

Señor Director

NUEVAS CREACIONES

Superintendencia de Industria y Comercio

E. S. D.

Referencia: Expediente NC2017/0010865

Asunto: Solicitud de patente para: *PAPEL TISÚ QUE COMPRENDE FIBRAS DE PULPA QUE SE ORIGINAN DE MISCANTHUS Y MÉTODO PARA LA ELABORACIÓN DEL MISMO*

Solicitante: SCA HYGIENE PRODUCTS AB

Fecha de solicitud: 25 de octubre de 2017

RESPUESTA A EXAMEN PRELIMINAR

ANDRES RINCON USCATEGUI, identificado como aparece al pie de mi firma, en mi condición de apoderado de la sociedad solicitante de la patente de la referencia, doy respuesta al Oficio 15695, notificado por fijación en lista el 03 de noviembre de 2017.

I. MODIFICACIONES AL CAPÍTULO REIVINDICATORIO

Con el fin de atender las observaciones realizadas por el Examinador de manera preliminar al examen de patentabilidad, apporto un Capítulo Reivindicatorio modificado conformado por 17 reivindicaciones en las que se han incluido las siguientes modificaciones:

1. La reivindicación original 2 ha sido eliminada.

2. Las reivindicaciones originales 1, 3, 4, 6, 7, 8, 12, 15 y 18 (nuevas reivindicaciones 1, 2, 3, 5, 6, 7, 11, 14 y 17) han sido limitadas para especificar únicamente que las fibras se originan a partir de *Miscanthus Gigantheus*,

“EXCELENCIA LEGAL EN UN MUNDO SIN FRONTERAS”

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Estas modificaciones se ajustan al Artículo 34 de la Decisión 486 de 2000, ya que no constituyen una ampliación de la protección que correspondería a la divulgación contenida en la solicitud inicial.

II. EN CUANTO A LAS OBJECIONES DE SUPUESTA FALTA DE CLARIDAD

1. Con respecto a la objeción del examinador en contra de las reivindicaciones originales 1 y 6 (nuevas reivindicaciones 1 y 5) según la cual estas comprenden términos generales, respetuosamente manifestamos nuestro desacuerdo teniendo en cuenta que las expresiones objetadas pertenecen al conocimiento general de la persona versada en la materia i.e. una persona versada en el campo de la química de papel, de modo que dicha persona entendería claramente la materia para la que se busca protección. Adicionalmente, los términos objetados se encuentran definidos en mayor profundidad en la descripción de la solicitud, particularmente en la página 11, líneas 11 a 21 (*genus Miscanthus*) y página 12, línea 10 a página 13, línea 15 (*pulpa químicas, pulpa mecánicas, fibras de pulpa*) de la publicación internacional, por lo que el alcance de las reivindicaciones debería considerarse totalmente definido. Lo anterior, si se tiene en cuenta que de conformidad con lo señalado en el artículo 51 de la Decisión 486 la descripción de una solicitud sirve para interpretar las reivindicaciones: *"El alcance de la protección conferida por la patente estará determinado por el tenor de las reivindicaciones. La descripción y los dibujos, o en su caso, el material biológico depositado, servirán para interpretarlas"*.

De igual manera, los términos objetados no solo son necesarios sino que además son los apropiados para definir y delimitar la invención. Lo anterior se puede evidenciar en el hecho que estos se encuentran definidos de manera básica en las correspondientes entradas en Wikipedia (<https://en.wikipedia.org/wiki/Miscanthus>; [https://en.wikipedia.org/wiki/Pulp_\(paper\)](https://en.wikipedia.org/wiki/Pulp_(paper))):

- **Genero Miscanthus:** "Miscanthus is un género de las islas africanas, eurasiáticas y del Pacífico perteneciente a la familia del cespèd"
- **Pulpa (fibras):** La pulpa es un material fibroso lignocelulósico preparado químicamente o mediante la separación mecánica de las fibras de celulosa de la

madera, cultivos de fibra, papel usado o trapos [...] La pulpa es una de las materias primas más abundantes en todo el mundo".

- **Pulpa química (fibras):** La pulpa química se produce combinando astillas de madera y productos químicos en grandes recipientes conocidos como digestores donde el calor y los productos químicos se rompen abajo de la lignina, que une las fibras de celulosa, sin degradar seriamente las fibras de celulosa
- **Pulpa mecánica (fibras):** Piedras fabricadas con carburo de silicio incrustado u óxido de aluminio se puede usar para moler troncos pequeños de madera llamados "pernos" para hacer pulpa de piedra. Si la madera se cuece al vapor antes de moler, se conoce como pulpa de madera molida a presión. La mayoría de las fábricas modernas usan trozos en lugar de troncos y discos de metal con surcos llamados placas refinadoras en lugar de piedras de afilar.

Teniendo en cuenta todo lo anterior, se concluye que las expresiones/términos objetados no solamente tienen un significado claro, sino que además son bien conocidas en el arte al pertenecer al conocimiento común de la persona versada en la materia. Por lo tanto, la objeción formulada a este respecto se debe tener por superada.

2. Con respecto a la objeción del examinador en contra de la reivindicación 1 según la cual la expresión "*sujetas a un pre-tratamiento químico*" es considerada una funcionalidad, respetuosamente manifestamos nuestro desacuerdo teniendo en cuenta que dicha expresión se refiere claramente (y está íntimamente ligada) a una propiedad física de la fibra. Específicamente, la expresión "*sujetas a un pre-tratamiento químico*" define a la pulpa pretratada como pulpa químico-mecánica (CMP por siglas en inglés) y pulpa químico-térmico-mecánica (CTMP por sus siglas en inglés), ver página 12, líneas 18 a 20 de la publicación internacional, dicho tipo de pulpa se diferencia tanto estructuralmente como químicamente de una pulpa no tratado en que contiene, por ejemplo, una cantidad diferente (reducida) de lignina.

