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(54) **Flexible starch bound non-asbestos paper.**

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EP 0 053 897 B1

Description

This invention relates to starch-bound paper, and provides non-asbestos alternatives to starch-bound asbestos papers.

Starch-bound asbestos papers contain asbestos fibres as the predominant raw material, these fibres being bound together with small amounts of hydrolysed starch to provide the necessary strength and flexibility. Such papers find use for a variety of purposes, e.g. as high temperature flexible insulation in electrical equipment. They are commonly made in the form of flexible sheet of thickness 0.1—1.5 mm on conventional paper-making machines such as the Fourdrinier. In the process, an aqueous slurry of the ingredients which are to compose the product is progressively dewatered as a layer on a water-permeable conveyor (usually of wire mesh), the dewatered layer being subsequently compressed and dried.

Our British Patent Application 2 031 043A published April 1980 discloses a non-asbestos product which comprises a matrix of unfired ball clay containing glassy inorganic reinforcement and organic web-forming fibres and which contains hydrolysed starch as complementary binder. However, although that product is made on paper-making machinery, it is a board having a flexural strength of the order of 4 MPa ie inflexible compared to paper, and the function of the starch in it is to enable the board to be remoulded when wetted with water.

EP—A—027 705 (priority: 19.10.79; date of filing: 09.10.80; date of publication: 29.04.81) describes non-asbestos sheet material comprising a matrix of unfired ball clay which is reinforced by vitreous fibres derived from wool-form material and by organic web-forming fibres, the whole being bound together by hydrolysed starch; said sheet material being made by dewatering on a water-permeable conveyor a layer of aqueous slurry of unfired ball clay, wool-form vitreous fibres, organic web-forming fibres and hydrolysed starch, and compressing and drying the dewatered layer; said aqueous slurry containing, by weight of solids content,

ball clay	45—70%
vitreous fibres	20—40%
organic web-forming fibres	3—15%
hydrolysed starch	2—6%

the organic web-forming fibres in said slurry having a freeness in the range 60—90° Schopper-Riegler; the sheet material being of thickness 0.1—1.5 mm and of flexibility such that a specimen thereof measuring 50 mm×230 mm, with the 230 mm side parallel to the grain of the material, shows no evidence of breaking when bent through 180° around a mandrel of 50 mm diameter, with the use of just enough force to keep the specimen in contact with the mandrel.

We have now found that useful alternatives to the non-asbestos flexible sheet material of EP—A—027 705 can be made by substituting for the vitreous fibres (which are, of course, silicate material) particles of the silicate mineral mica or the silicate mineral chlorite, with the proviso that at least 75% by weight of those particles should pass through a sieve of aperture 250 μm. Additionally, the aqueous slurry employed should have its solids content of ball clay in the range 30—60% by weight; and the solids content of the silicate mineral in the slurry should be in the range 25—55% by weight.

In the product of the present invention (referred to in the rest of the description as 'paper'), the ball clay provides a flexible cohesive matrix. Ball clay is a fine-grained, highly plastic, mainly kaolinitic sedimentary clay. (The terms 'kaolinitic' and 'kaolinite' are mineralogical ones, indicating chemical composition and chemical structure; they are not to be confused with their term 'kaolin', used to denote a highly refractory clay which approaches the mineral kaolinite in chemical composition and structure but which—by contrast with ball clay—is hardly plastic at all). Various types of ball clay have varying proportions of kaolinite, micaceous material, and quartz, with small amounts of organic matter and other minerals. Ball clays are used mainly in the manufacturing of pottery and refractories, in admixture with other clays (such as the kaolin mentioned earlier) to impart plasticity to them and to increase the green strength of the unfired ware.

The function of the organic web-forming fibres is primarily to enable the paper to be formed on conventional paper making machinery, but additionally those fibres impart strength to the ball clay matrix of the finished paper, just as the mineral mica or chlorite (the primary reinforcement) does. The organic web-forming fibres are preferably cellulose fibres, but may alternatively be polyethylene or polypropylene fibres of the kind commercially available under the name "Pulpex".

Mica and chlorite are non-fibrous charged-layer-silicate minerals. The structure of mica is well known. The chlorites have structures containing infinite two-dimensional ions of opposite electrical charge, the negatively charged layers having compositions ranging from

$$[Mg_3(AlSi_3O_{10})(OH)_2]^-$$

to

$$[Mg_2Al(Al_2Si_2O_{10})(OH_2)]^-,$$

the positively charged layers having the composition

$$[Mg_2Al(OH)_6]^+.$$

Such non-fibrous charged-layer-silicate minerals are to be distinguished from non-fibrous layer silicate minerals such as kaolinite, talc and pyrophyllite, where the infinite 2-dimensional layers (e.g.

$$Al_2(OH)_4Si_2O_5$$

in kaolinite) are uncharged.

