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WATER-SOLUBLE PAPER AND METHOD OF MAKING IT

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The essential process in the manufacture of paper is the felting of the fibres, which are necessary for the formation of the paper, in the shaking screen machine, leading to the formation of a fibrous mass which is no longer soluble in water. Paper, even when it is unsized, for example filter or blotting paper, is therefore insoluble in water. It is true that the paper fibres will swell and that the wet strength of the paper is lower than the dry strength, but the fibre bond remains stable, so that any wet paper can be dried and its original strength thus more or less restored.

If the paper is additionally sized, as for example with writing paper, the material has great resistance to water and is stable and relatively unchanged even after remaining in contact with water for hours.

A paper which disintegrates into its component parts in water cannot therefore be produced by the normal papermaking method, as the felting of the paper fibres results in a bond which is stable even in water.

It has now been found that a paper which in water disintegrates into its individual components can be produced by impregnating with a suitable water-soluble and film-forming substance fibres which have been united to form a loose fibre fleece, for example by means of carding machines or flat cards or by means of a Rando-Webb machine, thereupon drying them and forming the resulting material, if desired after re-wetting, into a paper-like product by calendering.

Natural and synthetic fibres, such as cotton, linen, hemp, ramie, wool, viscose staple fibre, acetate staple fibre, Perlon, nylon, Trevira, polyvinyl alcohol fibres or alginate fibres, are suitable for this process.

Water-soluble, film-forming substances may be used as binders, such as for example methyl cellulose, cellulose glycolates, polyacrylic acid and acrylates, polymerisation products on a basis of vinyl pyrrolidone, polycarboxylic acids, water-soluble urea formaldehyde condensation products, decomposed glues, water-soluble starch products, dextrins, and sugars; alkali, ammonium, and triethanolamine alginates; carrageen moss solutions, alkali caseinates, or waterglass (alkali metal silicate). The amount of the water-soluble film-forming binder to be incorporated in the fibrous structure is preferably 40%–100% of the weight of the fibres.

Known fillers, such as kaolin, chalk, talcum, gypsum, magnesite, pearl white, lithopone, titanium dioxide, kieselguhr, microcellulose, asbestos, and if desired emollients or hygroscopic media, such as glycerine, glycols, polyglcols, and urea, and if desired water-soluble dyestuffs may be added to these binders and the loose fibre fleece may be impregnated with an aqueous mixture on any of the well-known machines, e.g. a screen saturator, and dried. The concentration of said aqueous mixture depends upon the type of the employed machine. Generally, the aqueous mixture should contain 5 to 50% of said film-forming binders and fillers. Those skilled in the art will find out the preferable concentration for a specific case without difficulties. The amount of the fillers and emollients which may be added preferably amounts to 60%–200% of the weight of the dry fibers. The resulting intermediate product, after first being wetted

to a moisture content of 3 to 10%, is smoothed by hot rolls with increasing pressure to form the desired paper-like end product. The surface temperature of the heated rolls should lie between 50° and 200° C.; the handle and the smoothness of the finished material depends on the pressure and the temperature of the rolls.

Thus it is possible to produce papers, which in water disintegrate into their constituents. The weight of such paper is about 40 grams per square metre for carbon copy paper, 80 grams per square metre for writing papers, and 120 to 150 grams per square metre for book papers or the like. These papers can be written on normally with ink, ball point pen, or pencil, or used to make the normal number of carbon copies in the typewriter, and can just as easily be used for stencil duplicating. When the above mentioned papers are contacted with water, the binder material will be dissolved, thus releasing the individual fibres from the sheet and leaving a soft pulpy mass. This procedure takes only a few minutes. But even before the paper sheet has fully disintegrated, the writing on said paper becomes undecipherable immediately when subjecting it to the action of hot or cold water. Not only single sheets of paper, but even documents or books in which many sheets of this type are superimposed may be made undecipherable in this way.

The novel paper products are especially suitable for military purposes. So, radio operators no longer have to burn each sheet after reception and decoding of a cable. It is enough to destroy the text written on the novel paper products by dipping it into water.

The novel paper products are also suitable for the production of log books for battle ships and submarines. If such naval units should sink in shallow enemy coastal water, it is impossible for enemy divers to rescue and decipher the log books which may contain secret matter.

The invention will now be described with reference to the following typical examples in which the proportions given are by weight.

Example 1

A matted fibre fleece composed of 100% staple fibres with a weight of 24 grams per square metre is impregnated with an aqueous mixture containing:

30 parts of cellulose glycolate,
20 parts of maize dextrine,
15 parts of chalk,
15 parts of kaolin,
40 parts of gypsum,
1 part of wetting agent.

The intermediate product obtained after impregnating on a screen saturator and drying, with a weight of about 80 grams per square metre, is smoothed, after wetting to a moisture content of about 5%, on a heated calender at about 175° C., and cut. A smooth, strong writing paper is obtained, which swells on cold water in a few minutes and, after dissolution of the fibre bond, leaves behind a mixture of insoluble fibres.

Example 2

A carded fleece of 50% staple fibres and 50% polyamide fibres, with a weight of 60 grams per square metre, is impregnated with an aqueous mixture containing:

50 parts of polyacrylate,
10 parts of urea,
20 parts of gypsum,
10 parts of pearl white,
10 parts of talcum,
1 part of wetting agent.

After impregnation and drying an intermediate product with a weight of 150 grams per square metre is obtained,

which is wetted and calendered with increasing pressure at about 150° C., and thereupon cut. If the resulting paper is soaked in water, it breaks up into its fibrous constituents.

Example 3

A longitudinally directed carded fleece, consisting of 25% polyamide fibres, 25% acetate staple fibres, 20% ramie, 30% cotton, with a weight of 16 grams per square metre, is impregnated with an aqueous mixture containing:

33 parts of water-soluble starch,
5 parts of polyglycol,
15 parts of microcellulose,
20 parts of titanium dioxide,
20 parts of gypsum,
6 parts of lithopone,
1 part of wetting agent.

The impregnated and dried first stuff with a weight of about 40 grams per square metre is calendered, after wetting, with a roll temperature of about 100° C. This thinner paper disintegrates into its constituents after a very short time in water.

I claim:

1. In a method of producing a writing paper which in water disintegrates into its individual components, the steps of impregnating a fleece of cardable textile fibres with an aqueous dispersion containing a water-insoluble filler material and a water-soluble film-forming binder in such amounts as to incorporate said binder material in an amount of 40 to 200 percent, based upon the weight of the dry fibre fleece, drying the thus resulting structure, re-wetting said dry structure to a moisture content of about 3 to 10 percent and smoothing it on a heated calender at a temperature between 50 and 150° C.

2. A writing paper which in water disintegrates into its individual components consisting of cardable textile fibres being bonded together with a water-soluble film-forming binder and containing insoluble filler material.

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