De igual manera, lo anterior es explicado y confirmado por el artículo de Wikipedia relacionado con pulpa (mencionado anteriormente), en la definición de "*chemithermomechanical pulp*", indicando que dicha pulpa es sometida a un pre-tratamiento, específicamente un tratamiento con carbonato de sodio, hidróxido de sodio,

sulfito de sodio, etc. previo a su refinación, y que como resultado de dicho pretratamiento, las fibras son más fáciles de refinar. Así pues, la definición incluida en la reivindicación se refiere directamente a las características de la pulpa, y por ende, la objeción formulada a este respecto se debe tener por superada.

3. Con respecto a la objeción del examinador en contra de las reivindicaciones originales 9 y 10 (nuevas reivindicaciones 8 y 9) según la cual estas se encuentran mal definidas al hacer referencia a características de un proceso, respetuosamente manifestamos nuestro desacuerdo teniendo en cuenta las siguientes razones:

(i) En primer lugar, con respecto a la reivindicación original 9 (nueva reivindicación 8), esta menciona que las fibras de pulpa son obtenidas en un proceso de reducción a pulpa, química, químico-mecánica o química de alto rendimiento. Como fue discutido anteriormente, el uso de un producto químico o un proceso de pulpa químico-mecánico se encuentra asociado con propiedades físicas específicas de las fibras, por ejemplo, un contenido modificado (reducido) de lignina. Por lo tanto, no solo la persona versada en la materia se encuentra familiarizada con fibras de pulpa obtenidas por procesos de reducción a pulpa, química, químico-mecánica o química de alto rendimiento, sino que además está en la capacidad de verificar o medir si una fibra ha sido obtenida por alguno de dichos procesos. Por lo tanto, el significado y alcance de la nueva reivindicación 9 es clara.

(ii) En segundo lugar, con respecto a la reivindicación original 10 (nueva reivindicación 9) esta caracteriza las fibras NBSK mediante un parámetro i.e. un grado de finura de 19 a 35°SR. El grado de finura, algunas veces llamado “grado de pureza” o simplemente “pureza” es una medida de la capacidad de drenaje de una suspensión en pasta. En consecuencia, el grado de finura no se refiere a una característica del proceso, sino a un parámetro/propiedad mensurable de las fibras de la pulpa. El grado de finura (o franqueza) puede medirse fácilmente utilizando comprobadores de esterilización Schopper-Riegler (SR) disponibles comercialmente y/o basándose en estándares industriales tales como ISO 5267-1.

Teniendo en cuenta lo anterior, las expresiones objetadas deben ser consideradas apropiadas para la definición del producto reivindicado, toda vez que hacen una referencia directa a características físicas tangibles de los productos reclamados. En consecuencia, la objeción formulada a este respecto se debe tener por superada.

4. Finalmente, con respecto a la objeción del examinador en contra de las reivindicaciones 1, 3, 4 y 6 a 8 por contener la expresión “una o más” o “al menos”, se desea poner de presente que tal expresión establece los requisitos mínimos para que una persona medianamente versada en la materia pueda reproducir la invención. Adicionalmente, es preciso resaltar que dicho término está seguido por el número de capas y/o tipos de fibras de *Miscanthus* que son contenidas, características que no tienen que estar en un número determinado para alcanzar la ventaja técnica que ofrece la invención. En otras palabras, la limitación de dichas características a rangos específicos o valores concretos dejaría por fuera del espectro de protección a varias posibles configuraciones que de igual manera conseguirían solucionar el problema técnico que enfrenta la invención; fallándose así en reconocer debidamente el mérito investigativo de los inventores. Teniendo en cuenta lo anterior, la objeción formulada a este respecto se debe tener por superada.

III. EN CUANTO AL PAGO DE TASA ADICIONAL POR EL NÚMERO DE REIVINDICACIONES

Presento junto con este escrito el pago en línea por concepto de tasa adicional para el estudio de 7 reivindicaciones adicionales.

IV. PETICIÓN

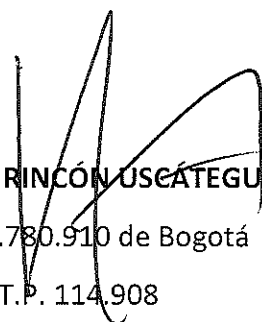
Teniendo en cuenta que la presente solicitud cumple con los requisitos de los Artículos 26 y 27 de la Decisión 486 de 2000, y considerando que se ha dado respuesta a cada una de las observaciones de la Dirección de Nuevas Creaciones con respecto a otros aspectos que tienen que ver con la patentabilidad de la invención, solicito a su Despacho continuar con el trámite administrativo correspondiente.

V. ANEXOS

1. Capítulo Reivindicatorio modificado conformado por 17 reivindicaciones;

2. Comprobante de pago de la tasa correspondiente a 7 reivindicaciones adicionales;
3. Artículo de Wikipedia relacionado con el término *Pulpa*
4. Artículo de Wikipedia relacionado con el término *Miscanthus*
5. Resumen del estándar internacional ISO 5267-1

Señor Director,


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CBA\CBA\ID-299252\WPC11256
No. M-2018-299252\CBA

REIVINDICACIONES

1. Trama de papel tisú compuesta de uno o más estratos, caracterizada porque al menos un estrato comprende fibras de pulpa que se originan de *Miscanthus Giganteus*, en donde las fibras de pulpa se seleccionan a partir de fibras de pulpa químicas, fibras de pulpa mecánicas sujetas a un pre-tratamiento químico y mezclas de las mismas.

2. Trama de papel tisú de conformidad con la reivindicación 1, caracterizada porque las fibras de pulpa que se originan a partir de *Miscanthus Giganteus*, se presentan en una cantidad de al menos 5% en peso, preferentemente en una cantidad de 10% en peso hasta 90% en peso, más preferentemente 15% en peso hasta 80% en peso, incluso más preferentemente 20% en peso hasta 70% en peso, en base al peso total de la trama de papel tisú.

