Estudio del Estado de la Técnica

Producción de etanol a partir de residuos lignocelulósicos

Resumen

Este informe recoge los principales resultados obtenidos a partir del estudio de información de patentes e información científica para determinar las tendencias tecnológicas en la producción de etanol a partir de los residuos lignocelulósicos.

La fuente de información fundamental para este estudio fue la base de datos de patentes QPAT la cual dispone de un sistema de búsqueda (PlusPat) que incluye cerca de 50 millones de documentos de patentes, colectados a partir de las bases de datos de 75 autoridades mundiales. De estos 50 millones, 14 millones tienen los resúmenes en inglés, existen 9 millones de dibujos, y para la mayoría de las naciones la data acumulada comienza en el principio del siglo XX. Dentro de PlusPat se encuentra la herramienta Fampat que potencia los resultados de la búsqueda al incluir toda la información relacionada con la familia de patentes. También se utilizó la base de datos Esp@cenet internacional, la cual incluye información de cerca de 70 países y regiones del mundo y contiene 59 millones de patentes. Complementariamente se consultaron las bases de datos de patentes de EE.UU. y la de los registros internacionales de patentes de acuerdo al Tratado Internacional de Patentes administrado por la OMPI. Además se utilizaron sitios de búsquedas de información científico-técnica, así como motores de búsquedas de compañías comerciales. Las palabras claves utilizadas están especificadas en el acápite **Estrategia de búsqueda**.

Como resultados importantes de este estudio se pudo concluir que:

- Estados Unidos es el mayor generador de patentes sobre el tema.
- Brasil, como primer productor de etanol a partir de la caña de azúcar, es una fuente de información muy importante, tanto desde el punto de vista empresarial como académico.
- La introducción del proceso de hidrólisis rápida en la producción de etanol a partir de los residuos lignocelulósico, permite, de una manera factible, usar esta materia prima como alternativa.
- Existe un auge de proyectos e inversiones relacionados con el tema ya que se ha demostrado que es viable la utilización del material lignocelulósico como fuente de energía renovable.

En el cuerpo de este informe si incluyen de forma explicita todos los resultados obtenidos a partir del análisis de información, los cuales permitieron llegar a estas conclusiones.

1. Introducción al estudio.

En este trabajo nos proponemos poner a disposición de los clientes, un paquete informativo con valor agregado, basado en el análisis, validación, y conjugación de las fuentes de información que estén a nuestro alcance. Esta gestión de la información, realizada para brindar conocimientos, resulta una herramienta poderosa para cualquier organización. Es importante tener en cuenta, que el desarrollo tecnológico es un proceso dinámico, por lo que su supervisión presupone métodos sistemáticos, con análisis de indicadores, señales de avisos, y seguimiento de tendencias para lograr una identificación precoz de oportunidades o amenazas, cuestión vital en el diseño de estrategias para las organizaciones.

Dentro de las fuentes de información a analizar se encuentra la información de Patentes. Los documentos de patentes tienen características técnico - legal que delimitan el alcance de los derechos monopólicos de comercialización sobre los objetos de invención amparados en las patentes tanto territorial como temporalmente, por ello en su contenido no se exige que se demuestre científicamente el por qué ocurren estos resultados. En esta fuente de información se recupera fundamentalmente alternativas de solución a problemas técnicos de la industria o de la sociedad en general, que para poder constituir objetos de invención deben ser innovaciones, tanto de productos o procesos que satisfagan los requisitos de patentabilidad: novedad mundial, actividad inventiva y aplicabilidad industrial.

Esta fuente de información presenta una serie de ventajas frente a otras fuentes de información entre las que se destacan:

- Trasmiten información reciente con un considerable tiempo de anticipación (dos a tres años) de la salida del producto al mercado, con un contenido científico técnico que en más de un 70% no aparece en otras fuentes.
- La información contenida es muy útil para la generación de nuevas innovaciones técnicas realmente competitivas en el mercado, para la adquisición de tecnologías, y para soluciones técnicas en la industria.
- Permite, a través de la fecha, realizar estudios de obsolescencia, tendencias, ciclos de vida, predicción de precios, valores, etc.
- Permite identificar lugares, autores, y patrocinadores de la competencia.

Conjugar la información de patentes, la información científico -comercial, y los criterios y valoraciones de expertos, a través del prisma de las necesidades del cliente, permite mostrar una visión global del desarrollo tecnológico en estudio. Lo cual suministra, de esta manera, elementos esenciales para la toma de decisiones.

El Tema del presente Informe es el siguiente:

- Estado Actual de la Técnica sobre producción de etanol a partir de residuos lignocelulósicos.

Para realizar este estudio analizaremos información publicada en documentos de patentes, artículos científicos, dictámenes de expertos, informes de autoridades nacionales, informes de organizaciones no gubernamentales, información de empresas productoras y comercializadoras, y cualquier otra fuente confiable de información que contribuya a

establecer, lo más real posible, el estado actual de la técnica relacionada con el tema en análisis.

Los BIOcombustibles son aquellos combustibles producidos a partir de biomasa y que son considerados, por tanto, una energía renovable. Se pueden presentar tanto en forma sólida (residuos vegetales, fracción biodegradable de los residuos urbanos o industriales) como líquida (bioalcoholes, biodiésel) y gaseosa (biogás, hidrógeno).

El alcohol etílico o etanol es un producto químico obtenido a partir de la fermentación de los azúcares que se encuentran en los productos vegetales. Estos azúcares están combinados en forma de sacarosa, almidón, hemicelulosa y celulosa. Actualmente, el bioetanol es el biocombustible con mayor producción mundial. Para su fabricación se pueden utilizar una gran cantidad de materias primas. El mayor productor mundial de etanol son los Estados Unidos con una producción anual aproximada de 18 Billones de litros, esta producción proviene principalmente del almidón de maíz, y muy cercano a él está Brasil con una producción anual de 17 Billones de litros principalmente a partir de caña de azúcar. También se utiliza remolacha, cereal o residuos forestales, etc. En la figura No. 1 se pueden observar una comparación en cuanto a rendimiento de diferentes cultivos energéticos**.**

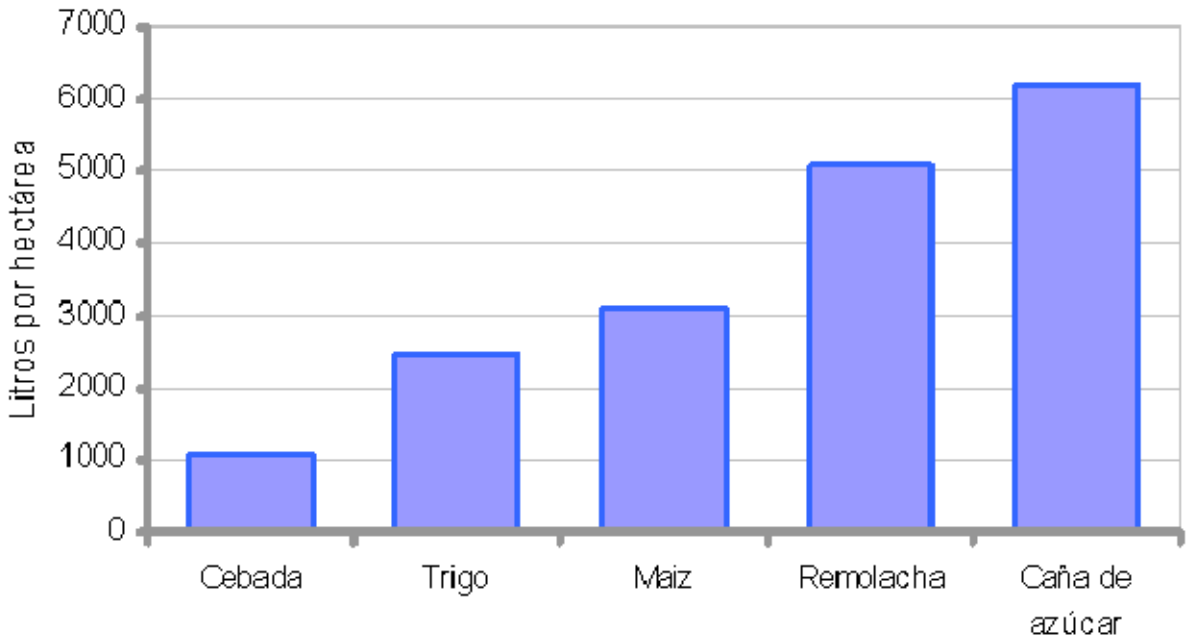


Figura No.1. ***Rendimiento por cultivos energéticos.***

1.1. Problemática

La subida de precio de los alimentos y los últimos informes negativos sobre estos BIOcombustibles han generado el rechazo y la desconfianza de la sociedad. La Agencia para los Combustibles Renovables de Reino Unido, llamado Informe Gallagher, recomienda frenar los objetivos de estos carburantes verdes para 2020 hasta que se pueda asegurar su sostenibilidad. Estos han pasado en pocos meses de ser parte de la solución para el cambio

climático a convertirse en el foco de todas las críticas. Sin embargo, no todos los biocombustibles tienen la misma responsabilidad en la crisis alimentaria global.
Un reciente estudio secreto del Banco Mundial, publicado por "The Guardian", aseguraba que el impacto de estos carburantes puede suponer el 75% del aumento de precio del maíz y el trigo. Pero dicho informe excluía de esa cifra al sustituto vegetal de la gasolina producido a partir de caña de azúcar. De hecho, este producto es la única materia prima agrícola que no ha aumentado de precio desde 2006, mientras el aumento medio del resto de alimentos ha sido del 83% en el mismo periodo.

El ciclo de vida del bioetanol de caña de azúcar emite cerca de un 85% menos de CO_2 que las gasolinas procedentes del petróleo, según datos extraídos de informes del "Worldwatch Institute" y de la Agencia Internacional de la Energía. El bioetanol producido a partir de cereales en Europa o Estados Unidos genera un 30% menos de carbono que la gasolina y el producido a partir de remolacha en la Unión Europea tiene un 45% de reducción.

Los materiales lignocelulósicos son los que ofrecen un mayor potencial para la producción de bioetanol. Se generan como residuos en los procesos productivos de los sectores agrícola, forestal e industrial. Muchos de estos residuos no sólo tienen valor económico en el contexto donde se generan sino que pueden ser causa de problemas ambientales durante su eliminación.

Sin embargo, el bioetanol producido a través de residuos lignocelulósicos tiene inconvenientes reportados por varios autores, los más frecuentes son:

- El pretratamiento utilizado tradicionalmente para eliminar la lignina es muy costoso.
- La producción de enzimas capaces de hidrolizar la celulosa/hemicelulosa ocurre en reactores microbiológicos muy costosos.
- El costo de inversión para una planta de producción de bioetanol a partir de bagazo de caña es 50% mayor que para una planta similar a partir de melazas.
- A pesar de que la melaza como materia prima cuesta 4 veces más que el bagazo de caña, el costo unitario por litro es 30% más caro para la producción a partir del bagazo que a partir de la melaza.

En estos momentos Brasil está implementando una nueva tecnología, llamada Hidrólisis Rápida la cual se basa en el máximo aprovechamiento del Bagazo de caña de azúcar la cuaL permitirá aumentar en un 30% la producción de etanol sin sembrar más caña. En el acápite de análisis de Información no patente ahondaremos sobre este aspecto.

1.2. Proceso

En la figura No. 2 se observa, de forma esquemática, el proceso completo de obtención del alcohol, a partir de las principales materias primas que se utilizan para su producción.

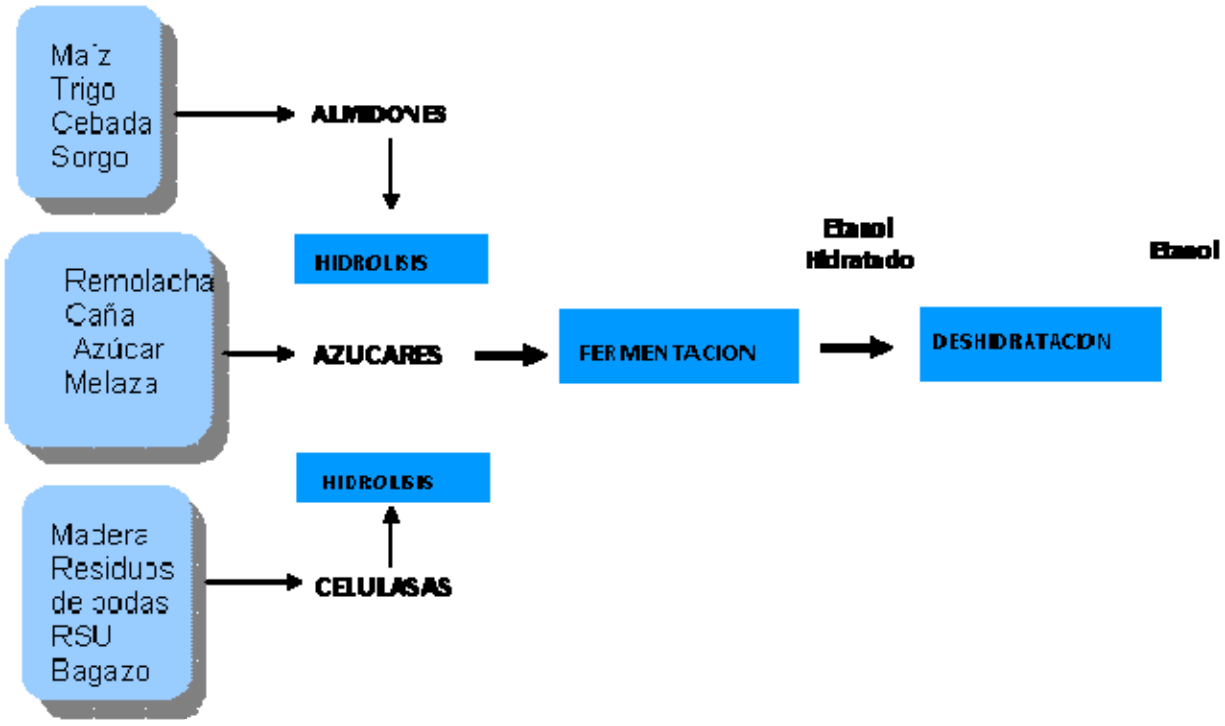


Figura No.2. *Proceso de Producción de Bioetanol.*

Los residuos de biomasa contienen mezclas complejas de carbohidratos, llamados celulosa, hemicelulosa y lignina. Para obtener los azúcares de la biomasa, esta es tratada con ácidos o enzimas que facilitan su obtención. La celulosa y hemicelulosa son hidrolizadas por enzimas o diluidas por ácidos para obtener sacarosa, que es entonces fermentada. Tres son los principales métodos convencionales para extraer estos azúcares: la hidrólisis con ácidos concentrados, la hidrólisis con ácidos diluidos y la hidrólisis enzimática.

A continuación, en la figura No.3, se muestra el contenido de azúcares en los residuos lignocelulósicos, notándose que la celulosa y la hemicelulosa constituyen alrededor del 80% del contenido total.

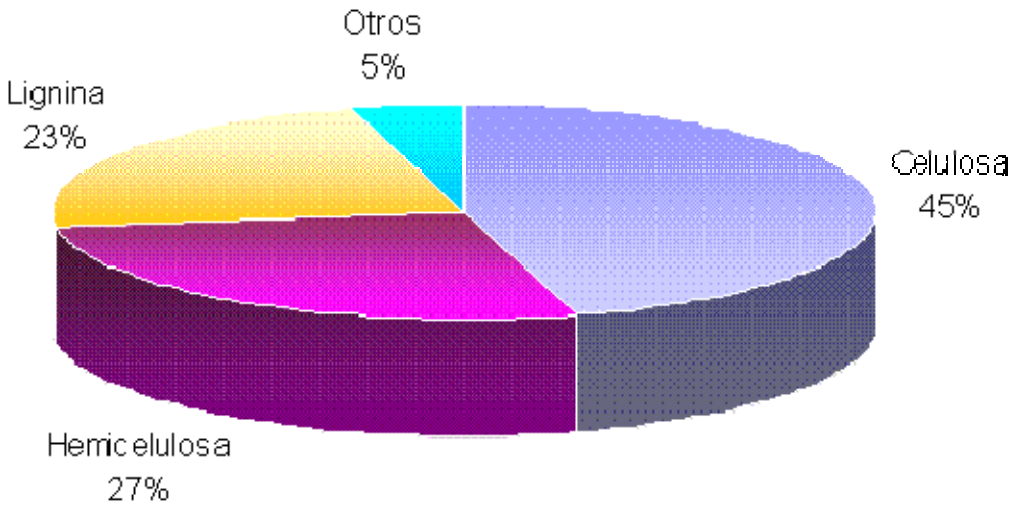


Figura No.3. *Composición de los residuos lignocelulósicos.*

En la figura No.4 se pueden ver las diferentes formas de procesar las materias primas, en función de su origen, para la obtención de sus azúcares.

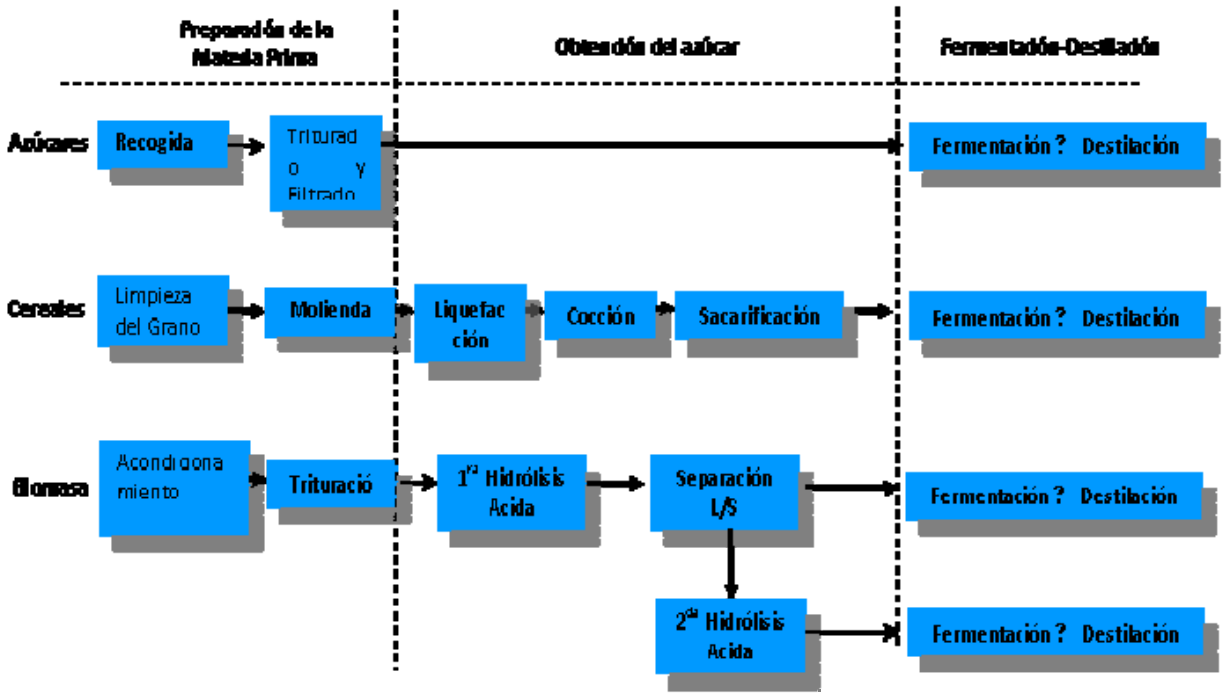


Figura No.4. *Diferenciación de procesos de Producción de Bioetanol.*

Pre-tratamiento

El pre-tratamiento en este proceso juega un rol muy importante ya que a través del mismo se elimina la lignina, que es la primera capa de protección vegetal para poder acceder a la

celulosa interior del material lignocelulósico. Están reportados diferentes tipos de pre-tratamientos, los cuales son representados en la siguiente figura:

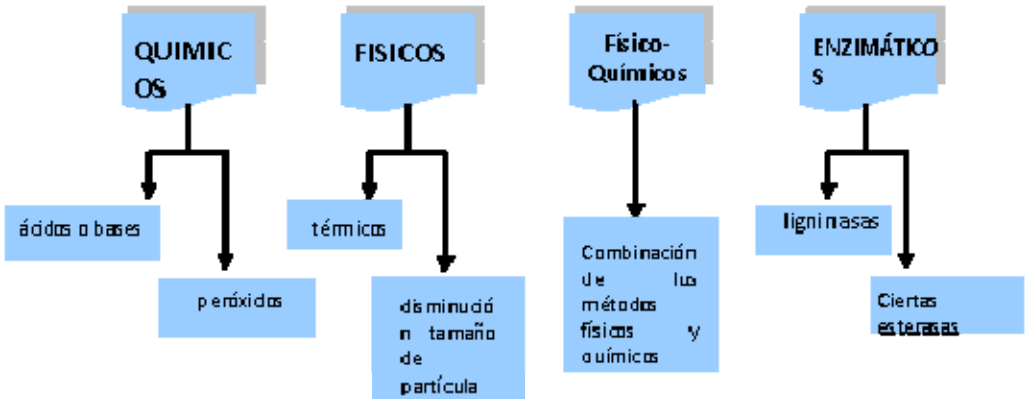


Figura No.5. *Diferentes tipos de pre-tratamientos.*

Hidrólisis

Las celulosas no pueden ser fermentadas directamente, es necesario convertirla en azúcares más sencillos para su conversión en alcohol. La hidrólisis es un proceso químico que divide la molécula de celulosa por la acción de la molécula de agua. Las complejas estructuras de la celulosa (celulosa, hemicelulosa y lignina) son divididas en diferentes procesos para conseguir una solución azucarada, y eliminar productos de descomposición de los azucares que pueden inhibirlo, al menos, dificultar el proceso de fermentación. Principalmente se realizan procesos de hidrólisis de ácidos concentrados y bajas temperaturas, de ácidos diluidos y altas temperaturas y enzimáticos.

Hidrólisis con ácidos concentrados.
En este proceso se añade entre 70-77% de ácido sulfúrico a la biomasa, que ha sido secada previamente hasta obtener una humedad menor del 10%. La proporción de ácido es de 1:25 por cada parte de biomasa y se mantiene a una temperatura controlada de 50ºC. Entonces se añade agua, para diluir el ácido a un 20-30% de la mezcla, aumentando su temperatura hasta los 100ºC. El gel producido en este proceso es prensado para obtener la mezcla de acido y azúcar, que finalmente son separados. Este es un proceso del que se obtiene rendimientos muy elevados pero a un costo igualmente muy elevado, por lo que industrialmente no se realiza.

Hidrólisis con ácidos diluidos.
Es uno de los procesos de hidrólisis más antiguos, simples y eficientes para la producción del alcohol. El primer paso es mezclar una proporción de 0,7% de ácido sulfúrico con la hemicelulosa presente en la biomasa, para que se hidrolice a 190ºC. La segunda parte consiste en optimizar el rendimiento de la reacción con la parte de la celulosa más resistente, para ello se usa un 0,4% de ácido sulfúrico a 215ºC. Finalmente los líquidos hidrolizados son neutralizados y recuperados, normalmente mediante percolación.

Hidrólisis enzimática.
Consiste en “romper” (hidrolizar) la celulosa por la adición de determinadas enzimas. La celulosa es degradada por las celulasas a azúcares, que pueden ser fermentados por levaduras o bacterias para producir etanol. En síntesis, el proceso consiste en descomponer

la celulosa y la hemicelulosa del residuo en azúcares sencillos y transformarlos en etanol por fermentación. En primer lugar se lleva a cabo un pretratamiento del residuo cuyo objetivo es alcanzar los mejores resultados en las etapas siguientes (hidrólisis y fermentación). Desde el punto de vista económico, esta etapa es crítica, puesto que gran parte del coste total del proceso estaría en esta primera etapa. Como resultado del pretratamiento se obtiene una disolución de azúcares provenientes de la ruptura de la hemicelulosa y un residuo sólido (constituido principalmente por la celulosa del residuo original).

La hidrólisis enzimática presenta ventajas frente a la hidrólisis química, como menores costos de equipamiento (debido a que se realiza a presión atmosférica y a temperatura próxima a la ambiental), mayores rendimientos y no necesita utilizar agentes químicos.

1. Bases de Datos y Sitios de Internet Consultados.

Las bases de datos de información de patentes e información científico técnica, consultadas en esta investigación fueron:

Tabla No.1. *Sitios de Bases de Datos en Internet.*

Países/Org.	Base de datos	Períodos consultados
Internet	QPAT	1900 - 2008
Estados Unidos	USPTO	1976 - 2008
Internet	Espacenet-Worl Wide	1900 - 2008
Internet	Scirus	1900- 2008
Internet	Scholar Google	1976 - 2008

1.1. Otros Sitios de Interés.

- **http://www.elmundo.es/**

Diario español El Mundo, artículo "La caña de azúcar: la mejor alternativa al petróleo" publicado el 21 de julio del 2008.

- **http: //www.ciatej.net.mx/**

Centro de Asistencia en Tecnología y Diseño de Jalisco, México.

- **http://ceticismo.wordpress.com/2007/12/17/bagaco-da-cana-tambem-produz-alcool/**

Sitio de ciencia y tecnología brasileño.

- **http://www.una.ac.cr/campus/**

Oficina de Comunicación. Universidad Nacional de Costa Rica.

