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(54) Title: PROCESS FOR RECYCLING COTTON FABRICS

(57) Abstract: The present invention relates to a process of recycling the cotton fabrics. More particularly, the present invention provides a process, which provides a new way of manufacturing yarns i.e. yarns made of recycled cotton paper. The process of present invention re-uses waste garments & rags to manufacture fresh fabric. The rags are collected and recycled in an inventive process so as to make recycled cotton products having quality and appearance as per the today’s market standards. The process of present invention is environment friendly in nature. The process is novel, inventive and at the same time not very complex.


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PROCESS FOR RECYCLING COTTON FABRICS

Field of the invention:

The present invention provides a process of recycling the cotton fabrics. In general, the present invention relates to the textile industry. The invention provides a process of recycling the cotton fabrics. More particularly, the present invention provides a process, which provides a new way of manufacturing yarns i.e. yarns made of recycled cotton paper. The rags are collected and recycled in an inventive process so as to make recycled cotton products having quality and appearance as per the today's market standards.

Thus, the present invention provides a process, which is environment friendly in its nature.

Background and prior art of the invention:

Landfills are almost reaching their maximum capacity. The biggest challenge identified now days is to keep up with the rate of clothing disposal. Some of the well-knows apparel brands have developed processes by which used polyester garments are being recycled. But not much work is being done on the reprocessing of cotton garments and what routes this may take, though they have the biggest share in apparels & textiles. The present invention solves this problem in the prior art and provides a process to actually recycle used cotton garments.

Although the majority of textile waste originates from household sources, waste textiles also arise during yarn and fabric manufacture, garment-making processes and from the retail industry. These are termed post-industrial waste, as opposed to the post-consumer waste, which goes to jumble sales and charity shops. Together they provide a vast potential for recovery and recycling.

Recovery and recycling provide both environmental and economic benefits and aids in fighting the following issues:

- According to government figures the clothing and textiles sector in the UK alone produces around 3.1m. tons of CO2, two million tons of waste and 70m tons of waste-water each year.
- Annual textile waste generated in the United States amounts to more than 70 pounds per person, according to the EPA's Office of Solid Waste. (www.epa.gov/waste/nonhaz/municipal/pubs/msw07-fs.pdf)

• Each year, 1.5 million tons of unwanted clothing ultimately ends up in landfill, a figure that has increased in recent years as the shift towards wider use of man-made fibers has made recycling more difficult.
• Researchers have revealed that 7% of all wastes in landfill sites are textiles and that's around 90,000 tons of textile waste a year.
• This effort will reduce pressure on virgin resources.

The ever-increasing cotton production is taking a toll on our ecological system. This is due to the fact that there is a very limited recycle/ reuse of our old garments.

By adapting recycled handmade yarn fabric (as explained in this invention), we will be able to overcome the above challenges & be able to manufacture a fresh fabric in the required color, construction, design etc. while making use of our waste garments. This will help us in de-restricting our designing innovations & abilities.

For consumers the most common way of recycling textiles is reuse through reselling or donating to charity (Goodwill Industries, Salvation Army, etc.). One of the major disadvantages of re-using the old garments is our inability to change its color, construction, count, design etc. Or we can also say that our designing become restricted to the available fabrics only.

By adapting recycled cotton paper yarn fabric, we will be able to overcome the above challenges & be able to manufacture a fresh fabric in the required color, construction, design etc. while making use of our waste garments. This will help us in de-restricting our designing innovations & abilities.

Some companies, such as Patagonia, an outdoor clothing and gear company, accept their product back for recycling. (www.patagonia.com Patagonia Common Threads Garment Recycling)

Textile reuse is not classified as "recycling" by the United States Environmental Protection Agency because the reused garments and wiper rags re-enter the waste stream eventually, so these techniques are classified as a diversion and not recovery for recycling estimates.

Recycling

After collection of the textiles workers sort and separate collected textiles into good quality clothing which can be reused or worn. Damaged textiles are sorted to make industrial wiping cloths.
Alternatively, the textiles are shredded into "shoddy" fibers and blended with other selected fibers, depending on the intended end use of the recycled yarn. The blended mixture is carded to clean and mix the fibers and spun ready for weaving or knitting. Textiles sent to the flocking industry are shredded to make filling material for car insulation, roofing felts, loudspeaker cones, panel linings and furniture padding.

(www.wasteonline.org.uk/resources/InformationSheets/Textiles.htm)

The main disadvantage in this system is the difficulty in shredding the fabric back to fibers. This is a very difficult process & might not bring out the desired results.