3. Trama de papel tisú de conformidad con cualquiera de las reivindicaciones 1 o 2, caracterizada porque la trama se compone de dos o tres estratos hechos de diferentes pulpas, en donde al menos uno de estos estratos se elabora de pulpa que comprende las fibras de pulpa que se originan a partir de *Miscanthus Giganteus*.

4. Trama de papel tisú de conformidad con cualquiera de las reivindicaciones 1 a 3, caracterizada porque las fibras restantes, presentes en tal trama de papel tisú, se seleccionan a partir de fibras de pulpa que comprenden fibras de madera dura, tal como fibras de eucalipto, haya, álamo, mimosa o abedul; fibras de madera suave tales como fibras de pino, abeto, cedro rojo, abeto de Douglas, cicuta, y alerce; y fibras sin madera tales como fibras de algodón, bagazo, cáñamo, lino, sisal, paja o linaza.

5. Trama de papel tisú de conformidad con la reivindicación 3 o 4, caracterizada porque la trama se compone de dos estratos, en donde (i) el primer estrato se conforma de fibras de pulpa (i-a) que consisten en fibras que se originan a partir de *Miscanthus Giganteus*, y opcionalmente fibras de madera dura, o de fibras de pulpa (i-b) que comprenden, o consisten en, fibras que se originan a partir de *Miscanthus Giganteus*, fibras de madera suave y opcionalmente fibras de madera dura; y (ii) un segundo estrato se conforma de fibras de pulpa que comprenden, o consisten en, fibras de madera suave.

6. Trama de papel tisú de conformidad con la reivindicación 5, caracterizada porque (i) el primer estrato se conforma de fibras de pulpa (i-a), en donde la proporción en peso de las fibras que se originan a partir de *Miscanthus Giganteus*, respecto a fibras duras, si se presentan, es de 100/0 hasta 10/90, preferentemente 100/0 hasta 20/80; y (ii) el segundo estrato se conforma de pulpa que comprende, o que consiste en, fibras de madera suave; y en donde la proporción en peso de fibras de pulpa que se originan a partir de *Miscanthus Giganteus*, en base al peso total de la trama de papel tisú, es preferentemente de 10 hasta 90% en peso, más preferentemente de 10 hasta 80% en peso, en particular, de 25 hasta 75% en peso, tal como 40 hasta 70% en peso.

7. Trama de papel tisú de conformidad con la reivindicación 5, caracterizada porque (i) el primer estrato se conforma de fibras de pulpa (i-b), que consisten en fibras que se originan a partir de *Miscanthus Giganteus* (MG), fibras de madera suave (SW) y opcionalmente fibras de madera dura (HW), en donde la proporción en peso de MG/HW/SW en %, en base al peso total de las fibras de pulpa (i-b), es de 10 a 90/0 a 50/10 a 90, preferentemente 20 a 80/0 a 50/20 a 80; y (ii) el segundo estrato se conforma de fibras de pulpa que comprenden, o consisten en, fibras de madera suave, y en donde la proporción en peso de las fibras de pulpa que se originan a partir de *Miscanthus*

Giganteus, en base al peso total de la trama de papel tisú, es preferentemente de 10 hasta 50% en peso, tal como 10 hasta 30% en peso.

8. Trama de papel tisú de conformidad con cualquiera de las reivindicaciones 1 a 7, caracterizada porque las fibras de pulpa que se originan de *Miscanthus Giganteus* se obtienen en un proceso de reducción a pulpa, química, químico-mecánica o química de alto rendimiento, preferentemente el proceso por sosa o el proceso de CTMP (reducción a pulpa Químico-Termo-Mecánica).

9. Trama de papel tisú de conformidad con cualquiera de las reivindicaciones 1 a 8, caracterizada porque las fibras de pulpa de madera dura se originan de eucalipto y/o las fibras de pulpa de madera suave son fibras de Papel Madera de Madera Suave Blanqueada del Norte (NBSK), en donde las fibras NBSK se refinan preferentemente hasta un grado de finura de 19 a 35°SR.

10. Trama de papel tisú de conformidad con cualquiera de las reivindicaciones 1 a 9, caracterizada porque (i) todas las fibras presentes en la trama son fibras de pulpa primaria, o (ii) una mezcla de fibras de pulpa primaria y secundaria (reciclada) en donde la proporción de las fibras de pulpa secundaria (reciclada) no excede 90% en peso, en base a la trama de papel tisú.

11. Trama de papel tisú de conformidad con cualquiera de las reivindicaciones 1 a 10, caracterizada porque se compone de uno o más estratos en donde las fibras de pulpa que se originan a partir de *Miscanthus Giganteus* cumple los siguientes requisitos: (i) longitud de fibra promedio desde 0.5 hasta 1.2 mm, preferentemente desde 0.8 hasta 1.0 mm; (ii) diámetro de fibra promedio desde 10 hasta 25 μm ; y (iii) grosor de pared de fibra promedio desde 3.0 hasta 5.0 μm .

12. Producto de papel tisú, caracterizado porque comprende al menos un pliegue hecho de trama de papel tisú de conformidad con cualquiera de las reivindicaciones 1 a 11.

13. Producto de papel tisú de conformidad con la reivindicación 12, caracterizado porque el producto de papel tisú se selecciona a partir de papel sanitario, toallas para manos, toallas de uso doméstico, pañuelos, servilletas y pañuelos faciales.

14. Producto de papel tisú de conformidad con la reivindicación 12 o 13, caracterizado porque el producto de papel tisú es un papel sanitario compuesto de 2 a 5 pliegues, en donde preferentemente al menos un pliegue externo, más preferentemente ambos pliegues externos, se elaboran de la trama de papel tisú de la reivindicación 6, y el/los pliegue/pliegues externo/externos se instalan de tal manera que, en el papel sanitario, el primer estrato del mismo (i), que comprende las fibras de pulpa que se originan a partir de *Miscanthus Giganteus*, se localiza sobre la superficie externa del papel sanitario.

