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(54) Embossed wet-laid fibrous structures

(57) The use of a repeating embossing pattern on a wet-laid cellulosic fibrous structure (10) is described to improve the cleaning performance of said cellulosic fibrous structure (10), said embossing pattern being non-continuous in at least one diagonal direction and comprising non-equidistant discrete embossing sites (14), the cleaning performance index (CPI_E) being not less than 105, wherein said index (CPI_E) is represented in terms of the following equation:

$$CPI_E = \frac{(CPV_E - CPV_R)}{CPV_R} \times 100 + 100$$

The cleaning performance index (CPI_E) is preferably 110. In a preferred embodiment of the present invention, the embossing pattern is of an angular nature. In a more preferred embodiment of the present invention, the embossing pattern is in the form of a rhombus.

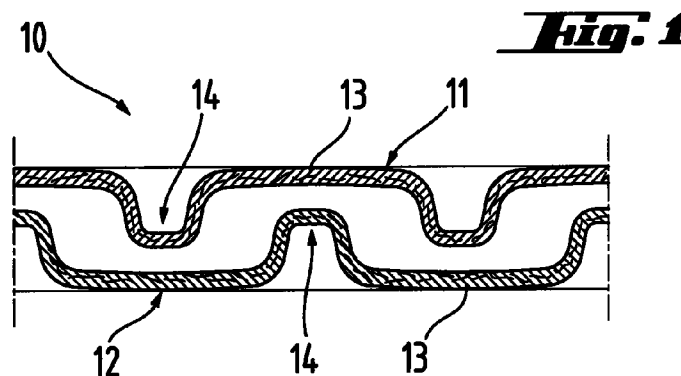


Fig. 1

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Description**Field of the invention**

5 This invention relates to the use of an embossing pattern on a wet-laid cellulosic fibrous structure for a superior cleaning response. The present invention has particular application to cellulosic fibrous structures which can be used for cleaning areas of the human person, for example, dry toilet tissue, paper towels, facial tissues, skin care articles for cosmetic and therapeutic purposes and dry wipes; for cleaning other surfaces, for example, kitchen and bathroom surfaces; and for surfaces which require cleaning in industry, for example, machinery or vehicle surfaces. For simplicity, the
 10 ensuing description focuses on cellulosic fibrous structures such as paper towels and toilet tissue for application to the human skin, but what is said must be understood in light of the foregoing comments about the wider applicability of the present invention.

Background of the invention

15 Embossed cellulosic fibrous structures are well known in the art and are a staple of everyday life. In general, cellulosic fibrous structures are formed by superimposing laminae. Typically, the embossing is performed by one of two processes, namely, nested embossing wherein the protuberances of a roll mesh between the protuberances of another roll, and knob-to-knob embossing wherein protuberances on axially parallel rolls juxtaposed to form a nip therebetween are
 20 registered with protuberances on the opposing roll. US 4,325,773, US 4,487,796, US 3,940,529, US 3,414,459, US 3,547,723, US 3,556,907, US 3,708,366, US 3,738,905, US 4,483,728, US 3,867,224 illustrate embossed cellulosic fibrous structures comprising either nested or knob-to-knob embossments on the constituent laminae. Furthermore, US 5,294,475 and US 5,468,323 teach an embossed cellulosic structure and an improved process and apparatus for making such embossed cellulosic structures. It has been recognised that laminae are embossed for both aesthetic purposes, to maintain the laminae in a face-to-face relation, and for providing spacing between the laminae for a thicker
 25 caper and a quilted cloth-like appearance, so that the consumer is presented with a product that has the appearance of quality and yet does not permit the separation of the laminae during use.

Nevertheless, none of the aforementioned patents exploits the use of a wet-laid cellulosic fibrous structure comprising a particular pattern for a superior and enhanced cleaning response. It has thus surprisingly been found in the
 30 present invention that the use of a wet-laid cellulosic fibrous structure with a non-continuous repeating pattern in at least one diagonal direction can be instinctively exploited by a consumer for an exemplary improvement in cleaning performance without a compromise in the fibrous structure's base attributes of tensile strength, bond strength, absorbency and softness. As a consequence of this improved cleaning performance, material utilisation is dramatically improved and a high level of consumer satisfaction and confidence ensues. In fact, the cleaning performance can be measured and
 35 expressed in terms of a cleaning performance index. For the wet-laid cellulosic fibrous structure comprising the particular pattern of the present invention, values in excess of 105 are typically obtained.

