illustrated by the following examples.

In the examples, the evenness of the coating resin layer formed on a surface of the sheet was evaluated in such a manner that a surface of a paper-like sheet specimen in A4 size was coated with an aqueous emulsion of a polyacrylic ester copolymer resin containing a white pigment (which resin was available under a trademark of BONLONS-480 and was made by Mitsui Toatsu Kagaku Co.) by using a knife coater, with which an excess amount of the coated resin was lightly removed. The amount of the coated resin emulsion was 80 g/m^2.

The coated sheet was vertically hung and dried with hot air at a temperature of 120°C for 2 minutes.

The evenness in distribution of the white pigment in the resultant coating layer was evaluated by the naked eye.

The resistance of the specimen to permeation of the white pigment-containing coating resin from one surface

to the opposite surface through the specimen was evaluated by observing the opposite surface of the specimen by the naked eye.

Examples 1 to 4 and Comparative Examples 1 and 2

Flat polyethylene terephthalate staple fibers (A) provided with a flat cross-sectional profile with a minor axis length of 2.5μm and a degree of flatness of 1/4 and having a denier of 2.5, a length of 5.0 mm, and a birefringence of 0.130, in an amount of 60 parts by weight and other flat polyethylene terephthalate staple fibers (B) provided with a minor axis length of 3.1μm and a degree of flatness of 1/4, and having a denier of 6.0, a length of 5.0 mm, and a birefringence of 0.008, in an amount of 40 parts by weight, were dispersed in water. The resultant aqueous fiber slurry was subjected to a wet paper-forming procedure by means of a cylinder paper-forming machine.

A web having a dry weight of 60 g/m^2 was obtained. The web was calendered at a temperature of 225°C under a linear pressure of between 5 to 50 kg/cm by using a metal roll / cotton roll type calender to provide a sheet having the weight, thickness, and bulk density as shown in Table 1.

The resultant sheet was subjected to the coating resin-permeating test and coating resin evenness test. The results are shown in Table 1.

Table 1

Example No.		Weight (g/m^2)	Thickness (mm)	Bulk density (g/cm^3)	Evenness of coating layer	Resistance to coating resin permeation
Example	1	60	0.140	0.43	Good	Good
	2	"	0.180	0.51	Good	Good
	3	"	0.100	0.60	Good	Good
	4	"	0.091	0.66	Good	Good
Comparative Example	1	"	0.170	0.35	Good	Bad
	2	"	0.078	0.77	Bad	Good

Comparative Examples 3 to 6

The same procedures as those described in Example 1 were carried out except that the sheet was made of 60 parts by weight of regular polyethylene terephthalate staple fibers (C) having a round regular cross-sectional profile, a diameter of 15.8μm (a denier of 2.5), a length of 5.0 mm, and a birefringence of 0.134 and 40 parts by weight of regular polyethylene terephthalate staple fibers (D) having a round regular cross-sectional profile, a diameter of 24.5 (a denier of 6.0), a length of 5.0 mm, and a birefringence of 0.010, and the resultant sheet had a weight of 62 g/m^2.

The results are shown in Table 2.

Table 2

Example No.		Weight (g/m^2)	Thickness (mm)	Bulk density (g/cm^3)	Evenness of coating layer	Resistance to coating resin permeation
Comparative Example	3	62	0.160	0.40	Good	Bad
	4	"	0.130	0.55	Good	Bad
	5	"	0.083	0.75	Slightly bad	Bad
	6	"	0.068	0.91	Bad	Bad

Examples 5 and 6 and Comparative Example 7

The same procedures as those described in Example 1 were carried out except that the sheet was made of the same principal flat fibers as the fibers (A) described in Example 1, the same additional regular fibers as the fibers (C) described in Comparative Example 3, and the same additional regular fibers as the fibers (D) described in Comparative Example 3 in the amounts as shown in Table 3, and the resultant sheet had the weight of about 50 g/m^2 as shown in Table 1.

The results of the tests are shown in Table 3.

Table 3

Example No.		Composition			Weight (g/m^2)	Thickness (mm)	Bulk density (g/cm^3)	Evenness of coating layer	Resistance to coating resin permeation
		Principal flat fiber (A)	Additional regular fiber (C)	Additional regular fiber (D)					
Example	5	40	20	40	53	0.083	0.64	Good	Good
	6	60	10	30	51	0.075	0.68	Good	Good
Comparative Example	7	20	40	40	50	0.082	0.61	Good	Bad

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Examples 7 to 10 and Comparative Examples 8 and 9

The same procedures as those described in Example 1 were carried out except that the sheet was made of 60 parts by weight of principal fine polyethylene terephthalate staple fibers (E) having a round regular cross-sectional profile, a diameter of 7.1μm (0.5 denier), a length of 5.0 mm, and a birefringence of 0.133, and 40 parts by weight of other principal fine polyethylene terephthalate staple fibers (F) provided with a round regular cross-sectional profile and having a diameter of 10.5μm (1.1 denier), a length of 5.0 mm, and a birefringence of 0.008, and the weight of the sheet was 62 g/m^2.