15. Producto de papel tisú de conformidad con la reivindicación 12 o 13, caracterizado porque el producto de papel tisú es una toalla para manos o una toalla de uso doméstico de 2 a 5 pliegues, en donde preferentemente al menos un pliegue, opcionalmente todos los pliegues, se elaboran a partir de la trama de papel tisú de la reivindicación 6 o la trama de papel tisú de la reivindicación 7.

16. Producto de papel tisú de conformidad con cualquiera de las reivindicaciones 12 a 15, caracterizado porque el producto de papel tisú se encuentra libre de un suavizante y/o se encuentra libre de una resina de endurecimiento.

17. Proceso para la elaboración de una trama de papel tisú, de conformidad con cualquiera de las reivindicaciones 1 a 11, caracterizado porque comprende las etapas de:

- (a) proporcionar fibras de pulpa química que comprenden fibras que se originan a partir de *Miscanthus Giganteus*;
- (b) formar una suspensión acuosa de tales fibras de pulpa;
- (c) alimentar la suspensión en un cajón de entrada para la elaboración de tejido;
- (d) depositar la suspensión en un cable para formar una trama húmeda;
- (e) desaguar la trama húmeda; y (f) secar y plisar la trama.

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WIKIPEDIA

Miscanthus

Miscanthus, **silvergrass**,^[4] is a genus of African, Eurasian, and Pacific Island plants in the grass family.^{[5][6]}

Species^{[3][7]}

1. *Miscanthus changii* Y.N.Lee – Korea
2. *Miscanthus depauperatus* Merr. – Philippines
3. *Miscanthus ecklonii* (Nees) Mabb. – southern Africa
4. *Miscanthus floridulus* – China, Japan, Southeast Asia, Pacific Islands
5. *Miscanthus fuscus* (Roxb.) Benth. – Indian Subcontinent, Indochina, Pen Malaysia
6. *Miscanthus junceus* – southern Africa
7. *Miscanthus lutarioriparius* L.Liu ex S.L.Chen & Renvoize – Hubei, Hunan
8. *Miscanthus nepalensis* (Trin.) Hack. – Indian Subcontinent, Tibet, Yunnan, Myanmar, Vietnam, Pen Malaysia
9. *Miscanthus nudipes* (Griseb.) Hack. – Assam, Bhutan, Nepal, Sikkim, Tibet, Yunnan
10. *Miscanthus × ogiformis* Honda – Korea, Japan
11. *Miscanthus oligostachyus* Stapf. – Korea, Japan
12. *Miscanthus paniculatus* (B.S.Sun) S.L.Chen & Renvoize – Guizhou, Sichuan, Yunnan
13. *Miscanthus sacchariflorus* – Korea, Japan, northeastern China, Russian Far East
14. *Miscanthus sinensis* – Korea, Japan, China, Southeast Asia, Russian Far East; naturalized in New Zealand, North + South America
15. *Miscanthus tinctorius* (Steud.) Hack. – Japan
16. *Miscanthus villosus* Y.C.Liu & H.Peng – Yunnan
17. *Miscanthus violaceus* (K.Schum.) Pilg. – tropical Africa

formerly included^[3]

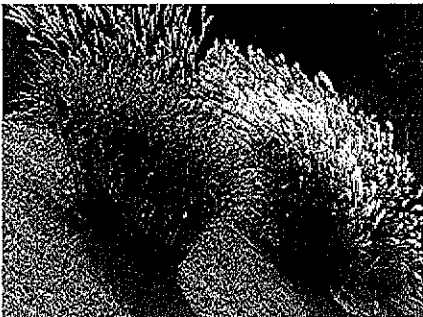
see *Chloris* *Pseudopogonatherum* *Saccharum* *Spodiopogon*

- *Miscanthus affinis* – *Pseudopogonatherum quadrinerve*
- *Miscanthus cotulifer* – *Spodiopogon cotulifer*
- *Miscanthus polydactylos* – *Chloris elata*
- *Miscanthus rufipilus* – *Saccharum rufipilum*
- *Miscanthus tanakae* – *Pseudopogonatherum speciosum*

Contents

Uses

Miscanthus



Miscanthus sinensis

Scientific classification

Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Monocots
(unranked):	Commelinids
Order:	Poales
Family:	Poaceae
Subfamily:	Panicoideae
Tribe:	Andropogoneae
Genus:	<i>Miscanthus</i> Andersson

Type species

Miscanthus capensis
(Nees) Andersson^{[1][2]}

Synonyms^[3]

- *Xiphagrostis* Coville ex Safford
- *Miscanthidium* Stapf
- *Sclerostachya* (Andersson ex Hack.) A.Camus
- *Triarrhena* (Maxim.) Nakai
- *Diandranthus* L.Liu
- *Rubimons* B.S.Sun

M. giganteus

M. sinensis

References

External links

Uses

M. giganteus

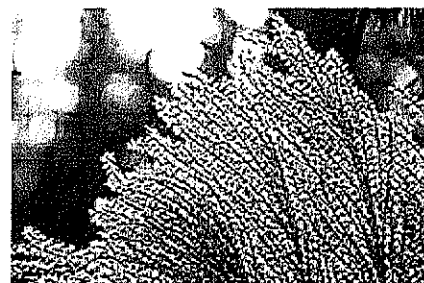
The sterile hybrid between *M. sinensis* and *M. sacchariflorus*, *Miscanthus giganteus*, has been trialed as a biofuel in Europe since the early 1980s. It can grow to heights of more than 3.5 m in one growth season. Its dry weight annual yield can reach 25 tonnes per hectare (10 tonnes per acre).^[8] It is sometimes called "elephant grass", so is thus confused with the African grass *Pennisetum purpureum*, also called that.