- **http://www.dedini.com.br/es/dhr.html**

Portal de Industrias DEDINI. Brasil

- **http://sistemasdeproducao.cnptia.embrapa.br/FontesHTML/Graspa/SistemaProducaoGraspa/fermentacao.htm**

Portal de la empresa brasileña para la producción de vino.

- **http://eventos.fim.uclv.edu.cu/comec/cd/ponen/c1/c1-29.pdf**

Universidad de Villa Clara.

- **http://www.iea.usp.br/iea/online/midiateca/etanolcelulosicosoares.pdf**

Instituto de Estudios Avanzados. Brasil.

- **http://www.senado.gob.mx/comisiones/LX/agroindustriaazucarera/content/eventos/forocadenadevalor/foro_guadalajara/bioenergeticos5.pdf**

Colegio de Post-graduados. México.

- **http://www.madrimasd.org**

Universidad Rey Juan Carlos del Círculo de Innovación en Tecnologías Medioambientales y Energía (CITME).

- **http://www.biodieselspain.com/2008/04/04/bioetanol-lignocelulosico-y-switchgrass/**

Sitio de Debate y marketplace de biocombustiles.

- **http://www.bolsageneral.es/acciones/abengoa/abengoa-produce-etanol-en-eeuu-a-partir-de-biomasa/**

Sitio de análisis e la bolsa de valores**.**

2. Estrategia de Búsqueda.

Por Clasificación Internacional de Patentes:

C12P Procesos de fermentación para la síntesis de un compuesto químico dado de composición dada. C12P 7/00 Preparación de compuestos orgánicos que contienen oxígeno. C12P 7/08 Preparación como subproducto o preparado a partir de un sustrato constituido por desechos o materias celulósicas.

Por palabras claves y operadores autorizados:

1. Bagasse fermentation ethanol
2. Bagaço fermentação álcool
3. Pretreatment bagasse fermentation.
4. Acid hydrolysis lignocellulosic
5. Enzyme hydrolysis lignocellulosic.
6. Lignocellulosic ethanol
7. Straw sugar cane Hydrolysis ethanol

La búsqueda realizada, conjugando las diferentes estrategias, arrojó como resultado 61 familias de patentes relacionadas con el tema del boletín. Los resúmenes de las patentes se encuentran en el **ANEXO 1**. Además se encontraron 26 artículos vinculados a proyectos de investigación e información académica resumidos en el **ANEXO 3**.

3. Análisis de Información.

3.1. Patentes.

Se recuperaron 61 familias de patentes relacionadas con la producción de etanol a partir de los residuos lignocelulósicos. En la el figura No. 6 se muestra la distribución de las patentes por países de origen.

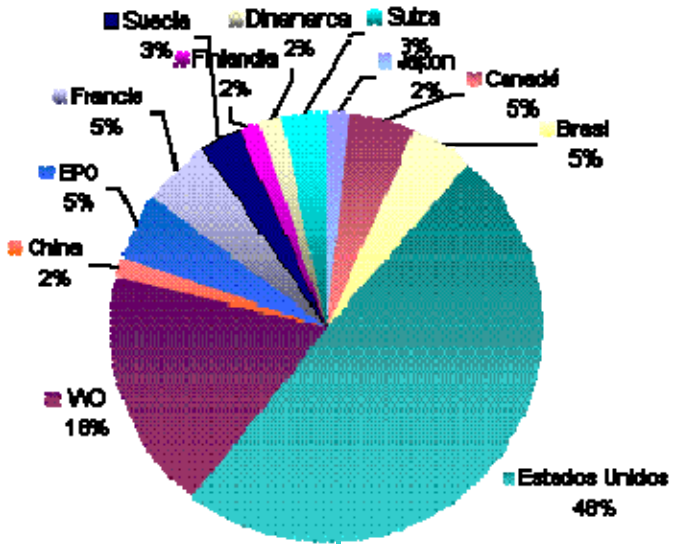


Figura No. 6. *Distribución por países de origen de las patentes publicadas*

Nótese como la generación de patentes está centralizada en los países desarrollados siendo Estados Unidos quien ha generado el 48% de las mismas, además se observa una tendencia a utilizar la vía PCT para registrar las invenciones. El contenido de los documentos abarca muchos aspectos relacionados con la producción de etanol a partir de los residuos lignocelulósicos, entre ellos se destacan tipos de hidrólisis, tipos de enzimas, tipos de pre- tratamientos, especies de microorganismo, y tipos de residuos lignocelulósicos. En la Tabla No.2 y en la figura No.7 se recoge la información anteriormente explicada con respecto a los procesos de producción. A continuación se relacionan los tipos de microorganismos reportados en los documentos de patentes y los tipos de materiales lignocelulósicos.

Microorganismos

- Sacharomyces cerevisiae.
- Pichia stipitis WPW9 ATCC PTA-3717
- Klugveromyces marxianus
- Klugveromyces genus
- Bacterias etalonogénicas.
- Bacterias anaerobias estrictas termófilas Thermoanazrubacter mathanii
- Clostridium carboxidivorans
- Thermoanazrubacter saccharolyticum.

Material Lignocelulósico.

- Residuos de madera, residuos de cosechas, bagazo de caña, hierbas, árboles gomíferos, madera de haya, roble, álamo, eucalipto, pino, abeto, papel reciclado, pulpa de papel, forraje animal, pajas y hongos.

Tabla No.2. *Temas abordados por las patentes.*

Cantidad de Patentes	Tema
7	Hidrólisis enzimática utilizando celulasa.
1	Hidrólisis enzimática utilizando celulasa y β-galactosidasa en buffer citrato.
4	Hidrólisis enzimática utilizando celulasa y xilasa.
1	Hidrólisis enzimática utilizando celulasa y amilasa.
10	Digestión utilizando métodos físicos-químicos con empleo de solventes orgánicos
1	Pre- tratamiento con líquido iónico.
2	Pre- tratamiento con soluciones alcalinas.
6	Hidrólisis ácida utilizando ácido sulfúrico combinado con hidrólisis enzimática.
1	Pre- tratamiento con hidróxido de amonio concentrado más vapor
1	Pre- tratamiento con vapor.
2	Tratamiento ultrasónico combinado con hidrólisis enzimática.

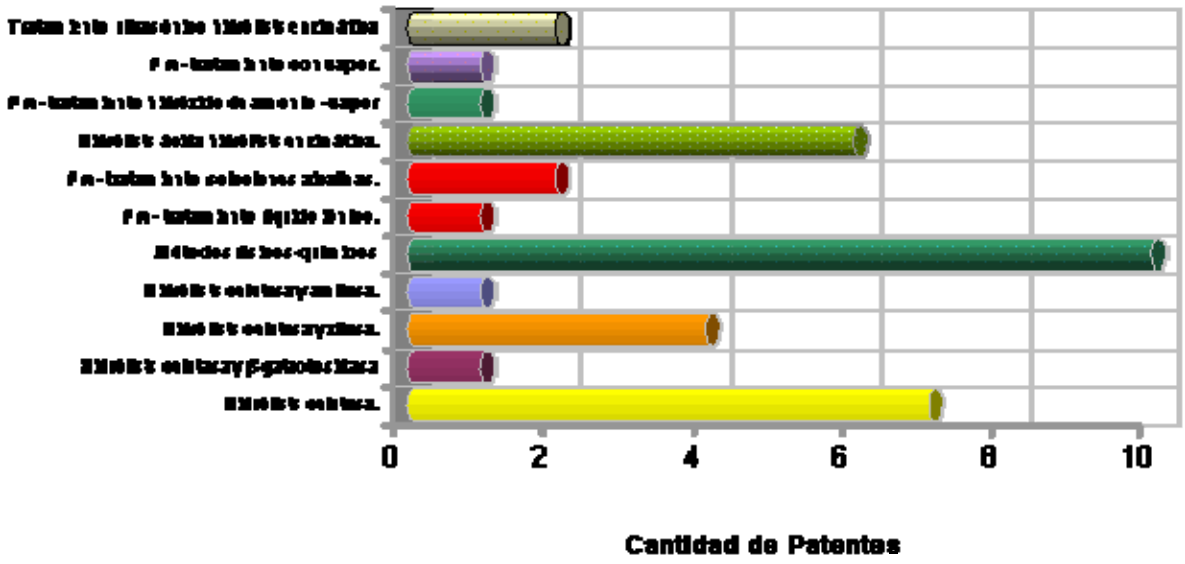
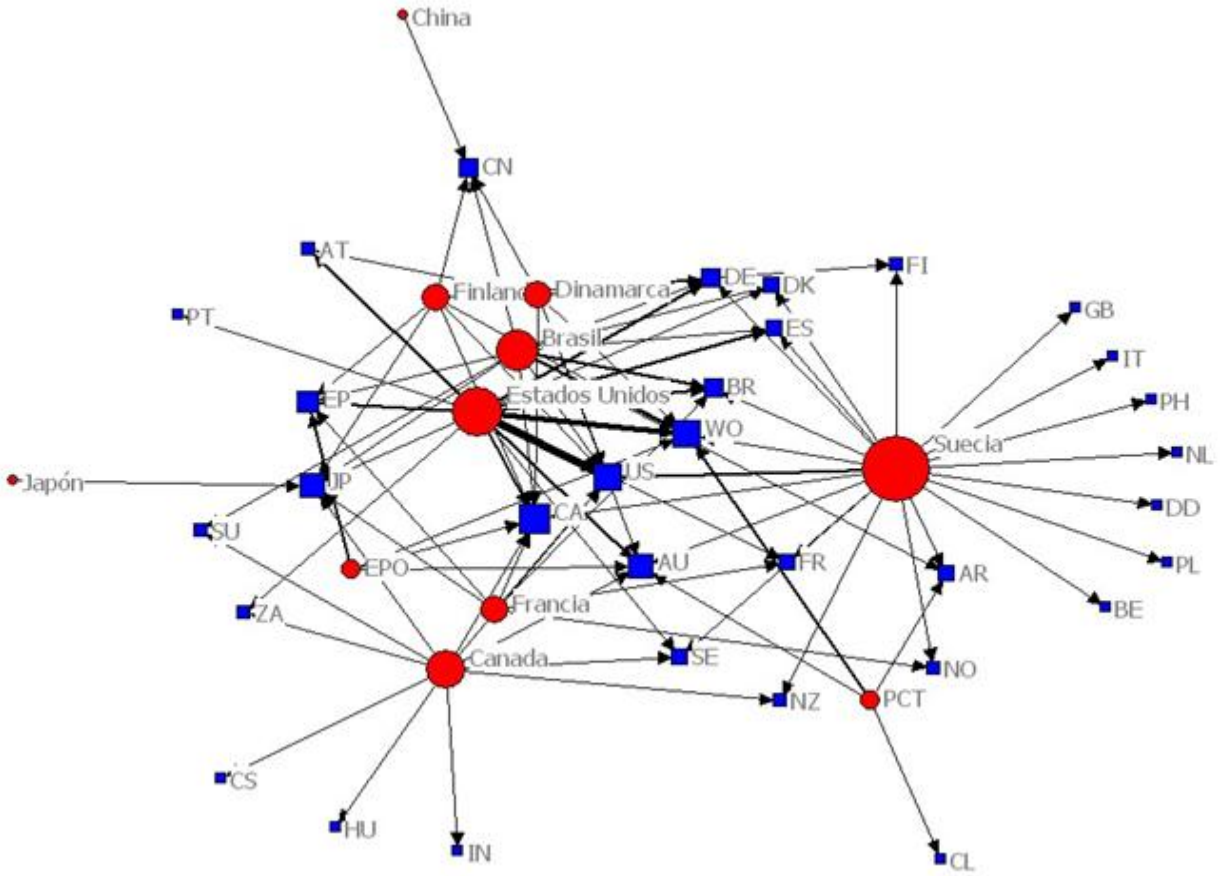


Figura No.7. *Distribución por Temas en los documentos recuperados de patentes publicadas.*

Utilizando la información brindada por los documentos de patentes entre el origen y el destino de las tecnologías realizamos un gráfico, figura No.8, donde se relaciona el flujo de publicación y generación. Las oficinas de origen se representan con un círculo rojo y las de destino se representan con un cuadrado azul. Se observa como Estados Unidos, Brasil y Suecia son los grandes emisores de solicitudes fuera de su territorio. El grosor asociado a algunas flechas indica el número de solicitudes en esa dirección, con lo que pudiéramos identificar la intensidad de internacionalización de la innovación patentada en este sector

por estos países y con ello su interés comercial. Coinciden Brasil y Estados Unidos como los países mayores productores de etanol.



PAIS	Código	PAIS	Código	PAIS	Código	PAIS	Código	PAIS	Código	PAIS	Código
Alemania	DE	OEP	EP	Suiza	SZ	Portugal	PT	Austria	AT	OMPI	WO
Japón	JP	Australia	AU	Francia	FR	Noruega	NO	España	ES	Italia	IT
Estados Unidos	US	Chile	CL	Argentina	AR	China	CN	Holanda	NL	Austria	AT
Dinamaca	DK	Finlandia	FI	Gran Bretaña	GB	Brasil	BR	Polonia	PL	Canadá	CA
Nueva Zelandia	NZ	Filipinas	PH	Bélgica	BE	Sudáfrica	ZA	Hungría	HU	India	IN
Unión Soviética	SU	Suecia	SE								

Figura No.8. *Origen y Destino de las tecnologías.*

En la figura No.9 se observa una clara meseta en la publicación de patentes de casi 17 años entre 1980 y 1997. En los años 70' la producción de bioetanol cobró auge por el incremento de los precios de la gasolina debido a la crisis energética internacional. A partir de los 80' el precio de la gasolina cayó estrepitosamente por lo que todos los proyectos investigativos, el desarrollo de tecnología y las inversiones se congelaron. No ha sido hasta años recientes, donde se ha retomado el desarrollo de combinaciones de combustibles utilizando el etanol en la mezcla, debido al alza de los precios de los combustibles fósiles.

Muchos son los campos investigativos donde se incursiona en la actualidad como son el biodiésel, el empleo de las mezclas de etanol en la gasolina, o el uso del ETBE (etil terbutil éter) como aditivo, etc, los cuales son de máxima importancia para la generalización del empleo de energías renovables y el desarrollo sostenible.

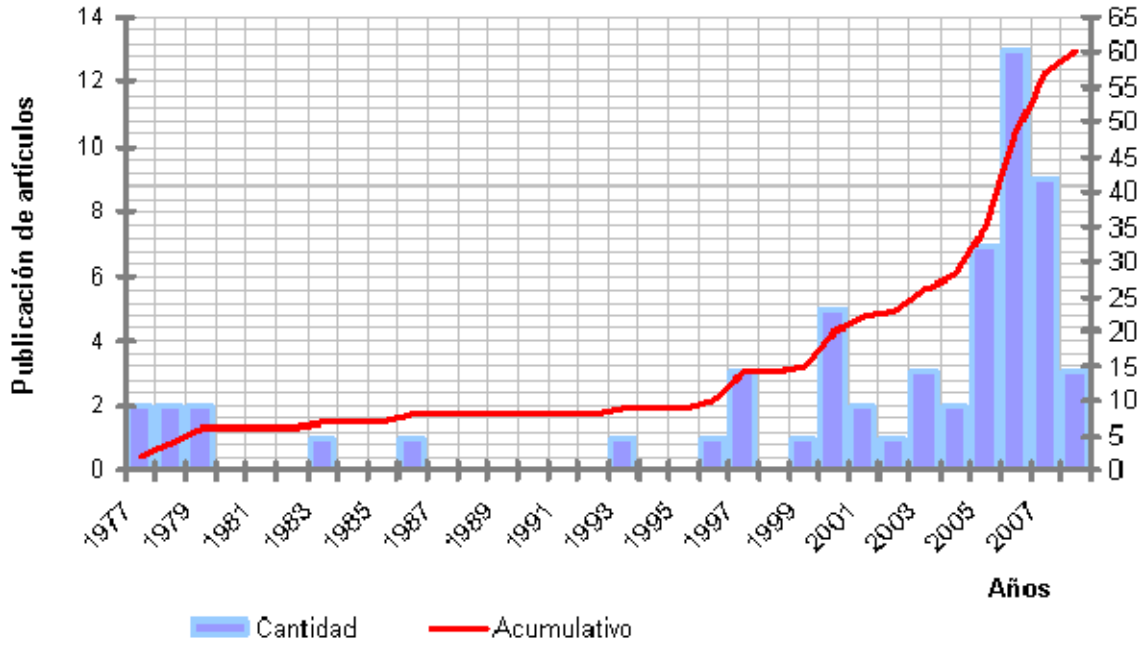


Figura No.9. *Publicación de patentes.*

En la figura No 10 se muestra la relación de titulares por patentes. Se observa como Estados Unidos tiene el 48% del total de patentes repartidas en 6 universidades, 1 centros de investigación y 4 compañías. Francia esta representada por el Instituto Nacional del Petróleo y Dinamarca por dos compañías, en estos casos las patentes están referidas a resultados de investigaciones básicas con probabilidades de ser aplicadas industrialmente.

Por otro lado, es importante señalar que la titularidad de las patentes brasileñas, país reconocido como el mayor productor de alcohol a partir de caña de azúcar, recae en dos de los grupos nacionales empresariales más potentes del país. Uno relacionado con los combustibles (Petrobrás) y otro con la agroindustria azucarera (DEDINI). El Resumen de las patentes de ambas empresas se encuentra en el **ANEXO 2**.

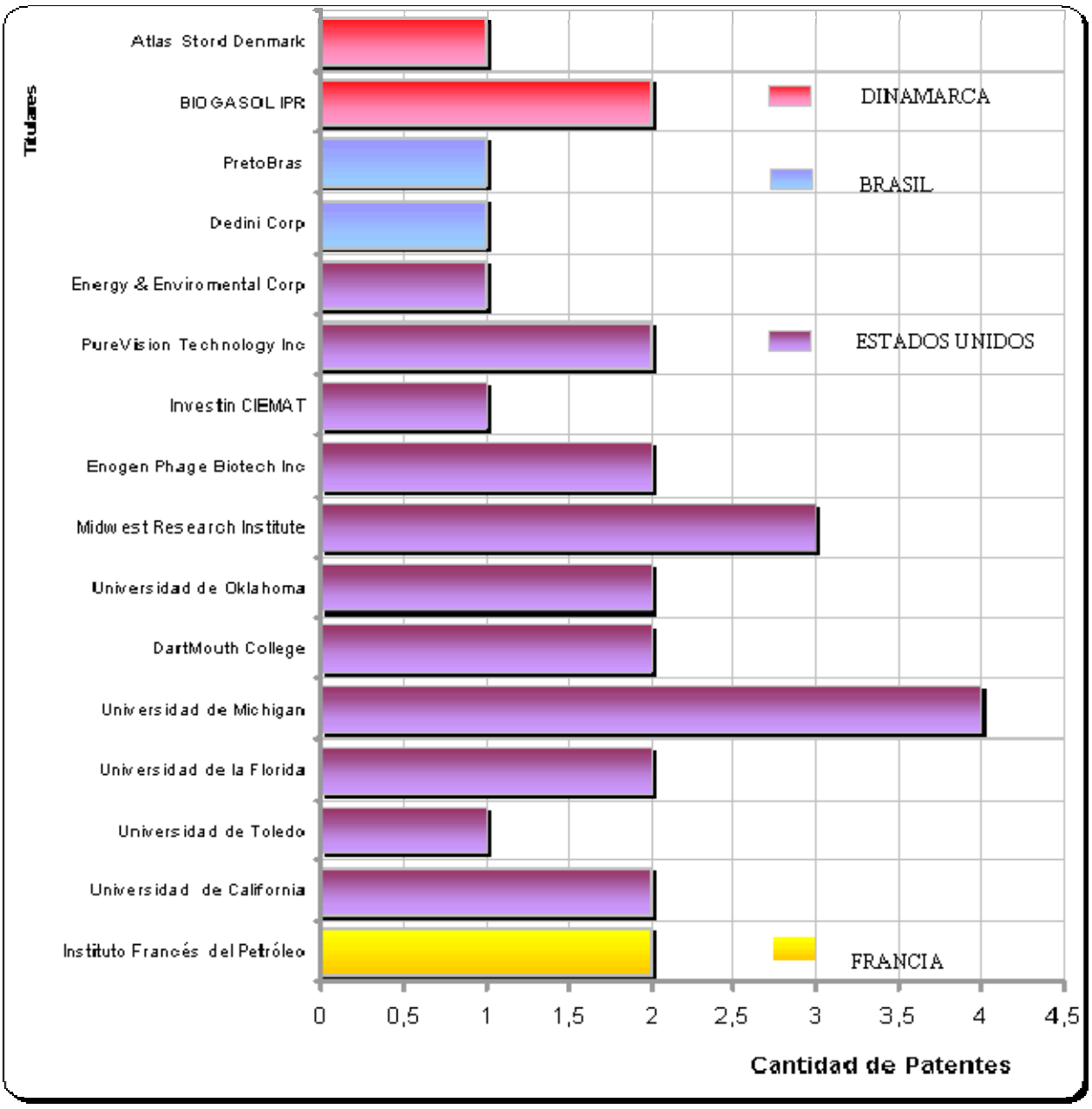


Figura No.10. *Titulares de patentes.*

PetroBras presenta la solicitud de una patente **BRPI0605017** para un proceso completo de obtención de alcohol a partir de residuos lignocelulósicos en especial bagazo de caña de azúcar. La cual comprende un paso de hidrólisis ácida de la hemicelulosa con ácido sulfúrico ocurriendo simultáneamente una fermentación alcohólica en la cual el índice de conversión a etanol es muy alto en muy poco tiempo. Dedini, uno de los mayores Grupos empresariales fabricantes de máquinas e implementos para el sector de azúcar y alcohol, ha depositado varios pedidos de patente referentes al proceso Dedini Hidrólisis Rápida (DHR) en Brasil; dos de éstas ya han sido concedidas y otras se encuentran en estudio. En el exterior, se solicitaron patentes en algunos países de Europa y en Japón. En Estados Unidos, la patente principal **BRPI0505212** ya ha sido otorgada. Esta patente comprende el diseño de un reactor en el cual, el residuo lignocelulósico, está distribuido a lo largo del

mismo y este está sometido a un flujo de solvente orgánico, agua y un ácido inorgánico fuerte diluido. Bajo estas condiciones se obtienen un extracto contenido en la fase líquida, mientras que la sólida no reacciona, este proceso ocurre bajo condiciones de temperatura controlada, y recirculación. La generalización de este proceso permitirá que Brasil, en el año 2012 suministrar el 10% de etanol de toda la gasolina global.

3.2. Información no Patente.

Se analizaron 26 artículos vinculados a usos en proyectos de investigación e información académica resumidos en el ANEXO 3.
En la figura No.10, mostramos la cinética de publicación de artículos científicos en los últimos 10 años.

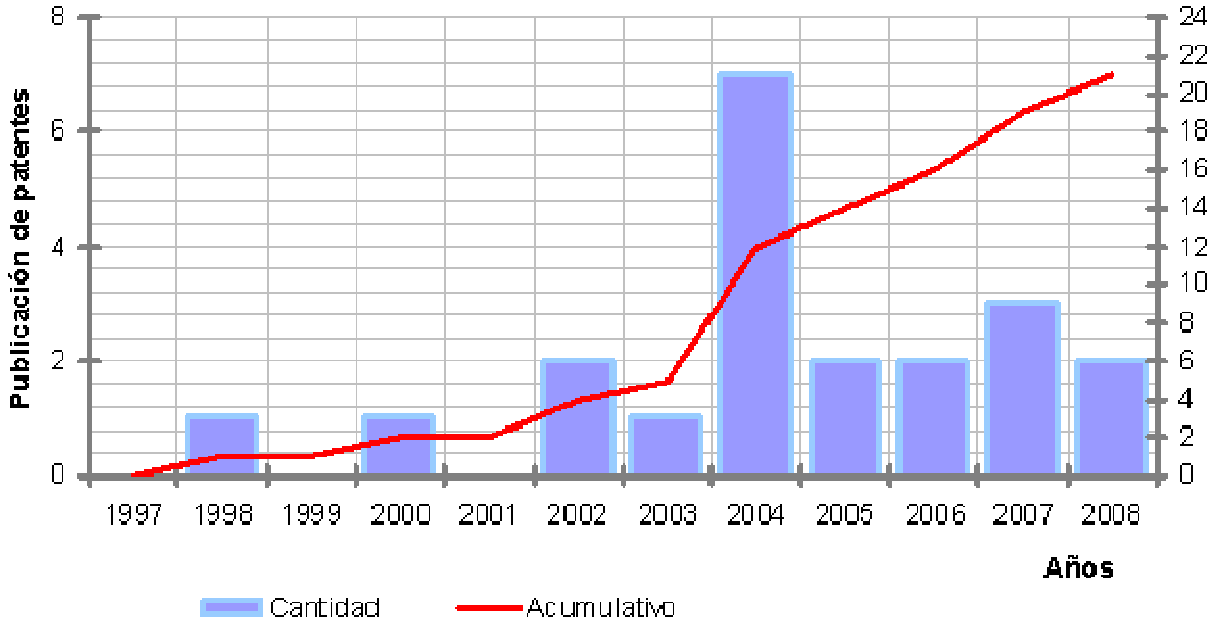


Figura No.11. *Publicación de artículos científicos.*

De todos los artículos encontrados, el 65% fueron publicados en los últimos 10 años. Es conveniente explicar que a su vez, se encontraron 3 artículos de principio de siglo XX relacionados con la hidrólisis ácida de la caña de azúcar, publicados en eventos de la revista "Royal Society of London".