The results of the tests are shown in Table 4.

Table 4

Example No.		Weight (g/m^2)	Thickness (mm)	Bulk density (g/cm^3)	Evenness of coating layer	Resistance to coating resin permeation
Example	7	62	0.143	0.43	Good	Good
	8	"	0.120	0.52	Good	Good
	9	"	0.100	0.62	Good	Good
	10	"	0.092	0.67	Good	Good
Comparative Example	8	"	0.171	0.36	Good	Bad
	9	"	0.079	0.78	Bad	Good

Comparative Examples 10 to 12

The same procedures as those described in Example 7 were carried out except that the principal fibers (E) and (F) were replaced by other polyethylene terephthalate staple fibers provided with a round regular cross-sectional profile and having a diameter of 15.8μm (2.5 denier), a length of 5.0 and a birefringence of 0.134.

The results are shown in Table 5.

Table 5

Example No.		Weight (g/m^2)	Thickness (mm)	Bulk density (g/cm^3)	Evenness of coating layer	Resistance to coating resin permeation
Comparative Example	10	62	0.147	0.42	Good	Bad
	11	"	0.125	0.50	Good	Bad
	12	"	0.085	0.73	Bad	Bad

Examples 11 and 12 and Comparative Example 13

The same procedures as those described in Example 7 were carried out except that the sheet was made of 65 parts by weight of staple fibers consisting of a polyethylene terephthalate copolymer containing 2.6 molar % of 5-sodium sulfoisophthalate, provided with a round regular cross-sectional profile and having a diameter of 12.2μm (1.5 denier), a length of 5.0 mm, and a birefringence of 0.130 and 35 parts by weight of the staple fibers (F), and the weight of the resultant sheet was 50 g/m^2.

The results are shown in Table 6.

Table 6

Example No.		Weight (g/m^2)	Thickness (mm)	Bulk density (g/cm^3)	Evenness of coating layer	Resistance to coating resin permeation
Example	11	50	0.104	0.48	Good	Good
	12	"	0.086	0.58	Good	Good
Comparative Example	13	"	0.065	0.77	Bad	Good

CLAIMS

1. A paper-like polyester fiber printing sheet comprising 25% to 100% by weight of at least one type of principal polyester staple fibers selected from the group consisting of fine polyester staple fibers having a round cross-sectional profile with an average diameter of 1 to 20 μm and flat polyester staple fibers having a flat cross-sectional profile with an average minor axis length of 1 to 20 μm, and 0 to 75% by weight of additional polyester staple fibers, which sheet has a weight of 25 to 80 g/m^2 and a bulk density of 0.40 to 0.70 g/cm^3.

2. The paper-like sheet as claimed in claim 1, which consists of said fine polyester staple fibers alone.

3. The paper-like sheet as claimed in claim 1, which consists of 45% to 70% by weight of the flat polyester staple fibers and 30% to 55% by weight of the regular polyester staple fibers.

4. The paper-like sheet as claimed in claim 1, wherein the fine polyester staple fibers have a denier of 0.01 to 2.0 and a length of 1.0 to 30.0 mm.

5. The paper-like sheet as claimed in claim 1, wherein the flat polyester staple fibers have an average degree of flatness of 1/2 to 1/10 and a length of 1.0 to 30.0mm.

6. The paper-like sheet as claimed in claim 1, wherein the additional polyester staple fibers have a denier of from 0.1 to 20 and a length of 1.0 to 30mm.

7. The paper-like sheet as claimed in claim 1, wherein the additional polyester staple fibers have a birefringence of from 0.005 to 0.05.

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EUROPEAN SEARCH REPORT

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EP 87 10 3161

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	GB-A-2 106 148 (SONY CORP.) * Page 4, lines 81-98 *	1	D 21 H 5/20 B 41 M 1/36
A	US-A-3 223 581 (E. SOMMER et al.) * Figures 1,3; example 2 *	1,2,4, 5	
A	ABSTRACT BULLETIN OF THE INSTITUTE OF PAPER CHEMISTRY, vol. 56, no. 9, March 1986, page 1136, abstract no. 10349, Appleton, Wisconsin, US; & JP-A-38 193/85 (KURARAY CO.) 27-02-1985 * Whole abstract *	1,2	
A	EP-A-0 043 555 (TEIJIN LTD)		TECHNICAL FIELDS SEARCHED (Int. Cl.4) B 41 M D 21 H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26-05-1987	NESTBY K.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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