The rapid growth, low mineral content, and high biomass yield of *Miscanthus* make it a favorite choice as a biofuel.^[9] *Miscanthus* can be used as input for ethanol production, often outperforming corn and other alternatives in terms of biomass and gallons of ethanol produced. Additionally, after harvest, it can be burned to produce heat and steam for power turbines. In addition to the amount of CO₂ emissions from burning the crop, any fossil fuels that might have been used in planting, fertilizing, harvesting, and processing the crop, as well as in transporting the biofuel to the point of use, must also be considered when evaluating its carbon load. Its advantage, though, is that it is not usually consumed by humans, making it a more available crop for ethanol and biofuel, than, say, corn and sugarcane. When mixed 50%-50% with coal, *Miscanthus* biomass can be used in some current coal-burning power plants without modifications.

Miscanthus has also been suggested as a "green" building material, for both wall construction and general insulation. An experimental house based on *Miscanthus* straw bales was under construction in 2017^[10].

M. sinensis

M. sinensis is cultivated as an ornamental plant. In Japan, where it is known as *susuki* (すすき), it is considered an iconic plant of late summer and early autumn. It is mentioned in *Man'yōshū* (VIII:1538) as one of the seven autumn flowers (*aki no nana kusa*, 秋の七草). It is used for the eighth month in hanafuda playing cards. It is decorated with bush clover for the Mid-Autumn Festival. *Miscanthus* has also excellent fiber properties for papermaking.



Winter miscanthus, an ornamental grass, growing in Southern Ontario, Canada

References

- lectotype designated by Coville, Contr. U.S. Natl. Herb. 9: 400 (8 Apr 1905)
- Tropicos, *Miscanthus* Andersson (<http://www.tropicos.org/Name/40020367>)
- Kew World Checklist of Selected Plant Families (http://apps.kew.org/wcsp/namedetail.do?name_id=424578)

4. ["Miscanthus"](https://plants.usda.gov/core/profile?symbol=MISCA) (<https://plants.usda.gov/core/profile?symbol=MISCA>). Natural Resources Conservation Service PLANTS Database. [USDA](#). Retrieved 13 July 2015.
5. Andersson, Nils Johan. 1855. Öfversigt af Förhandlingar: Kongl. Svenska Vetenskaps-Akademien 12: 165.
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External links

- [UK's National Centre for Biorenewable Energy, Fuels and Materials](http://www.nnfcc.co.uk/) (<http://www.nnfcc.co.uk/>)
 - *Miscanthus x giganteus* - as an energy crop (<http://miscanthus.uiuc.edu/>) - *Miscanthus* Research at the University of Illinois
 - [\[1\]](http://www.newenergyfarms.com/) (<http://www.newenergyfarms.com/>) - New Energy Farms - *Miscanthus* developers and suppliers
 - [\[2\]](http://www.terravesta.com/) (<http://www.terravesta.com/>) - Terravesta - The complete supply chain solution for *Miscanthus* Europe.
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Pulp (paper)

Pulp is a lignocellulosic fibrous material prepared by chemically or mechanically separating cellulose fibres from wood, fiber crops, waste paper, or rags. Many kinds of paper are made from wood with nothing else mixed into them. This includes newspaper, magazines and even toilet paper. Pulp is one of the most abundant raw materials worldwide.

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Structure of fibres of pulp



Pulp at a paper mill near Pensacola, 1947

History

Pulp for papermaking was produced by macerating mulberry bark as early as the 2nd century in Han dynasty China, where the invention of paper is traditionally attributed to Cai Lun.^[1] Lu Ji, in his 3rd century commentary on the *Classic of Poetry*, mentions that people residing south of the Yangtze River would traditionally pound mulberry bark to make paper or clothing.^[2] By the 6th century, the mulberry tree was domesticated by farmers in China specifically for the purpose of producing pulp to be used in the papermaking process. In addition to mulberry, pulp was also made from bamboo, hibiscus bark, blue sandalwood, straw, and cotton.^[3] Papermaking using pulp made from hemp and linen fibers from tattered clothing, fishing nets and fabric bags spread to Europe in the 13th century, with an ever-increasing use of rags being central to the manufacture and affordability of rag paper, a factor in the development of printing.^[5] By the 1800s, demand often exceeding the available supply of rags, and also the manual labor of papermaking resulted in paper being still a relatively pricey product.^[8]

Using wood pulp to make paper is a fairly recent innovation, that was almost concurrent to the invention of automatic papermaking machines, both together resulting in paper and cardboard becoming an inexpensive commodity in modern times.^[3] Although the first use of paper made from wood pulp dates from 1800, as seen in some pages of a book published by Matthias Koops that year in London,^[3] large-scale wood paper production began with the development of mechanical pulping in Germany by Friedrich Gottlob Keller in the 1840s,^[4] and by the Canadian inventor Charles Fenerty in Nova Scotia.^[5] Chemical processes quickly followed, first with J. Roth's use of sulfurous acid to treat wood, then by Benjamin Tilghman's U.S. patent on the use of calcium bisulfite, Ca(HSO₃)₂, to pulp wood in 1867.^[6] Almost a decade later, the first commercial sulfite pulp mill was built, in Sweden. It used magnesium as the counter ion and was based on work by Carl Daniel Ekman. By 1900, sulfite pulping had become the dominant means of producing wood pulp, surpassing mechanical pulping methods. The competing chemical pulping process, the sulfate, or kraft, process, was developed by Carl F. Dahl in 1879; the first kraft mill started, in Sweden, in 1890.^[8] The invention of the recovery boiler, by G.H. Tomlinson in the early 1930s,^[4] allowed kraft mills to recycle almost all of their pulping chemicals. This, along with the ability of the kraft process to accept a wider variety of types of wood and to produce stronger fibres,^[7] made the kraft process the dominant pulping process, starting in the 1940s.^[6]

Global production of wood pulp in 2006 was 175 million tons (160 million tonnes).^[8] In the previous year, 63 million tons (57 million tonnes) of market pulp (not made into paper in the same facility) was sold, with Canada being the largest source at 21 percent of the total, followed by the United States at 16 percent. The wood fiber sources required for pulping are "45% sawmill residue, 21% logs and chips, and 34% recycled paper" (Canada, 2014).^[9] Chemical pulp made up 93 percent of market pulp.^[10]

Wood pulp manufacture

The timber resources used to make wood pulp are referred to as pulpwood.^[11] Wood pulp comes from softwood trees such as spruce, pine, fir, larch and hemlock, and hardwoods such as eucalyptus, aspen and birch.^[12]



Five seminal steps in ancient Chinese papermaking outlined in a woodcut.