Recycling Obstacles

If textile re-processors receive wet or soiled clothes however, these may still end up being disposed of in landfill, as the washing and drying facilities are not present at sorting units.

Traditional Paper Fabric

Traditionally, paper yarn was made in Japan called Shifu & Saga Nishiki, using trees bark to make fresh paper. Besides being very expensive, commercial use of this paper fabric may lead to deforestation.

Paper is thin material mainly used for writing upon, printing upon or for packaging. It is produced by pressing together moist fibers, typically cellulose pulp derived from wood, rags or grasses, and drying them into flexible sheets. Fabric refers to any material made through weaving, knitting, crocheting, or bonding.

Fabric & Textiles have an assortment of uses, the most common of which are for clothing and containers such as bags and baskets. In the household, they are used in carpeting, upholstered furnishings, window shades, towels, covering for tables, beds, and other flat surfaces, and in art. In the workplace, they are used in industrial and scientific processes such as filtering. Miscellaneous uses include flags, backpacks, tents, nets, cleaning devices such as handkerchiefs and rags, transportation devices such as balloons, kites, sails, and parachutes; and strengthening in composite materials such as fiberglass and industrial geo textiles. (http://en.wikipedia.org/wiki/Fabric)

Sources of Fabric Yarn

Textiles can be made from many materials. These materials come from four main sources: animal, plant, mineral, and synthetic. In the past, all textiles were made
from natural fibers, including plant, animal, and mineral sources. In the 20th century, these were supplemented by artificial fibers made from petroleum. One of the major disadvantages which we can identify with these traditional methods are that they either use non-replenishable materials like oil etc. or harm the environment during their course of production, like Cotton, Flax etc.

**Production Methods**

Weaving is a textile production method, which involves interlacing a set of longer threads (called the warp) with a set of crossing threads (called the weft).

Knitting and crocheting involve interlacing loops of yarn, which are formed either on a knitting needle on a crochet hook, together in a line.

Braiding or plaiting involves twisting threads together into cloth. Knotting involves tying threads together and is used in making macrame.

Felting involves pressing a mat of fibers together, and working them together until they become tangled.

There is a major and ever-growing need for recycled Cotton Fabric, which is easily manufactured and economically viable.

Reference may be made to US patent number 5,481,864, titled 'A cloth scrap recycling method'. This invention relates to a method for producing high quality fabrics using recycled fabric scraps. By use of pre-gin contacting of the virgin carrier fibers as well as moistening the fiber scraps that are recycled, fiber length and fiber uniformity percentages are maintained higher than the prior art. The process reduces the need for re-dyeing the resulting material and shrinkage is minimum.

Reference may be made to US patent number 5,236,959, titled 'process for recycling polyester/cotton blends'. This process involves reducing the polyester to a lower dialkyl ester of terephthalic acid and reducing the cotton to cellulose acetate. The process involves the steps of:

- providing a blend of polyester and cotton fibers;
- subjecting the polyester/cotton blend to a first alcoholysis in a bath containing an alcohol and an effective catalyst at a suitable temperature until the polyester is depolymerized to a lower molecular weight polyester oligomer;
- remove the cotton fibers from the alcoholic solution of oligomers and process the recovered cotton fibers by pulping the acetylyzing processes to recover the cellulose acetate;
• Alcoholyze the low molecular weight polyester oligomers to produce the lower dialkyl ester of terephthalic acid.

Further reference may be made to US patent number 5,331,801, which relates to a method of manufacturing years using recycled cotton waste and a new type of recycled cotton yarn. Various types of cotton waste materials such as manufacturing by-products and post-consumer material are used in conjunction with virgin yarns to produce recycled yarns of sufficient quality to be used for garment manufacture.

However, none of the inventions discussed above in prior art provide a process, which is effective and easy at the same time and also, which is environment friendly in its nature. The processes discussed in the prior art are all complex in nature.

The present invention overcomes those problems in the prior art by providing a new and inventive method to recycle the cotton fabrics.

Objectives of the invention:

The main object of the present invention is to provide a process of recycling the cotton fabrics.

Another object of the present invention is to provide a new way of manufacturing yarns i.e. using yarns made of recycled cotton paper.

Another objective of the present invention is to provide the method for producing recycled paper yarn fabric.

A further objective of the present invention is to justify the need for this innovative technique to produce paper yarn.