Summary of the invention

40 The use of a repeating embossing pattern on a wet-laid cellulosic fibrous structure to improve the cleaning performance of the cellulosic fibrous structure is described. The embossing pattern is non-continuous in at least one diagonal direction and comprises non-equidistant discrete embossing sites. The cleaning performance of the cellulosic fibrous structure can be measured and is expressed in terms of an index, the index being not less than 105 and preferably being 110. The index is represented in terms of an equation. In a preferred embodiment of the present invention, the
 45 embossing pattern is of an angular nature. In a more preferred embodiment of the present invention, the embossing pattern is in the form of a rhombus. Typically, the cellulosic fibrous structure comprises at least two laminae. Each of the laminae comprises discrete embossed sites and essentially continuous non-embossed regions; each of the discrete embossed sites of one lamina being oriented towards the non-embossed region of the opposite lamina.

Brief description of the drawings

50 It is believed that the invention will be better understood from the foregoing description in conjunction with the accompanying drawings in which:

55 Figure 1 is a fragmentary vertical sectional view of wet-laid cellulosic fibrous structure according to the present invention; and

Figure 2 is a plan view of the more preferred embossing pattern on the wet-laid cellulosic fibrous structure.

Detailed description of the invention

As used herein, the term "embossing" refers to the process of deflecting a relatively small portion of a cellulosic fibrous structure normal to its plane and impacting the projected portion of the cellulosic fibrous structure against a relatively hard surface to permanently disrupt the fibre to fibre bonds. Embossing typically results in a permanent localised deformation of the "embossed site" so deflected. The embossed site projects normal to the plane of the cellulosic fibrous structure and towards the opposite lamina. As used herein, the term "discrete" means not contiguous.

Cellulosic fibrous structure

The cellulosic fibrous structure **10** according to the present invention is macroscopically two-dimensional and planar, although not necessarily flat. The cellulosic fibrous structure **10** does have some thickness in the third dimension. The third dimension, however, is relatively small compared to the actual first two dimensions or to the capability to manufacture a cellulosic fibrous structure **10** having relatively large measurements in the first two dimensions. Figure 1 displays a fragmentary vertical sectional view of a cellulosic fibrous structure **10** according to the present invention. The cellulosic fibrous structure **10** of the present invention comprises at least two laminae, namely lamina **11** and lamina **12**. Each of the laminae **11** and **12** comprises two distinct zones, essentially continuous non-embossed regions **13** and discrete embossed sites **14** projecting generally outward therefrom and preferably orthogonal thereto. Each discrete embossed site **14** of one lamina **11**, **12** is oriented towards the non-embossed region **13** of the opposite lamina **11**, **12**. The non-embossed regions **13** and the embossed sites **14** of each lamina **11**, **12** are composed of fibres approximated by linear elements.

The fibres are components of the cellulosic fibrous structure **10**, which have one relatively large dimension (along the longitudinal axis of the fibre) compared to the other two relatively very small dimensions (mutually perpendicular, and being both radial and perpendicular to the longitudinal axis of the fibre), so that linearity is approximated. While microscopic examination of the fibres may reveal two other dimensions which are small compared to the principal dimension of the fibres, such other two small dimensions need not be substantially equivalent nor constant throughout the axial length of the fibre. It is only important that the fibre be able to bend about its axis, be able to bond to other fibres and be distributed by a liquid carrier or by air. The fibres comprising the cellulosic fibrous structure **10** may be synthetic, such as polyolefin or polyester; are preferably cellulosic, such as cotton linters, rayon or bagasse; and more preferably are wood pulp, such as soft woods (gymnosperms or coniferous) or hard woods (angiosperms or deciduous). As used herein, a fibrous structure **10** is considered "cellulosic" if the fibrous structure **10** comprises at least about 50 weight percent or at least about 50 volume percent cellulosic fibres, including but not limited to those fibres listed above. A cellulosic mixture of wood pulp fibres comprising softwood fibres having a length of 2.0 to about 4.5 millimetres and a diameter of about 25 micrometres to about 50 micrometres, and hardwood fibres having a length of less than about 1.0 millimetre and a diameter of about 12 micrometres to about 25 micrometres has been found to work well for the cellulosic fibrous structures **10** described herein. If wood pulp fibres are selected for the cellulosic fibrous structures **10**, the fibres may be produced by any pulping process including chemical processes such as sulphite, sulphate and soda processes; and mechanical processes such as stone groundwood. Alternatively, the fibres may be produced by combinations of chemical and mechanical processes or may be recycled. The type, combination and processing of the fibres used are not critical to the present invention. The hardwood and softwood fibres may be layered throughout the thickness of the cellulosic fibrous structures **10**.