En la siguiente tabla se relaciona la cantidad de publicaciones por revistas y año de publicación.

Tabla No.3. *Relación de publicación de artículos por Revistas.*

REVISTA	Cantidad de	Año de la

	artículos	publicación
Applied Biochemestry and Biotechnology	1	2003
	1	2005
	1	2007
	1	2008
Journal of Food Engineering	1	2002
	1	2004
	1	2006
Biotechnology Bioengineering	1	1987
Catalysis Today	1	2000
Polymer Degradation and stability	1	2004
Applied Polymer Science	1	2004
Journal of Chromatography	1	2004
Biomacromolecules	1	2005
Canadian Journal of Microbiotechnology	1	2008

Nótese que las la gama de revista que han publicado sobre este tema es amplia y la que más publicaciones tienen, son la **Applied Biochemestry and Biotechnology** y la **Journal of Food Engineering,** dos publicaciones de alto impacto en la comunidad científica.

A continuación, en la tabla No 4 y la figura No 11 relacionamos las instituciones que más publicaciones han generado en los últimos 10 años. Se observa como las universidades Brasileñas acaparan el 30% del total de artículos, y las otras instituciones pertenecen a países productores de azúcar a partir de la caña, con excepción de España.

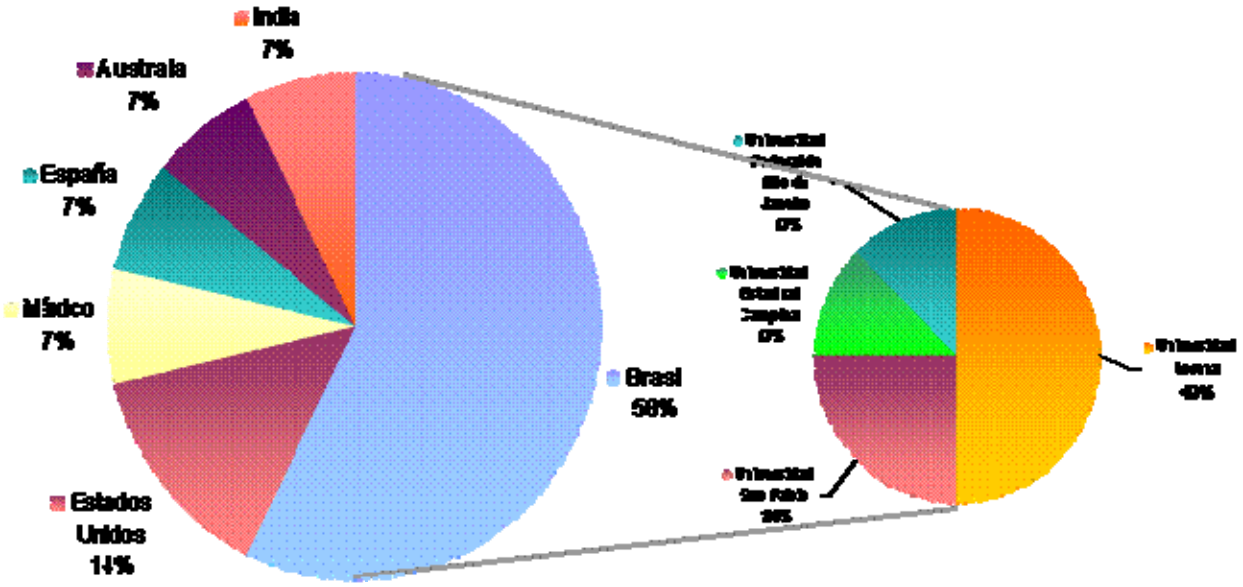


Figura No.12. *Distribución por países e Instituciones de artículos científicos publicados.*

Tabla No.4. *Distribución por países e Instituciones de artículos científicos publicados.*

INSTITUCIÓN	País	Cantidad de publicaciones
Universidad de Lorena	Brasil	4
Universidad de Sao Pablo		2
Universidad Estadual de Campina		1
Universidad Federal de Río de Janeiro		1
Universidad Auburn Texas	E.U.A	1
Instituto del Azúcar de Los Angerles		1
Universidad de Tamulipas	México	4
Universidad Santiago de Compostela	España	3
Instituto de Investigaciones azucareras de Australia	Australia	1
Universidad de Delhi	India	1

En el proceso de recuperación de información, quedó evidenciado que la mayor cantidad de información disponible se encuentra en los sitios de información científico-técnica y comercial de los países con mayor volumen de exportación de bioetanol, tomaremos a Brasil como ejemplo por ser el mayor exportador a nivel mundial de etanol a partir de caña de azúcar y a los Estados Unidos como el mayor productor de etanol a partir de maíz.

3.2.1. Brasil.

En Brasil el 45% de los carburantes que se usan para el transporte provienen de la caña de azúcar. El 1% de la tierra cultivable produce casi el 50% del combustible que se consume en el país", asegura Marcos S. Jank, presidente de la Asociación de la Industria Brasileña de la Caña de Azúcar (UNICA). La cosecha no cesa durante los 12 meses del año ya que existen variedades de caña adaptadas a las condiciones climáticas de las épocas secas y de lluvias.

En estos momentos se está implementando en los centrales y refinerías de azúcar y alcohol de Brasil una nueva tecnología desarrollada en el Centro de Tecnología (CTC) de la Cooperativa de Productores de Caña, Azúcar y Alcohol del Estado de São Paulo (Copersucar) de Piracicaba y del grupo empresarial DEDINI, uno de los mayores fabricantes de máquinas e implementos para el sector de azúcar y alcohol. Esta tecnología es capaz de hacer crecer la producción de alcohol alrededor de un 30% sin necesidad de plantar ni una caña más. Esto es resultado del aprovechamiento total de la biomasa de la caña, más precisamente del bagazo. Estos investigadores consiguieron comprobar que es posible fabricar alcohol etílico (etanol) carburante partiendo del bagazo de la caña, mediante un proceso denominado Dedini Hidrólisis Rápida (DHR). El proceso DHR podrá suministrar alcohol a costos competitivos, utilizando una materia prima ya existente y liberando más caldo de caña para la producción de azúcar.

La tecnología está formada por un reactor, que opera a una presión de entre 25 y 27 kg/cm2 y a una temperatura próxima a los 190 grados, es continuamente alimentada con bagazo y con un hidrosolvente orgánico (etanol, preferentemente, pese a que otros, como la acetona, el ácido acético y el metanol pueden también emplearse) mezclado con ácido sulfúrico. Esa mezcla hará la transformación de la celulosa presente en el bagazo en glucosa. En seguida, el jarabe de glucosa es purificado, para retirar las sustancias indeseables, principalmente el ácido sulfúrico, y recibe la adición de nutrientes, resultando en un mosto fermentable que se mezclará al caldo y a la melaza utilizada normalmente para la fabricación del alcohol. El resto del proceso -fermentación y destilación- es realizado en las instalaciones ya existentes.

La gran ventaja del proceso DHR es su rapidez, según criterio del ingeniero químico Antônio Hilst, consultor de Dedini que inventó la técnica, la cual queda protegida en una patente que hicimos referencia en el acápite **4.1 Patente**. La transformación se produce en apenas diez minutos, en cuanto que los procesos clásicos de hidrólisis que recurren a ácidos concentrados o diluidos demoran por lo menos cinco horas. El bagazo permanece dentro del reactor el tiempo necesario para que se produzca la disolución de la lignina y la hidrólisis de la celulosa llegando a un rendimiento de alrededor de un 60% sobre el azúcar contenido en el bagazo lo cual garantizar una fermentación y una destilación completamente viables desde el punto de vista económico.

La glucosa es tan solo una de las sustancias resultantes del beneficiado. Al margen de ésta, se extraen del bagazo otros subproductos, como el metanol, el ácido acético, la lignina y el furfural, cuyo uso comercial podrá elevar aún más la rentabilidad del proceso.

3.2.2. Estados Unidos

Entre los artículos encontrados comentaremos el del científico Jay J. Cheng el cual es profesor de la Universidad NC State, en Carolina del Norte. Este artículo contempla el estudio energético del "switch grass", un tipo de pasto que habitualmente está destinado a la alimentación del ganado y que hoy es considerado de menor impacto ambiental que la producción de maíz. Cheng manifiesta que para explotar el "switch grass" no es necesario tener una tierra fértil; porque crece en cualquier superficie. Un informe científico publicado por la revista "Proceedings of the National Academy of Sciences" muestra que el "switch grass" produce más de energía que la que se requiere para procesarlo en la obtención de etanol.

Una de las ventajas de este pasto es que absorbe del dióxido de carbono de la atmósfera durante su crecimiento. Aunque el desarrollo de esta fuente está menos avanzada que el de los cereales, es una energía viable. Por eso, hay grupos de investigación en el mundo que alientan los estudios del "switch grass" y de los materiales lignocelulósicos: residuos agrícolas, agroindustriales y forestales. Por otro lado, Cheng colabora con la Universidad Pontificia Católica de Ecuador en un proyecto dirigido por el científico Javier Carvajal, jefe del área de levaduras del Laboratorio de Bioquímica dedicado a impulsar los estudios de materiales lignocelulósicos. Su equipo está produciendo, a escala de laboratorio, etanol a partir de papel reciclado. Decidieron utilizar papel, porque en la Universidad ya existe un proyecto llamado de Reciclaje pro Ambiente para recoger el papel y el cartón generado en las oficinas. Señala que el rendimiento energético de la producción de etanol a partir de maíz, en EE.UU. es, en el mejor de los casos, del 25%. Eso significa que se obtiene menos energía de la invertida. En cambio, con el etanol lignocelulósico, el rendimiento es del 45%, es decir, se obtiene más energía de la que se invierte. Javier Carvajal dice que en el futuro no solo se buscará obtener etanol del papel, sino de desechos vegetales que hay en abundancia: desechos de plátano, palmito y de caña de azúcar. Incluso de los desechos urbanos ya clasificados. El etanol de maíz contabiliza pequeñas emisiones de gases efecto invernadero, lo que no ocurre con el obtenido a partir del etanol de la celulosa.

El científico Cheng señala que el Congreso estadounidense aprobó una ley para que la producción de etanol lignocelulósico llegue a 1000 millones de galones hasta el 2020. Dice que hay un interés creciente por estudiarlo más.

Por otro lado, la compañía española Abengoa Bioenergía ha logrado producir etanol a partir de biomasa en su planta piloto situada en el estado de Nebraska (Estados Unidos), donde ha invertido más de 35 millones de dólares. La planta se dedicará a la investigación y desarrollo de los procesos de producción de biocombustible a partir de biomasa lignocelulósica, la materia prima orgánica más abundante en la tierra y forma parte del acuerdo firmado con el DOE (Ministerio de Energía estadounidense) en 2003. Ubicada en las instalaciones de producción de etanol de Abengoa Bioenergía en York (Nebraska), la planta piloto de la empresa española investigará y probará una tecnología patentada de conversión de biomasa a etanol para su uso a nivel comercial, no se ofrecen detalles sobre la tecnología referida, aunque por nuestra investigación Abego no presenta patentes sobre el tema. Las innovaciones tecnológicas obtenidas se pondrán en práctica en la biorrefinería de biomasa que Abengoa Bioenergía está construyendo en Kansas y que será pionera en su género.

La planta piloto inaugurada por Abengoa Bioenergía en Estados Unidos es única en su género; servirá de plataforma para la prueba de nuevos equipos, sistemas y catalizadores necesarios para descomponer varios compuestos orgánicos y procesarlos, como materias herbáceas y leñosas, optimizando en varios procesos de obtención de etanol. Será también un núcleo de investigación y de capacitación para otros equipos dentro de Abengoa Bioenergía mientras la empresa evalúa y prueba productos adicionales, equipos y otros procesos en cuyo diseño se está trabajando actualmente para mejorar los procesos orgánicos de biomasa.

Además, durante el transcurso del acto, Javier Salgado ha anunciado que ha firmado un contrato de colaboración con el Departamento de Energía de Estados Unidos (DOE) por importe de 38 millones de dólares para el diseño y desarrollo de la primera planta mundial a escala comercial de producción de etanol a partir de biomasa en Hugoton, Kansas.

Esta planta de biomasa procesará 700 toneladas métricas de biomasa al día para producir anualmente 44 millones de litros de etanol, además de otras formas de energía renovable en forma de electricidad y vapor. La planta de biomasa tendrá anexa una planta de etanol convencional a partir de cereal de 88 millones de galones (más de 300 millones de litros), que permitirá a ambas disfrutar de las sinergias de una capacidad combinada de 100 millones de galones (más de 400 millones de litros). La inversión conjunta superará los 300 millones de dólares. Abengoa Bioenergía presente en Estados Unidos, Brasil y Europa, invertirá más de 500 millones de dólares en los próximos cinco años en su programa tecnológico de producción de etanol a partir de biomasa lignocelulósica.

Conclusiones

- Se recuperaron 61 familias de patentes relacionadas con el tema.
- El 48% de las patentes recuperadas fueron generadas por los Estados Unidos, abarcando muchos aspectos relacionados con la producción de etanol a partir de los residuos lignocelulósicos, entre ellos se destacan tipos de hidrólisis, tipos de enzimas, tipos de pre-tratamientos, especies de microorganismo, y tipos de residuos lignocelulósicos.
- El Brasil es el mayor país productor-exportador de etanol a partir de caña de azúcar y Estados Unidos el mayor productor - exportador de etanol a partir del maíz.
- Hay una voluntad general de los gobiernos de estimular los proyectos y las inversiones en plantas de procesamiento de materiales lignocelulósicos para obtener etanol ya que el rendimiento energético de la producción es del 45% comparado con el 25% a partir de maíz, es decir, se obtiene más energía de la que se invierte.
- Se contabiliza pequeñas emisiones de gases efecto invernadero, lo que no ocurre con el obtenido a partir del etanol de la celulosa.
- Se recuperaron 2 patentes brasileñas de alto impacto en la producción de etanol a gran escala. Las grandes empresas Petrobrás y DEDINI son los titulares de las mismas.
- A través del método de hidrólisis rápida, el procesamiento del material lignocelulósico resulta factible para la producción de bioetanol.
- Se recuperaron 26 artículos científicos encontrándose el 65% de ellos publicados en los últimos 10 años.

- Las revistas **Applied Biochemestry and Biotechnology** y la **Journal of Food Engineering,** fueron las que más artículos han publicado sobre este tema.
- El 30% de los artículos fueron generados por Universidades brasileñas.
- La compañía española Abengoa Bioerngía tiene una fuerte presencia en Estados Unido y Brasil como inversoras en proyectos y Plantas de producción de etanol a partir de material lignocelulósico.

1 Resumen de patentes.

Resumen de las patentes recuperadas sobre obtención de alcohol a partir de residuos lignocelulósicos

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
1. US20090035826	METHOD FOR THE PRODUCTION OF ALCOHOL FROM A PRETREATED **LIGNOCELLULOSIC** FEEDSTOCK	20070802	TOLAN JEFFREY S; FOODY BRIAN; ROWLAND STEPHEN	FOODY BRIAN E IOGEN ENERGY CORP ROWLAND STEPHEN A TOLAN JEFFREY S

Resumen:
A process for the production of glucose from a pretreated **lignocellulosic** feedstock is provided. The method comprises enzymatically hydrolyzing the pretreated **lignocellulosic** feedstock with cellulase enzymes to produce a hydrolyzate slurry comprising glucose and unhydrolyzed cellulose and fermenting the hydrolyzate slurry in a fermentation reaction to produce a fermentation broth comprising alcohol. A process stream is obtained comprising unhydrolyzed cellulose, which is then subjected to a denaturing step, preferably comprising exposing the unhydrolyzed cellulose to elevated temperatures, thereby producing a heat-treated stream comprising the unhydrolyzed cellulose. The heat-treated stream comprising unhydrolyzed cellulose is then further hydrolyzed with cellulase enzymes to hydrolyze the cellulose to glucose.

2. US20090042259	Process for enzymatically converting a plant biomass	20080808	DALE BRUCE E; TEYMOURI FARZANEH; CHUNDAWAT SHISHIR; BALAN VENKATESH	UNIV MICHIGAN STATE

Resumen:
The present invention describes a process for at least a 90% conversion of a plant biomass preferably by a reduction of the units of cellulase needed and by using a xylanase which acts synergistically with the cellulase to improve the yield of xylose and glucose as sugars. The process enables greater conversion of a **lignocellulosic** plant biomass to glucose and xylose for use as animal feeds and as fermentation as medium for producing **ethanol**.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
3. WO200911645	AUTO-IMMOBILIZED CO-FERMENTATION	20070713	EDEBO LARS	EDEBO LARS

Resumen:
The present invention discloses a fermentation process wherein a filamentous micro-organism and yeast cells are co-operating by fermenting **ethanol** from **lignocellulosic** hydrolysates which contain mixtures of both sugars and toxic substances. The fermentation process comprises two steps, wherein the first step the filamentous micro-organism is aerobically cultivated in a medium and produces a mycelium network; and in the second step the non-filamentous micro-organisms are immobilized with said mycelium network and incubated under oxygen-limited conditions. The invention also discloses a fermentor optimized for the fermentation process of the invention.

4. WO200915614	METHOD AND EQUIPMENT FOR PRODUCTION OF GLUCOSE, **ETHANOL**, FURFURAL, FURANE AND LIGNIN FROM RENEWABLE RAW MATERIALS	20070730	KRATOCHVIL ZDENEK; RYCHTAR LIBOR; MACHEK FRANTISEK; BOUSKA FRANTISEK	BOUSKA FRANTISEK KMPS FINANCIAL GROUP S R O KRATOCHVIL ZDENEK MACHEK FRANTISEK RYCHTAR LIBOR

Resumen:
Method and equipment for production of fermentable saccharides, **ethanol**, furfural, furane, lignin, acetic acid and formic acid from **lignocellulosic** and amylaceous materials. The method comprises one-stage or two-stage continuous thermo-compressive hydrolysis of **lignocellulosic** particles, cellulase treatment of unreacted lignocellulose, amylase treatment of formed monosaccharides combined with added amylaceous materials, and fermentation of the combined processed monosaccharide solutions into **ethanol**. Side products furfural, methanol, acetic acid, formic acid and lignin are recovered and purified, optionally furfural is further converted to furan. An integrated process for recovery and recycling of all products and by-products, and recycling of heat energy is disclosed.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
5.US20080295980	CONTINUOUS COUNTER-CURRENT ORGANOSOLV PROCESSING OF **LIGNOCELLULOSIC** FEEDSTOCKS	20070815	HALLBERG CHRISTER; O'CONNOR DONALD; RUSHTON MICHAEL; PYE EDWARD KENDALL; GJENNESTAD GORDON; BERLIN ALEX; MACLACHLAN JOHN ROSS	BERLIN ALEX GJENNESTAD GORDON HALLBERG CHRISTER LIGNOL INNOVATIONS LTD MACLACHLAN JOHN ROSS O'CONNOR DONALD PYE EDWARD KENDALL RUSHTON MICHAEL

Resumen:
A modular process for organosolv fractionation of **lignocellulosic** feedstocks into component parts and further processing of said component parts into at least fuel-grade **ethanol** and four classes of lignin derivatives. The modular process comprises a first processing module configured for physico-chemically digesting **lignocellulosic** feedstocks with an organic solvent thereby producing a cellulosic solids fraction and a liquid fraction, a second processing module configured for producing at least a fuel-grade **ethanol** and a first class of novel lignin derivatives from the cellulosic solids fraction, a third processing module configured for separating a second class and a third class of lignin derivatives from the liquid fraction and further processing the liquid fraction to produce a distillate and a stillage, a fourth processing module configured for separating a fourth class of lignin derivatives from the stillage and further processing the stillage to produce a sugar syrup.

6.US20090011484	CONCURRENT SACCHARIFICATION AND	20070704	BERLIN ALEX; PYE EDWARD KENDALL;	BERLIN ALEX LIGNOL INNOVATIONS LTD O'CONNOR DONALD

	FERMENTATION OF FIBROUS BIOMASS		O'CONNOR DONALD	PYE EDWARD KENDALL

Resumen:
A process for simultaneous saccharification and fermentation of a cellulosic solids fraction extracted from a **lignocellulosic** feedstock. The viscosity of the cellulosic solids fraction is reduced by intermixing with a liquid carbohydrate stream. A suitable liquid carbohydrate stream is a de-lignified liquids fraction that was previously separated from the solids fraction during processing of the **lignocellulosic** feedstock. Alternatively, the viscosity of the solids fraction may be reduced by commingling with a liquid carbohydrate stream comprising one or more monosaccharides. The reduced-viscosity cellulosic solids fraction is then commingled with a fermentative microbial inoculant and a cellulosic biomass-degrading enzyme composition. The commingled mixture is maintained in a pressurized reaction vessel under elevated temperatures to enable simultaneous enzymatic hydrolysis of the cellulosic solids to monosaccharides and fermentation of the monosaccharides to produce an **ethanolic** beer. The **ethanolic** beer is distillable for recovery of fuel-grade **ethanol** and a stillage that may be further processed.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
7. US20080227162	Biomass pretreatment	20080313	VARANASI SASIDHAR; SCHALL CONSTANCE ANN; DADI ANANTHARAM PRASAD; ANDERSON JARED; RAO KRIPA	ANDERSON JARED DADI ANANTHARAM PRASAD KUMAR GUNEETRIPATI PRAVEEN RAO KRIPA SCHALL CONSTANCE ANN UNIV TOLEDO ARANASI SASIDHAR

Resumen:
A method for lignocellulose conversion to sugar with improvements in yield and rate of sugar production has been developed by using ionic liquid pretreatment. This new pretreatment strategy substantially improves the efficiency (in terms of yield and reaction rates) of saccharification of **lignocellulosic** biomass. Cellulose and hemicellulose, when hydrolyzed into their sugars, can be converted into **ethanol** fuel through well established fermentation technologies. These sugars also form the feedstocks for production of variety of chemicals and polymers. The complex structure of biomass requires proper pretreatment to enable efficient saccharification of cellulose and hemicellulose components to their constituent sugars. Current pretreatment approaches suffer from slow reaction rates of cellulose hydrolysis (by using the enzyme cellulase) and low yields.

8. US20080227161	METHODS FOR PRODUCING A HYDROLYSATE AND **ETHANOL** FROM **LIGNOCELLULOSIC** MATERIALS	20070316	LEVIE BENJAMIN E; NEOGI AMAR N; DUFF SHELDON J B; MAYOVSKY JEFFREY E; ANDERSON DWIGHT E; ECKERT ROBERT C; KRISHNA CHUNDAKKADU	ANDERSON DWIGHT E DUFF SHELDON J B ECKERT ROBERT C KRISHNA CHUNDAKKADU LEVIE BENJAMIN E MAYOVSKY JEFFREY E NEOGI AMAR N WEYERHAEUSER CO

Resumen:
A method for producing a hydrolysate from **lignocellulosic** materials generally includes fiberizing the **lignocellulosic** materials, separating the **lignocellulosic** materials into at least a first portion and a second portion, wherein at least the first portion includes lignin, treating the first portion to deactivate at least a portion of the lignin in the first portion, re-combining the first and second portions after treating the first portion, and hydrolyzing the **lignocellulosic** materials with enzymes to produce a hydrolysate.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
9. WO200895098	PROCESS FOR SUGAR PRODUCTION FROM **LIGNOCELLULOSIC** BIOMASS USING ALKALI PRETREATMENT	CHUNG CHANG-HO; DAY DONAL F	CHUNG CHANG-HO DAY DONAL F UNIV LOUISIANA STATE	CHUNG CHANG-HO; DAY DONAL F

Resumen:
We have discovered a new method to treat biomass with alkali, for example lime. The lime and lignin was sufficiently removed from the treated biomass b> squeezing with a high pressure device to remove alkali and other potential inhibitors of the cellulase enzymes added for sacchapfication. The resulting fibrous material was rapidly solubihzed by cellulases, even at solid loads ranging from 10 to 30 % (w/w) without inhibitory effects on the cellulase activity. The lime pretreatment removed lignin effectively and left the cellulose and hemicellulose almost intact. The method yielded a biomass with structure capable of being enzyme solubhzed and fermented readily at a solids loading of 10-30% for a production of **ethanol**.

10. CN101235392	Cellulose fuel **ethanol** and preparation method thereof	20080116	XIAODONG BAI; FENGJU XU; BAIYIN LIU; XIAOGANG BAI	XIAODONG BAI

Resumen:
The invention relates to a cellulose fuel alcohol and the manufacturing method, which belongs to the technical field of processing and utilizing **lignocellulosic** wastes such forest secondary products, forest crotches, farm crop straws and the like. The key point of the invention is that an integral coupling new method is optimized to lead fibrous raw material to process, ferment, distill and dewater to achieve technical innovation and lower production cost. The application of the cellulose fuel alcohol is suitable for engine fuel of vehicle gasoline, and each physical chemical properties and environment protection index completely reach to the national standard. The cellulose fuel alcohol effectively lowers the pollution of automobile exhaust which is carbon monoxide, carbon dioxide and hydrocarbon, which saves raw material such as foodstuff and fecula, and reduces petroleum oil consumption

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
11. JP2008092910	METHOD FOR PRODUCING **ETHANOL**	20061016	NOJIRI MASANOBU; IKEDA TSUTOMU; SUGIMOTO TOMOKO; MAGARA	FORESTRY & FOREST PRODUCTS RES

KENGO

Resumen:
PROBLEM TO BE SOLVED: To provide a method for efficiently producing **ethanol**, with slight burden on the environment, by reducing the cost of both saccharification and fermentation with **lignocellulosic** biomass as feedstock.

