(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 306 484 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.05.2003 Bulletin 2003/18

(51) Int Cl.[7]: **D21H 17/07**

(21) Application number: **02257231.7**

(22) Date of filing: **17.10.2002**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SK TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **25.10.2001 GB 0125605**

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(54) Tracing paper

(57) A process for modifying natural tracing paper to reduce its susceptibility to cracking on folding comprises the step of treating the paper with an aqueous urea solution of a concentration of at least 40% by weight, preferably about 50% by weight. The treatment is preferably carried out at the size press or bath of the paper machine on which the tracing paper is produced. The urea solution may also contain a surface sizing agent. The resulting treated tracing paper is particularly suitable for the production of envelopes, or packaging for luxury products.

EP 1 306 484 A2

Description

[0001] This invention relates to natural tracing paper suitable for conversion into envelopes or other products for which folding is required, for example packaging for luxury items (hereafter referred to as "luxury packaging").

[0002] Natural tracing paper derives its translucency primarily from the unusually high degree of refining given to the cellulose pulp fibres from which it is made. This results in a sheet without the air/fibre interfaces which give most papers their opacity. Natural tracing paper should not be confused with "prepared" tracing paper (also known as "vellum") which is rendered translucent by impregnation with an oil or other transparentising chemical.

[0003] Natural tracing paper is dense and hard compared with most other papers. As a result, it is brittle and prone to cracking if it is folded or crumpled, unlike, for example, bond paper as used in photocopiers. Cracking, and consequent loss of strength, is particularly apparent if a hard fold is made across the grain of the tracing paper sheet, and the effect becomes worse with increasing grammage.

[0004] Traditionally, natural tracing paper has been used in flat sheet form in engineering and architectural drawing offices, where folding is not practised. The problem of cracking therefore does not arise in these applications. However, there is now an increasing demand for tracing paper in the manufacture of envelopes, luxury packaging or other products in which unusual visual or tactile effects are required. Production of such products requires the paper to be folded both with and across the grain of the paper, i.e. in the machine and cross directions. The cracking and weakening which results is a significant problem.

[0005] It is an object of the present invention to eliminate or alleviate the problem just described.

[0006] Since the cause of the problem is believed to be the inherent brittleness of tracing paper, it might be thought that the use of paper softening agents as used in, for example, tissue paper manufacture, would provide a solution. Such softening agents are proprietary compositions, the exact chemical nature of which is not divulged by their manufacturers. In general they appear to be based on cationic surfactants, with quaternary ammonium compounds or fatty acid esters as active ingredients, depending on the manufacturer. In use, they are added to a suspension of paper-making fibres, and their effect appears to be to disrupt or reduce bonding between adjoining fibres. As a result the fibres are somewhat more free to move in relation to each other than if the softening agent were not present. This is not conducive to the generation of translucency, which requires a very high degree of inter-fibre bonding. As the addition level of softening agent increases, so does the loss of translucency, and an unacceptable level of sheet opacity results well before there is any noticeable softening effect. Consequently, softening agents of this general kind cannot be satisfactorily used in the manufacture of natural tracing paper.

[0007] Softening agents of the kind used in regenerated cellulose film might also be considered for use in tracing paper, in view of their proven affinity or compatibility with cellulose. Such softening agents include glycerol, propylene glycol and di-, tri- and poly-ethylene glycols. We evaluated all of these materials, and also monoethylene glycol and sorbitol, but none were satisfactory.

[0008] We have now found that treatment of natural tracing paper with a strong aqueous urea solution results in (a) improved folding endurance (b) greater resistance to tearing (c) greater stretch ability under tensile loading before a break occurs (d) reduced tensile strength and (e) reduced stiffness. Taken together, these changes markedly reduce the "rattle" of the paper, modify its tactile characteristics and improve its suitability for use in envelope manufacture. By a "strong" aqueous urea solution, we mean a solution of a concentration of at least 40% by weight, preferably around 50% by weight.

[0009] Much lower concentration solutions of urea than just referred to, namely from around 2 to 9% by weight solutions, have in the past been used in commercial production of tracing paper at our Chartham Paper Mill, Kent, England. The patent literature also contains a number of disclosures of the inclusion of urea in tracing paper.

[0010] Japanese Patent Publication No. 45-38729 discloses introduction of solutions of guanidine, urea, thiourea or certain derivatives thereof into tracing paper in the wet state to provide improved tearing strength. In a specific Example, use of a 20% solution of guanidine hydrochloride is disclosed.