A **pulp mill** is a manufacturing facility that converts wood chips or other plant fibre source into a thick fiberboard which can be shipped to a paper mill for further processing. Pulp can be manufactured using mechanical, semi-chemical or fully chemical methods (kraft and sulfite processes). The finished product may be either bleached or non-bleached, depending on the customer requirements.

Wood and other plant materials used to make pulp contain three main components (apart from water): cellulose fibers (desired for papermaking), **lignin** (a three-dimensional polymer that binds the cellulose fibres together) and **hemicelluloses**, (shorter branched carbohydrate polymers). The aim of pulping is to break down the bulk structure of the fibre source, be it chips, stems or other plant parts, into the constituent fibres.



Fibres in wood pulp

Chemical pulping achieves this by degrading the lignin and hemicellulose into small, water-soluble molecules which can be washed away from the cellulose fibres without depolymerizing the cellulose fibres (chemically depolymerizing the cellulose weakens the fibres). The various mechanical pulping methods, such as groundwood (GW) and refiner mechanical (RMP) pulping, physically tear the cellulose fibres one from another. Much of the lignin remains adhering to the fibres. Strength is impaired because the fibres may be cut. There are a number of related hybrid pulping methods that use a combination of chemical and thermal treatment to begin an abbreviated chemical pulping process, followed immediately by a mechanical treatment to separate the fibres. These hybrid methods include thermomechanical pulping, also known as TMP, and chemithermomechanical pulping, also known as CTMP. The chemical and thermal treatments reduce the amount of energy subsequently required by the mechanical treatment, and also reduce the amount of strength loss suffered by the fibres.

Global pulp production by category (2000)
^[13]

Pulp category	Production (M ton)
Chemical	131.2
Kraft	117.0
Sulfite	7.0
Semichemical	7.2
Mechanical	37.8
Nonwood	18.0
Total virgin fibres	187.0
Recovered fibres	147.0
Total pulp	334.0

Harvesting trees

Most pulp mills use good **forest management** practices in harvesting trees to ensure that they have a sustainable source of raw materials. One of the major complaints about harvesting wood for pulp mills is that it reduces the **biodiversity** of the harvested forest. Pulp **tree plantations** account for 16 percent of world pulp production, **old-growth forests** 9 percent, and second- and third- and more generation forests account for the rest.^[14] **Reforestation** is practiced in most areas, so trees are a **renewable resource**. The FSC (**Forest Stewardship Council**), SFI (**Sustainable Forestry Initiative**), PEFC (**Programme for the Endorsement of Forest Certification**), and other bodies certify paper made from trees harvested according to guidelines meant to ensure good forestry practices.^[15]

The number of trees consumed depends on whether mechanical processes or chemical processes are used. It has been estimated that based on a mixture of **softwoods** and **hardwoods** 12 metres (40 ft) tall and 15–20 centimetres (6–8 in) in diameter, it would take an average of 24 trees to produce 0.9 tonne (1 ton) of printing and writing paper, using the **kraft process** (chemical pulping). Mechanical pulping is about twice as efficient in using trees, since almost all of the wood is used to make fibre, therefore it takes about 12 trees to make 0.9 tonne (1 ton) of mechanical pulp or **newsprint**.^[16]

There are roughly 2 short tons in a **cord of wood**.^[17]

Preparation for pulping

Wood chipping is the act and industry of chipping wood for pulp, but also for other **processed wood** products and **mulch**. Only the **heartwood** and **sapwood** are useful for making pulp. **Bark** contains relatively few useful fibers and is removed and used as fuel to provide steam for use in the pulp mill. Most pulping processes require that the wood be chipped and screened to provide uniform sized chips.

Pulping

There are a number of different processes which can be used to separate the wood fiber:

Mechanical pulp

Manufactured **grindstones** with embedded **silicon carbide** or **aluminum oxide** can be used to grind small wood logs called "bolts" to make stone pulp (SGW). If the wood is steamed prior to grinding it is known as pressure ground wood pulp (PGW). Most modern mills use chips rather than logs and ridged metal discs called refiner plates instead of grindstones. If the chips are just ground up with the plates, the pulp is called refiner mechanical pulp (RMP) and if the chips are steamed while being refined the pulp is called thermomechanical pulp (TMP). Steam treatment significantly reduces the total energy needed to make the pulp and decreases the damage (cutting) to fibres. Mechanical pulps are used for products that require less strength, such as **newsprint** and **paperboards**.

Thermomechanical pulp

Thermomechanical pulp is pulp produced by processing **wood chips** using heat (thus "**thermo-**") and a mechanical refining movement (thus "**-mechanical**"). It is a two-stage process where the logs are first stripped of their **bark** and converted into small chips. These chips have a moisture content of around 25–30 percent and a mechanical force is applied to the wood chips in a crushing or grinding action which generates heat and water vapour and softens the **lignin** thus separating the individual fibres. The pulp is then screened and cleaned, any clumps of fibre are reprocessed. This process gives a high yield of fibre from the **timber** (around 95 percent) and as the lignin has not been removed, the fibres are hard and rigid.^[18]



Mechanical pulping process.^[18]

Chemithermomechanical pulp

Wood chips can be pretreated with [sodium carbonate](#), [sodium hydroxide](#), [sodium sulfite](#) and other chemicals prior to refining with equipment similar to a mechanical mill. The conditions of the chemical treatment are much less vigorous (lower temperature, shorter time, less extreme pH) than in a chemical pulping process since the goal is to make the fibres easier to refine, not to remove lignin as in a fully chemical process. Pulps made using these hybrid processes are known as chemithermomechanical pulps (CTMP).