SOLUTION: The method for producing **ethanol** comprises the following process: **Lignocellulosic** biomass is delignified by alkali digestion technique, saccharifying enzyme-productive bacteria are cultured with the resultant biomass as a carbon source to produce an enzyme suitable to saccharifying the **lignocellulosic** biomass, and a cultured liquid containing the resultant saccharifying enzyme and **ethanol**-fermentative bacteria are added to the alkali-digested **lignocellulosic** biomass to effect fermentation.

12. BR200605017	PROCESS FOR THE FERMENTATIVE PRODUCTION OF **ETHANOL** FROM SOLID **LIGNOCELLULOSIC** MATERIAL COMPRISING A STEP OF TREATING A SOLID **LIGNOCELLULOSIC** MATERIAL WITH ALKALINE SOLUTION IN ORDER TO REMOVE THE LIGNIN	20061130	SANTA ANNA LIDIA MARIA MELO; PEREIRA NEI; GOMES ABSAI DA CONCEICAI; VASQUES MARIANA PENUELA	BENSON JOHN EVERETT GOMES ABSAI DA CONCEICAI PEREIRA NEI PETROLEO BRASILEIRO SA SANTA ANNA LIDIA MARIA MELO VASQUES MARIANA PENUELA

Resumen:
The present invention relates to a process for obtaining fuel **ethanol** by using agricultural and agroindustrial waste materials composed of lignocellulose, and especially sugar cane bagasse. These residues have significant contents of carbohydrates in the form of polysaccharides (cellulose and hemicellulose), which can be hydrolysed by chemical and enzymic processes. The hemicellulose fraction is submitted to mild hydrolysis with sulphuric acid, and the solid material from this hydrolysis is submitted to a process of saccharif ication (enzymic hydrolysis) with simultaneous rapid alcoholic fermentation under conditions which allow a significant increase in conversion to alcohol in a greatly shortened time.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
13. US20080029233	MOVING BED BIOMASS FRACTIONATION SYSTEM AND METHOD	20060803	WINGERSON RICHARD C; KADAM KIRAN L	KADAM KIRAN L PUREVISION TECHNOLOGY INC WINGERSON RICHARD C

Resumen:
Countercurrent extraction of **lignocellulosic** biomass such as trees, grasses, shrubs, and agricultural residues or waste involves the separation of cellulose fibers from other constituents, for subsequent use in the manufacture of paper, plastics, **ethanol**, and other industrial chemicals. Systems and methods involve continuous, multiple processing steps that may include chemical reactions with mixing

at elevated temperature and/or pressure, efficient reagent or solvent utilization, filtration at elevated temperature and/or pressure, controlled discharge of liquid and solid products, and energy recuperation.

14. US20080057555	Integrated process for separation of **lignocellulosic** components to fermentable sugars for production of **ethanol** and chemicals	20060905	NGUYEN XUAN NGHINH	NGUYEN XUAN NGHINH

Resumen:
A continuous and modular process converts **lignocellulosic** materials for the production of **ethanol** principally and/or chemicals such as methanol, butanediol, propanediol, hydrocarbon fuel, etc. Renewable **lignocellulosic** biomass such as but not all inclusive hardwoods (gum, beech, oak, sweet gum, poplar, eucalyptus, etc.), soft woods (pines, firs, spruce, etc.), corn stovers, straws, grasses, recycled papers, waste products from pulp and paper mills, etc can be used as feedstock. The process is designed to be modular and the feed entry point can be selected to adapt to different biomass feedstock. **Lignocellulosic** biomass such as hardwood and softwood are subjected to chemical/pressure treatment stages using potent and selective chemicals such as sodium chlorite/acetic acid (anhydrous) and chlorine/chlorine dioxide to separate the main components-lignin, cellulose (glucose) and hemicelluloses (xylose, arabinose, galactose)-into three process streams. The separated carbohydrates are further subjected to washing, cleaning, neutralization, and/or mild hydrolysis and subsequently fermented to produce **ethanol**. Residual lignin and extractives remained with the cellulose are removed by chemical treatment steps to enhance the fermentations of cellulose. Pre-hydrolysate after neutralization to neutralize and remove toxic components such as acetic acid, furfural, phenolics, etc. containing (xylose, arabinose, galactose) and hexoses (glucose) can be either separately or together with the purified cellulosic fraction fermented to produce **ethanol**. Approximately 100 gallons of **ethanol**, suitable to be used as a fuel, can be produced from one dried ton of wood. Significant amount of lignin are separated as a by-product and can be converted to hydrocarbon fuel, surfactant, drilling aid, or can be incinerated for generation of power and steam.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
15. WO2007134607	THERMOANAEROBACTER MATHRANII STRAIN BGl	20060522	MIKKELSEN MARIE JUST; AHRING BIRGITTE KIAER	AHRING BIRGITTE KIAER BIOGASOL IPR APS MIKKELSEN MARIE JUST

Resumen:
Strict anaerobic thermophilic bacterium belonging to the group of Thermoanaerobacter mathranii and mutants and derivatives thereof. The bacterium is particularly suitable for the production of fermentation products such as **ethanol**, lactic acid, acetic acid and hydrogen from **lignocellulosic** biomass.

16. US20070275447	Indirect or direct fermentation of biomass to fuel alcohol	20060525	LEWIS RANDY S; TANNER RALPH S; HUHNKE RAYMOND L	HUHNKE RAYMOND L LEWIS RANDY S TANNER RALPH S UNIV OKLAHOMA STATE

Resumen:
A novel clostridia bacterial species (Clostridium carboxidivorans, ATCC BAA-624, "P7") is provided. P7 is capable of synthesizing, from waste gases, products which are useful as biofuel. In particular, P7 can convert CO to **ethanol**. Thus, this novel bacterium can transform waste gases (e.g. syngas and refinery wastes) into useful products. P7 also catalyzes the production of acetate and butanol. Further, P7 is also capable of directly fermenting **lignocellulosic** materials to produce **ethanol** and other substances.

17. US20080008783	Process for the treatment of **lignocellulosic** biomass	20060501	DALE BRUCE	UNIV MICHIGAN STATE

Resumen:
A process for the treatment of biomass to render structural carbohydrates more accessible and/or digestible using concentrated ammonium hydroxide with or without anhydrous ammonia addition, is described. The process preferably uses steam to strip ammonia from the biomass for recycling. The process yields of monosaccharides from the structural carbohydrates are good, particularly as measured by the enzymatic hydrolysis of the structural carbohydrates. The monosaccharides are used as animal feeds and energy sources for **ethanol** production.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
18. WO200795215	PRODUCTION OF GASOLINE FROM FERMENTABLE FEEDSTOCKS	20060214	BRADIN DAVID	BRADIN DAVID CPS BIOFUELS INC

Resumen:
Compositions and methods for forming hexane, and, optionally, gasoline and/or components of a gasoline composition, from fermentable sugars are disclosed. The sugars are fermented using a bacteria or yeast that predominantly forms butyric acid. The butyric acid is subjected to Kolbe or photo-Kolbe electrolysis to form hexane. The hexane can be subjected to catalytic reforming and/or isomerization steps to form higher octane products, which are or can be included in gasoline compositions. In one aspect, the fermentable sugars are derived from **lignocellulosic** materials such as wood products, switchgrass, or agricultural wastes. These materials are delignified to form lignin, cellulose and hemicellulose. The cellulose and hemicellulose are depolymerized to form glycose and xylose, either or both of which can be fermented by the bacteria. The lignin can be used to generate heat energy and/or electric energy for use in one or more process steps, such as the fermentation, product isolation, Kolbe electrolysis, catalytic reforming and/or isomerization steps. Alternatively, the lignin can be converted to synthesis gas, which can then be subjected to Fischer-Tropsch synthesis, or converted to methanol and/or **ethanol**. Thus, the methods described herein can convert biomass to a fuel composition or fuel additive, which can be used in a conventional gasoline engine, unlike traditional fuels such as **ethanol** or

biodiesel.

19. US20070227063	Process for conversion of mushroom **lignocellulosic** waste to useful byproducts	20060330	DALE BRUCE E; BALAN VENKATESH; CHUNDAWAT SHISHIR P	UNIV MICHIGAN STATE

Resumen:
A process for the conversion of monocot **lignocellulosic** grass waste from mushroom growth into byproducts is described. In particular, the present invention releases glucans from the waste which can be easily hydrolyzed, after a less severe thermochemical process (i.e. AFEX), and into sugars for producing **ethanol** or other by-products by fermentation.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
20. EP2013368	PROCESS FOR THE TREATMENT OF **LIGNOCELLULOSIC** BIOMASS	20060501	DALE BRUCE E; LYND LEE R; LASER MARK	DALE BRUCE E ARTMOUTH COLLEGE LASER MARK YND LEE RUNIV MICHIGAN STATE

Resumen:
A process for the treatment of biomass to render structural carbohydrates more accessible and/or digestible using concentrated ammonium hydroxide with or without anhydrous ammonia addition, is described. The process preferably uses steam to strip ammonia from the biomass for recycling. The process yields of monosaccharides from the structural carbohydrates are good, particularly as measured by the enzymatic hydrolysis of the structural carbohydrates. The monosaccharides are used as animal feeds and energy sources for **ethanol** production.

21. EP2021487	THERMOPHILIC ORGANISMS FOR CONVERSION OF **LIGNOCELLULOSIC** BIOMASS TO **ETHANOL**	20051031	DESAI SUNIL G; SHAW ARTHUR JOSEPHUS IV; LYND LEE R; TYURIN MIKHAIL V	BARDSLEY JOHN ARTMOUTH COLLEGE DESAI SUNIL G OGSETT DAVID ANTHONY LYND LEE R MASCOMA CORP PODKAMINE KARAHAW ARTHUR JOSEPHUS SHAW ARTHUR JOSEPHUS IVRIN MIKHAIL V

Resumen:
Mutant thermophilic organisms that consume a variety of biomass derived substrates are disclosed herein. Strains of Thermoanaerobacterium saccharolyticum with acetate kinase and phosphotransacetylase expression eliminated are disclosed herein. Further, strain ALKl has been engineered by site directed homologous recombination to knockout both acetic acid and lactic acid production. Continuous culture involving a substrate concentration challenge lead to evolution of ALKl , and formation of a more robust strain designated ALK2. Both organisms produce near theoretical

ethanol yields without expressing pyruvate decarboxylase

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
22. US20070134781	Method for producing bioethanol from a **lignocellulosicbiomass** and recycled paper sludge	20051212	AGBLEVOR FOSTER A	AGBLEVOR FOSTER A AGBLEVOR FOSTER ARYL

Resumen:
A method producing **ethanol** by combining an plant fiber material containing calcium carbonate with at least one **lignocellulosic** agricultural residue into a mixture. The plant fiber material can be a paper sludge. The mixture is then hydrolyzed and the resultant hydrolysate is then fermented into **ethanol**.

23. WO200792898	PROCESS FOR CONVERTING ANHYDROSUGARS TO GLUCOSE AND OTHER FERMENTABLE SUGARS	20060207	OLSON EDWIN S; FREEL BARRY	ENERGY & ENVIRONMENTAL RES CT FREEL BARRY LSON EDWIN S

Resumen:
A process is provided for producing glucose and other fermentable sugars from a liquid mixture containing anhydrosugars. One example of a process encompasses: 1) water extraction of a anhydrosugar-rich fast-pyrolysis bio-oil fraction that constitutes a residual after removal of volatile impurities, 2) further purification of said anhydrosugar-rich fraction, and 3) solid-phase catalytic hydrolysis of the anhydrosugars to yield glucose and other fermentable sugars. An exemplary application of the process is in the production of **ethanol** and other sugar-based fermentation products from bio-oil generated via fast pyrolysis of low-cost, high-availability **lignocellulosic** biomass resources.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
24. EP1767658	Method of processing **lignocellulosic** feedstock for enhanced xylose and **ethanol** production	20010228	GRIFFIN ROBERT; NICHOLSON COLIN; MOTT CORINNE; TOLAN JEFFREY S; ANAND VIJAY	IOGEN ENERGY CORP

Resumen:
The present invention provides a method of producing xylose from **lignocellulosic** feedstock. The method comprises disrupting **lignocellulosic** feedstock; leaching the **lignocellulosic** feedstock by contacting the feedstock with at least one aqueous solution for a period greater than about 2 minutes to produce a leached feedstock and a leachate; removing the leachate from the leached feedstock; acidifying the leached feedstock to a pH between about 0.5 and about 3 to produce an acidified feedstock, and; reacting the acidified feedstock under conditions which disrupt fiber structure and hydrolyze a portion of hemicellulose and cellulose of the acidified feedstock, to produce a composition

comprising xylose and a pretreated feedstock. The xylose may be purified from the pretreated feedstock or it may be converted to **ethanol** with the pretreated feedstock

25. FR2881753	Production of cellulase enzymes using the residues from **ethanolic** fermentation distillation of enzymatic hydrolysates from (ligno-)cellulosic materials	20050209	WARZYWODA MICHEL; BALLERINI DANIEL; MONOT FREDERIC	BALLERINI DANIEL INST FRANCAIS DU PETROLE Institut Francais du Petrole MONOT FREDERIC WARZYWODA MICHEL

Resumen:
Producing cellulolytic and/or hemicellulolytic enzymes by a cellulolytic microorganism comprises using the residue from the **ethanolic** fermentation of enzymatic hydrolysates of cellulosic or ligno-cellulosic materials. An independent claim is also included for a process for producing **ethanol** from cellulosic or ligno-cellulosic materials

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
26. US20050069998	Procedure for the production of **ethanol** from **lignocellulosic** biomass using a new heat-tolerant yeast	20000224	BALLESTEROS PERDICES IGNACIO; BALLESTEROS PERDICES MERCEDES; OLIVA DOMINGUEZ JOSE MIGUEL; CARRASCO GARCIA JUAN	CT INVESTIG ENERGETICAS CIEMAT

Resumen:
It includes the stages of grinding the **lignocellulosic** biomass to a size of 15-30 mm, subjecting the product obtained to steam explosion pre-treatment at a temperature of 190-230deg. C. for between 1 and 10 minutes in a reactor (2), collecting the pre-treated material in a cyclone (3) and separating the liquid and solid fractions by filtration in a filter press (9), introducing the solid fraction in a fermentation deposit (10), adding a cellulase at a concentration of 15 UFP per gram of cellulose and 12.6 International Units of beta-glucosidase enzyme dissolved in citrate buffer pH 4.8, inoculating the fermentation deposit (10) with a culture of the heat-tolerant bacteria Kluyveromyces marxianus CECT 10875, obtained by chemical mutagenesis from strain DER-26 of Kluyveromyces marxianus and shaking the mixture for 72 hours at 42deg. C.

27. FI200505143	PRODUCTION OF PULP USING A GASEOUS ORGANIC AGENT AS	20050331	ENQVIST ERIC; TIKKA PANU; HEINRICH LEOPOLD; LUHTANEN MATTI	ENQVIST ERIC HEINRICH LEOPOLD LUHTANEN MATTIMETSO PAPER INC TIKKA PANU

	HEATING AND REACTION-ACCELERATING MEDIA			

Resumen:
The invention relates to an improved process to break down lignin macromolecules and liberating cellulose fibers in **lignocellulosic** material using delignifying reactants with a gaseous organic agent as a heating and reaction-accelerating media. **Lignocellulosic** material is first impregnated with reactant chemicals, e.g. commonly used agents such as sodium hydroxide and sodium sulfide. Subsequently, the energy required for the delignification reactions is provided through heating with a gaseous organic agent such as methanol or **ethanol**, condensing and releasing energy to the solid **lignocellulosic** material. The temperature during the heating step with a gaseous organic agent is higher than the temperature during the impregnation step.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
28. US7344876	Kluyveromyces strains metabolizing cellulosic and hemicellulosic materials	20030124	LEVINE ROBERT P	ENOGEN INC PHAGE BIOTECHNOLOGY PHAGE BIOTECHNOLOGY INC

Resumen:
This invention relates to the use of microorganisms for the generation of **ethanol** from **lignocellulosic** waste materials. Yeast strains of the genus Kluyveromyces which have the capability to ferment cellulose, hexose sugars to **ethanol** are provided. Also provided are methods for converting cellulose, hexoses, or mixed hydrolysates of hexoses to **ethanol** by fermentation with Kluyveromyces strains. The invention also provides methods to isolate yeast strains which metabolize cellulose, pentoses, or hemicelluloses from waste materials.

29. US20040231661	METHOD OF PROCESSING **LIGNOCELLULOSIC** FEEDSTOCK FOR ENHANCED XYLOSE AND **ETHANOL** PRODUCTION	20010228	GRIFFIN ROBERT; NICHOLSON COLIN; MOTT CORINNE; TOLAN JEFFREY S; ANAND VIJAY	ANAND VIJAY GRIFFIN ROBERT OGEN BIO PRODUCTS CORP IOGEN ENERGY CORP MOTT CORINNENICHOLSON COLIN TOLAN JEFFREY S

Resumen:
The present invention provides a method of producing xylose from **lignocellulosic** feedstock. The method comprises disrupting **lignocellulosic** feedstock; leaching the **lignocellulosic** feedstock by contacting the feedstock with at least one aqueous solution for a period greater than about 2 minutes to produce a leached feedstock and a leachate; removing the leachate from the leached feedstock; acidifying the leached feedstock to a pH between about 0.5 and about 3 to produce an acidified feedstock, and; reacting the acidified feedstock under conditions which disrupt fiber structure and hydrolyze a portion of hemicellulose and cellulose of the acidified feedstock, to produce a composition comprising xylose and a pretreated feedstock. The xylose may be purified from the pretreated feedstock or it may be converted to **ethanol** with the pretreated feedstock.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante

30. US7189306	Process of treating **lignocellulosic** material to produce bio-**ethanol**	20020222	GERVAIS GIBSON W	GERVAIS GIBSON W GERVAIS GILLES

Resumen:
This invention relates to a process of treating a **lignocellulosic** material to produce bio-**ethanol**. The process includes the steps of: (a) exposing the **lignocellulosic** material to conditions including a pH not less than about 8, and steam at a first pressure, to produce a step (a) product; (b) explosively discharging the step (a) product to a second pressure less than the first pressure to produce a step (b) product; and (c) further processing the step (b) product to produce bio-**ethanol** and other co-products. In another embodiment, the invention relates to a conical auger fractionation column. The fractionation column includes a column body having an input and an output. A conical filter is positioned inside the column body, the filter having a larger diameter end directed toward the input and a smaller diameter end directed toward the output. A conical auger is positioned inside the conical filter, the conical auger having an outer diameter which is approximately the same as an inner diameter of the conical filter. The auger and filter are adapted to cooperate to separate cellulosic solids from a liquid stream in a process of producing bio-**ethanol** from a **lignocellulosic** material.

31. US20040185542	Lignin-blocking treatment of biomass and uses thereof	20030319	YANG BIN; WYMAN CHARLES E	DARTMOUTH COLLEGE WYMAN CHARLES E YANG BIN

Resumen:
Disclosed is a method for converting cellulose in a **lignocellulosic** biomass. The method provides for a lignin-blocking polypeptide and/or protein treatment of high lignin solids. The treatment enhances cellulase availability in cellulose conversion. Cellulase efficiencies are improved by the protein or polypeptide treatment. The treatment may be used in combination with steam explosion and acid prehydrolysis techniques. Hydrolysis yields from lignin containing biomass are enhanced 5-20%, and enzyme utilization is increased from 10% to 50%. Thus, a more efficient and economical method of processing lignin containing biomass materials utilizes a polypeptide/protein treatment step that effectively blocks lignin binding of cellulase.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
32. SE200401303	**ETHANOL** PRODUCTIVITIES OF SACCHAROMYCES CEREVISIAE STRAINS IN FERMENTATION OF DILUTE-ACID HYDROLYZATES DEPEND ON THEIR FURAN REDUCTION CAPACITIES	20040519	NILSSON ANNELI; LIDEN GUNNAR; GORWA-GRAUSLUND MARIE-FRANCOIS; HAHN-HAEGERDAL BAERBEL; MODIG CARL TOBIAS; MOREIRA DE ALMEIDA JOAO RICARD	FORSKARPATENT I SYD AB GORWA-GRAUSLUND MARIE-FRANCOIS HAHN-HAEGERDAL BAERBEL LIDEN GUNNAR MODIG CARL T MOREIRA DE ALMEIDA JOAO R NILSSON ANNELI

Resumen:
The present invention relates to an **ethanol** producing microbial strain, such as Saccharomyces cerevisiae strain, being able to grow and produce **ethanol** from **lignocellulosic** hydrolysates comprising growth inhibiting compounds of the group furfural and 5-hydroxy-methyl furfural, in a batch, fed-batch or continuous fermentation, said microbial strain being tolerant to such inhibiting compounds, which strain is upregulated and/or over expressed with regard to one or more of the following genes: LAT1, ALD6, ADH5, ADH6, GDH3, OYE3, SER3, GND2, MDH2, IDP3, ADH7, AAD15, ERG27, HMG1, LYS5, SPS19, SGE1.

33. FI200400775	PROCESS FOR PRODUCING **ETHANOL**	20040604	PENTTILAE MERJA; SIIKA-AHO MATTI; UUSITALO JAANA; VIIKARI LIISA	PENTTILA MERJA SIIKA-AHO MATTI UUSITALO JAANA VALTION TEKNILLINEN VIIKARI LIISA

Resumen:
A process for producing **ethanol** from a fibrous **lignocellulosic** raw material. After pre-treatment of the raw material, the fibrous fraction is first hydrolysed at high consistency and then the modified material is subjected simultaneously to continued hydrolysis with a cellulase and to **ethanol** fermentation in a fermentation mixture. Fermentation is continued to convert an essential portion of the available cellulose into **ethanol**, then a liquid fraction containing solubilized hemicelluloses is added to the fermentation mixture and fermentation continued. By means of the invention, high fermentation rates, high **ethanol** concentrations and low **ethanol** production costs can be attained.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
34. US7419809	METHOD FOR GLUCOSE PRODUCTION WITH A CELLULASE MIXTURE COMPRISING A MODIFIED CELLULASE	20000925	FOODY BRIAN; WHITE THERESA C; TOLAN JEFFREY S; DONALDSON JENNIFER	DONALDSON JENNIFER, FOODY BRIAN, IOGEN BIO PRODUCTS CORP, IOGEN ENERGY CORP, TOLAN JEFFREY S, WHITE THERESA C

Resumen:
The present invention pertains to a method of converting cellulose to glucose by treating a pretreated **lignocellulosic** substrate with an enzyme mixture comprising cellulase enzyme and a modified CBHO, wherein the modified CBHI is present in the enzyme mixture at an amount relative to all CBHI-type enzymes from about 15% to about 100% (w/w),depending upon the modified CBHI used. The pretreated **lignocellulosic** substrate is selected from the group consisting of agricultural residues, residues after starch or sugar removal dedicated **ethanol** crops forestry products, and pulp and paper products, or combinations thereof

35. US6660506	DILUTE ACID/METAL SALT HYDROLYSIS OF **LIGNOCELLULOSICS**	20000809	NGUYEN QUANG A; TUCKER MELVIN P	KELLER FRED A MIDWEST RESEARCH INST NGUYEN QUANG A TUCKER MELVIN P

Resumen:
A modified dilute acid method of hydrolyzing the cellulose and hemicellulose in **lignocellulosic** material under conditions to obtain higher overall fermentable sugar yields than is obtainable using dilute acid alone, comprising:impregnating a **lignocellulosic** feedstock with a mixture of an amount of aqueous solution of a dilute acid catalyst and a metal salt catalyst sufficient to provide higher overall fermentable sugar yields than is obtainable when hydrolyzing with dilute acid alone;loading the impregnated **lignocellulosic** feedstock into a reactor and heating for a sufficient period of time to hydrolyze substantially all of the hemicellulose and greater than 45% of the cellulose to water soluble sugars; and recovering the water soluble sugars.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
36. US6419788	CELLULOSE PRODUCTION FROM **LIGNOCELLULOSIC** BIOMASS	20000816	WINGERSON RICHARD C	PUREVISION TECHNOLOGY INC PUREVISION TECNOLOGY INC

Resumen:
A multi-function process is described for the separation of cellulose fibers from the other constituents of **lignocellulosic** biomass such as found in trees, grasses, agricultural waste, and waste paper with application in the preparation of feedstocks for use in the manufacture of paper, plastics, **ethanol**, and other chemicals. This process minimizes waste disposal problems since it uses only steam, water, and oxygen at elevated temperature in the range of 180deg. C. to 240deg. C. for 1 to 10 minutes plus a small amount of chemical reagents to maintain pH in the range 8 to 13. An energy recuperation function is important to the economic viability of the process.