[0011] Russian (USSR) Patent No. 239028 discloses the use of a solution containing a mixture of 85% gelatine and 15% urea (v/v) for surface treatment of a dry tracing paper intended for use as a base for light-sensitive diazo paper. The treatment is intended to increase the elasticity and transparency of the paper.

[0012] Russian (USSR) Patent No. 1231094 discloses treatment of tracing paper with a solution of a mixture of carboxymethyl cellulose (CMC) and urea to improve product quality and reduce product cost (as a result of savings in the amount of pulp used) . The CMC is present in an amount of from 50-62.6% by weight, with the amount of urea being, correspondingly, from 37.4-50% by weight.

[0013] According to a first aspect of the invention, there is provided a process for modifying natural tracing paper to reduce its susceptibility to cracking on folding, wherein the paper is treated with an aqueous urea solution of a concentration of at least about 40% by weight, preferably about 50% by weight.

[0014] In a second aspect, the invention resides in natural tracing paper containing urea introduced by a process according to said first aspect of the invention.

[0015] In a third aspect, the present invention resides in the use, for the purpose of reducing the susceptibility of natural tracing paper to cracking on folding, of an aqueous urea solution of a concentration of at least about 40% by weight, preferably about 50% by weight.

[0016] In a fourth aspect, the invention resides in envelopes, luxury packaging or other folded products produced from natural tracing paper according to said second aspect of the invention.

[0017] The urea treatment is conveniently carried out at the size press or bath of the paper machine on which the tracing paper is produced. The treating solution may contain other ingredients besides urea, for example a surface sizing agent of the kind compatible with and conventionally used in natural tracing paper manufacture. Typically, the surface sizing agent is present in the solution in an amount of about 0.5%$^{w}/_{w}$, based on weight of sizing agent as supplied, i.e. as an aqueous composition of about 20% solids content.

[0018] Natural tracing paper is manufactured at many different grammages. Papers within the range 110-115 gm^{-2}, and specifically ca. 112 gm^{-2} are probably the most widely manufactured. Typical properties for such natural tracing papers both according to the present invention (i.e treated with a 50% urea solution) and an otherwise similar untreated paper are shown in Table 1 below:

Table 1

Property		Urea-treated Paper	Untreated Paper
Tear Strength (mN)(Tappi T414)	MD	430 - 510	360 - 430
	CD	500 - 800	390 - 470
MIT Fold (-) (Tappi T511)	MD	3500 - 5500	1100 - 2200
	CD	1400 - 3000	700 - 1600
Stretch (%) (Tappi T494)	MD	6 - 9	4.5 - 6.5
	CD	9 - 13	5 - 7
Tensile Strength (N/15mm)(Tappi T494)	MD	100 - 130	115 - 145
	CD	50 - 70	65 - 85
Stiffness (mN 15°/10mm) (ISO 2493:1992)	MD	70 - 90	95 - 115
	CD	40 - 60	60 - 70
Burst (kPa) (Tappi T403)		340 - 460	370 - 510
Opacity (Contrast Ratio) (Tappi T425)		27 - 30	27 - 30
MD = Machine Direction CD = Cross Direction The standard Test Methods used are indicated in brackets.			

[0019] In evaluating the data presented in Table 1, it should be borne in mind that because the treated paper contains a proportion of urea, its fibre content will be less than that of untreated paper of the same grammage. However, the effect of urea treatment on the properties listed, particularly fold, was much more than would be expected to occur just as a result of the fibre content change.

[0020] The invention will now be illustrated by the following Examples, in which all parts and percentages are by weight unless otherwise stated, and in which an asterisk (*) indicates a trade mark.

Example 1

[0021] A range of aqueous treating solutions was applied to sheets of ca.90gm^{-2} water leaf (unsized) natural tracing paper by means of a laboratory size press. The sheets had been cut from paper produced on a full-scale Fourdrinier papermachine. The wet pick-up was of the order of 20-25% in each case. The active ingredient of the treating solutions were as follows:

- glycerol
- propylene glycol
- monoethylene glycol

- diethylene glycol
- triethylene glycol
- polyethylene glycol -(200 grade, approximate M.Wt of 200, supplied by Fisher Chemicals, Loughborough, UK.)
- polyethylene glycol -(400 grade, approximate M.Wt of 400, supplier as above)
- sorbitol
- urea

[0022] The propylene glycol, diethylene glycol and 200 grade polyethylene glycol were used as commercially supplied, i.e. with no dilution. The glycerol, monoethylene glycol and 400 grade polyethylene glycol were all diluted with an equal volume of water. Sorbitol and urea were each used at a range of different concentrations, namely 12.5%, 25% and 50% in the case of sorbitol and 20%, 40% and 50% in the case of urea.