The hydrolysed starch is preferably a farina starch. The paper may also contain a small proportion, suitably in the range of 1—10%, of rayon fibres, to impart green strength to the sheet material between the dewatering and drying operations, and also to impart additional strength to the finished paper.

The density of the paper will ordinarily be in the range 700—1100 kg/m^3, its tensile strength at least 3 MPa and its burst strength at least 40 KPa.

The papers of the invention may be impregnated with other materials, such as resins, to give special properties for particular purposes. They may have surface coatings e.g. of shellac varnish or synthetic resin applied to them. They may also be given a backing e.g. of manilla paper, to increase mechanical strength, especially tensile strength, when that is required in the wrapping of conductors and the like, and they may be incorporated in double or multiple layer constructions with glass threads between adjacent paper layers to give particularly high strength, as when wrapping cables.

The invention is further illustrated by the following Example.

Example

A. Preparation of stock

(i) Lapponia pulp (bleached softwood sulphate pulp) in sheet form was made into an aqueous slurry of solids content about 3% by weight and treated in a disc refiner until its freeness value was 90° Schopper Riegler.

(ii) The pulp of (1) (500 g. dry weight=16.7 kg wet weight) was added to 90 litres of water in a mixing tank, and the diluted pulp was agitated vigorously for 1 minute. There were then added, with vigorous stirring: silicate mineral (mica or chlorite), at least 75% by weight of which passes through a sieve of aperture 250 μm; ball clay (90% passing a sieve of aperture 5 μm); rayon fibre (3 denier; chopped to 3—8 mm fibre length); farina starch (5% aqueous solution, prepared by heating at 100°C for 5—10 minutes); in proportions such that the solids content of the resulting slurry was made up of 46% silicate mineral, 5% cellulose fibres, 40% unfired ball clay, 5% rayon fibres and 4% hydrolysed starch.

(iii) The slurry of (ii) was diluted to 1—3% solids content.

B. Preparation of paper

The stock (slurry) of A above was made into flexible sheet material in an entirely conventional way on a Fourdrinier flat wire paper machine, such as is described in chapters 10 and 11 of "Paper and Board Manufacture" by Julius Grant, James H. Young, and Barry G. Watson (Publishers: Technical Division, the British Paper and Board Industry Federation, London, 1978). The slurry is progressively dewatered as it travels on the water-permeable conveyor of the machine, and the dewatered material is consolidated by pressing between rollers, and then dried to low moisture content (suitably 2% by weight). The properties of the paper thus obtained were:—

Thickness	0.25 mm
Density	940 kg/m^3
Mass per unit area ('substance')	235 g/m^2
Tensile strength in machine direction	4.61 MPa
across machine	3.55 MPa
Burst strength	73.4 KPa
Ignition Loss	18.1%
Flexibility Test	passed

To pass the flexibility test referred to, a specimen of paper (50 mm×230 mm, with the 230 mm side parallel to the grain) should show no evidence of breaking when bent through 180°C around a mandrel of 50 mm diameter, with use of just enough force to keep the specimen in contact with the mandrel.

Claims

1. Non-asbestos flexible sheet material of thickness 0.1—1.5 mm comprising a matrix of unfired ball clay which is reinforced by silicate material and by organic web-forming fibres, the whole being bound together by hydrolysed starch; said sheet material being made by dewatering on a water-permeable conveyor a layer of aqueous slurry, and compressing and drying the dewatered layer; said aqueous slurry containing, by weight of solids content,

ball clay	up to 60%
silicate material	not less than 25%
organic web-forming fibres	3—15%
hydrolysed starch	2—6%

the organic web-forming fibres in said slurry having a freeness in the range 60—90° Schopper-Riegler; the sheet material being of flexibility such that a specimen thereof measuring 50 mmx230 mm, with the 230 mm side parallel to the grain of the material, shows no evidence of breaking when bent through 180° around a mandrel of 50 mm diameter, with the use of just enough force to keep the specimen in contact with the mandrel; characterised in that said silicate material consists of particles of the mineral mica or chlorite, at least 75% by weight of which pass a seive of aperture 250 μm, the particles forming not more than 55% by weight of the solids content of said slurry and the ball clay forming not less than 30% by weight of the solids content of said slurry.

