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(54) **Heat bonded paper.**

(57) This invention relates to a heat bonded paper web comprising cellulosic fibres, synthetic thermoplastic fibres and a resinous additive. It has been found that the tear strength, tensile strength and stretch properties of the heat bonded web are improved by adding a resinous additive to the paper before heat bonding. Paper according to the invention is particularly suitable for base paper for book binding.

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Heat Bonded Paper

This invention relates to heat-bonded paper webs made from a blend of natural cellulosic fibres and synthetic thermoplastic fibres.

Paper webs have traditionally been formed from cellulosic fibres derived from various materials of vegetable origin, for example woodpulp. Where it is desirable for the web to be susceptible to heat treatment, it has been proposed to incorporate a proportion of synthetic thermoplastic fibres in the web. Originally, chopped staple fibres were proposed for this purpose. However, such fibres are unfibrillated and incapable of hydrogen bonding, and thus they are inherently unsuited to the production of strong paper webs. With the exception of one or two speciality products therefore, the inclusion of chopped staple fibres in paper webs has not been widespread.

In recent years, so-called synthetic woodpulp fibres have become available. These fibres are produced specially for use in papermaking, and have a gross morphology (i.e. length: diameter ratio) and diameter of the same order of magnitude as cellulosic papermaking fibres derived from woodpulp. They also resemble cellulosic fibres in being fibrillated to a considerable extent, and they thus permit stronger webs to be obtained than is the case with chopped staple fibres. Examples of commercially-available synthetic woodpulps are "SWP" supplied by Crown Zellerbach, "Pulpex" supplied by Solvay, and "Ferlosa" supplied by Montedison, all of which are polyethylenic. Fibres of other polyolefins may be used.

Although synthetic woodpulp fibres produce reasonably strong paper webs when blended with cellulosic fibres, it is frequently desirable to heat the web after it has been made

to soften the thermoplastic material and thus to enhance the strength of the web by increasing the extent of inter-fibre bonding.

It has now surprisingly been found that the tear strength, tensile strength and stretch properties of a heat-bonded paper web made from a blend of cellulose fibres and synthetic thermoplastic fibres may be considerably enhanced by including a resinous additive in the paper web before heat bonding.

According to the invention therefore, there is provided a heat-bonded paper web comprising cellulosic fibres and synthetic thermoplastic fibres characterised in that the web also contains a resinous additive.

The resinous additive may be a synthetic or a natural material. An example of a suitable natural resin is rosin. Suitable synthetic resins include materials sold as wet-strength resins for paper, for example aminoplast resins such as melamine formaldehyde resin and urea formaldehyde resin. Melamine formaldehyde resin is particularly preferred (in this specification, the expression "resin" comprehends not only polymers having a large number of repeating units, but also so-called prepolymers or pre-condensates which have only a relatively small number of repeating units). Other materials which may be used include polyamine resins, such as epichlorohydrin-modified polyamine or polyamidepolyamine resins, polyethylene imine resins, and the resins sold as "Kymene" by Hercules Powder Company and "Nopcobond" by Diamond Shamrock Corporation.

The amount of resinous additive to be used is of the order of a few per cent, based on the total weight of the paper. Above a certain % addition, the improvement in properties after heat bonding levels off. For melamine formaldehyde resin, optimum results are achieved with additions of at least 2%.

The relative proportions of cellulosic and synthetic thermoplastic fibres in the web may vary widely. Enhanced properties are obtained for example at 25%, 50% and 75% synthetic contents. Preferably however, the amount of synthetic fibres is from about 30% to about 50% based on the total fibre content. The type of cellulosic pulp used is not critical.. Bleached or unbleached softwood or hardwood kraft pulps may for example be used.

In the case of a cross-linkable resin, such as a cross-linkable melamine-formaldehyde resin, a pre-heating step may be carried out to cure the resin before heat bonding at a higher temperature is carried out.

The resinous additive may be incorporated in the web by methods normally used in the paper industry for the inclusion of additives. Beater addition is preferred.

The furnish should be relatively free-beaten if it is desired to achieve an especially stretchable product.

Heat bonding may be carried out by conventional techniques such as passage round a heated roller or passage through a heating tunnel.

The present invention is applicable to the manufacture of products for a range of uses, but is particularly suited to the manufacture of base paper for bookbinding. Such paper needs to have good tear strength and tensile strength, and to be capable of stretching to a considerable degree. It is also desirable that it should be capable of easily accepting an emboss, for example a simulated leather emboss. Such papers are conventionally made from latex containing wholly cellulosic webs. The present invention thus makes it possible to dispense with the need to incorporate latex into the paper-making furnish or with the need for a separate saturation step.

The invention will now be illustrated by the following examples, in which all percentages are by weight, and the synthetic fibres in every case were polyolefin fibres:-

EXAMPLE 1

Four sets of laboratory handsheets of substance 100 g/m^2 were prepared using a 50% woodpulp - 50% synthetic furnish (the woodpulp was a bleached softwood kraft pulp). One set contained no additives, the second a 2% Kymene resin addition, the third a 2% melamine formaldehyde addition, and the fourth a 2% rosin addition. The melamine formaldehyde and rosin additions were made in the presence of alum. The tear strength, tensile strength and stretch properties were then determined. The sheets were then heat-bonded in a laboratory oven for a period of 3 minutes at a temperature of 160°C. The tear strength, tensile strength and % stretch properties were then re-measured. The mean results are set out in Table 1 below:-

TABLE 1

Property Measured	No additives		2% Kymene		2% MF + alum		2% rosin + alum	
	Unbonded (U)	Bonded (B)	U	B	U	B	U	B
Tear Strength (mN)	255	960	285	1020	390	1470	270	1230
Tensile Strength (N/15 mm)	6.4	19.5	6.5	24.0	8.5	32.5	6.0	23.5
Stretch (%)	0.8	5.2	1.0	11.0	1.4	15.0	1.0	9.8

It will be seen that in each case, the properties obtained with resinous additives in the sheet are considerably better than those obtained in the absence of additives.

