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(54) Non-asbestos paper.

(57) Non-asbestos alternatives to asbestos papers comprise a matrix of unfired ball clay which is reinforced by organic web-forming fibres such as cellulose and by either:

(i) vitreous fibres derived from wool-form material
or
(ii) fine particles of a non-fibrous charged-layer-silicate mineral such as mica

the whole being bound together by a binder which consists essentially of a synthetic resin of the acrylic or polyvinyl acetate variety.

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Non-Asbestos Paper

This invention provides non-asbestos alternatives to asbestos papers.

Asbestos papers contain asbestos fibres as the predominant raw material, these fibres being bound together with small amounts of hydrolysed starch, acrylic resin, or polyvinyl acetate 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.

The present invention provides non-asbestos flexible sheet material which has flexibility and toughness such that it is specially suited to conversion to corrugated form, suitable for use as thermally insulating material for pipes, domestic hot water boilers and the like.

According to the invention, non-asbestos flexible sheet material of thickness 0.1-1.5 mm. comprises a matrix of unfired ball clay which is reinforced by organic web-forming fibres and by either

(i) vitreous fibres derived from wool-form material, or

(ii) fine particles of a non-fibrous charged-layer-silicate mineral

the whole being bound together by a binder which consists essentially of a synthetic resin, said resin being of the acrylic or polyvinyl acetate variety; said flexible sheet material being made by dewatering on a water-permeable conveyor a layer of aqueous slurry of unfired ball clay, organic web-forming fibres, and either (i) vitreous fibres derived from wool-form material or (ii) fine particles of a non-fibrous charged-layer-silicate mineral, said slurry containing a synthetic resin of the acrylic or polyvinyl acetate variety; and compressing and drying the dewatered layer; said aqueous slurry containing, by weight of solids content,

ball clay	30 - 60%
organic web forming fibres	3 - 15%
vitreous fibres or silicate mineral particles	20 - 40%
synthetic resin binder	25 - 55%
	2 - 10%

Our British Patent Application 2 031 043A published April 1980 discloses a non-asbestos product which comprises a matrix of unfired ball clay containing 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, i.e. inflexible compared to

paper, and the function of the starch in it is to enable the board to be remoulded when wetted with water.

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 the 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 manufacture 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 do the vitreous fibres derived from wool-form material or the non-fibrous charged-layer-silicate mineral (the primary reinforcement). The organic web-forming fibres are preferably cellulose fibres, but may alternatively be polyethylene or polypropylene fibres of the kind commercally available under the name PULPEX. In the preparation of the aqueous slurry to be dewatered, the web-forming fibres are employed at a freeness of 60-90° Schopper-Riegler.

If vitreous fibres derived from wool-form material provide the primary reinforcement, the material may be mineral wool or glass wool. If glass wool is used, it is preferably employed in a form which has been treated with a silane coupling agent (e.g. gamma-aminopropyl triethoxysilane). Preferably, the wool-form vitreous fibre material employed has fibres which are predominantly in the range 0.25-5mm in length.

If fine particles of a non-fibrous charged-layer-silicate mineral are used as primary reinforcement, the particles should be capable of passing a sieve of aperture 250 μm. Preferably at least 75% by weight of the particulate non-fibrous charged-layer-silicate mineral present should meet this specification.

The non-fibrous charged-layer-silicate mineral employed is preferably a mica or a chlorite. 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.

As already stated, the binder employed consists essentially of a synthetic resin, said resin being of the acrylic or polyvinyl acetate variety.

Suitable acrylic resins are available in the form of

synthetic polymeric latices consisting of a fine suspension in water of a copolymer based on an acrylic ester as the principal monomer.

Suitable polyvinyl acetate resins are also available as synthetic resin emulsions consisting of a fine suspension in water of a polymer based on vinyl acetate.

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 within the range 700-1100 kg/m^3, its tensile strength at least 3 MPa and its burst strength at least 40 KPa. The paper can be corrugated in a corrugating machine of standard construction, and withstands very well the stresses imposed by passage between the corrugating rollers of the machine.

The invention is further illustrated by the following Examples.