37. US6130076	**Ethanol** production using a soy hydrolysate-based medium or a yeast autolysate-based medium	19970619	INGRAM LONNIE O; YORK SEAN W	UNIV FLORIDA

Resumen:
This invention presents a method for the production of **ethanol** that utilizes a soy hydrolysate-based nutrient medium or a yeast autolysate-based medium nutrient medium in conjunction with **ethanologenic** bacteria and a fermentable sugar for the cost-effective production of **ethanol** from **lignocellulosic** biomass. The invention offers several advantages over presently available media for use in **ethanol** production, including consistent quality, lack of toxins and wide availability.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
38. US6498029	Pentose fermentation of normally toxic lignocellulose prehydrolysate with strain of Pichia stipitis	19991117	KELLER FRED A; NGUYEN QUANG A	MIDWEST RESEARCH INST

	yeast using air			

Resumen:
Strains of the yeast Pichia stipitis NPw9 (ATCC PTA-3717) useful for the production of **ethanol** using oxygen for growth while fermenting normally toxic **lignocellulosic** prehydrolysates.

39. CH-645685	Process allowing the delignification and the transformation into sugar of lignocellulose vegetal material by using organic solvents	19780831	PASZNER L; CHANG P	PASZNER LASZLO CHANG PEI CHING THERMOFORM AG

Resumen:
Minced lignocellulose, such as wood, straw, bamboos, bagasse or any other structured vegetal material, is treated in a discontinuous or continuous process. The process consists in boiling this material in an acidified mixture of solvents in an aqueous phase. This mixture of solvents contains water in a proportion of 30 to 70 parts and an organic solvent in a proportion of 70 to 30 parts. The organic solvent consists of either an alcohol of light molecular weight, or a ketone of light molecular weight; it must be easily evaporable and soluble in water. The pH of the medium is adjusted to a pH from 3.5 to 1.7 by adding a catalytic compound selected within the group of the strong acids: hydrochloric, nitric and phosphoric; within the group of these strong acids neutralized by their neutral salts; within the group of the following organic acids: oxalic, maleic, o-phthalic, l-malic, succinic, nicotinic, salicylic and trifluoracetic. The boiling temperatures range between 160 and 210'C, preferably between 180 and 200'C. After three minutes at the minimum, we obtain the separation of the lignin and the hydrolysis of the hemicelluloses dissolved; after that, the fibres are easily dispersible while forming a pulp. By proceeding to a mechanical refining at a high pressure, a high density thermomechanical pulp is obtained after a shorter boiling time. With the neutralized acids, as well as with the organic acids, particularly with the oxalic acid, we can obtain a fibre with a high degree of polymerization. The lignin is obtained as a precipitate which separates from the liquid; the liquid solvent, usually ethanol or acetone, is evaporated; then the drained lignin is redissolved in the minimal quantity of acetone; a new precipitation with an excess of water allows to obtain the lignin in the form of a slightly coloured powder. A prolonged boiling dehydrates and disaggregates the sugars; by the strong acids action, takes place the formation of light molecular weight or microcristalline cellulose, glucose or organic acids, methanol and furfuralic compounds.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
40. CA1100266	Organosolv delignification and saccharification process for **lignocellulosic** plant materials	19770831	PASZNER LASZLO; CHANG PEI-CHING	BAU UND FORSHUNGSGEZELSHAFT TE CHANG P CHANG PEI CHING PASZNER L PASZNER LASZLO THERMOFORM BAU FORSCHUNG

Resumen:
Cellulose-containing material is rapidly saccharified to convert pentosans and hexosans to sugars by cooking under pressure at from 180 DEG C. to 220 DEG C. with acetone-water solvent mixture carrying from 0.05 to 0.25 weight percent of phosphoric, sulfuric or hydrochloric acids. A predominantly cellulosic material, e.g. a delignified pulp, is hydrolysed to yield relatively pure glucose recoverable from liquor which is flowed through the cellulose, then withdrawn and cooled and neutralized within an elapsed time of a minute or less. Whole wood is nearly totally dissolvable by the process, yielding mixed pentoses and hexoses. The dehydration and degradation products of sugars are formed by prolonging retention time of liquor from 20 to 45 minutes.

41. DK1259466T	A METHOD FOR PROCESSING **LIGNOCELLULOSIC** MATERIAL	20000217	AHRING BIRGITTE KIAER; THOMSEN ANNE BELINDA	AHRING BIRGITTE KIAER BIOGASOL IPR APS FORSKNINGSCT RISO FORSKNINGSCT RISOE THOMSEN ANNE BELINDA UNIV DENMARK TECH DTU

Resumen:
A method wherein **lignocellulosic** biomass materials are converted into combustible fuel products. In particular, the method is a continuous process, involving wet oxidation or steam explosion, for fermentatively converting such biomass materials into **ethanol** using a process design that permits all or part of the process water from the **ethanol** fermentation process to be recycled to reduce the consumption of process water. The effluent from the **ethanol** fermentation step may be subjected to an anaerobic fermentation step generating methane and a water effluent in which the amount of potentially inhibitory substances is at a sub-inhibitory level, which in turn permits all or part of the effluent water from the anaerobic fermentation step to be recycled into the process.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
42. US4594130	Pulping of lignocellulose with aqueous alcohol and alkaline earth metal salt catalyst	19781127	CHANG PEI-CHING; PASZNER LASZLO	CHANG PEI CHING PASZNER LASZLO

Resumen:
High yield pulping is achieved by cooking a **lignocellulosic** material in a confined chamber in the absence of added oxygen at elevated temperatures up to 240 DEG C. with an initially neutral or acidic mixture of alcohol and water in volume ratio between 50:50 and virtually anhydrous alcohol cooking liquor, using a lower aliphatic alcohol namely methanol, **ethanol** or n-propanol, carrying in solution at least about 0.002 moles per liter of a magnesium, calcium or barium salt as a primary catalyst soluble in at least catalytic amounts in the mixture to form barium, calcium and magnesium ions. The cooking time may range from at least two (2) minutes to under three (3) hours. The process yields bright, free-fiber pulp even at residual lignin of 80 Kappa number as high as 80% of softwood and up to 75% of hardwood weight, of viscosity (TAPPI 0.5% Cu En) above 18 up to 60 centipoise. Addition of trace amounts of an acidic compound as a secondary catalyst increases the rate of delignification. Elevated pressures on the cooking solvent mixture also increases the rate of delignification.

43. CA1175820	UTILIZATION OF CELLULOSE AND LIGNOCELLULOSE	19790323	DEIBUITSUDO ERU BURINKU; RARII ERU	UNIV CALIFORNIA

SHIYAREJIYAA

Resumen:
Method of converting **lignocellulosic** material to useful products such as **ethanol**, methanol, methane, organic acids and furfural, also producing best for use in the process and if feasible or advantageous for use outside the system; such method comprising a two stage hydrolysis with a sensitization step between, followed by wet oxidation whereby the production of monosaccharides is maximized and their degradation is minimized; the products of hydrolysis (monosaccharides) and of wet oxidation of ligneous material left as residue from hydrolysis are converted. as by fermentation of monosaccharides, methanantion and processes of separation into useful end products such as **ethanol**, methane, methanol, organic acids and furfural; such method and system minimizing degradation to carbon dioxide, carbon monoxide and water and minimizing or eliminating the production of solid waste material.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
44. US4342831	Fermentable acid hydrolyzates and fermentation process	19790702	FABER MARCEL D; ERNST RICHARD H; LEFEBVRE PHILIP	AMERICAN CAN CO

Resumen:
Method of preconditioning acid hydrolyzates derived from **lignocellulosic** materials such as sawdust or newspaper and preconditioned acid hydrolyzates are provided. The preconditioning negates the effect of substances which tend to inhibit fermentation and comprises a series of steps including steam-stripping, calcium oxide treatment at a pH of 10 to 10.5, adjusting the pH to about 6 to 7 with a mineral acid and especially phosphoric acid and concentrating the hydrolyzate solution to a glucose concentration of less than 150 grams per liter. Glucose contained in such preconditioned hydrolyzates is readily fermentable to ethyl alcohol, in theoretical yield, after fermentation for as short a period as 1 to 2 hours.

45. SE8302654	Method for producing **ethanol** from xylose-containing substance	19830509	VAN DIJKEN JOHANNES; SCHEFFERS ALEXANDER	ALFA LAVAL AB ALFALAVAL AB DIJKEN JOHANNES VAN SCHEFFERS ALEXANDER

Resumen:
A method for fermenting xylose-containing substance, such as a **lignocellulosic** degradation product into **ethanol**. Yeast of the species Pichia stipitis and/or Pichia segobiensis and/or Candida shehatae are utilized for the fermentation.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante

46. US5258293	Continuous process for **ethanol** production from **lignocellulosic** materials without mechanical agitation	19910503	LYND LEE R; HOGSETT DAVID A; SPIELES GISBERT	DARTMOUTH COLLEGE

Resumen:
An improved and highly productive method of continuously producing **ethanol** from **lignocellulosic** substrates is provided. The method involves providing a suitable microbial system within a reaction vessel and adding fermentable substrate to the reactor to form a reaction mixture. The fermentation reaction is allowed to proceed while a quiescent state is maintained within the reactor. During the fermentation, soluble substrate is differentially retained relative to the feed slurry and reaction biocatalysts are retained and internally recycled within the system. Further, while fermenting substrate is retained within the system, it forms a stratified zone within the reactor such that the concentration of actively fermenting substrate is highest at upper portions of the reaction zone and is lowest, near zero, at a lower portion of the reaction zone. Insoluble, fully reacted substrate may be withdrawn from a region near the bottom of the reactor

47. CA2071185	PROCESS FOR DELIGNIFYING **LIGNOCELLULOSIC** PULP BY MEANS OF OXYGEN	19910614	COLODETTE JORGE L; SANTOS DE CAMPOS ANA S	WHITE MARTINS SA

Resumen:
IMPROVEMENT IN A PROCESS FOR DELIGNIFYING **LIGNOCELLULOSIC** PULP BY MEANS OF OXYGEN The present invention refers to an improvement for delignifying a **lignocellulosic** pulp by means of oxygen wherein **ethanol** is used as an additive and the process is carried out at high temperature thereby obtaining a higher reduction of ligin content of the **lignocellulosic** pulp, that is, a higher reduction of the Kappa Number in comparison with conventional processes without, however, prejudicing the pulp quality. The use of the present invention provides a pulp which, when subjected to subsequent bleaching sequences, will require a lower amount of chloro compounds in order to achieve the desired whiteness and will also exhibit a high viscosity thus rendering a product with good resistance properties. D-16935

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
48. WO9429475	CELL MASS FROM FERMENTERS AS NUTRIENT SOURCE IN BIOMASS-TO-**ETHANOL** CONVERSION	19930611	PHILIPPIDIS GEORGE P; WYMAN CHARLES E; HINMAN NORMAN D; SPINDLER DIANE D; SCHELL DANIEL J	MIDWEST RESEARCH INST

Resumen:
An improved process for converting **lignocellulosic** biomass-to-**ethanol** comprising: providing a biomass material selected from the group consisting of unmodified carbohydrate material, chemically modified carbohydrate material, derivatized carbohydrate material and mixtures thereof; treating said material enzymatically, chemically, physically or mechanically to produce a glucose containing fluid; treating the glucose containing fluid in a fermenter with a fermentative microorganism at temperatures between about 20 DEG C to about 50 DEG C and at pH ranges from about 3.0 to about 7.0; separating cell mass from said material and solutions surrounding said cell mass from said materials and recycling the cell mass and solutions surrounding the cell mass back to the fermenter to provide a source of nutrients for the fermentative organism; extracting **ethanol** from the fermentation broth with distillation or an extracting solvent or with membranes; and evaporating the **ethanol** from the fermentation broth.

49. US6333181	IMPROVEMENT OF **ETHANOL** PRODUCTION FROM LIGNOCELLULOSE	19970407	INGRAM LONNIE O; WOOD BRENT E	UNIV FLORIDA

Resumen:
This invention presents a method of improving enzymatic degradation of lignocellulose, as in the production of **ethanol** from **lignocellulosic** material, through the use of ultrasonic treatment. The invention shows that ultrasonic treatment reduces cellulase requirements by [VULGAR FRACTION ONE THIRD] to 1/2. With the cost of enzymes being a major problem in the cost-effective production of **ethanol** from **lignocellulosic** material, this invention presents a significant improvement over presently available methods.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
50. BR200500534	ACID HYDROLYSIS PROCESS OF CELLULOSIC AND **LIGNOCELLULOSIC** MATERIALS, DIGESTION VESSEL AND HYDROLYSIS REACTOR	20050215	BULLA ROMEO; GONZALO SIEIRO GONZALEZ; PELLEGRINI FRANCISCO INACIO	BULLA ROMEO GONZALO SIEIRO GONZALEZ OXITENO S A IND E COM PELLEGRINI FRANCISCO INACIO

Resumen:
The present invention relates to an enhanced process for sugar production through the acid hydrolysis of cellulosic and **lignocellulosic** materials characterized by the treatment of these materials in three steps. In the first step, it is made a digestion of the **lignocellulosic** material using a solvent capable of partially dissolving the lignin, which constitutes part of the **lignocellulosic** material. In the second step, the cellulosic material resulting from the treatment with the solvent is subjected to an acid treatment in such conditions that mainly hemicellulose is hydrolyzed to form a sugar solution rich with pentose monomers and oligomers. In the third step, the cellulosic material from the second step is subjected to an acid treatment in such conditions that the major part of the cellulose is hydrolyzed to form a sugar solution rich with hexose monomers and oligomers. This invention also relates to a Digestion Vessel and a Reactor, with this set being constituted by a single vessel or a set of vessels where it's possible to identify three areas where the three process steps are conducted.

51. BR9600672	A PROCESS FOR RAPID ACID **HYDROLISIS** OF **LIGNOCELLULOSIC** MATERIAL AND **HYDROLISIS** REACTOR	19960308	HILST ANTONIO GERALDO PROENCA	DEDINI S A ADMINISTRACAO E PAR HILST ANTONIO GERALDO PROENCA

Resumen:
The present invention relates to a continuous process for acid hydrolysis of **lignocellulosic** material through which the delignification and saccharification operations are carried out in a single reaction cycle utilizing a solubilizing organic solvent of lignin and a strong and extremely diluted inorganic acid, and obtaining highly concentrated recoveries of sugar. For the execution of the present process a hydrolysis reactor is further presented.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
52. CH-609092	Process for continuous acid hydrolysis and saccharification	19770401	ARMANET JEAN-MICHEL; HAMM THOMAS; REGNAULT ALAIN; SACHETTO JEAN-PIERRE; TOURNIER HERVE	BATELLE MEMERIAL INST BATTELLE MEMORIAL INSTITUTE

Resumen:
Continuous hydrolysis to produce sugars is effected by cyclically immersing a solid, divided **lignocellulosic** material in a bath of concentrated hydrochloric acid and draining the material between successive immersions so as to dissolve the produced sugars, until the sugar concentration of the acid in the bath has attained a desired value. The solid material and the liquid acid are delivered to a tubular horizontal rotary reactor arranged to provide a bath of the acid, to produce a rotating movement for cyclical immersion of the solid material in the bath of acid and longitudinally displace the solid material undergoing hydrolysis together with the acid of the bath and to continuously discharge solid residue and acid containing dissolved sugars due to overflow by gravity at an outlet end of the reactor.

53. WO2008141174	GENE KNOCKOUT MESOPHILIC AND THERMOPHILIC ORGANISMS, AND METHODS OF USE THEREOF	20070509	HOGSETT DAVID A; RAJGARHIA VINEET B	HOGSETT DAVID A MASCOMA CORP RAJGARHIA VINEET B

Resumen:
One aspect of the invention relates to a genetically modified thermophilic or mesophilic **microorganism**, wherein a first native gene is partially, substantially, or completely deleted, silenced, inactivated, or down-regulated, which first native gene encodes a first native enzyme involved in the metabolic production of an organic acid or a salt thereof, thereby increasing the native ability of said thermophilic or mesophilic **microorganism** to produce ethanol as a **fermentation** product. In certain embodiments, the aforementioned **microorganism** further comprises a first non-native gene, which first non- native gene encodes a first non-native enzyme involved in the metabolic production of ethanol. Another aspect of the invention relates to a process for converting **lignocellulosic** biomass to ethanol, comprising contacting **lignocellulosic** biomass with a genetically modified thermophilic or mesophilic **microorganism**

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
54. WO2008119009	MATERIALS AND METHODS FOR EFFICIENT ALANINE PRODUCTION	20070327	ZHANG XUELI ZHANG; JANTAMA KAEMWICH; MOORE JONATHAN C; SHANMUGAM KEELNATHAM T; INGRAM LONNIE O'NEAL	INGRAM LONNIE O'NEAL JANTAMA KAEMWICH MOORE JONATHAN C SHANMUGAM KEELNATHAM T UNIV FLORIDA ZHANG XUELI ZHANG

Resumen:
The subject application provides genetically engineered **microorganisms** that produce L-alanine as the primary **fermentation** product from sugars. Pentose sugars, such as xylose, and hexose sugars, such as glucose, can be effectively fermented to L-alanine. The strains described herein have the ability to metabolize all sugars that are constituents of **lignocellulosic** biomass and a variety of disaccharides, including lactose, maltose, sucrose and others.

55. US20070275447	Indirect or direct **fermentation** of biomass to fuel alcohol	20060525	LEWIS RANDY S; TANNER RALPH S; HUHNKE RAYMOND L	HUHNKE RAYMOND L LEWIS RANDY S TANNER RALPH S UNIV OKLAHOMA STATE

Resumen:
A novel clostridia bacterial species (Clostridium carboxidivorans, ATCC BAA-624, "P7") is provided. P7 is capable of synthesizing, from waste gases, products which are useful as biofuel. In particular, P7 can convert CO to ethanol. Thus, this novel bacterium can transform waste gases (e.g. syngas and refinery wastes) into useful products. P7 also catalyzes the production of acetate and butanol. Further, P7 is also capable of directly fermenting **lignocellulosic** materials to produce ethanol and other substances

No Patente	*Título*	*Fecha de Publicación*	*Inventor*	*Solicitante*
56. WO200718442	EXPRESSION OF AN ACTIVE CARRIER FOR XYLOSE IN GENETICALLY MODIFIED SACCHAROMYCES CEREVISIAE	20050805	TRAVASSOS LEANDRO MARIA JOSE; THERIAGA MENDES BERNARDO GONCA; SPENCER VIEIRA MARTINS ISABEL	FUNDACAO DA FACULDADE DE CIENC SPENCER VIEIRA MARTINS ISABEL THERIAGA MENDES BERNARDO GONCA TRAVASSOS LEANDRO MARIA JOSE

Resumen:
The present invention confers to the fermentative yeast Saccharomyces cerevisiae, genetically modified by insertion of a nucleic acid sequence encoding a xylose and glucose active transporter, the ability to assimilate xylose using a system of co-transport with protons exhibiting a high affinity for xylose. The invention is useful for the production of bioethanol from plant biomass and other **lignocellulosic** materials, using genetically modified **microorganisms** for assimilating and fermenting xylose in mixtures of hexoses and pentoses resulting from raw material of industrial interest

57. FR2881753	Production of cellulase enzymes using the residues from ethanolic **fermentation** distillation of enzymatic hydrolysates from (ligno-)cellulosic materials	20050209	WARZYWODA MICHEL; BALLERINI DANIEL; MONOT FREDERIC	BALLERINI DANIEL INST FRANCAIS DU PETROLE Institut Francais du Petrole MONOT FREDERIC WARZYWODA MICHEL

Resumen:
Producing cellulolytic and/or hemicellulolytic enzymes by a cellulolytic **microorganism** comprises using the residue from the ethanolic **fermentation** of enzymatic hydrolysates of cellulosic or ligno-cellulosic materials. An independent claim is also included for a process for producing ethanol from cellulosic or ligno-cellulosic materials.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
58. US7344876	Kluyveromyces strains metabolizing cellulosic and hemicellulosic materials	20030124	LEVINE ROBERT P	ENOGEN INC PHAGE BIOTECHNOLOGY PHAGE BIOTECHNOLOGY INC

Resumen:
This invention relates to the use of **microorganisms** for the generation of ethanol from **lignocellulosic** waste materials. Yeast strains of the genus Kluyveromyces which have the capability to ferment cellulose, hexose sugars to ethanol are provided. Also provided are methods for converting cellulose, hexoses, or mixed hydrolysates of hexoses to ethanol by **fermentation** with Kluyveromyces strains. The invention also provides methods to isolate yeast strains which metabolize cellulose, pentoses, or hemicelluloses from waste materials.

59. US5733758	Tower reactors for bioconversion of **lignocellulosic** material	19970110	NGUYEN QUANG A	NGUYEN QUANG A

Resumen:
An apparatus for enzymatic hydrolysis and **fermentation** of pretreated **lignocellulosic** material, in the form of a tower bioreactor, having mixers to achieve intermittent mixing of the material. Precise mixing of the material is important for effective heat and mass transfer requirements without damaging or denaturing the enzymes or fermenting **microorganisms**. The pretreated material, generally in the form of a slurry, is pumped through the bioreactor, either upwards of downwards, and is mixed periodically as it passes through the mixing zones where the mixers are located. For a thin slurry, alternate mixing can be achieved by a pumping loop which also serves as a heat transfer device. Additional heat transfer takes place through the reactor heat transfer jackets.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
60. US5047332	Integrated process for the production of food, feed and fuel from biomass	19860903	CHAHAL DEVINDER S	FRAPPIER ARMAND INST INST ARMAND FRAPPIER UNIV OF Q

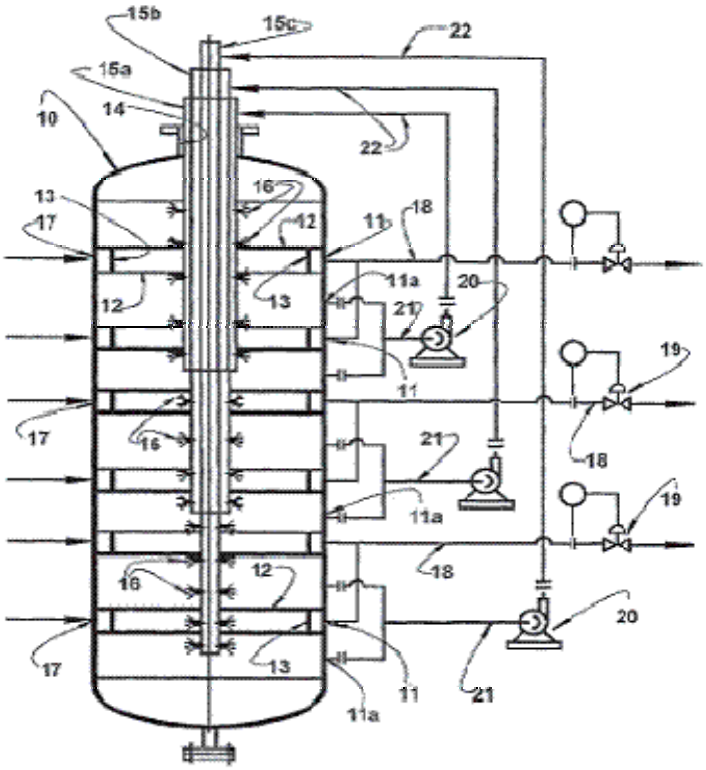
Resumen:
A feedstock containing a biomass such as **lignocellulosic** materials, e.g. forest biomass; agricultural residues; or manures, is pretreated and thereafter is fractionated into cellulose, lignin and hemicelluloses. New mutants are disclosed which include Chaetomium cellulolyticum IAF-101 (NRRL 18756), Aspergillus sp. IAF-201 (NRRL 18758), Penicillum sp. IAF-603 (NRRL 18759), and Trichoderma reesei QMY-1. With these new mutants and also known fungi including Pleurotus sajor-caju and other Pleurotus spp. unfractionated predetermined biomass is converted into feed. The same treatment can also be applied to hemicelluloses, and cellullose. Cellulose can also be hydrolyzed by means of a cellulase-system prepared from cellulose and Tricoderma reesei to prepare glucose which can be converted to alcohol with Saccharomyces cerevisiae, Kluyveromyces spp. and Zymomonas mobilis. The residual microbial biomass of these **microorganisms** from alcohol **fermentation** broth is also used as feed. The process is economical and non polluting.

61. WO200912779	A METHOD AND A SYSTEM FORTHE **PRETREATMENT** OF **LIGNOCELLULOSIC** MATERIAL	20070725	FOSBOL PEDER; HANSEN PALLE	ATLAS STORD DENMARK FOSBOL PEDER HANSEN PALLE

Resumen:
The invention relates to a method and a system for the **pretreatment** of **lignocellulosic** material by thermal hydrolysis, in particular with a view to producing bioethanol, wherein the material is first admixed with water and is then passed to a reactor, in which the soaked material is subjected to a high temperature and a high pressure to such an extent that it is accessible for a subsequent treatment with enzymes, following which the treated material is separated into a liquid part and a solid part, where the solid component is subsequently used for the production of bioethanol by enzymation and fermentation. Exclusively steam is used in the method and the corresponding system for heating, stirring and transport, as e.g. the transport through the various elements of the system is provided by a pressure difference between the compartments of the elements. The material (30) is introduced through a gate (2) into a reactor (3) in which the hydrolysis takes place. After completed treatment, the material (32) is discharged to an economizer (4), in which a separator (5) separates the material into a solid part and a liquid part. The solid part (29) is discharged for use in the further process. The method is performed as a two step process, as the material (32) from the first reactor (3) is injected into the economizer (4) and from there further on (26) to an additional reactor (8) for an additional treatment step. A high efficiency is achieved, as all pressures are established by direct steam addition, and heating surfaces and mechanical elements, such as pumps, stirrers, stuffing boxes, bearings, etc. are avoided. The use of economizers (4, 9) improves the consumption of energy relative to previously known processes.