Chemical pulp

Chemical pulp is produced by combining wood chips and chemicals in large vessels known as digesters where heat and the chemicals break down the lignin, which binds the [cellulose](#) fibres together, without seriously degrading the [cellulose fibres](#). Chemical pulp is used for materials that need to be stronger or combined with mechanical pulps to give a product different characteristics. The [kraft process](#) is the dominant chemical pulping method, with the [sulfite process](#) being second. Historically [soda pulping](#) was the first successful chemical pulping method.



International Paper Company. Pulp mill that makes fluff pulp for use in absorbent products with the kraft process.

Recycled pulp

Recycled pulp is also called [deinked pulp](#) (DIP). DIP is [recycled paper](#) which has been processed by chemicals, thus removing [printing inks](#) and other unwanted elements and freed the paper fibres. The process is called [deinking](#).

DIP is used as raw material in [papermaking](#). Many [newsprint](#), [toilet paper](#) and [facial tissue](#) grades commonly contain 100 percent deinked pulp and in many other grades, such as lightweight coated for offset and printing and writing papers for office and home use, DIP makes up a substantial proportion of the furnish.

Organosolv pulping

Organosolv pulping uses organic solvents at temperatures above 140 °C to break down lignin and hemicellulose into soluble fragments. The pulping liquor is easily recovered by distillation. The reason for using a solvent is to make the [lignin](#) more soluble in the cooking liquor. Most common used solvents are [methanol](#), [ethanol](#), [formic acid](#) and [acetic acid](#) often in combination with [water](#).

Alternative pulping methods

Research is under way to develop biopulping (biological pulping), similar to chemical pulping but using certain species of [fungi](#) that are able to break down the unwanted lignin, but not the cellulose fibres.^[18] In the biopulping process, the fungal enzyme [lignin peroxidase](#) selectively digests lignin to leave remaining cellulose fibres. This could have major [environmental benefits](#) in reducing the pollution associated with chemical pulping. The pulp is bleached using chlorine dioxide stage followed by neutralization and calcium hypochlorite. The oxidizing agent in either case oxidizes and destroys the dyes formed from the tannins of the wood and accentuated (reinforced) by sulfides present in it.

[Steam exploded fibre](#) is a pulping and extraction technique that has been applied to wood and other fibrous organic material.^[20]

Bleaching

The pulp produced up to this point in the process can be [bleached](#) to produce a [white paper](#) product. The chemicals used to bleach pulp have been a source of environmental concern, and recently the pulp industry has been using alternatives to [chlorine](#), such as [chlorine dioxide](#), [oxygen](#), [ozone](#) and [hydrogen peroxide](#).

Alternatives to wood pulp

Non-wood pulp made from rags, or from linters (short fibers discarded by the textile industry), is still manufactured today mostly as a pricey product perceived as being of better quality, especially for the art market and so-called "archival" paper. The modern source fiber is most often cotton, with a much higher value given to paper made from linen, hemp, [abaca](#), [kozo](#) or other fibers. 100% cotton, or a combination of cotton and linen pulp is used for certificates, currency, and passports.^{[21][22][23]} Abaca pulp has very long, strong fibers, and is used for teabags.

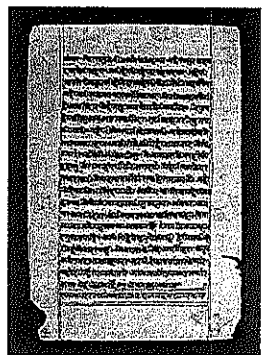
Today, some people and groups advocate using field crop fibre or agricultural residues instead of wood fibre as being more [sustainable](#).

There is enough [straw](#) to meet much of North America's book, magazine, catalogue and copy paper needs. Agricultural-based paper does not come from [tree farms](#). Some agricultural residue pulps take less time to cook than wood pulps. That means agricultural-based paper uses less energy, less water and fewer chemicals. Pulp made from wheat and flax straw has half the ecological footprint of pulp made from forests.^[24]

[Hemp paper](#) is a possible replacement, but processing infrastructure, storage costs and the low usability percentage of the plant means it is not a ready substitute.

However, wood is also a renewable resource, with about 90 percent of pulp coming from [plantations](#) or reforested areas.^[14] Non-wood fibre sources account for about 5–10 percent of global pulp production, for a variety of reasons, including seasonal availability, problems with chemical recovery, brightness of the pulp etc.^{[16][25]} Non-wood pulp processing requires a high use of water and energy.^[26]

[Nonwovens](#) are in some applications alternatives to paper made from wood pulp, like [filter paper](#) or [tea bags](#).



Ancient Sanskrit on Hemp based Paper. Hemp Fiber was commonly used in the production of paper from 200 BC to the Late 1800's.

Comparison of typical feedstocks used in pulping^[27]

Component	Wood	Nonwood
Carbohydrates	65–80%	50–80%
Cellulose	40–45%	30–45%
Hemicellulose	23–35%	20–35%
Lignin	20–30%	10–25%
Extractives	2–5%	5–15%
Proteins	<0.5%	5–10%
Inorganics	0.1–1%	0.5–10%
SiO ₂	<0.1%	0.5–7%

Market pulp is any variety of pulp that is produced in one location, dried and shipped to another location for further processing.^[28] Important quality parameters for pulp not directly related to the fibres are brightness, dirt levels, viscosity and ash content. In 2004 it accounted for about 55 million metric tons of market pulp.^[29]

Air dry pulp is the most common form to sell pulp. This is pulp dried to about 10 percent moisture content. It is normally delivered as sheeted bales of 250 kg. The reason to leave 10 percent moisture in the pulp is that this minimizes the fibre to fibre bonding and makes it easier to disperse the pulp in water for further processing to paper.^[25]

Roll pulp or **reel pulp** is the most common delivery form of pulp to non traditional pulp markets. Fluff pulp is normally shipped on rolls (reels). This pulp is dried to 5–6 percent moisture content. At the customer this is going to a comminution process to prepare for further processing.^[28]

Some pulps are flash dried. This is done by pressing the pulp to about 50 percent moisture content and then let it fall through silos that are 15–17 m high. Gas fired hot air is the normal heat source. The temperature is well above the char point of cellulose, but large amount of moisture in the fibre wall and lumen prevents the fibres from being incinerated. It is often not dried down to 10 percent moisture (air dry). The bales are not as densely packed as air dry pulp.^[28]

Environmental concerns

The major environmental impacts of producing wood pulp come from its impact on forest sources and from its waste products.