[0023] After treatment, the sheets were dried by clamping in handsheet rings, in order to ensure that the dried sheets were flat. Discs of paper were cut from the dried sheets and were evaluated on a paired comparison basis by holding them vertically from one edge and shaking.

[0024] Treatment with the strongest urea solution (50%) was found to produce a marked effect on the floppiness of the sheet, i.e. the least "rattle". The 40% urea solution had a lesser, but still noticeably beneficial effect, but the 20% urea solution produced only a marginal improvements. The other treating solutions showed no worthwhile effect.

Example 2

[0025] A trial reel of ca. 112 gm^{-2} natural tracing paper was manufactured in conventional manner on a Fourdrinier paper machine, except that a 50% urea solution was used in the size bath. Initially, i.e. at the start of the reel, no surface sizing agent was present. Part-way through manufacture of the trial reel a styrene copolymer sizing agent as conventionally used in the manufacture of natural tracing paper was introduced into the size bath solution at a concentration (after equilibration) of 0.5% (based on sizing agent as supplied at ca. 20% solids content). The properties of the resulting paper were determined, both in relation to the unsized paper produced at the start of the reel and the sized paper from the end of the reel. The test methods used were as detailed in Table 1 and the results are set out in Tables 2a and 2b respectively. These also include corresponding data from standard production reels made immediately before and after the trial reel respectively.

Table 2a (Unsized

Property (Units)	Urea-treated Paper		Untreated Paper
Tear Strength (mN)	MD	443	411
	CD	521	427
MIT Fold (-)	MD	3742	1072
	CD	1503	981
Stretch (%)	MD	7.0	4.9
	CD	9.6	5.0
Tensile Strength (N/15mm)	MD	109.9	129.1
	CD	55.7	71.4
Stiffness (mN 15°/10mm)	MD	89.2	107.2
	CD	51.8	65.0
Burst (kPa)		428	419
Opacity (Contrast Ratio)		28.6	28.8
MD = Machine Direction CD = Cross Direction			

Table 2b (Sized)

Property (Units)	Urea-treated Paper		Untreated Paper
Tear Strength (mN)	MD	475	419
	CD	701	435
MIT Fold (-)	MD	5106	1351
	CD	2128	1659
Stretch (%)	MD	8.2	6.2
	CD	11.5	6.9
Tensile Strength (N/15mm)	MD	114.0	133.5
	CD	55.1	67.0
Stiffness (mN 15°/10mm)	MD	81.8	105.2
	CD	52.0	60.5
Burst (kPa)		402	446
Opacity (Contrast Ratio)		28.1	29.5
MD = Machine Direction CD = Cross Direction			

[0026] It will be seen that MIT fold, tear strength and stretch values were all significantly increased by urea treatment, whereas tensile strength, stiffness and burst values were reduced. As with the data presented in Table 1 above, the effects were all much more than would be expected to occur as a result of the lesser fibre content of the treated paper compared with untreated paper of the same overall grammage. Opacity, and therefore translucency, was substantially unaffected.

[0027] When the urea treated paper was subjected to hard folding, in both the machine and cross directions, it was observed to show markedly less cracking and weakening than the otherwise similar untreated papers produced before and after the trial.

Claims

1. A process for modifying natural tracing paper to reduce its susceptibility to cracking on folding, wherein the paper is treated with an aqueous urea solution of a concentration of at least 40% by weight.

2. A process as claimed in claim 1, wherein the concentration of the aqueous urea solution is about 50% by weight.

3. A process as claimed in claim 1 or claim 2, wherein the urea treatment is carried out at the size press or bath of the paper machine on which the tracing paper is produced.

4. A process as claimed in any preceding claim wherein the urea solution also contains a surface sizing agent.

5. Natural tracing paper containing urea introduced by a process as claimed in any preceding claim.

6. The use, for the purpose of reducing the susceptibility of natural tracing paper to cracking on folding, of a strong aqueous urea solution of a concentration of at least 40% by weight.

7. The use as claimed in claim 6, wherein the concentration of the aqueous urea solution is about 50% by weight.

8. Folded products produced from natural tracing paper as claimed in claim 5.