WATER-SOLUBLE PAPER AND METHOD OF MAKING IT
Hans Böe, Augsburg, Germany, assignor to Firmn Carl Frondenberg, Kommanditgesellschaft auf Aktien, Weih-
heim-Bergstr., Germany
No Drawing. Filed July 23, 1959, Ser. No. 828,943
Claims priority. application Germany Aug. 1, 1958
2 Claims. (Cl. 117—63)

The essential process in the manufacture of paper is the felting of the fibres, which are necessary for the forma-
tion 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 felt 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 remain-
ing 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 pro-
duced 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 card-
ing machines or flat cards or by means of a Rando-Webb
machine, thereupon drying them and forming the result-
ing material, if desired after re-wetting, into a paper-like
product by calendaring.

Natural and synthetic fibres, such as cotton, linen,
ramie, wool, viscose staple fibre, acetate staple
fibre, Perlon, nylon, Trevira, polyvinyl alcohol fibres or
alginic 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, polyvinylglyco-
lic acid, water-soluble urea formaldehyde condensation
products, decomposed glues, water-soluble starch prod-
cuts, dextrians, and sugars; alkali, ammonium, and tri-
ethanolamine 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 100%—
100% of the weight of the fibres.

Known fillers, such as kaolin, chalk, talcum, gypsum,
magnesite, pearl white, lithopone, titanium dioxide, kiesel-
guhr, microcellulose, asbestos, and if desired emoli-
lients or hygroscopic media, such as glycine, glycols,
polyglycols and urea, and if desired water-soluble dye-
stuffa 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. Gen-
erally, 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 emolients 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 pa-
pers, and 120 to 150 grams per square metre for book
papers or the like. These papers can be written on nor-
mally 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 wa-
ter, 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 im-
mediately when subjecting it to the action of hot or cold
water. Not only single sheets of paper, but even docu-
ments 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 pro-
duction 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 propor-
tions 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 impreg-
nated with an aqueous mixture containing:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight (g/sq m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulose glycolate</td>
<td>30</td>
</tr>
<tr>
<td>Maize dextrose</td>
<td>20</td>
</tr>
<tr>
<td>chalk</td>
<td>15</td>
</tr>
<tr>
<td>kaolin</td>
<td>15</td>
</tr>
<tr>
<td>gyspsum</td>
<td>40</td>
</tr>
<tr>
<td>wetting agent</td>
<td>1</td>
</tr>
</tbody>
</table>

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 pa-
paper is obtained, which swells on cold water in a few min-
utes and, after dissolution of the fibre bond, leaves be-
hind a mixture of insoluble fibres.

Example 2
A carded fleece of 50% staple fibres and 50% poly-
amide fibres, with a weight of 60 grams per square metre, is impregnated with an aqueous mixture containing:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight (g/sq m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>polycrylate</td>
<td>50</td>
</tr>
<tr>
<td>urea</td>
<td>10</td>
</tr>
<tr>
<td>gyspsum</td>
<td>20</td>
</tr>
<tr>
<td>pearl white</td>
<td>10</td>
</tr>
<tr>
<td>talcum</td>
<td>10</td>
</tr>
<tr>
<td>wetting agent</td>
<td>1</td>
</tr>
</tbody>
</table>

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.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Inventor(s)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,034,922</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,518,944</td>
<td>Sulzberger</td>
<td>Dec. 9, 1924</td>
</tr>
<tr>
<td>2,208,653</td>
<td>Whitehead</td>
<td>July 23, 1940</td>
</tr>
<tr>
<td>2,402,542</td>
<td>Foote et al.</td>
<td>June 25, 1946</td>
</tr>
<tr>
<td>2,705,688</td>
<td>Ness et al.</td>
<td>Apr. 5, 1955</td>
</tr>
<tr>
<td>2,880,113</td>
<td>Drelich</td>
<td>Mar. 31, 1959</td>
</tr>
<tr>
<td>2,893,754</td>
<td>Richter et al.</td>
<td>July 7, 1959</td>
</tr>
</tbody>
</table>