Forest resources

The impact of logging to provide the raw material for wood pulp is an area of intense debate. Modern logging practices, using forest management seek to provide a reliable, renewable source of raw materials for pulp mills. The practice of clear cutting is a particularly sensitive issue since it is a very visible effect of logging. Reforestation, the planting of tree seedlings on logged areas, has also been criticized for decreasing biodiversity because reforested areas are monocultures. Logging of old growth forests accounts for less than 10 percent of wood pulp,^[14] but is one of the most controversial issues.

Effluents from pulp mills

The process effluents are treated in a biological effluent treatment plant, which guarantees that the effluents are not toxic in the recipient.

Mechanical pulp is not a major cause for environmental concern since most of the organic material is retained in the pulp, and the chemicals used (hydrogen peroxide and sodium dithionite) produce benign byproducts (water and sodium sulfate (finally), respectively).

Chemical pulp mills, especially kraft mills, are energy self-sufficient and very nearly closed cycle with respect to inorganic chemicals.

Bleaching with chlorine produces large amounts of organochlorine compounds, including dioxins.^[30]

Odor problems

The kraft pulping reaction in particular releases foul-smelling compounds. The hydrogen sulfide reagent that degrades lignin structure also causes some demethylation to produce methanethiol, dimethyl sulfide and dimethyl disulfide. These same compounds are released during many forms of microbial decay, including the internal microbial action in Camembert cheese, although the kraft process is a chemical one and does not involve any microbial degradation. These compounds have extremely low odor thresholds and disagreeable smells; a common saying in communities economically dependent on nearby papermills is "Smells like a job" or "Smells like money."

Applications

The main applications for pulp are paper and board production. The furnish of pulps used depends on the quality on the finished paper. Important quality parameters are wood furnish, brightness, viscosity, extractives, dirt count and strength.

Chemical pulps are used for making nanocellulose.

Speciality pulp grades have many other applications. Dissolving pulp is used in making regenerated cellulose that is used textile and cellophane production. It is also used to make cellulose derivatives. Fluff pulp is used in diapers, feminine hygiene products and nonwovens.

Paper production

The Fourdrinier Machine is the basis for most modern papermaking, and it has been used in some variation since its conception. It accomplishes all the steps needed to transform a source of wood pulp into a final paper product.

Economics

In 2009, NBSK pulp sold for \$650/ton in the United States. The price had dropped due to falling demand when newspapers reduced their size, in part, as a result of the recession.^[?]

See also

- Nanocellulose
- Paper chemicals
- Pulp mill
- Pulpwood
- Johan Richter. Developed the process for continuous cooking of pulp.
- World Forestry Congress

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Pulps — Determination of drainability —
Part 1:
Schopper-Riegler method

Pâtes — Détermination de l'égouttabilité —
Partie 1: Méthode Schopper-Riegler



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 5267-1 was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*, Subcommittee SC 5, *Test methods and quality specifications for pulp*.

This second edition cancels and replaces the first edition (ISO 5267-1: 1979), of which it constitutes a minor revision. The main amendment is the addition of ISO 14487 to clause 6 (formerly clause 7) to specify the water used in the test.

ISO 5267 consists of the following parts, under the general title *Pulps — Determination of drainability*:

- *Part 1: Schopper-Riegler method*
- *Part 2: "Canadian Standard" freeness method*

Annexes A and B form an integral part of this part of ISO 5267.

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Pulps — Determination of drainability — Part 1: Schopper-Riegler method

1 Scope

This part of ISO 5267 specifies a method for the determination of the drainability of a pulp suspension in water in terms of the Schopper-Riegler (SR) number.

The Schopper-Riegler test is designed to provide a measure of the rate at which a dilute suspension of pulp may be dewatered. It has been shown that the drainability is related to the surface conditions and swelling of the fibres, and constitutes a useful index of the amount of mechanical treatment to which the pulp has been subjected.

In principle, this method is applicable to all kinds of pulp in aqueous suspension. However, in practice, the Schopper-Riegler test provides acceptable results only if a sufficiently dense mat of fibres is formed on the wire screen. For this reason, the test is not recommended for some extremely short-fibred pulps, such as those from well-beaten hardwoods, as most of the fibres will pass through the wire screen, resulting in anomalous reduction of the SR number. The most reliable results are obtained within the range of 10 to 90 SR number.

The results of this test do not necessarily correlate with the drainage behaviour of a pulp material on a commercial paper machine.

NOTE A method for the determination of drainability in terms of the "Canadian Standard" freeness number is specified in ISO 5267-2:1980, *Pulps — Determination of drainability — Part 2: "Canadian Standard" freeness method*.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 5267. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 5267 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 4119:1995, *Pulps — Determination of stock concentration*.

ISO 14487:1997, *Pulps — Standard water for physical testing*.

3 Definition

For the purposes of this part of ISO 5267, the following definition applies.

3.1 Schopper-Riegler number scale

scale on which a discharge of 1 000 ml corresponds to a SR number of zero and zero discharge to a SR number of 100

3.2 stock

aqueous suspension of disintegrated pulp