Another objective of the present invention is to resolve the problems in commercialization of this fabric.

Statement of the invention:

Accordingly, the present invention provides a process of recycling the cotton fabrics in order to manufacture recycled cotton paper, said process comprising the steps of:
a) sorting and dusting the raw material cotton to remove unwanted materials and dust;

b) optionally bleaching the raw material after cleaning in step (a);

c) chopping/ cutting the material of step (b) in small uniform sized pieces to make pulp;

d) beating the rags of step (c) in water to obtain the pulp;

e) forming the sheets using the beaten pulp of step (d), wherein some chemicals/ additives are optionally added to improve the physical/ aesthetic properties;

f) transferring the sheets of step (e) on a support in order to build up a stack of interleaved sheets;

g) squeezing the excess water from sheets of step (f) using mechanized pressing/ crushing to improve physical properties of paper and facilitate drying;

h) hanging the sheets of step (g) to complete drying;

i) cleaning the dried sheets of step (h) to remove any left dirt particles;

j) optionally placing clean sheets from step (i) between metallic plates and passing through spring-loaded rollers to smooth them and enhance gloss to obtain desired recycled cotton paper;

k) optionally slitting the sheets of step (j) into small strips;

l) weaving or knitting or braiding the fabric out of these strips in combination with silk or cotton or any other suitable material as and when required to obtain the desired product.

Summary of the invention:

The present invention relates to a process of recycling the cotton fabrics. More particularly, the present invention provides a process, which provides a new way of manufacturing yarns i.e. yarns made of recycled cotton paper. The rags are collected and recycled in an inventive process so as to make recycled cotton products having quality and appearance as per the today's market standards. The process of present invention is environment friendly in nature. The process is novel, inventive and at the same time not very complex.
Detailed Description of the invention:

Although this invention has been described in conjunction with the exemplary embodiments outlined below, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, the exemplary embodiments of the invention as set forth above are intended to be illustrative and not limiting. Various changes may be made without departing from the spirit and scope of the invention.

This particular process of creating paper yarns from old garments, addresses the complexity of the growing environment issues in the fashion world, which are challenged by consumption trends like 'Fast Fashion' & shorter product life span. Recycled Paper Fabric can change the lifecycle of cotton fabrics, which might provide a solution to the ecological concerns. Keeping the changing fashion needs in mind, recycled paper has the scope to develop new & innovative fabrics & looks.

Process Steps:

A brief outline of the process, which the present invention provides to manufacture this recycled paper is provided. The process of recycling the cotton fabrics in order to manufacture recycled cotton paper comprises the steps of:

a) Sorting and dusting the raw material cotton in order to remove unwanted materials and dust. This is a common procedure to remove any extra material/ parts and get plain pieces of rags.

b) Bleaching the raw material after cleaning.

Many numbers of machines can be used for bleaching purpose, like industrial-washing machines, dyeing machines etc. Bleaching is commonly done for producing other yarns as well like shoddy yarn etc.

c) Chopping/cutting the material of step (b) in small uniform sized pieces to make pulp with the help of scissors/ blades.

This step is a being followed in many industries including paper industries. It is done by using a local machine with blades, which runs by a motor.

d) Beating the chopped/cut rags of step (c) in water to obtain the pulp.
For this purpose machines like Hollander/ Jordan Beater are used. This beater design consists of a circular or ovoid water raceway with a beater wheel at a single point along the raceway. The beater wheel is made with multiple "blades" mounted on an axle-like shaft, similar to the construction of a water wheel. Under power, the blades rotate to beat the fiber into a usable pulp slurry to create longer, hydrated, fibrillated fibers. In earlier days Stamp Mills were used to perform this function. This step is used to make paper either using wood or rags.

e) forming the sheets using the beaten pulp of step (d), wherein some chemicals/additives are optionally added to improve the physical/aesthetic properties;

This is achieved either by hand or by using Fourdrinier machine. Fourdrinier machine has 4 sections (Wet end, Press Section, Drying & Calendering). If this machine is used then we can avoid steps (f) to (j) This machine is not used for making paper from old apparel rags.