2. Non-asbestos sheet material according to claim 1, in which the organic web-forming fibres are cellulose fibres.

3. Non-asbestos sheet material according to claim 1 or 2, which includes rayon fibres as additional reinforcement.

4. Non-asbestos sheet material according to claim 3, in which the content of rayon fibres is 1—10% by weight.

Revendications

1. Matière en feuille flexible sans amiante d'épaisseur de 0,1 à 1,5 mm comprenant une matrice d'argile figuline non cuite qui est renforcée per une matière silicatée et par des fibres organiques formant tissu, le tout étant lié par de l'amidon hydrolysé; ladite matière en feuille étant fabriquée en essorant sur un transporteur perméable à l'eau une couche de suspension aqueuse, et en comprimant et séchant la couche essorée; ladite suspension aqueuse ayant pour teneur en poids en solides

argile figuline	jusqu'à 60%
matière silicatée	pas moins de 25%
fibres organiques formant tissu	3 à 15%
amidon hydrolysè	2 à 6%

les fibres organiques formant tissu de ladite suspension ayant un indice de raffinage compris entre 60 et 90° Schopper-Riegler; la matière en feuilles étant d'une souplesse telle qu'un spécimen de cette matière mesurant 50x230 mm, le côté de 230 mm étant parallèle au grain de la matière, ne présente aucun signe de rupture lorsqu'on le ploie à 180° autour d'un mandrin de 50 mm de diamètre, avec juste assez de force pour maintenir le spécimen en contact avec le mandrin; caractérisée en ce que ladite matière silicatée est composée de particules du minéral mica ou chlorite, dont au moins 75% en poids passent au tamis d'ouverture de 250 μm, les particules ne formant pas plus de 55% en poids de la teneur en solides de ladite suspension et l'argile figuline ne formant pas moins de 30% en poids de la teneur en solides de ladite suspension.

2. Matière en feuille sans amiante selon la revendication 1, caractérisée en ce que les fibres organiques formant tissue sont des fibres cellulosiques.

3. Matière en feuille sans amiante selon la revendication 1 ou 2, caractérisée en ce qu'elle comporte des fibres de rayonne en tant que renforcement supplémentaire.

4. Matière en feuille sans amiante selon la revendication 3, caractérisée en ce que la teneur en fibres de rayonne est de 1 à 10% en poids.

Patentansprüche

1. Biegsames Nichtasbest-Bahnmaterial mit einer Dicke von 0,1 bis 1,5 mm aus einer Matrix aus einem nichtgebrannten plastischen Ton, der durch ein Silikatmaterial und durch organische bahnbildende Fasern verstärkt ist, wobei das ganze durch hydrolysierte Stärke miteinander verbunden ist, und wobei das Bahnmaterial hergestellt wird durch Entwässern einer Schicht aus einer wäßrigen Aufschlämming auf einer wasserdurchlässigen Fördereinrichtung sowie durch Verpressen und Trocknen der entwässerten Schicht, und wobei die wäßrige Aufschlämmung, bezogen auf das Gewicht des Feststoffgehalts, folgende Bestandteile enthält

plastischer Ton	bis zu 60%
Silikatmaterial	nicht weniger als 25%
organische bahnbildende Faser	3 bis 15%
hydrolysierte Stärke	2 bis 6%

wobei die organischen bahnbildenden Fasern in der Aufschlämmung ein Mahlgrad zwischen 60 und 90° Schopper-Riegler besitzen, das Bahnmaterial eine solche Flexibilität besitzt, daß eine Probe davon mit einer Abmessung von 50x230 mm, wobei die 230 mm-Seite parallel zu dem Korn des Materials verläuft, keine Anzeichen eines Brechens aufweist, wenn sie um 180° un einen Dorn mit einem Durchmesser

von 50 mm gebogen wird, wobei gerade soviel Kraft angewendet wird, un die Probe in Kontakt mit dem Dorn zu halten, dadurch gekennzeichnet, daß das Silikatmaterial aus Teilchen des Minerals Glimmer oder Chlorit besteht, wobei wenigstens 75 Gew.-% durch ein Sieb mit einer Öffnung von 250 μm hindurchgehen, die Teilchen nicht mehr als 55 Gew.-% des Feststoffgehalts der Aufschlämmung ausmachen und der plastiche Ton zu nicht weniger als 30 Gew.-% des Feststoffgehalts der Aufschlämmung beiträgt.

2. Nichtasbest-Bahnmaterial gemäß Anspruch 1, dadurch gekennzeichnet, daß die organischen bahnbildenden Fasern aus Zellulosefasern bestehen.

3. Nichtasbest-Bahnmaterial nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß sie Reyon-Fasern als zusätzliche Verstärkung enthalten.

4. Nichtasbest-Bahnmaterial nach Anspruch 3, dadurch gekennzeichnet, daß der Gehalt an Reyon-Fasern 1 bis 10 Gew.-% beträgt.