1.1. Anexo 2 Resumen de patentes, Brasil.

Resumen de Patente empresa DEDINI. Brasil



PN - WO2007051269 A1 20070510 [WO200751269]
STG: Publ. Of int. Appl. With int. Search rep
AP : 2006WO-BR00239 20061031
CA2613745 A1 20070510 [CA2613745]
STG: Application laid open
AP : 2006CA-2613745 20061031
AU2006308733 A1 20070510 [AU2006308733]
STG: Patent not preceeded by A1-lapsed
AP : 2006AU-0308733 20061031
BRPI0505212 A 20070807 [BR200505212]
STG: Patent Application
AP : 2005BR-0005212 20051101
AR057564 A1 20071205 [AR--57564]
STG: Independent patent application
AP : 2006AR-P104735 20061030
CN101223288 A 20080716 [CN101223288]
STG: Unexamined application
AP : 2006CN-80026130 20061031
FD : PCT PN: WO2007/051269 20070510 [WO200751269]
FD : PCT PAP: PCT/BR2006/000239 20061031 [2006WO-BR00239]
EP1945823 A1 20080723 [EP1945823]
STG: Public. Of applic. With search report
28/08/08 1 15*54*24
AP : 2006EP-0804597 20061031
TI - IMPROVEMENTS IN A PROCESS FOR RAPID ACID HYDROLYSIS OF LIGNOCELLULOSIC
MATERIAL AND IN A HYDROLYSIS REACTOR
OTI - (EP1945823)
VERBESSERUNG BEI EINEM VERFAHREN ZUR SCHNELLEN SAUREN HYDROLYSE VON

LIGNOCELLULOSEMATERIAL UND BEI EINEM HYDROLYSEREAKTOR
AMÉLIORATIONS CONCERNANT UN PROCÉDÉ POUR L'HYDROLYSE ACIDE RAPIDE DE MATIÈRE LIGNOCELLULOSIQUE ET CONCERNANT UN RÉACTEUR D'HYDROLYSE
AMÉLIORATIONS CONCERNANT UN PROCÉDÉ POUR L'HYDROLYSE ACIDE RAPIDE DE MATIÈRE LIGNOCELLULOSIQUE ET CONCERNANT UN RÉACTEUR D'HYDROLYSE
AMELIORATIONS CONCERNANT UN PROCEDE POUR L'HYDROLYSE ACIDE RAPIDE DE MATIERE LIGNOCELLULOSIQUE ET CONCERNANT UN REACTEUR D'HYDROLYSE
aperfeiçoamentos em processo de hidrólise ácida rápida de material lignocelulósico e em reator
de hidrólise
PROCESO DE HIDROLISIS ACIDA RAPIDA DE MATERIAL LIGNOCELULOSICO Y UN REACTOR DE HIDROLISIS

AB - (WO200751269)

Improvements in a process for rapid acid hydrolysis of lignocellulosic material and in a hydrolysis
reactor, said lignocellulosic material being fed in different levels of a reactor (10) and contacted with flows of lignin organic solvent, water and an extremely dilute solution of a strong inorganic acid, for obtaining a liquid phase of hydrolysis extract and a solid phase of non-reacted and nondissolved
material. A controlled steam flow is injected into the different levels of the reactor (10),
so as to provide adequate temperatures of organic solvent and strong inorganic acid and forming
the desired products (sugars). A flow of the liquid phase is recirculated in different levels of the reactor (10), the remainder thereof being withdrawn from the reactor (10), abruptly cooled with the solvent submitted to evaporation to obtain a concentrate. The lignin is transferred by decantation and the concentrate is transferred to subsequent process steps.
DS - (EP1945823)
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DS - (WO200751269)
AE AG AL AM AT AU AZ BA BB BG BW BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE EG ES FI GB GD GE GH GM GT HN HR HU ID IL IN IS JP KE KG KM KN KP KR KZ LA LC
LK LR LS LT LU LV LY MA MD MG MK MN MW MX MY MZ NA NG NI NO NZ OM PG PH PL PT RO RS RU SC SD SE SG SK SL SM SV SY TJ TM TN TR TT TZ UA UG US UZ VC VN ZA
ZM ZW
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Eurasian patent : AM AZ BY KG KZ MD RU TJ TM
European patent : AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LT LU LV MC
NL PL PT RO SE SI SK TR
OAPI patent : BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG
FD - (CN101223288)
PCT PN: WO2007/051269 20070510 [WO200751269]
PCT PAP: PCT/BR2006/000239 20061031 [2006WO-BR00239]
PR - 2005BR-0005212 20051101
2006WO-BR00239 20061031
IN - HILST ANTONIO GERALDO PROENCA
PA - DE DINI BASIC INDUSTRIES [machine translation]
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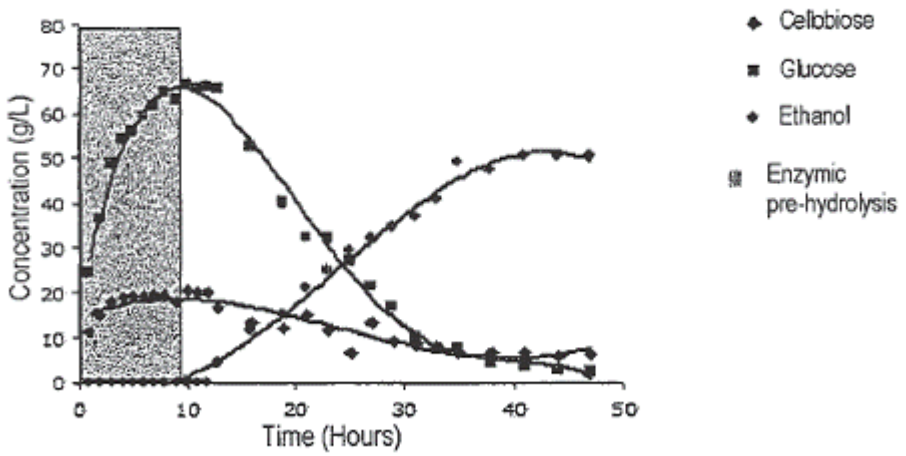
HILST ANTONIO GERALDO PROENCA
PA0 - DEDINI S/A. INDÚSTRIAS DE BASE; / Rodovia Rio Claro - Piracicaba - Km 26,3, Bairro Cruz
Caiada, 13412-900 Piracicaba - SP (BR) (except US)
HILST, Antonio Geraldo Proença; / Rua Félix de Lavalle, 161, Bairro Nova Piracicaba, 13405-148 Piracicaba (BR) (only US)



PN - WO2008065433 A1 20080605 [WO200865433]
STG: Publ. Of int. Appl. With int. Search rep
AP : 2007WO-GB04618 20071130
BRPI0605017 A 20080715 [BR200605017]
STG: Patent Application
AP : 2006BR-0005017 20061130
TI - **PROCESS** FOR THE **FERMENTATIVE PRODUCTION** OF **ETHANOL** FROM **SOLID LIGNOCELLULOSIC** MATERIAL COMPRISING A STEP OF TREATING A **SOLID LIGNOCELLULOSIC** MATERIAL WITH ALKALINE SOLUTION IN ORDER TO REMOVE THE LIGNIN
OTI - (WO200865433)
PROCÉDÉ POUR LA **PRODUCTION FERMENTATIVE** D'**ÉTHANOL** À PARTIR D'UNE MATIÈRE LIGNOCELLULOSIQUE SOLIDE COMPRENANT UNE ÉTAPE DE TRAITEMENT D'UNE MATIÈRE LIGNOCELLULOSIQUE SOLIDE PAR UNE SOLUTION ALCALINE AFIN D'ÉLIMINER LA LIGNINE
processo para a produção de etanol a partir de materiais lignocelulósicos por via enzimática
AB - (WO200865433)
The present invention relates to a process for obtaining fuel ethanol by using agricultural and agroindustrial waste materials composed of lignocellulose, and especially sugar cane bagasse. These residues have significant contents of carbohydrates in the form of polysaccharides (cellulose and hemicellulose), which can be hydrolysed by chemical and enzymic processes. The hemicellulose fraction is submitted to mild hydrolysis with sulphuric acid, and the solid material from this hydrolysis is submitted to a process of saccharif ication (enzymic hydrolysis) with simultaneous rapid alcoholic fermentation under conditions which allow a significant increase in conversion to alcohol in a greatly shortened time.
DS - (WO200865433)
AE AG AL AM AT AU AZ BA BB BG BH BR BW BY BZ CA CH CN CO CR CU CZ DE DK DM DO DZ EC EE EG ES FI GB GD GE GH GM GT HN HR HU ID IL IN IS JP KE KG KM KN KP KR KZ LA LC LK LR LS LT LU LY MA MD ME MG MK MN MW MX MY MZ NA NG NI NO NZ OM PG PH PL PT RO RS RU SC SD SE SG SK SL SM SV SY TJ TM TN TR TT TZ UA UG US
UZ VC VN ZA ZM ZW
ARIPO patent : BW GH GM KE LS MW MZ NA SD SL SZ TZ UG ZM ZW
Eurasian patent : AM AZ BY KG KZ MD RU TJ TM
European patent : AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LT LU LV MC
NL PL PT RO SE SI SK TR
OAPI patent : BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG
PR - 2006BR-0005017 20061130
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28/08/08 2 16*55*44

3 Artículos científicos.

Artículos publicados sobre temas relacionados con la obtención de etanol a partir de residuos lignocelulósicos.

1. Thermoset phenolic matrices reinforced with unmodified and surface-grafted furfuryl alcohol sugar cane bagasse and curaua fibers: properties of fibers and composites. Trindade, W G / Hoareau, W / Megiatto, J D / Razera, I A T / Castellan, A / Frollini, E , Biomacromolecules, 6 (5), p.2485-2496, Sep 2005 Composites based on phenolic matrices and unmodified and chemically modified sugar cane bagasse and curaua fibers were prepared. The fibers were oxidized by chlorine dioxide, mainly phenolic syringyl and guaiacyl units of the lignin polymer, followed by ...

2. Hoareau, W. / Trindade, W.G. / Siegmund, B. / Castellan, A. / Frollini, E. , Polymer Degradation and Stability, 86 (3), p.567-576, Dec 2004 Sugar cane bagasse and curaua acidolysis lignins were used to get a better understanding of the mechanism involved in a new chemical modification of sugar cane bagasse and curaua fibres, consisting in a selective oxidation of lignin by...Sugar cane bagasse and curaua lignins oxidized by chlorine dioxide and reacted with furfuryl alcohol: characterization...

3. Thermo-Mechanical Behavior of Poly(vinyl alcohol) and Sugarcane Bagasse Composites. attivita' di ricerca [10K] Sep 2007 attività di ricerca Articolo in rivista Autori E. Chiellini, P. Cinelli, R. Solaro, M. Laus Titolo Thermo-Mechanical Behavior of Poly(vinyl alcohol) and Sugarcane Bagasse Composites Anno 2004 Lingua Inglese Rivista J.Appl.Polym.Sci. Volume 92 Pagina iniziale 426 Pagina finale 432 Numero http://brett.adm.unipi.it/cgi-bin/virmap/vmibo?doc_pub...] Perspectivas sobre la producción de Bioetanol en México http: //www.ciatej.net.mx/ Centro de Asistencia en Tecnología y Diseño de Jalisco.

4. Planeación estratégica de la agroindustria azucarera mexicana para la producción de biocombustibles. Colegios de Postgraduados. México.

5. Evaluation of inoculum of Candida guilliermondii grown in presence of glucose on xylose reductase and xylitol dehydrogenase activities and xylitol production during batch fermentation of sugarcane bagasse hydrolysate. da Silva, Débora Danielle Virgínio / das Graças de Almeida Felipe, Maria / de Mancilha, Ismael Maciel / da Silva, Sílvio Silvério , Applied biochemistry and biotechnology, 121-124, p.427-437, Apr 2005 The effect of glucose on xylose-xylitol metabolism in fermentation medium consisting of sugarcane bagasse hydrolysate was evaluated by employing an inoculum of...56 g/g) and productivity (0.46 g/[L.h]) after 48 h of fermentation.

6. Estudo de recuperação xilitol produzido por fermentação do hidrolisado de bagaço de cana-de-açucar utilizando zeolitas. Study ... Tihany Morita Antero dos Santos , Dec 2004 ...produced by fermentation of the hidrolisate one of bagasse of sugar cane-of-sugar...Xilitol , Fermentation , Separation...is a sugar alcohol with large...production from the fermentation of hemicellulosic...sugar cane bagasse hydrolysate...

7. Potential for reduction of alcohol production costs in Brazil Rosa, L.P. / Tolmasquim, M.T. / Arouca, M.C. , Energy, 23 (11), p.987-995, Nov 1998 ...hydrated alcohol) but also...The use of bagasse as a wood-subsdtute...method for fermentation and (iii) the use of bagasse as fuel...juice and bagasse. In distelle...or syrup fermentation at independent...hydrated alcohol (96 GL) and...

8. Optimized extraction by cetyl trimethyl ammonium bromide reversed micelles of xylose reductase and xylitol dehydrogenase from Candida guilliermondii homogenate. Cortez, Ely Vieira / Pessoa, Adalberto / das Graças de Almeida Felipe, Maria / Roberto, Inês Conceição / Vitolo, Michele , Journal of chromatography. B, Analytical technologies in the biomedical and life sciences, 807 (1), p.47-54, Jul 2004 The intracellular enzymes xylose reductase (XR, EC 1.1.1.21) and xylitol dehydrogenase (XD, EC 1.1.1.9) from Candida guilliermondii, grown in sugar cane bagasse hydrolysate, were separated by reversed micelles of cetyl trimethyl ammonium bromide (CTAB)

9. A survey of potential health and safety hazards of commercial-scale ethanol production facilities [PDF-8MB] Sep 2004 3 4456 0452033 5 ORML4TM-7817 Contract No. W-7405-eng-26 Health and Safety Research D i v i s i o n Environmental Sciences Division** In formation D iv i s i on* A SURVEY OF POTENTIAL HEALTH AND SAFETY HAZARDS OF COMMERCIAL-SCALE ETHANOL PRODUCTION FACILITIES A. P. Watson J. I;. Smith* J. L. http://www.ornl.gov/info/reports/1982/3445604520935.pd

10. Poster Presentation 3-35 [9K] Mar 2002 Research and development studies of alcohol fermentation technology have been conducted over the last decades to make alcohol production more efficient. In this context there are clear advantages in using surplus bagasse from ethanol plants as a raw material for the same end product. http://www.ct.ornl.gov/symposium/24th/index_files/post...]

11. Novel Ethanol Fermentations from Sugar Cane and Straw Hartley, B. S. / Shama, G. , Philosophical Transactions of the Royal Society of London. Series A, Mathematical and Physical Sciences (1934-1990), 321 (1561), p.555-568, Apr 1987 doi:10.1098/rsta.1987.0032Most agree that it is ultimately desirable to produce bulk chemicals such as ethanol from

renewable resources; the questions focus on `where', `when' and `how'

12. Ethanol/water pulps from sugar cane straw and their biobleaching with xylanase from Bacillus pumilus. Moriya, Regina Y / Gonçalves, Adilson R / Duarte, Marta C T , Applied biochemistry and biotechnology, 137-140 (1-12), p.501-513, Apr 2007 The influence of independent variables (temperature and time) on the cooking of sugar cane straw with ethanol/water mixtures was studied to determine operating conditions that obtain pulp with high cellulose contents and a low lignin content.

13. Hydrolysis of Ammonia-pretreated Sugar Cane Bagasse with Cellulase, beta-Glucosidase, and Hemicellulase Preparations. Prior, Bernard A / Day, Donal F , Applied biochemistry and biotechnology, 146 (1-3), p.151-164, Mar 2008 Sugar cane bagasse consists of hemicellulose (24%) and cellulose (38%), and bioconversion of both fractions to ethanol should be considered for a viable process. We have evaluated the hydrolysis of pretreated bagasse with combinations of cellulase,

14. Study of the hydrolysis of sugar cane bagasse using phosphoric acid Gamez, S. / Gonzalez-Cabriales, J.J. / Ramirez, J.A. / Garrote, G. / Vazquez, M. , Journal of Food Engineering, 74 (1), p.78-88, May 2006 In the present work, samples of sugar cane bagasse were hydrolysed with phosphoric acid under mild conditions (H"3PO"4 2-6%, time 0-300min and 122^oC) to study the feasibility of using the liquid phase as fermentation media. Solid yield,...

15. Hydrolysis of sugar cane bagasse using nitric acid: a kinetic assessment Rodriguez-Chong, A. / Alberto Ramirez, J. / Garrote, G. / Vazquez, M. , Journal of Food Engineering, 61 (2), p.143-152, Feb 2004 Sugar cane bagasse was hydrolysed using nitric acid at variable concentration (2-6%), reaction time (0-300 min) and temperature (100-128 ^oC). The concentration of sugars released (xylose, glucose and arabinose) and degradation products...

16. Modeling of the hydrolysis of sugar cane bagasse with hydrochloric acid. Bustos, Guadalupe / Ramírez, José Alberto / Garrote, Gil / Vázquez, Manuel , Applied biochemistry and biotechnology, 104 (1), p.51-68, Jan 2003 Sugar cane bagasse was hydrolyzed under different concentrations of hydrochloric acid (2-6%), reaction times (0-300 min), and temperatures (100-128 degrees C). Sugars obtained (xylose, glucose, arabinose, and glucose) and degradation products (furfural ...

17. Kinetic study of the acid hydrolysis of sugar cane bagasse Aguilar, R. / Ramrez, J.A. / Garrote, G. / Vazquez, M. , Journal of Food Engineering, 55 (4), p.309-318, Dec 2002 Economic interest in xylitol production can be enhanced if the needed xylose solutions can be obtained from the hydrolysis of low-cost lignocellulosic

wastes. Sugar cane bagasse is a renewable, cheap and widely available waste in...

18. Measured kinetics of the acid-catalysed hydrolysis of sugar cane bagasse to produce xylose Lavarack, B.P. / Griffin, G.J. / Rodman, D. , Catalysis Today, 63 (2), p.257-265, Dec 2000 Experimental trials of the water hydrolysis of bagasse to produce xylose, arabinose and glucose were conducted using a temperature-controlled microwave digester. The experimental variables were temperature, ratio of water mass to bagasse...

19. Hydrolysis of Cane Sugar by d- and l-Camphor-$\beta \text{-Sulphonic}$ Acid Caldwell, Robert John , Proceedings of the Royal Society of London (1854-1905), 74 (-1), p.184-187, Jan 1904 doi:10.1098/rspl.1904.0101The Royal Society is collaborating with JSTOR to digitize, preserve, and extend access to Proceedings of the Royal Society of London. www.jstor

20. Studies of the Processes Operative in Solutions. XXI. The Hydrolysis of Cane Sugar by Dilute Acids Worley, F. P. , Proceedings of the Royal Society of London. Series A, Containing Papers of a Mathematical and Physical Character (1905-1934), 87 (599), p.555-563, Dec 1912 doi:10.1098/rspa.1912.0110The Royal Society is collaborating with JSTOR to digitize, preserve, and extend access to Proceedings of the Royal Society of London. Series A, Containing Papers of a Mathematical and Physical Character. www.jstor.

21. Studies of the Processes Operative in Solutions. XXII. The Hydrolysis of Cane Sugar by Sulphuric Acid; Also a Note on ... Worley, F. P. , Proceedings of the Royal Society of London. Series A, Containing Papers of a Mathematical and Physical Character (1905-1934), 87 (599), p.563-581, Dec 1912 doi:10.1098/rspa.1912.0111The Royal Society is collaborating with JSTOR to digitize, preserve, and extend access to Proceedings of the Royal Society of London. Series A, Containing Papers of a Mathematical and Physical Character. www.jstor

22. Enhancement of enzymatic hydrolysis of sugar cane bagasse by steam explosion pretreatment. Kling, S H / Neto, C C / Ferrara, M A / Torres, J C / Magalhaes, D B / Ryu, D D , Biotechnology and bioengineering, 29 (8), p.1035-1039, Jun 1987

23. Pretreatment of lignocellulosic material with fungi capable of higher lignin degradation and lower carbohydrate degradation improves substrate acid hydrolysis and the eventual conversion to ethanol. uhar, Sarika / Nair, Lavanya M / Kuhad, Ramesh Chander , Canadian journal of microbiology, 54 (4), p.305-313, Apr 2008 Phanerochaete chrysosporium, Pycnoporus cinnabarinus,and fungal isolates RCK-1 and RCK-3 were tested for their lignin degradation abilities when grown on wheat straw (WS) and Prosopis juliflora (PJ) under solid-state cultivation conditions. Fungal isolate

23.

24. Industrial Bioprocessing Alert. Polyethylene from Sugarcane Ethanol Ammonia Biomass Hydrolysis Pretreatment Computer Modeling A ... [35K] Nov 2007 Marrone Organic Innovations obtains a portfolio of natural product pesticide candidates from DuPont. Braskem will produce polyethylene sfrom sugarcane ethanol in Brazil. Michigan State researchers continue to investigate pretreatment of cellulose with ammonia before hydrolysis. Diversa generates[https://www.frost.com/prod/servlet/market-service-segm

25. BIOCONVERSION OF LIGNOCELLULOSIC MATERIAL INTO BIOFUEL (ETHANOL) PRETREATMENT, ENZYMATIC HYDROLYSIS, AND ETHANOL FERMENTATION [PDF-484K] Oct 2007 Biomass Refining CAFI Auburn University Soaking in Aqueous Ammonia (SAA) for Pretreatment of Corn Stover Tae Hyun Kim and Y. Y. Lee Department of Chemical Engineering Auburn University AIChE 2004 Annual Meeting Austin, TX. http://www.public.iastate.edu/~thkim/publication/prese...]

26. Bioetanol Lignocelulósico y switch grass http://www.pnas.org/search?fulltext=switch+grass+bioethanol+lignocelulosic&submit=yes&go.x=5&go.y=7

Estrategia de Búsqueda.

Por Clasificación Internacional de Patentes:

C12P Procesos de fermentación para la síntesis de un compuesto químico dado de composición dada. C12P 7/00 Preparación de compuestos orgánicos que contienen oxígeno. C12P 7/08 Preparación como subproducto o preparado a partir de un sustrato constituido por desechos o materias celulósicas.

Por palabras claves y operadores autorizados:

1. Bagasse fermentation ethanol
2. Bagaço fermentação álcool
3. Pretreatment bagasse fermentation.
4. Acid hydrolysis lignocellulosic
5. Enzyme hydrolysis lignocellulosic.
6. Lignocellulosic ethanol
7. Straw sugar cane Hydrolysis ethanol

La búsqueda realizada, conjugando las diferentes estrategias, arrojó como resultado 61 familias de patentes relacionadas con el tema del boletín. Los resúmenes de las patentes se encuentran en el **ANEXO 1**. Además se encontraron 26 artículos vinculados a proyectos de investigación e información académica resumidos en el **ANEXO 3**.

1 Resumen de patentes.

Resumen de las patentes recuperadas sobre obtención de alcohol a partir de residuos lignocelulósicos

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
1. US20090035826	METHOD FOR THE PRODUCTION OF ALCOHOL FROM A PRETREATED **LIGNOCELLULOSIC** FEEDSTOCK	20070802	TOLAN JEFFREY S; FOODY BRIAN; ROWLAND STEPHEN	FOODY BRIAN IOGEN ENERGY COR ROWLAND STEPHEN TOLAN JEFFREY S

Resumen:
A process for the production of glucose from a pretreated **lignocellulosic** feedstock is provided. The metho comprises enzymatically hydrolyzing the pretreated **lignocellulosic** feedstock with cellulase enzymes to produce hydrolyzate slurry comprising glucose and unhydrolyzed cellulose and fermenting the hydrolyzate slurry in fermentation reaction to produce a fermentation broth comprising alcohol. A process stream is obtained comprisin unhydrolyzed cellulose, which is then subjected to a denaturing step, preferably comprising exposing th unhydrolyzed cellulose to elevated temperatures, thereby producing a heat-treated stream comprising th unhydrolyzed cellulose. The heat-treated stream comprising unhydrolyzed cellulose is then further hydrolyzed wit cellulase enzymes to hydrolyze the cellulose to glucose.

2. US20090042259	Process for enzymatically converting a plant biomass	20080808	DALE BRUCE E; TEYMOURI FARZANEH; CHUNDAWAT SHISHIR; BALAN VENKATESH	UNIV MICHIGAN STATE

Resumen:
The present invention describes a process for at least a 90% conversion of a plant biomass preferably by a reductio of the units of cellulase needed and by using a xylanase which acts synergistically with the cellulase to improve th yield of xylose and glucose as sugars. The process enables greater conversion of a **lignocellulosic** plant biomass t glucose and xylose for use as animal feeds and as fermentation as medium for producing **ethanol**.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
3. WO200911645	AUTO-IMMOBILIZED CO-FERMENTATION	20070713	EDEBO LARS	EDEBO LARS

Resumen:
The present invention discloses a fermentation process wherein a filamentous micro-organism and yeast cells are co-operating by fermenting **ethanol** from **lignocellulosic** hydrolysates which contain mixtures of both sugars and toxic substances. The fermentation process comprises two steps, wherein the first step the filamentous micro-organism is aerobically cultivated in a medium and produces a mycelium network; and in the second step the non-filamentous micro-organisms are immobilized with

said mycelium network and incubated under oxygen-limited conditions. The invention also discloses a fermentor optimized for the fermentation process of the invention.