EXAMPLE 1

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 (i) (500 g. dry weight = 16.7 kg. wet weight) was added to 90 ltres of water in a mixing tank, and the diluted pulp was agitated vigorously for 1 minute. There were then added, with vigorous stirring:

mineral wool free from 'shot', ie. free from granular vitreous material; filament length 0.25-5mm

ball clay (90% passing a sieve of aperture 5 µm)

rayon fibre (3 denier; chopped to 3-8 mm. fibre length)

acrylic latex (commercially available anionic emulsion of a self-crosslinking acrylic copolymer: pH 4; particle size 0.2 µm; 45.5% solids content; film curing at 120°C or below) diluted with 10 times its volume of water

papermakers' alum to reduce the pH to 4/4.5

in proportions such that the solids content of the resulting slurry was made up of 30% vitreous fibres derived from mineral wool, 5% cellulose fibres, 56% unfired ball clay, 3% rayon fibres and 6% acrylic resin.

(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 is 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 Frederation, 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 finished paper can at once or later be submitted to a corrugating process as described, for example, in Chapter 24 (page 262ff) of "Paper - Its Merchanting and Usage", Editor S. Carter Gilmour (publ. The National Association of Paper Merchants, with Longmans, Green & Co.).

Example 2

A. Preparation of Stock

As in Example 1, except that under (ii), the acrylic latex is replaced by:-

polyvinyl acetate emulsion (viscosity at 25°C, 10-18 poise; pH 4-4.5; stabilised with polyvinyl alcohol; solids content 53%) diluted with 10 times its volume of water; polyvinyl acetate content of slurry (ii) was 6% by weight.

B. Preparation of Paper

As in Example 1.

Example 3

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 (i) (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:

non-fibrous charged-layer 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 3-8mm. fibre length)

acrylic latex (particle size 0.2 μm; 45.5% solids content) diluted with 10 times its volume of water

papermakers' alum to reduce the pH to 4/4.5

in proportions such that the solids content of the resulting slurry was made up of 46% non-fibrous charged-layer-silicate mineral, 5% cellulose fibres, 40% unfired ball clay, 3% rayon fibres and 6% acrylic resin.

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

B. Preparation of Paper

As in Example 1

Example 4

A. Preparation of Stock

As in Example 3, except that under (ii), the acrylic latex is replaced by:-

polyvinyl acetate emulsion (53% solids content) diluted with 10 times its volume of water

B. Preparation of Paper

As in Example 1.

CLAIMS:-

1. Non-asbestos flexible sheet material of thickness 0.1-1.5mm comprising a matrix of unfired ball clay which is reinforced by organic web-forming fibres and by either

(i) vitreous fibres derived from wool-form material, or

(ii) fine particles of a non-fibrous charged-layer-silicate mineral

the whole being bound together by a binder which consists essentially of a synthetic resin, said resin being of the acrylic or polyvinyl acetate variety; said flexible sheet material being made by dewatering on a water-permeable conveyor a layer of aqueous slurry of unfired ball clay, organic web-forming fibres, and either (i) vitreous fibres derived from wool-form material or (ii) fine particles of non-fibrous charged- layer-silicate mineral, said slurry containing a synthetic resin of the acrylic or polyvinyl acetate variety; and compressing and drying the dewatered layer; said aqueous slurry containing, by weight of solids content,

ball clay	30-60%
organic web-forming fibres	3-15%
vitreous fibres	20-40%
or	
silicate mineral particles	25-55%
synthetic resin binder	2-10%

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

3. Flexible sheet material according to claim 1 or 2, made from a slurry which includes rayon fibres as additional reinforcement for the sheet material.

4. Flexible sheet material according to claim 3, in which the content of rayon fibres in the slurry is 1 to 10% by weight of slurry solids.

5. Flexible sheet material according to any preceding claim, in which the organic web-forming fibres present in the slurry have a freeness of 60-90° Schopper-Riegler.

European Patent Office

EUROPEAN SEARCH REPORT

0055033
Application number
EP 81 30 5598

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
Y	WO - A - 80/01576 (HOLLINGSWORTH & VOSE) * Entire document *	1-3
PY	EP - A - 0 027 705 (TURNER & NEWALL) * Entire document *	1-5
DY	GB - A - 2 031 043 (TURNER & NEWALL) * Entire document *	1,2

CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

D 21 H 5/00//
C 04 B 43/00

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

C 04 B
D 21 H

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same category
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	05-03-1982	NESTBY

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