Wet-laid cellulosic fibrous structure

According to the present invention, the cellulosic fibrous structure **10** is wet-laid according to principles and machinery associated with paper-making. In the wet-laid process, the fibres are first mixed with chemicals and water to obtain a uniform dispersion called a slurry at very high dilutions of 0.01 to 0.5 percent weight of the fibre. The slurry is then deposited on a moving wire screen where the excess water is drained off, leaving the fibres randomly laid in a uniform web, which is then bonded and finished as required. The webs are usually formed at rates up to 300 metres per minute from textile fibres and up to 2500 metres per minute for tissue made from pulp fibres.

Embossing pattern

As is evident from Figure 1, the embossed sites **14** of lamina **11** are not registered with the embossed sites **14** of lamina **12**. The embossed sites **14** of each lamina **11**, **12** represent discrete regions of relatively high density due to the compaction of the fibres which occur during embossing. The essentially continuous non-embossed regions **13** have a lesser density than the embossed sites **14**, since the essentially continuous non-embossed regions **13** are not compacted in the embossing process. The density of the essentially continuous non-embossed regions **13** approximate the

density of the discrete embossed sites 14 prior to begin embossed.

According to the present invention, use is made of a repeating embossing pattern on a wet-laid cellulosic fibrous structure 10 to improve the cleaning performance of the cellulosic fibrous structure 10, the embossing pattern being non-continuous in at least one diagonal direction and comprising non-equidistant discrete embossing sites 14. By being "non-continuous", there is an interruption in the equidistant spacing of the embossing sites 14 on the laminae 11, 12. As used herein, the term "repeating" means that the pattern is formed more than once in the cellulosic fibrous structure 10. The embossed sites 14 of the cellulosic fibrous structure 10 correspond to the topography of the apparatus used to manufacture the cellulosic fibrous structure 10. A preferred embodiment of the present invention is that the embossing pattern is of an angular nature. A more preferred embodiment of the present invention is that the embossing pattern is in the form of a rhombus. The more preferred embodiment is illustrated in Figure 2. Nevertheless, any shape is possible and shapes include, but are not limited to, polygons, semi-circles, ellipsoids, etc., and any combinations thereof providing that the pattern is a non-continuous, repeating diagonal one.

Cleaning performance indices

As described above, use is made of a repeating embossing pattern on the cellulosic fibrous structure 10 in order to improve the cleaning performance of same 10. The cleaning performance is expressed in terms of an index CPI_E , the index being not less than 105 and preferably being 110. Table I indicates the results obtained from tests in which the cleaning performance of the DNE (samples with the preferred embossing pattern) and regular (samples with embossing but no pattern) samples were measured. A suitable method to enable the calculation of the cleaning performance index for the cellulosic fibrous structure 10 of the present invention is described below in the "Description of test procedure" section.

Table I

Sample type	Basis weight [g/m ²]	Cleaning pressure [g]	Soil removed [g]	No. sheets	Cleaning performance value	Cleaning performance index
DNE	46.8	800	0.66±0.07	4	0.165±0.017	118
Regular	46.8	800	0.56±0.05	4	0.14±0.013	100

For all the samples tested, the basis weight was 46.8 grammes per square metre, the cleaning pressure applied (in terms of a weight) was 800 grammes and the number of sheets involved in the cleaning action was 4. While these particular values were selected for the tests, other values are equally possible. Twenty measurements were taken and the average values are tabulated in Table I above. The cleaning performance is a function of the soil removed divided by the number of sheets used for cleaning. For experimental purposes, a value of 0.8 grammes is chosen to represent the maximum removable quantity of soil. Thus, for an ideal cleaning performance, the amount of soil removed is 0.8 grammes and the number of sheets used by the consumer is 1, resulting in a cleaning performance value of 0.8. Using the calculated cleaning performance values for the DNE and regular samples CPV_E and CPV_R , the cleaning performance index CPI_E can be calculated. The cleaning performance index CPI_E is represented in terms of the following equation:

$$CPI_E = \frac{(CPV_E - CPV_R)}{CPV_R} \times 100 + 100$$

wherein

CPI_E is the cleaning performance index of said fibrous structure 10;
 CPV_E is the cleaning performance value of said fibrous structure 10;
 CPV_R is the cleaning performance value of said fibrous structure 10

without said embossing pattern;
 and

$$CPV_E = \frac{\text{soil removed from said fibrous structure 10}}{\text{no. of said fibrous structure 10 sheets}}$$

$$CPV_R = \frac{\text{soil removed from said fibrous structure 10 without said pattern}}{\text{no. of said fibrous structure 10 sheets without said pattern}}$$

In the CPI_E equation above, a value of 100 is assumed for the cleaning performance index for the regular sample types. It is most apparent from the results in Table I that the cleaning performance index for the DNE samples CPI_E is much greater than 100, i.e., not less than 105 and preferably 110. This suggests that the consumer is most positively influenced by the presence of a particular embossing pattern on a cellulosic fibrous structure 10.