The chemicals/additives, which are added optionally in the above step, are well known in the art and are commercially available under different brand names such as RSF-100, RSN and CartaBond etc. Some of these chemicals act as surface strength improvers. These chemicals are formaldehyde-free.

f) Transferring the sheets of step (e) on a support in order to build up a stack of interleaved sheets;

This step is used to make handmade paper.

g) Squeezing the excess water from sheets of step (f) using mechanized pressing/crushing to improve physical properties of paper and facilitate drying;

This step is used to make handmade paper.

h) Hanging the sheets of step (g) to complete drying;

This step is used to make handmade paper.

i) Cleaning the dried sheets of step (h) to remove any left dirt particles;

The cleaned sheets might be coated to further improve the physical properties of the paper.
j) Optionally placing clean sheets from step (i) between metallic plates and passing through spring-loaded rollers to smooth them and enhance gloss to obtain desired recycled cotton paper;

The sheets are placed between metallic plates and passed through spring-loaded rollers in a calendaring machine. This smoothensthem and enhances the gloss. This process is known as Calendaring and is also used to get different surface textures.

k) Optionally slitting the sheets of step (j) into small strips;

This step is used to make paper ropes but is not being used to make paper yarns.

I) Weaving or knitting or braiding the fabric out of these strips in combination with silk or cotton or any other suitable material as and when required to obtain the desired product.

This step is innovative as no industry is using slit/extruded/ twisted papers as a yarn to weave a piece of fabric.

The sorting and dusting of raw material is done preferably by hand. A few machines may be used to make this process semi-automatic like electric cutter to remove seams, machine used for removing buttons, but these arenot very relevant.

The chemicals used for bleaching are selected from hydrochloric acid, salt or bleaching powder. If we use colored rags, this process helps in providing us with an option of dyeing the paper pulp into any color as desired. We can omit this step if we want the paper to be in the same color as the rags or wish to over dye the rags at the pulp stage.

The sheet formation in step (e) is preferably achieved by steps of:

(a) diluting the pulp with water and putting it into a masonry trough or vat; (b) dipping a lifting mould into the trough; (c) shaking it evenly and lifting it out with the pulp on it.

The sheet formation in step (e) is preferably achieved by steps of:

(a) pouring a fixed measure of pulp evenly on a mould which is clamped between two wooden frames in a water tank; (b) raising the mould mechanically to drain excess water.
The sheet formation in step (e) is preferably achieved by using a mechanized cylindrical drum or rotary belt with or without seam.

The cleaned sheets are preferably coated with starch or any other suitable material to improve physical properties of the paper.

Two or more recycled cotton paper sheets are optionally pasted together with the help of suitable adhesives well known in the art to improve the thickness and physical properties of the final product.

The slitting of recycled sheets in step (k) is done preferably in the range of 0.1 to 2 mm strips by breadth and/or length.

In case of short lengths of two or more paper yarns are optionally pasted end-to-end or together to get a long or thicker paper yarn or are twisted to get a twisted recycled paper yarn.

The fabric in step (l) is made either by hand-operated machine or by automated machinery depending upon the requirement and final product desired.

**Manufacturing process of Paper Yarn**

After the manufacturing process of Recycled cotton handmade sheets, the following process manufactures paper yarn:

**Slitting**

The recycled handmade sheets are then slit into 0.1~2 mm strips.

**Manufacturing process of Paper Yarn Fabric**

Once the paper yarn strips are cut, the following method is used to weave a fabric out of these yarns:

**Weaving:**

These strips along with silk or cotton is used as weft yarns & warp yarns respectively, to weave a fabric.

It has been observed through the results of this invention that picking the recycled handmade paper to weave a fabric can provide us with a fabric that not only uses fabrics from landfills, but can also provide a new alternative.

The quality of this fabric is also improved and fabric becomes commercially more viable & acceptable. Certain improvements have been made in the fabric by altering the process of manufacturing paper (like adding old silk yarns in the
paper, during the manufacturing process, like giving a Lacquer coating, a starch coating etc.)
The process of present invention re-uses waste garments & rags to manufacture fresh fabric.

Some of the properties of recycled handmade Paper Fabric:

1. Once paper yarn has been woven, it retains its strength and can be cleaned by wiping with a damp cloth.
2. Paper yarn is low in dust and is a good alternative for those with allergies and environmental health problems.
3. Absorbs odors and dust
4. The products are also biodegradable.
5. Use of Solar energy while manufacturing

The textile industry is considered one of the most ecologically harmful industries in the world. This is evident in both its production and finishing processes, and through the use of synthetic fibers, which aid in the fast depletion of our forests. Because of this, fashionistas who are environmentally conscious are demanding eco-friendly fabrics.

The present invention provides a process for manufacturing of such eco-friendly fabrics and also reusing the fabrics.