EXAMPLE 2

This demonstrates the effect of different levels of melamine formaldehyde addition. 100 g/m^2 handsheets were made by the procedure generally described in Example 1, and the results obtained are set out in Table 2 below:-

TABLE 2

Property Measured	No additives		1% MF		2% MF		3% MF		4% MF		5% MF	
	Unbonded (U)	Bonded (B)	U	B	U	B	U	B	U	B	U	B
Tear Strength (mN)	180	780	210	1215	225	1410	225	1530	255	1460	255	1490
Tensile Strength (N/15mm)	5.0	17.5	5.0	24.5	6.0	27.0	6.0	30.5	6.0	31.0	6.0	32.5
Stretch (%)	1.0	4.9	1.2	12.5	1.5	14.2	1.2	15.4	1.3	15.0	1.2	15.0

It will be seen that whilst a 3% melamine formaldehyde addition produces the most significant enhancement in the properties measured, above 2% addition there is little further effect.

EXAMPLE 3

This demonstrates that the melamine formaldehyde additive may be pre-heated to cure the resin before heat bonding treatment is carried out. The procedure involved taking some of the 2% MF handsheets prepared for Example 2 above and stoving them in an oven at 105°C for ten minutes before carrying out the three minute heat-treatment at 160°C.

The results obtained were as follows:-

Tear Strength	1320 mN
Tensile Strength	25.0 N/15 mm
% Stretch	13.6

It will be seen that although these results are marginally worse than obtained with a 2% MF addition without stoving, they represent a significant improvement on the values obtained without any additive.

EXAMPLE 4

This illustrates the effect of changing the relative proportions of cellulosic and synthetic fibres in the sheet. 100 g/m^2 handsheets containing 3% MF were prepared from furnishes containing 75%, 50%, 25% and 0% synthetic fibres. The sheets were heat bonded in a laboratory oven at 160°C for 3 minutes, and the tear strength, tensile strength and % stretch properties were measured. The results for the bonded sheets are as shown in Table 4 below:-

TABLE 4

Property Measured	75% Synthetic		50% Synthetic		25% Synthetic		0% Synthetic	
	No MF	MF	No MF	MF	No MF	MF	No MF	MF
Tear Strength (mN)	840	1230	960	1490	870	1350	890	900
Tensile Strength (N/15 mm)	23.0	30.0	19.5	30.0	18.0	21.0	12.0	12.0
Stretch (%)	3.2	8.0	5.2	15.0	4.5	10.2	2.4	2.5

It will be seen that the greatest improvement in properties occurred with a 50% synthetic content.

Claims

1. A heat-bonded paper web comprising cellulosic fibres and synthetic thermoplastic fibres characterised in that the web also contains a resinous additive.

2. Paper as claimed in claim 1, characterised in that the synthetic thermoplastic fibres are present in an amount of from 30 to 50% of the total fibre content.

3. Paper as claimed in claim 1 or 2, characterised in that the resinous additive is rosin.

4. Paper as claimed in claim 1 or 2, characterised in that the resinous additive is a wet strength resin.

5. Paper as claimed in claim 1 or 2, characterised in that the resinous additive is a polyamine resin.

6. Paper as claimed in claim 1 or 2, characterised in that the resinous additive is a polyamide-polyamine resin.

7. Paper as claimed in claim 1 or 2, characterised in that the resinous additive is a polyethylene-imine resin.

8. Paper as claimed in claim 1 or 2, characterised in that the resinous additive is an aminoplast resin.

9. Paper as claimed in claim 8, characterised in that the aminoplast resin is a melamine-formaldehyde resin.

10. Paper as claimed in claim 9, characterised in that the melamine-formaldehyde resin is present in an amount of at least 2% of the total weight of the paper.

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EUROPEAN SEARCH REPORT

Application number EP 79 30 2579

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	US - A - 3 669 829 (C. CALDO et al.) * Column 1, lines 35-75; column 2; column 3, first paragraph; examples 4-9 *	1,2,4, 5	D 21 H 5/00 C 08 J 5/00
	GB - A - 1 423 967 (LES PAPETERIES DE GENVAL) * Page 1, line 77 to page 3, line 16; example 1 *	1-3	TECHNICAL FIELDS SEARCHED (Int.Cl. 3)
	DE - A - 2 358 506 (MITSUBISHI PAPER MILLS) * Claims 1-3; pages 2-5; examples 1-9 *	1,2	D 21 H 1/48 5/00

CATEGORY OF CITED DOCUMENTS

- X: particularly relevant
- A: technological background
- O: non-written disclosure
- P: intermediate document
- T: theory or principle underlying the invention
- E: conflicting application
- D: document cited in the application
- L: citation for other reasons
- &: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	13-02-1980	NESTBY