Description of test procedure

A method is herein described which outlines the procedure for the calculation of the cleaning performance index for the cellulosic fibrous structure 10 of the present invention. The cellulosic fibrous structure 10 is taken to be a sheet of toilet tissue.

Mechanical cleaning methodology

1.1 Materials

- 1.1.1 DC-fix foil (ref. no. 346-0012, Konrad Hornbusch AG, 64679 Weissbach, Germany);
- 1.1.2 Light grey board used as a pad for the DC-fix foil;
- 1.1.3 Artificial faecal material (Feclone BFPS 6, 1.3 percent dawn solution);
- 1.1.4 Glass jar with lid (dimensions: 75 millimetres x 75 millimetres);
- 1.1.5 Slide (wood block of dimensions: 80 millimetres x 80 millimetres);
- 1.1.6 Speed control equipment (motor);
- 1.1.7 Weighing scales.

1.2 Procedure

- 1.2.1 Prepare the artificial faecal material by following the manufacturer's instructions. (It is important to note that the mass must be cooled down at room temperature without mechanical help e.g., a mixer.).
- 1.2.2 Adjust the weight of the slide to the appropriate weight for the toilet tissue.
- 1.2.3 Take the weight of four sheets of toilet tissue and tabulate.
- 1.2.4 Place the four sheets in a pile on the bottom of the slide and connect the string with the speed control equipment.
- 1.2.5 Put the prepared slide horizontally on its side.
- 1.2.6 Put the slide on the weighing scales and apply 0.8 grammes of artificial faecal material. Wipe the mass directly from the slide into a marked box on the DC-fix foil.
- 1.2.7 Apply the glass jar to the mass and make circular movements (5 times) to spread the mass up to a diameter of about 30 to 40 millimetres. Execute this without applying extra pressure to the glass.
- 1.2.8 Apply a weight of 1000 grammes directly into the middle of the glass jar and close with lid. After 5 seconds, push the glass jar with the weight over the mass without applying any additional pressure. Place two fingers at the back of the glass jar and push the glass jar with these fingers towards oneself (spread within 5 seconds).
- 1.2.9 Remove the weight and the glass jar.
- 1.2.10 Push the spread mass completely back into the marked box on the DC-fix foil using the sharp edge of the glass jar. Push from the bottom and the top.
- 1.2.11 Take the glass jar and apply it to the mass. Place the glass jar directly before the edge of the DC-fix foil without applying any additional pressure on the glass jar.
- 1.2.12 Leave the slide for 5 seconds.
- 1.2.13 Turn on the speed control equipment and draw the glass jar over the mass using a speed of 7.8 centimetres per second.
- 1.2.14 Stop the machine after 10 centimetres wiping distance.
- 1.2.15 Leave the slide for 5 seconds.
- 1.2.16 Take the weight of the used toilet tissue and tabulate.

Note:

Clean the DC-fix foil after every measurement.

Mix the artificial faecal material before placing on slide.

GLOSSARY

- 10 Cellulosic fibrous structure
- 11, 12 Lamina
- 13 Non-embossed region
- 14 Embossed sites

Claims

1. Use of a repeating embossing pattern on a wet-laid cellulosic fibrous structure (10) to improve cleaning performance of said cellulosic fibrous structure (10), said embossing pattern being non-continuous in at least one diagonal direction and comprising non-equidistant discrete embossing sites (14), the cleaning performance index (CPI_E) being not less than 105, wherein said index (CPI_E) is represented in terms of the following equation:

$$CPI_E = \frac{(CPV_E - CPV_R)}{CPV_R} \times 100 + 100$$

wherein

CPI_E is the cleaning performance index of said fibrous structure (10);
 CPV_E is the cleaning performance value of said fibrous structure (10);
 CPV_R is the cleaning performance value of said fibrous structure (10)

without said embossing pattern;
 and

$$CPV_E = \frac{\text{soil removed from said fibrous structure (10)}}{\text{no. of said fibrous structure (10) sheets}}$$

$$CPV_R = \frac{\text{soil removed from said fibrous structure (10) without said pattern}}{\text{no. of said fibrous structure (10) sheets without said pattern}}$$

2. Use of an embossing pattern according to claim 1 wherein said cleaning performance index (CPI_E) is preferably 110.
3. Use of an embossing pattern according any of the preceding claims wherein said embossing pattern is of an angular nature.
4. Use of an embossing pattern according to claim 3 wherein said embossing pattern is in the form of a rhombus.
5. Use of an embossing pattern according to any of the preceding claims wherein said cellulosic fibrous structure (10) comprises at least two laminae (11, 12).
6. Use of an embossing pattern according to any of the preceding claims wherein each of said laminae (11, 12) comprises said discrete embossed sites (14) and essentially continuous non-embossed regions (13), each of said discrete embossed sites (14) of said one lamina (11) being oriented towards said non-embossed region (13) of opposite said lamina (12).