The present invention has applications in the following:

• Textiles & Apparel: Textile & Apparel industry can use this paper to commercially develop this fabric.
• Garbage Disposal: Garbage disposal industry can clear their landfills, and sell off old ragged clothes to the textile industry.
• Paper Industry: Paper industry can use this opportunity & aid the textile industry by supplying the required raw material to develop this fabric.

Thus, the present invention provides a process of recycling the cotton fabrics in order to manufacture recycled cotton paper, said process comprising the steps of:

a) sorting and dusting the raw material cotton to remove unwanted materials and dust;
b) optionally bleaching the raw material after cleaning in step (a);

c) chopping/ cutting the material of step (b) in small uniform sized pieces to make pulp;

d) beating the rags of step (c) in water to obtain the pulp;

e) forming the sheets using the beaten pulp of step (d), wherein some well-known chemicals/ additives are optionally added to improve the physical/aesthetic properties;

f) transferring the sheets of step (e) on a support in order to build up a stack of interleaved sheets;

g) squeezing the excess water from sheets of step (f) using mechanized pressing/ crushing to improve physical properties of paper and facilitate drying;

h) hanging the sheets of step (g) to complete drying;

i) cleaning the dried sheets of step (h) to remove any left dirt particles;

j) optionally placing clean sheets from step (i) between metallic plates and passing through spring-loaded rollers to smooth them and enhance gloss to obtain desired recycled cotton paper;

k) optionally slitting the sheets of step (j) into small strips;

l) weaving or knitting or braiding the fabric out of these strips in combination with silk or cotton or any other suitable material as and when required to obtain the desired product.

In an embodiment, the sorting and dusting of raw material is done by hand and/or by machines.

In another embodiment, chemicals used for bleaching are selected from hydrochloric acid, salt or bleaching powder.

In yet another embodiment, the sheet formation in step (e) is preferably achieved by steps of: (a) diluting the pulp with water and putting it into a masonry trough or vat; (b) dipping a lifting mould into the trough; (c) shaking it evenly and lifting it out with the pulp on it.
In another embodiment, the sheet formation in step (e) is preferably achieved by steps of: (a) pouring a fixed measure of pulp evenly on a mould which is clamped between two wooden frames in a water tank; (b) raising the mould mechanically to drain excess water.

In another embodiment, the sheet formation in step (e) is preferably achieved by using a mechanized cylindrical drum or rotary belt with or without seam.

In yet another embodiment, the sheet formation in step (e) is done with the help of Fourdrinier machine.

Fourdrinier machine has 4 sections (Wet end, Press Section, Drying & Calendering). If this machine is used then we can avoid steps (f) to (j).

In another embodiment, the cleaned sheets are preferably coated with starch or any other suitable material to improve physical properties of the paper.

In another embodiment, two or more recycled cotton paper sheets are optionally pasted together with the help of suitable adhesives known in the art to improve the thickness and other physical properties of the final product.

In another embodiment, slitting of recycled sheets in step (k) is done preferably in the range of 0.1 to 2 mm strips by breadth and/or by length.

In another embodiment, short lengths of two or more paper yarns are optionally pasted end-to-end or together to get a long or thicker paper yarn or are twisted to get a twisted recycled paper yarn.

In another embodiment, the fabric in step (l) is made either by hand-operated machine or by automated machinery depending upon the requirement and final product desired.

In another embodiment, the chemicals used in any of the steps mentioned in the entire process are preferably selected from the chemicals well known in the art.

Although only a few exemplary embodiments of this invention have been described in detail above, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention as defined in the accompanying claims.
Applications:

There is a lot of scope of this invention, especially in Developed market where there is a higher rate of consumption coupled with growing environmental issues. It will assist the following industries:

- Textiles & Apparel
- Garbage Disposal
- Paper Industry

Advantages of the invention:

Some of the properties of recycled handmade Paper Fabric:

1. Once paper yarn has been woven, it retains its strength and can be cleaned by wiping with a damp cloth.
2. Paper yarn is low in dust and is a good alternative for those with allergies and environmental health problems.
3. Absorbs odors and dust.
4. The products are also biodegradable.
5. Use of Solar energy while manufacturing.
6. The process does not use any hazardous chemical/material.
7. The process is eco-friendly and environmentally safe.
8. The entire process is easy to carry and cost-effective.
9. Very useful for cleaning garbage, as Garbage disposal industry can clear their landfills, and sell off old ragged clothes to the textile industry.
I Claim:

1. A process of recycling the cotton fabrics in order to manufacture recycled cotton paper, said process comprising the steps of:

   a. sorting and dusting the raw material cotton to remove unwanted materials and dust;

   b. optionally bleaching the raw material after cleaning in step (a);

   c. chopping/ cutting the material of step (b) in small uniform sized pieces to make pulp;

   d. beating the rags of step (c) in water to obtain the pulp;

   e. forming the sheets using the beaten pulp of step (d), wherein some well-known chemicals/ additives are optionally added to improve the physical/ aesthetic properties;

   f. transferring the sheets of step (e) on a support in order to build up a stack of interleaved sheets;

   g. squeezing the excess water from sheets of step (f) using mechanized pressing/ crushing to improve physical properties of paper and facilitate drying;

   h. hanging the sheets of step (g) to complete drying;

   i. cleaning the dried sheets of step (h) to remove any left dirt particles;

   j. optionally placing clean sheets from step (i) between metallic plates and passing through spring-loaded rollers to smooth them and enhance gloss to obtain desired recycled cotton paper;

   k. optionally slitting the sheets of step (j) into small strips;
1. weaving or knitting or braiding the fabric out of these strips in combination with silk or cotton or any other suitable material as and when required to obtain the desired product.

2. The process as claimed in claim 1, wherein the sorting and dusting of raw material is done by hand and/or by machines.

3. The process as claimed in claim 1, wherein chemicals used for bleaching are selected from hydrochloric acid, salt or bleaching powder.

4. The process as claimed in claim 1, wherein the sheet formation in step (e) is preferably achieved by steps of: (a) diluting the pulp with water and putting it into a masonry trough or vat; (b) dipping a lifting mould into the trough; (c) shaking it evenly and lifting it out with the pulp on it.

5. The process as claimed in claim 1, wherein the sheet formation in step (e) is preferably achieved by steps of: (a) pouring a fixed measure of pulp evenly on a mould which is clamped between two wooden frames in a water tank; (b) raising the mould mechanically to drain excess water.

6. The process as claimed in claim 1, wherein the sheet formation in step (e) is preferably achieved by using a mechanized cylindrical drum or rotary belt with or without seam.

7. The process as claimed in claim 1, wherein the sheet formation from step (e) to (j) is preferably done with the help of Fourdrinier machine.

8. The process as claimed in claim 1, wherein the cleaned sheets are preferably coated with starch or any other suitable material to improve physical properties of the paper.

9. The process as claimed in claim 1, wherein two or more recycled cotton paper sheets are optionally pasted together with the help of suitable
adhesives known in the art to improve the thickness and other physical properties of the final product.

10. The process as claimed in claim 1, wherein slitting of recycled sheets in step (k) is done preferably in the range of 0.1 to 2 mm strips by breadth and/or by length.

11. The process as claimed in claim 1, wherein short lengths of two or more paper yarns are optionally pasted end to end or together to get a long or thicker paper yarn or are twisted to get a twisted recycled paper yarn.

12. The process as claimed in claim 1, wherein the fabric in step (l) is made either by hand operated machine or by automated machinery depending upon the requirement and final product desired.

13. A process of recycling the cotton fabrics in order to manufacture recycled cotton paper, substantially as hereinbefore described with reference to the accompanying specification.
# INTERNATIONAL SEARCH REPORT

**A. CLASSIFICATION OF SUBJECT MATTER**

<table>
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**ADD.**

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

| Fields searched (classification system followed by classification symbols) |
|-----------------|-----------------|
| D21B D21D D21F | D21B1/Q8 D21D1/02 D21F11/02 |

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
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<tr>
<th>Category</th>
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<td>Y</td>
<td>pages 8-12</td>
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<td>su 519 519 AI (PROE-R) PROEKTMAASHDETAL 30 June 1976 (1976-06-30) col umn 1, paragraph 1-2 col umn 1, line 30 - col umn 3, line 2 figures</td>
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**X** Further documents are listed in the continuations of Box C.  
**X** See patent family annex.

* Special categories of cited documents:
  
  "A" document defining the general state of the art which is not considered to be of particular relevance  
  "E" earlier document but published on or after the international filing date  
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  "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone  
  "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art  
  "A" document member of the same patent family

**Date of the actual completion of the international search**  
21 March 2011

**Date of mailing of the international search report**  
19/04/2011

**Name and mailing address of the ISA/Office**

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**Authorized officer**

Pregetter, Mari
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