4. WO200915614	METHOD AND EQUIPMENT FOR PRODUCTION OF GLUCOSE, **ETHANOL**, FURFURAL, FURANE AND LIGNIN FROM RENEWABLE RAW MATERIALS	20070730	KRATOCHVIL ZDENEK; RYCHTAR LIBOR; MACHEK FRANTISEK; BOUSKA FRANTISEK	BOUSKA FRANTISEK KMPS FINANCIAL GROUP S R O KRATOCHVIL ZDENEK MACHEK FRANTISEK RYCHTAR LIBOR

Resumen:
Method and equipment for production of fermentable saccharides, **ethanol**, furfural, furane, lignin, acetic acid and formic acid from **lignocellulosic** and amylaceous materials. The method comprises one-stage or two-stage continuous thermo-compressive hydrolysis of **lignocellulosic** particles, cellulase treatment of unreacted lignocellulose, amylase treatment of formed monosaccharides combined with added amylaceous materials, and fermentation of the combined processed monosaccharide solutions into **ethanol**. Side products furfural, methanol, acetic acid, formic acid and lignin are recovered and purified, optionally furfural is further converted to furan. An integrated process for recovery and recycling of all products and by-products, and recycling of heat energy is disclosed.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
5.US20080295980	CONTINUOUS COUNTER-CURRENT ORGANOSOLV PROCESSING OF **LIGNOCELLULOSIC** FEEDSTOCKS	20070815	HALLBERG CHRISTER; O'CONNOR DONALD; RUSHTON MICHAEL; PYE EDWARD KENDALL; GJENNESTAD GORDON; BERLIN ALEX; MACLACHLAN JOHN ROSS	BERLIN ALEX GJENNESTAD GORDON HALLBERG CHRISTER LIGNOL INNOVATIONS LTD MACLACHLAN JOHN ROSS O'CONNOR DONALD PYE EDWARD KENDALL RUSHTON MICHAEL

Resumen:
A modular process for organosolv fractionation of **lignocellulosic** feedstocks into component parts and further processing of said component parts into at least fuel-grade **ethanol** and four classes of lignin derivatives. The modular process comprises a first processing module configured for physico-chemically digesting **lignocellulosic** feedstocks with an organic solvent thereby producing a cellulosic solids fraction and a liquid fraction, a second processing module configured for producing at least a fuel-grade **ethanol** and a first class of novel lignin derivatives from the cellulosic solids fraction, a third processing module

configured for separating a second class and a third class of lignin derivatives from the liquid fraction and further processing the liquid fraction to produce a distillate and a stillage, a fourth processing module configured for separating a fourth class of lignin derivatives from the stillage and further processing the stillage to produce a sugar syrup.

6.US20090011484	CONCURRENT SACCHARIFICATION AND FERMENTATION OF FIBROUS BIOMASS	20070704	BERLIN ALEX; PYE EDWARD KENDALL; O'CONNOR DONALD	BERLIN ALEX LIGNOL INNOVATIONS LTD O'CONNOR DONALD PYE EDWARD KENDALL

Resumen:
A process for simultaneous saccharification and fermentation of a cellulosic solids fraction extracted from a **lignocellulosic** feedstock. The viscosity of the cellulosic solids fraction is reduced by intermixing with a liquid carbohydrate stream. A suitable liquid carbohydrate stream is a de-lignified liquids fraction that was previously separated from the solids fraction during processing of the **lignocellulosic** feedstock. Alternatively, the viscosity of the solids fraction may be reduced by commingling with a liquid carbohydrate stream comprising one or more monosaccharides. The reduced-viscosity cellulosic solids fraction is then commingled with a fermentative microbial inoculant and a cellulosic biomass-degrading enzyme composition. The commingled mixture is maintained in a pressurized reaction vessel under elevated temperatures to enable simultaneous enzymatic hydrolysis of the cellulosic solids to monosaccharides and fermentation of the monosaccharides to produce an **ethanolic** beer. The **ethanolic** beer is distillable for recovery of fuel-grade **ethanol** and a stillage that may be further processed.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
7. US20080227162	Biomass pretreatment	20080313	VARANASI SASIDHAR; SCHALL CONSTANCE ANN; DADI ANANTHARAM PRASAD; ANDERSON JARED; RAO KRIPA	ANDERSON JARED DADI ANANTHARAM PRASAD KUMAR GUNEETRIPATI PRAVEEN RAO KRIPA SCHALL CONSTANCE ANN UNIV TOLEDO ARANASI SASIDHAR

Resumen:
A method for lignocellulose conversion to sugar with improvements in yield and rate of sugar production has been developed by using ionic liquid pretreatment. This new pretreatment strategy substantially improves the efficiency (in terms of yield and reaction rates) of saccharification of **lignocellulosic** biomass. Cellulose and hemicellulose, when hydrolyzed into their sugars, can be converted into **ethanol** fuel through well established fermentation technologies. These sugars also form the feedstocks for production of variety of chemicals and polymers. The complex structure of biomass requires proper pretreatment to enable efficient saccharification of cellulose and hemicellulose components to their constituent sugars. Current pretreatment approaches suffer from slow reaction rates of cellulose hydrolysis (by using the enzyme cellulase) and low yields.

8. US20080227161	METHODS FOR PRODUCING A HYDROLYSATE AND **ETHANOL** FROM **LIGNOCELLULOSIC** MATERIALS	20070316	LEVIE BENJAMIN E; NEOGI AMAR N; DUFF SHELDON J B; MAYOVSKY JEFFREY E; ANDERSON DWIGHT E; ECKERT ROBERT C; KRISHNA CHUNDAKKADU	ANDERSON DWIGHT E DUFF SHELDON J B ECKERT ROBERT C KRISHNA CHUNDAKKADU LEVIE BENJAMIN E MAYOVSKY JEFFREY E NEOGI AMAR N WEYERHAEUSER CO

Resumen:
A method for producing a hydrolysate from **lignocellulosic** materials generally includes fiberizing the **lignocellulosic** materials, separating the **lignocellulosic** materials into at least a first portion and a second portion, wherein at least the first portion includes lignin, treating the first portion to deactivate at least a portion of the lignin in the first portion, re-combining the first and second portions after treating the first portion, and hydrolyzing the **lignocellulosic** materials with enzymes to produce a hydrolysate.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
9. WO200895098	PROCESS FOR SUGAR PRODUCTION FROM **LIGNOCELLULOSIC** BIOMASS USING ALKALI PRETREATMENT	CHUNG CHANG-HO; DAY DONAL F	CHUNG CHANG-HO DAY DONAL F UNIV LOUISIANA STATE	CHUNG CHANG-HO; DAY DONAL F

Resumen:
We have discovered a new method to treat biomass with alkali, for example lime. The lime and lignin was sufficiently removed from the treated biomass b> squeezing with a high pressure device to remove alkali and other potential inhibitors of the cellulase enzymes added for sacchapfication. The resulting fibrous material was rapidly solubihzed by cellulases, even at solid loads ranging from 10 to 30 % (w/w) without inhibitory effects on the cellulase activity. The lime pretreatment removed lignin effectively and left the cellulose and hemicellulose almost intact. The method yielded a biomass with structure capable of being enzyme solubhzed and fermented readily at a solids loading of 10-30% for a production of **ethanol**.

10. CN101235392	Cellulose fuel **ethanol** and preparation method thereof	20080116	XIAODONG BAI; FENGJU XU; BAIYIN LIU; XIAOGANG BAI	XIAODONG BAI

Resumen:
The invention relates to a cellulose fuel alcohol and the manufacturing method, which belongs to the technical field of processing and utilizing **lignocellulosic** wastes such forest secondary products, forest crotches, farm crop straws and the like. The key point of the invention is that an integral coupling new method is optimized to lead fibrous raw material to process, ferment, distill and dewater to achieve technical innovation and lower production cost. The application of the cellulose fuel alcohol is suitable for engine fuel of vehicle gasoline, and each physical chemical properties and environment protection index completely reach to the national standard. The cellulose fuel alcohol effectively lowers the pollution of automobile exhaust which is carbon monoxide, carbon dioxide and hydrocarbon, which saves raw material such as foodstuff and fecula, and reduces petroleum oil consumption

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
11. JP2008092910	METHOD FOR PRODUCING **ETHANOL**	20061016	NOJIRI MASANOBU; IKEDA TSUTOMU; SUGIMOTO TOMOKO; MAGARA KENGO	FORESTRY & FOREST PRODUCTS RES

Resumen:
PROBLEM TO BE SOLVED: To provide a method for efficiently producing **ethanol**, with slight burden on the environment, by reducing the cost of both saccharification and fermentation with **lignocellulosic** biomass as feedstock.

SOLUTION: The method for producing **ethanol** comprises the following process: **Lignocellulosic** biomass is delignified by alkali digestion technique, saccharifying enzyme-productive bacteria are cultured with the resultant biomass as a carbon source to produce an enzyme suitable to saccharifying the **lignocellulosic** biomass, and a cultured liquid containing the resultant saccharifying enzyme and **ethanol**-fermentative bacteria are added to the alkali-digested **lignocellulosic** biomass to effect fermentation.

12. BR200605017	PROCESS FOR THE FERMENTATIVE PRODUCTION OF **ETHANOL** FROM SOLID **LIGNOCELLULOSIC** MATERIAL COMPRISING A STEP OF TREATING A SOLID **LIGNOCELLULOSIC** MATERIAL WITH ALKALINE SOLUTION IN ORDER TO REMOVE THE LIGNIN	20061130	SANTA ANNA LIDIA MARIA MELO; PEREIRA NEI; GOMES ABSAI DA CONCEICAI; VASQUES MARIANA PENUELA	BENSON JOHN EVERETT GOMES ABSAI DA CONCEICAI PEREIRA NEI PETROLEO BRASILEIRO SA SANTA ANNA LIDIA MARIA MELO VASQUES MARIANA PENUELA

Resumen:
The present invention relates to a process for obtaining fuel **ethanol** by using agricultural and agroindustrial waste materials composed of lignocellulose, and especially sugar cane bagasse. These residues have significant contents of carbohydrates in the form of polysaccharides (cellulose and hemicellulose), which can be hydrolysed by chemical and enzymic processes. The hemicellulose fraction is submitted to mild hydrolysis with sulphuric acid, and the solid material from this hydrolysis is submitted to a process of saccharif ication (enzymic hydrolysis) with simultaneous rapid alcoholic fermentation under conditions which allow a significant increase in conversion to alcohol in a greatly shortened time.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
13. US20080029233	MOVING BED BIOMASS FRACTIONATION SYSTEM AND METHOD	20060803	WINGERSON RICHARD C; KADAM KIRAN L	KADAM KIRAN L PUREVISION TECHNOLOGY INC WINGERSON RICHARD C

Resumen:
Countercurrent extraction of **lignocellulosic** biomass such as trees, grasses, shrubs, and agricultural residues or waste involves the separation of cellulose fibers from other constituents, for subsequent use in the manufacture of paper, plastics, **ethanol**, and other industrial chemicals. Systems and methods involve continuous, multiple processing steps that may include chemical reactions with mixing at elevated temperature and/or pressure, efficient reagent or solvent utilization, filtration at elevated temperature and/or pressure, controlled discharge of liquid and solid products, and energy recuperation.

14. US20080057555	Integrated process for separation of **lignocellulosic** components to fermentable sugars for production of **ethanol** and chemicals	20060905	NGUYEN XUAN NGHINH	NGUYEN XUAN NGHINH

Resumen:
A continuous and modular process converts **lignocellulosic** materials for the production of **ethanol** principally and/or chemicals such as methanol, butanediol, propanediol, hydrocarbon fuel, etc. Renewable **lignocellulosic** biomass such as but not all inclusive hardwoods (gum, beech, oak, sweet gum, poplar, eucalyptus, etc.), soft woods (pines, firs, spruce, etc.), corn stovers, straws, grasses, recycled papers, waste products from pulp and paper mills, etc can be used as feedstock. The process is designed to be modular and the feed entry point can be selected to adapt to different biomass feedstock. **Lignocellulosic** biomass such as hardwood and softwood are subjected to chemical/pressure treatment stages using potent and selective chemicals such as sodium chlorite/acetic acid (anhydrous) and chlorine/chlorine dioxide to separate the main components-lignin, cellulose (glucose) and

hemicelluloses (xylose, arabinose, galactose)-into three process streams. The separated carbohydrates are further subjected to washing, cleaning, neutralization, and/or mild hydrolysis and subsequently fermented to produce **ethanol**. Residual lignin and extractives remained with the cellulose are removed by chemical treatment steps to enhance the fermentations of cellulose. Pre-hydrolysate after neutralization to neutralize and remove toxic components such as acetic acid, furfural, phenolics, etc. containing (xylose, arabinose, galactose) and hexoses (glucose) can be either separately or together with the purified cellulosic fraction fermented to produce **ethanol**. Approximately 100 gallons of **ethanol**, suitable to be used as a fuel, can be produced from one dried ton of wood. Significant amount of lignin are separated as a by-product and can be converted to hydrocarbon fuel, surfactant, drilling aid, or can be incinerated for generation of power and steam.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
15. WO2007134607	THERMOANAEROBACTER MATHRANII STRAIN BGl	20060522	MIKKELSEN MARIE JUST; AHRING BIRGITTE KIAER	AHRING BIRGITTE KIAER BIOGASOL IPR APS MIKKELSEN MARIE JUST

Resumen:
Strict anaerobic thermophilic bacterium belonging to the group of Thermoanaerobacter mathranii and mutants and derivatives thereof. The bacterium is particularly suitable for the production of fermentation products such as **ethanol**, lactic acid, acetic acid and hydrogen from **lignocellulosic** biomass.

16. US20070275447	Indirect or direct fermentation of biomass to fuel alcohol	20060525	LEWIS RANDY S; TANNER RALPH S; HUHNKE RAYMOND L	HUHNKE RAYMOND L LEWIS RANDY S TANNER RALPH S UNIV OKLAHOMA STATE

Resumen:
A novel clostridia bacterial species (Clostridium carboxidivorans, ATCC BAA-624, "P7") is provided. P7 is capable of synthesizing, from waste gases, products which are useful as biofuel. In particular, P7 can convert CO to **ethanol**. Thus, this novel bacterium can transform waste gases (e.g. syngas and refinery wastes) into useful products. P7 also catalyzes the production of acetate and butanol. Further, P7 is also capable of directly fermenting **lignocellulosic** materials to produce **ethanol** and other substances.

17. US20080008783	Process for the treatment of **lignocellulosic** biomass	20060501	DALE BRUCE	UNIV MICHIGAN STATE

Resumen:
A process for the treatment of biomass to render structural carbohydrates more accessible and/or digestible using concentrated ammonium hydroxide with or without anhydrous ammonia addition, is described. The process preferably uses steam to strip ammonia from the biomass for recycling. The process yields of monosaccharides from the structural carbohydrates are good, particularly as measured by the enzymatic hydrolysis of the structural carbohydrates. The monosaccharides are used as animal feeds and energy sources for **ethanol** production.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
18. WO200795215	PRODUCTION OF GASOLINE FROM FERMENTABLE FEEDSTOCKS	20060214	BRADIN DAVID	BRADIN DAVID CPS BIOFUELS INC

Resumen:
Compositions and methods for forming hexane, and, optionally, gasoline and/or components of a gasoline composition, from fermentable sugars are disclosed. The sugars are fermented using a bacteria or yeast that predominantly forms butyric acid. The butyric acid is subjected to Kolbe or photo-Kolbe electrolysis to form hexane. The hexane can be subjected to catalytic reforming and/or isomerization steps to form higher octane products, which are or can be included in gasoline compositions. In one aspect, the fermentable sugars are derived from **lignocellulosic** materials such as wood products, switchgrass, or agricultural wastes. These materials are delignified to form lignin, cellulose and hemicellulose. The cellulose and hemicellulose are depolymerized to form glycose and xylose, either or both of which can be fermented by the bacteria. The lignin can be used to generate heat energy and/or electric energy for use in one or more process steps, such as the fermentation, product isolation, Kolbe electrolysis, catalytic reforming and/or isomerization steps. Alternatively, the lignin can be converted to synthesis gas, which can then be subjected to Fischer-Tropsch synthesis, or converted to methanol and/or **ethanol**. Thus, the methods described herein can convert biomass to a fuel composition or fuel additive, which can be used in a conventional gasoline engine, unlike traditional fuels such as **ethanol** or biodiesel.

19. US20070227063	Process for conversion of mushroom **lignocellulosic** waste to useful byproducts	20060330	DALE BRUCE E; BALAN VENKATESH; CHUNDAWAT SHISHIR P	UNIV MICHIGAN STATE

Resumen:
A process for the conversion of monocot **lignocellulosic** grass waste from mushroom growth into byproducts is described. In particular, the present invention releases glucans from the waste which can be easily hydrolyzed, after a less severe thermochemical process (i.e. AFEX), and into sugars for producing **ethanol** or other by-products by fermentation.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante

20. EP2013368	PROCESS FOR THE TREATMENT OF **LIGNOCELLULOSIC** BIOMASS	20060501	DALE BRUCE E; LYND LEE R; LASER MARK	DALE BRUCE E ARTMOUTH COLLEGE LASER MARK YND LEE RUNIV MICHIGAN STATE

Resumen:
A process for the treatment of biomass to render structural carbohydrates more accessible and/or digestible using concentrated ammonium hydroxide with or without anhydrous ammonia addition, is described. The process preferably uses steam to strip ammonia from the biomass for recycling. The process yields of monosaccharides from the structural carbohydrates are good, particularly as measured by the enzymatic hydrolysis of the structural carbohydrates. The monosaccharides are used as animal feeds and energy sources for **ethanol** production.

21. EP2021487	THERMOPHILIC ORGANISMS FOR CONVERSION OF **LIGNOCELLULOSIC** BIOMASS TO **ETHANOL**	20051031	DESAI SUNIL G; SHAW ARTHUR JOSEPHUS IV; LYND LEE R; TYURIN MIKHAIL V	BARDSLEY JOHN ARTMOUTH COLLEGE DESAI SUNIL G OGSETT DAVID ANTHONY LYND LEE R MASCOMA CORP PODKAMINE KARAHAW ARTHUR JOSEPHUS SHAW ARTHUR JOSEPHUS IVRIN MIKHAIL V

Resumen:
Mutant thermophilic organisms that consume a variety of biomass derived substrates are disclosed herein. Strains of Thermoanaerobacterium saccharolyticum with acetate kinase and phosphotransacetylase expression eliminated are disclosed herein. Further, strain ALKl has been engineered by site directed homologous recombination to knockout both acetic acid and lactic acid production. Continuous culture involving a substrate concentration challenge lead to evolution of ALKl , and formation of a more robust strain designated ALK2. Both organisms produce near theoretical **ethanol** yields without expressing pyruvate decarboxylase

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
22. US20070134781	Method for producing bioethanol from a **lignocellulosicbiomass** and recycled paper sludge	20051212	AGBLEVOR FOSTER A	AGBLEVOR FOSTER A AGBLEVOR FOSTER ARYL

Resumen:
A method producing **ethanol** by combining an plant fiber material containing calcium carbonate with at least one **lignocellulosic** agricultural residue into a mixture. The plant fiber material can be a paper sludge. The mixture is then hydrolyzed and the resultant hydrolysate is then fermented into **ethanol**.

23. WO200792898	PROCESS FOR CONVERTING ANHYDROSUGARS TO GLUCOSE AND OTHER FERMENTABLE SUGARS	20060207	OLSON EDWIN S; FREEL BARRY	ENERGY & ENVIRONMENTAL RES CT FREEL BARRY LSON EDWIN S

Resumen:
A process is provided for producing glucose and other fermentable sugars from a liquid mixture containing anhydrosugars. One example of a process encompasses: 1) water extraction of a anhydrosugar-rich fast-pyrolysis bio-oil fraction that constitutes a residual after removal of volatile impurities, 2) further purification of said anhydrosugar-rich fraction, and 3) solid-phase catalytic hydrolysis of the anhydrosugars to yield glucose and other fermentable sugars. An exemplary application of the process is in the production of **ethanol** and other sugar-based fermentation products from bio-oil generated via fast pyrolysis of low-cost, high-availability **lignocellulosic** biomass resources.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
24. EP1767658	Method of processing **lignocellulosic** feedstock for enhanced xylose and **ethanol** production	20010228	GRIFFIN ROBERT; NICHOLSON COLIN; MOTT CORINNE; TOLAN JEFFREY S; ANAND VIJAY	IOGEN ENERGY CORP

Resumen:
The present invention provides a method of producing xylose from **lignocellulosic** feedstock. The method comprises disrupting **lignocellulosic** feedstock; leaching the **lignocellulosic** feedstock by contacting the feedstock with at least one aqueous solution for a period greater than about 2 minutes to produce a leached feedstock and a leachate; removing the leachate from the leached feedstock; acidifying the leached feedstock to a pH between about 0.5 and about 3 to produce an acidified feedstock, and; reacting the acidified feedstock under conditions which disrupt fiber structure and hydrolyze a portion of hemicellulose and cellulose of the acidified feedstock, to produce a composition comprising xylose and a pretreated feedstock. The xylose may be purified from the pretreated feedstock or it may be converted to **ethanol** with the pretreated feedstock

25. FR2881753	Production of cellulase enzymes using the residues from **ethanolic** fermentation distillation of enzymatic hydrolysates from (ligno-)cellulosic materials	20050209	WARZYWODA MICHEL; BALLERINI DANIEL; MONOT FREDERIC	BALLERINI DANIEL INST FRANCAIS DU PETROLE Institut Francais du Petrole MONOT FREDERIC WARZYWODA MICHEL

Resumen:
Producing cellulolytic and/or hemicellulolytic enzymes by a cellulolytic microorganism comprises using the residue from the **ethanolic** fermentation of enzymatic hydrolysates of cellulosic or ligno-cellulosic materials. An independent claim is also included for a process for producing **ethanol** from cellulosic or ligno-cellulosic materials

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
26. US20050069998	Procedure for the production of **ethanol** from **lignocellulosic** biomass using a new heat-tolerant yeast	20000224	BALLESTEROS PERDICES IGNACIO; BALLESTEROS PERDICES MERCEDES; OLIVA DOMINGUEZ JOSE MIGUEL; CARRASCO GARCIA JUAN	CT INVESTIG ENERGETICAS CIEMAT

Resumen:
It includes the stages of grinding the **lignocellulosic** biomass to a size of 15-30 mm, subjecting the product obtained to steam explosion pre-treatment at a temperature of 190-230deg. C. for between 1 and 10 minutes in a reactor (2), collecting the pre-treated material in a cyclone (3) and separating the liquid and solid fractions by filtration in a filter press (9), introducing the solid fraction in a fermentation deposit (10), adding a cellulase at a concentration of 15 UFP per gram of cellulose and 12.6 International Units of beta-glucosidase enzyme dissolved in citrate buffer pH 4.8, inoculating the fermentation deposit (10) with a culture of the heat-tolerant bacteria Kluyveromyces marxianus CECT 10875, obtained by chemical mutagenesis from strain DER-26 of Kluyveromyces marxianus and shaking the mixture for 72 hours at 42deg. C.

27. FI200505143	PRODUCTION OF PULP USING A GASEOUS ORGANIC AGENT AS HEATING AND REACTION-ACCELERATING MEDIA	20050331	ENQVIST ERIC; TIKKA PANU; HEINRICH LEOPOLD; LUHTANEN MATTI	ENQVIST ERIC HEINRICH LEOPOLD LUHTANEN MATTIMETSO PAPER INC TIKKA PANU

Resumen:
The invention relates to an improved process to break down lignin macromolecules and liberating cellulose fibers in **lignocellulosic** material using delignifying reactants with a gaseous organic agent as a heating and reaction-accelerating media. **Lignocellulosic** material is first impregnated with reactant chemicals, e.g. commonly used agents such as sodium hydroxide and sodium sulfide. Subsequently, the energy required for the delignification reactions is provided through heating with a gaseous organic agent such as methanol or **ethanol**, condensing and releasing energy to the solid **lignocellulosic** material. The temperature during the heating step with a gaseous organic agent is higher than the

temperature during the impregnation step.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
28. US7344876	Kluyveromyces strains metabolizing cellulosic and hemicellulosic materials	20030124	LEVINE ROBERT P	ENOGEN INC PHAGE BIOTECHNOLOGY PHAGE BIOTECHNOLOGY INC

Resumen:
This invention relates to the use of microorganisms for the generation of **ethanol** from **lignocellulosic** waste materials. Yeast strains of the genus Kluyveromyces which have the capability to ferment cellulose, hexose sugars to **ethanol** are provided. Also provided are methods for converting cellulose, hexoses, or mixed hydrolysates of hexoses to **ethanol** by fermentation with Kluyveromyces strains. The invention also provides methods to isolate yeast strains which metabolize cellulose, pentoses, or hemicelluloses from waste materials.