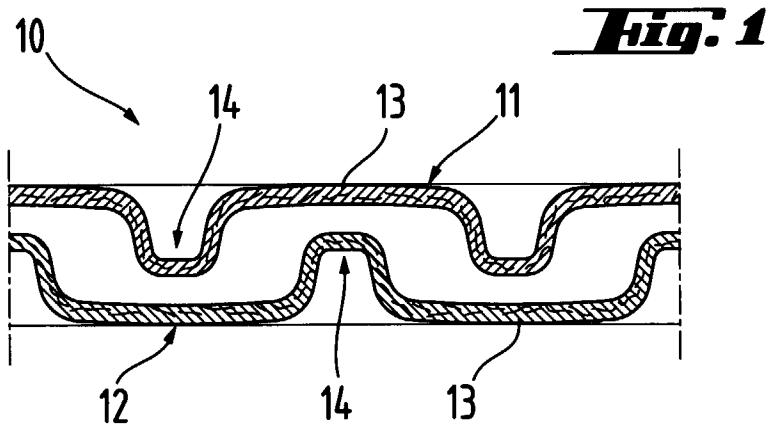
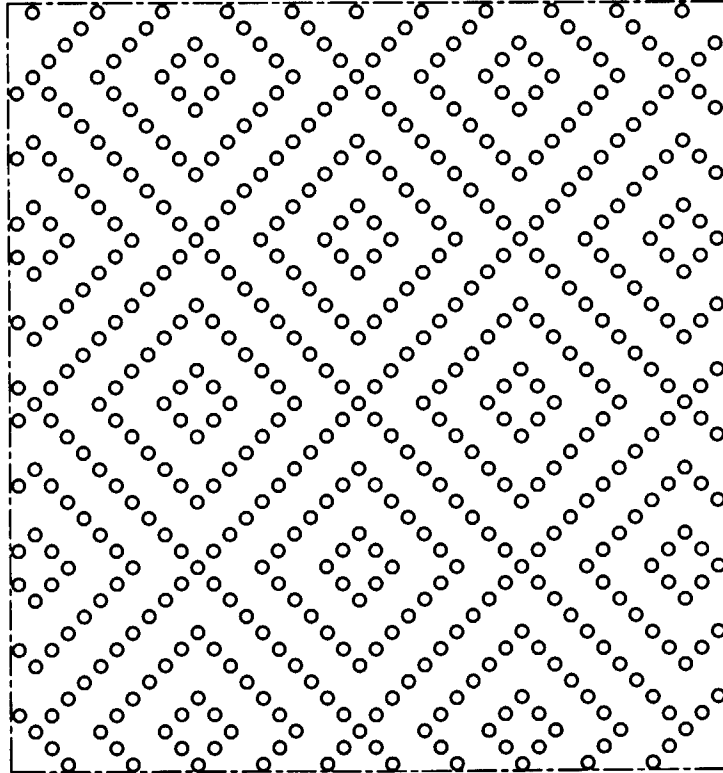


Fig. 2





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 96 12 0452

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
D,A	US 3 547 723 A (GRESHAM JAMES T) * figures 3,4 * ---	1-6	D21H27/02 A47K10/16
A	US 3 953 638 A (KEMP CLIFFORD B) * figure 14 * ---	1-6	
D,A	US 5 468 323 A (MCNEIL KEVIN B) * the whole document * ---	1-6	
A	US 4 671 983 A (BURT JOHN T) * figures 5-11 * ---	1-6	
A	US 5 458 950 A (BREDENDICK KENNETH E ET AL) * figures 7,9A-9C * ---	1-6	
A	EP 0 565 838 A (KIMBERLY CLARK CO) * figures * ---	1-6	
A	GB 2 132 141 A (KIMBERLY CLARK CO) * figures 3,4 * ---	1-6	
A	US 5 173 351 A (RUPPEL REMY ET AL) * figure 4 * -----	1-6	D21H B31F A47K D04H
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 24 February 1998	Examiner Barathe, R
<p>CATEGORY OF CITED DOCUMENTS</p> <p>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</p> <p>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</p>			

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