29. US20040231661	METHOD OF PROCESSING **LIGNOCELLULOSIC** FEEDSTOCK FOR ENHANCED XYLOSE AND **ETHANOL** PRODUCTION	20010228	GRIFFIN ROBERT; NICHOLSON COLIN; MOTT CORINNE; TOLAN JEFFREY S; ANAND VIJAY	ANAND VIJAY GRIFFIN ROBERT OGEN BIO PRODUCTS CORP IOGEN ENERGY CORP MOTT CORINNENICHOLSON COLIN TOLAN JEFFREY S

Resumen:
The present invention provides a method of producing xylose from **lignocellulosic** feedstock. The method comprises disrupting **lignocellulosic** feedstock; leaching the **lignocellulosic** feedstock by contacting the feedstock with at least one aqueous solution for a period greater than about 2 minutes to produce a leached feedstock and a leachate; removing the leachate from the leached feedstock; acidifying the leached feedstock to a pH between about 0.5 and about 3 to produce an acidified feedstock, and; reacting the acidified feedstock under conditions which disrupt fiber structure and hydrolyze a portion of hemicellulose and cellulose of the acidified feedstock, to produce a composition comprising xylose and a pretreated feedstock. The xylose may be purified from the pretreated feedstock or it may be converted to **ethanol** with the pretreated feedstock.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
30. US7189306	Process of treating **lignocellulosic** material to	20020222	GERVAIS GIBSON W	GERVAIS GIBSON W GERVAIS GILLES

	produce bio-**ethanol**			

Resumen:
This invention relates to a process of treating a **lignocellulosic** material to produce bio-**ethanol**. The process includes the steps of: (a) exposing the **lignocellulosic** material to conditions including a pH not less than about 8, and steam at a first pressure, to produce a step (a) product; (b) explosively discharging the step (a) product to a second pressure less than the first pressure to produce a step (b) product; and (c) further processing the step (b) product to produce bio-**ethanol** and other co-products. In another embodiment, the invention relates to a conical auger fractionation column. The fractionation column includes a column body having an input and an output. A conical filter is positioned inside the column body, the filter having a larger diameter end directed toward the input and a smaller diameter end directed toward the output. A conical auger is positioned inside the conical filter, the conical auger having an outer diameter which is approximately the same as an inner diameter of the conical filter. The auger and filter are adapted to cooperate to separate cellulosic solids from a liquid stream in a process of producing bio-**ethanol** from a **lignocellulosic** material.

31. US20040185542	Lignin-blocking treatment of biomass and uses thereof	20030319	YANG BIN; WYMAN CHARLES E	DARTMOUTH COLLEGE WYMAN CHARLES E YANG BIN

Resumen:
Disclosed is a method for converting cellulose in a **lignocellulosic** biomass. The method provides for a lignin-blocking polypeptide and/or protein treatment of high lignin solids. The treatment enhances cellulase availability in cellulose conversion. Cellulase efficiencies are improved by the protein or polypeptide treatment. The treatment may be used in combination with steam explosion and acid prehydrolysis techniques. Hydrolysis yields from lignin containing biomass are enhanced 5-20%, and enzyme utilization is increased from 10% to 50%. Thus, a more efficient and economical method of processing lignin containing biomass materials utilizes a polypeptide/protein treatment step that effectively blocks lignin binding of cellulase.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
32. SE200401303	**ETHANOL** PRODUCTIVITIES OF SACCHAROMYCES CEREVISIAE STRAINS IN FERMENTATION OF DILUTE-ACID HYDROLYZATES DEPEND ON THEIR FURAN REDUCTION CAPACITIES	20040519	NILSSON ANNELI; LIDEN GUNNAR; GORWA-GRAUSLUND MARIE-FRANCOIS; HAHN-HAEGERDAL BAERBEL; MODIG CARL TOBIAS; MOREIRA DE ALMEIDA	FORSKARPATENT I SYD AB GORWA-GRAUSLUND MARIE-FRANCOIS HAHN-HAEGERDAL BAERBEL LIDEN GUNNAR MODIG CARL T MOREIRA DE ALMEIDA JOAO R NILSSON ANNELI

JOAO RICARD

Resumen:
The present invention relates to an **ethanol** producing microbial strain, such as Saccharomyces cerevisiae strain, being able to grow and produce **ethanol** from **lignocellulosic** hydrolysates comprising growth inhibiting compounds of the group furfural and 5-hydroxy-methyl furfural, in a batch, fed-batch or continuous fermentation, said microbial strain being tolerant to such inhibiting compounds, which strain is upregulated and/or over expressed with regard to one or more of the following genes: LAT1, ALD6, ADH5, ADH6, GDH3, OYE3, SER3, GND2, MDH2, IDP3, ADH7, AAD15, ERG27, HMG1, LYS5, SPS19, SGE1.

33. FI200400775	PROCESS FOR PRODUCING **ETHANOL**	20040604	PENTTILAE MERJA; SIIKA-AHO MATTI; UUSITALO JAANA; VIIKARI LIISA	PENTTILA MERJA SIIKA-AHO MATTI UUSITALO JAANA VALTION TEKNILLINEN VIIKARI LIISA

Resumen:
A process for producing **ethanol** from a fibrous **lignocellulosic** raw material. After pre-treatment of the raw material, the fibrous fraction is first hydrolysed at high consistency and then the modified material is subjected simultaneously to continued hydrolysis with a cellulase and to **ethanol** fermentation in a fermentation mixture. Fermentation is continued to convert an essential portion of the available cellulose into **ethanol**, then a liquid fraction containing solubilized hemicelluloses is added to the fermentation mixture and fermentation continued. By means of the invention, high fermentation rates, high **ethanol** concentrations and low **ethanol** production costs can be attained.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
34. US7419809	METHOD FOR GLUCOSE PRODUCTION WITH A CELLULASE MIXTURE COMPRISING A MODIFIED CELLULASE	20000925	FOODY BRIAN; WHITE THERESA C; TOLAN JEFFREY S; DONALDSON JENNIFER	DONALDSON JENNIFER, FOODY BRIAN, IOGEN BIO PRODUCTS CORP, IOGEN ENERGY CORP, TOLAN JEFFREY S, WHITE THERESA C

Resumen:
The present invention pertains to a method of converting cellulose to glucose by treating a pretreated **lignocellulosic** substrate with an enzyme mixture comprising cellulase enzyme and a modified CBHO, wherein the modified CBHI is present in the enzyme mixture at an amount relative to all CBHI-type enzymes from about 15% to about 100% (w/w),depending upon the modified CBHI used. The pretreated **lignocellulosic** substrate is selected from the group consisting of agricultural residues, residues after starch or sugar removal dedicated **ethanol** crops forestry products, and pulp and paper products, or combinations thereof

35. US6660506	DILUTE ACID/METAL SALT HYDROLYSIS OF **LIGNOCELLULOSICS**	20000809	NGUYEN QUANG A; TUCKER MELVIN P	KELLER FRED A MIDWEST RESEARCH INST NGUYEN QUANG A TUCKER MELVIN P

Resumen:
A modified dilute acid method of hydrolyzing the cellulose and hemicellulose in **lignocellulosic** material under conditions to obtain higher overall fermentable sugar yields than is obtainable using dilute acid alone, comprising:impregnating a **lignocellulosic** feedstock with a mixture of an amount of aqueous solution of a dilute acid catalyst and a metal salt catalyst sufficient to provide higher overall fermentable sugar yields than is obtainable when hydrolyzing with dilute acid alone;loading the impregnated **lignocellulosic** feedstock into a reactor and heating for a sufficient period of time to hydrolyze substantially all of the hemicellulose and greater than 45% of the cellulose to water soluble sugars; and recovering the water soluble sugars.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
36. US6419788	CELLULOSE PRODUCTION FROM **LIGNOCELLULOSIC** BIOMASS	20000816	WINGERSON RICHARD C	PUREVISION TECHNOLOGY INC PUREVISION TECNOLOGY INC

Resumen:
A multi-function process is described for the separation of cellulose fibers from the other constituents of **lignocellulosic** biomass such as found in trees, grasses, agricultural waste, and waste paper with application in the preparation of feedstocks for use in the manufacture of paper, plastics, **ethanol**, and other chemicals. This process minimizes waste disposal problems since it uses only steam, water, and oxygen at elevated temperature in the range of 180deg. C. to 240deg. C. for 1 to 10 minutes plus a small amount of chemical reagents to maintain pH in the range 8 to 13. An energy recuperation function is important to the economic viability of the process.

37. US6130076	**Ethanol** production using a soy hydrolysate-based medium or a yeast autolysate-based medium	19970619	INGRAM LONNIE O; YORK SEAN W	UNIV FLORIDA

Resumen:
This invention presents a method for the production of **ethanol** that utilizes a soy hydrolysate-based nutrient medium or a yeast autolysate-based medium nutrient medium in conjunction with **ethanologenic** bacteria and a fermentable sugar for the cost-effective production of **ethanol** from **lignocellulosic** biomass. The invention offers several advantages over presently available media for use in **ethanol** production, including consistent quality, lack of toxins and wide availability.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante

38. US6498029	Pentose fermentation of normally toxic lignocellulose prehydrolysate with strain of Pichia stipitis yeast using air	19991117	KELLER FRED A; NGUYEN QUANG A	MIDWEST RESEARCH INST

Resumen:
Strains of the yeast Pichia stipitis NPw9 (ATCC PTA-3717) useful for the production of **ethanol** using oxygen for growth while fermenting normally toxic **lignocellulosic** prehydrolysates.

39. CH-645685	Process allowing the delignification and the transformation into sugar of lignocellulose vegetal material by using organic solvents	19780831	PASZNER L; CHANG P	PASZNER LASZLO CHANG PEI CHING THERMOFORM AG

Resumen:
Minced lignocellulose, such as wood, straw, bamboos, bagasse or any other structured vegetal material, is treated in a discontinuous or continuous process. The process consists in boiling this material in an acidified mixture of solvents in an aqueous phase. This mixture of solvents contains water in a proportion of 30 to 70 parts and an organic solvent in a proportion of 70 to 30 parts. The organic solvent consists of either an alcohol of light molecular weight, or a ketone of light molecular weight; it must be easily evaporable and soluble in water. The pH of the medium is adjusted to a pH from 3.5 to 1.7 by adding a catalytic compound selected within the group of the strong acids: hydrochloric, nitric and phosphoric; within the group of these strong acids neutralized by their neutral salts; within the group of the following organic acids: oxalic, maleic, o-phthalic, l-malic, succinic, nicotinic, salicylic and trifluoracetic. The boiling temperatures range between 160 and 210'C, preferably between 180 and 200'C. After three minutes at the minimum, we obtain the separation of the lignin and the hydrolysis of the hemicelluloses dissolved; after that, the fibres are easily dispersible while forming a pulp. By proceeding to a mechanical refining at a high pressure, a high density thermomechanical pulp is obtained after a shorter boiling time. With the neutralized acids, as well as with the organic acids, particularly with the oxalic acid, we can obtain a fibre with a high degree of polymerization. The lignin is obtained as a precipitate which separates from the liquid; the liquid solvent, usually ethanol or acetone, is evaporated; then the drained lignin is redissolved in the minimal quantity of acetone; a new precipitation with an excess of water allows to obtain the lignin in the form of a slightly coloured powder. A prolonged boiling dehydrates and disaggregates the sugars; by the strong acids action, takes place the formation of light molecular weight or microcristalline cellulose, glucose or organic acids, methanol and furfuralic compounds.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
40. CA1100266	Organosolv delignification and saccharification process for **lignocellulosic** plant materials	19770831	PASZNER LASZLO; CHANG PEI-CHING	BAU UND FORSHUNGSGEZELSHAFT TE CHANG P CHANG PEI CHING PASZNER L PASZNER LASZLO THERMOFORM BAU FORSCHUNG

Resumen:
Cellulose-containing material is rapidly saccharified to convert pentosans and hexosans to sugars by cooking under pressure at from 180 DEG C. to 220 DEG C. with acetone-water solvent mixture carrying from 0.05 to 0.25 weight percent of phosphoric, sulfuric or hydrochloric acids. A predominantly cellulosic material, e.g. a delignified pulp, is hydrolysed to yield relatively pure glucose recoverable from liquor which is flowed through the cellulose, then withdrawn and cooled and neutralized within an elapsed time of a minute or less. Whole wood is nearly totally dissolvable by the process, yielding mixed pentoses and hexoses. The dehydration and degradation products of sugars are formed by prolonging retention time of liquor from 20 to 45 minutes.

41. DK1259466T	A METHOD FOR PROCESSING **LIGNOCELLULOSIC** MATERIAL	20000217	AHRING BIRGITTE KIAER; THOMSEN ANNE BELINDA	AHRING BIRGITTE KIAER BIOGASOL IPR APS FORSKNINGSCT RISO FORSKNINGSCT RISOE THOMSEN ANNE BELINDA UNIV DENMARK TECH DTU

Resumen:
A method wherein **lignocellulosic** biomass materials are converted into combustible fuel products. In particular, the method is a continuous process, involving wet oxidation or steam explosion, for fermentatively converting such biomass materials into **ethanol** using a process design that permits all or part of the process water from the **ethanol** fermentation process to be recycled to reduce the consumption of process water. The effluent from the **ethanol** fermentation step may be subjected to an anaerobic fermentation step generating methane and a water effluent in which the amount of potentially inhibitory substances is at a sub-inhibitory level, which in turn permits all or part of the effluent water from the anaerobic fermentation step to be recycled into the process.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
42. US4594130	Pulping of lignocellulose with aqueous alcohol and alkaline earth metal salt catalyst	19781127	CHANG PEI-CHING; PASZNER LASZLO	CHANG PEI CHING PASZNER LASZLO

Resumen:
High yield pulping is achieved by cooking a **lignocellulosic** material in a confined chamber in the absence of added oxygen at elevated temperatures up to 240 DEG C. with an initially neutral or acidic mixture of alcohol and water in volume ratio between 50:50 and virtually anhydrous alcohol cooking liquor, using a

lower aliphatic alcohol namely methanol, **ethanol** or n-propanol, carrying in solution at least about 0.002 moles per liter of a magnesium, calcium or barium salt as a primary catalyst soluble in at least catalytic amounts in the mixture to form barium, calcium and magnesium ions. The cooking time may range from at least two (2) minutes to under three (3) hours. The process yields bright, free-fiber pulp even at residual lignin of 80 Kappa number as high as 80% of softwood and up to 75% of hardwood weight, of viscosity (TAPPI 0.5% Cu En) above 18 up to 60 centipoise. Addition of trace amounts of an acidic compound as a secondary catalyst increases the rate of delignification. Elevated pressures on the cooking solvent mixture also increases the rate of delignification.

43. CA1175820	UTILIZATION OF CELLULOSE AND LIGNOCELLULOSE	19790323	DEIBUITSUDO ERU BURINKU; RARII ERU SHIYAREJIYAA	UNIV CALIFORNIA

Resumen:
Method of converting **lignocellulosic** material to useful products such as **ethanol**, methanol, methane, organic acids and furfural, also producing best for use in the process and if feasible or advantageous for use outside the system; such method comprising a two stage hydrolysis with a sensitization step between, followed by wet oxidation whereby the production of monosaccharides is maximized and their degradation is minimized; the products of hydrolysis (monosaccharides) and of wet oxidation of ligneous material left as residue from hydrolysis are converted. as by fermentation of monosaccharides, methanantion and processes of separation into useful end products such as **ethanol**, methane, methanol, organic acids and furfural; such method and system minimizing degradation to carbon dioxide, carbon monoxide and water and minimizing or eliminating the production of solid waste material.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
44. US4342831	Fermentable acid hydrolyzates and fermentation process	19790702	FABER MARCEL D; ERNST RICHARD H; LEFEBVRE PHILIP	AMERICAN CAN CO

Resumen:
Method of preconditioning acid hydrolyzates derived from **lignocellulosic** materials such as sawdust or newspaper and preconditioned acid hydrolyzates are provided. The preconditioning negates the effect of substances which tend to inhibit fermentation and comprises a series of steps including steam-stripping, calcium oxide treatment at a pH of 10 to 10.5, adjusting the pH to about 6 to 7 with a mineral acid and especially phosphoric acid and concentrating the hydrolyzate solution to a glucose concentration of less than 150 grams per liter. Glucose contained in such preconditioned hydrolyzates is readily fermentable to ethyl alcohol, in theoretical yield, after fermentation for as short a period as 1 to 2 hours.

45. SE8302654	Method for producing **ethanol** from xylose-containing	19830509	VAN DIJKEN JOHANNES; SCHEFFERS ALEXANDER	ALFA LAVAL AB ALFALAVAL AB DIJKEN JOHANNES VAN SCHEFFERS ALEXANDER

substance

Resumen:
A method for fermenting xylose-containing substance, such as a **lignocellulosic** degradation product into **ethanol**. Yeast of the species Pichia stipitis and/or Pichia segobiensis and/or Candida shehatae are utilized for the fermentation.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
46. US5258293	Continuous process for **ethanol** production from **lignocellulosic** materials without mechanical agitation	19910503	LYND LEE R; HOGSETT DAVID A; SPIELES GISBERT	DARTMOUTH COLLEGE

Resumen:
An improved and highly productive method of continuously producing **ethanol** from **lignocellulosic** substrates is provided. The method involves providing a suitable microbial system within a reaction vessel and adding fermentable substrate to the reactor to form a reaction mixture. The fermentation reaction is allowed to proceed while a quiescent state is maintained within the reactor. During the fermentation, soluble substrate is differentially retained relative to the feed slurry and reaction biocatalysts are retained and internally recycled within the system. Further, while fermenting substrate is retained within the system, it forms a stratified zone within the reactor such that the concentration of actively fermenting substrate is highest at upper portions of the reaction zone and is lowest, near zero, at a lower portion of the reaction zone. Insoluble, fully reacted substrate may be withdrawn from a region near the bottom of the reactor

47. CA2071185	PROCESS FOR DELIGNIFYING **LIGNOCELLULOSIC** PULP BY MEANS OF OXYGEN	19910614	COLODETTE JORGE L; SANTOS DE CAMPOS ANA S	WHITE MARTINS SA

Resumen:
IMPROVEMENT IN A PROCESS FOR DELIGNIFYING **LIGNOCELLULOSIC** PULP BY MEANS OF OXYGEN The present invention refers to an improvement for delignifying a **lignocellulosic** pulp by means of oxygen wherein **ethanol** is used as an additive and the process is carried out at high temperature thereby obtaining a higher reduction of ligin content of the **lignocellulosic** pulp, that is, a higher reduction of the Kappa Number in comparison with conventional processes without, however, prejudicing the pulp quality. The use of the present invention provides a pulp which, when subjected to subsequent bleaching sequences, will require a lower amount of chloro compounds in order to achieve the desired whiteness and will also exhibit a high viscosity thus rendering a product with good resistance properties. D-16935

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
48. WO9429475	CELL MASS FROM FERMENTERS AS NUTRIENT SOURCE IN BIOMASS-TO-**ETHANOL** CONVERSION	19930611	PHILIPPIDIS GEORGE P; WYMAN CHARLES E; HINMAN NORMAN D; SPINDLER DIANE D; SCHELL DANIEL J	MIDWEST RESEARCH INST

Resumen:
An improved process for converting **lignocellulosic** biomass-to-**ethanol** comprising: providing a biomass material selected from the group consisting of unmodified carbohydrate material, chemically modified carbohydrate material, derivatized carbohydrate material and mixtures thereof; treating said material enzymatically, chemically, physically or mechanically to produce a glucose containing fluid; treating the glucose containing fluid in a fermenter with a fermentative microorganism at temperatures between about 20 DEG C to about 50 DEG C and at pH ranges from about 3.0 to about 7.0; separating cell mass from said material and solutions surrounding said cell mass from said materials and recycling the cell mass and solutions surrounding the cell mass back to the fermenter to provide a source of nutrients for the fermentative organism; extracting **ethanol** from the fermentation broth with distillation or an extracting solvent or with membranes; and evaporating the **ethanol** from the fermentation broth.

49. US6333181	IMPROVEMENT OF **ETHANOL** PRODUCTION FROM LIGNOCELLULOSE	19970407	INGRAM LONNIE O; WOOD BRENT E	UNIV FLORIDA

Resumen:
This invention presents a method of improving enzymatic degradation of lignocellulose, as in the production of **ethanol** from **lignocellulosic** material, through the use of ultrasonic treatment. The invention shows that ultrasonic treatment reduces cellulase requirements by [VULGAR FRACTION ONE THIRD] to 1/2. With the cost of enzymes being a major problem in the cost-effective production of **ethanol** from **lignocellulosic** material, this invention presents a significant improvement over presently available methods.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
50. BR200500534	ACID HYDROLYSIS PROCESS OF CELLULOSIC AND **LIGNOCELLULOSIC** MATERIALS, DIGESTION VESSEL	20050215	BULLA ROMEO; GONZALO SIEIRO GONZALEZ; PELLEGRINI FRANCISCO	BULLA ROMEO GONZALO SIEIRO GONZALEZ OXITENO S A IND E COM PELLEGRINI FRANCISCO INACIO

	AND HYDROLYSIS REACTOR		INACIO

Resumen:
The present invention relates to an enhanced process for sugar production through the acid hydrolysis of cellulosic and **lignocellulosic** materials characterized by the treatment of these materials in three steps. In the first step, it is made a digestion of the **lignocellulosic** material using a solvent capable of partially dissolving the lignin, which constitutes part of the **lignocellulosic** material. In the second step, the cellulosic material resulting from the treatment with the solvent is subjected to an acid treatment in such conditions that mainly hemicellulose is hydrolyzed to form a sugar solution rich with pentose monomers and oligomers. In the third step, the cellulosic material from the second step is subjected to an acid treatment in such conditions that the major part of the cellulose is hydrolyzed to form a sugar solution rich with hexose monomers and oligomers. This invention also relates to a Digestion Vessel and a Reactor, with this set being constituted by a single vessel or a set of vessels where it's possible to identify three areas where the three process steps are conducted.

51. BR9600672	A PROCESS FOR RAPID ACID **HYDROLISIS** OF **LIGNOCELLULOSIC** MATERIAL AND **HYDROLISIS** REACTOR	19960308	HILST ANTONIO GERALDO PROENCA	DEDINI S A ADMINISTRACAO E PAR HILST ANTONIO GERALDO PROENCA

Resumen:
The present invention relates to a continuous process for acid hydrolysis of **lignocellulosic** material through which the delignification and saccharification operations are carried out in a single reaction cycle utilizing a solubilizing organic solvent of lignin and a strong and extremely diluted inorganic acid, and obtaining highly concentrated recoveries of sugar. For the execution of the present process a hydrolysis reactor is further presented.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
52. CH-609092	Process for continuous acid hydrolysis and saccharification	19770401	ARMANET JEAN-MICHEL; HAMM THOMAS; REGNAULT ALAIN; SACHETTO JEAN-PIERRE; TOURNIER HERVE	BATELLE MEMERIAL INST BATTELLE MEMORIAL INSTITUTE

Resumen:
Continuous hydrolysis to produce sugars is effected by cyclically immersing a solid, divided **lignocellulosic** material in a bath of concentrated hydrochloric acid and draining the material between successive immersions so as to dissolve the produced sugars, until the sugar concentration of the acid in the bath has attained a desired value. The solid material and the liquid acid are delivered to a tubular horizontal rotary reactor arranged to provide a bath of the acid, to produce a rotating movement for cyclical immersion of the solid material in the bath of acid and longitudinally displace the solid material undergoing hydrolysis together with the acid of the bath and to continuously discharge solid residue and acid containing dissolved sugars due to overflow by gravity at an outlet end of the reactor.

53. WO2008141174	GENE KNOCKOUT MESOPHILIC AND THERMOPHILIC ORGANISMS, AND METHODS OF USE THEREOF	20070509	HOGSETT DAVID A; RAJGARHIA VINEET B	HOGSETT DAVID A MASCOMA CORP RAJGARHIA VINEET B

Resumen:
One aspect of the invention relates to a genetically modified thermophilic or mesophilic **microorganism**, wherein a first native gene is partially, substantially, or completely deleted, silenced, inactivated, or down-regulated, which first native gene encodes a first native enzyme involved in the metabolic production of an organic acid or a salt thereof, thereby increasing the native ability of said thermophilic or mesophilic **microorganism** to produce ethanol as a **fermentation** product. In certain embodiments, the aforementioned **microorganism** further comprises a first non-native gene, which first non- native gene encodes a first non-native enzyme involved in the metabolic production of ethanol. Another aspect of the invention relates to a process for converting **lignocellulosic** biomass to ethanol, comprising contacting **lignocellulosic** biomass with a genetically modified thermophilic or mesophilic **microorganism**

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
54. WO2008119009	MATERIALS AND METHODS FOR EFFICIENT ALANINE PRODUCTION	20070327	ZHANG XUELI ZHANG; JANTAMA KAEMWICH; MOORE JONATHAN C; SHANMUGAM KEELNATHAM T; INGRAM LONNIE O'NEAL	INGRAM LONNIE O'NEAL JANTAMA KAEMWICH MOORE JONATHAN C SHANMUGAM KEELNATHAM T UNIV FLORIDA ZHANG XUELI ZHANG

Resumen:
The subject application provides genetically engineered **microorganisms** that produce L-alanine as the primary **fermentation** product from sugars. Pentose sugars, such as xylose, and hexose sugars, such as glucose, can be effectively fermented to L-alanine. The strains described herein have the ability to metabolize all sugars that are constituents of **lignocellulosic** biomass and a variety of disaccharides, including lactose, maltose, sucrose and others.

55. US20070275447	Indirect or direct **fermentation** of biomass to fuel alcohol	20060525	LEWIS RANDY S; TANNER RALPH S; HUHNKE RAYMOND L	HUHNKE RAYMOND L LEWIS RANDY S TANNER RALPH S UNIV OKLAHOMA STATE

Resumen:
A novel clostridia bacterial species (Clostridium carboxidivorans, ATCC BAA-624, "P7") is provided. P7 is capable of synthesizing, from waste gases, products which are useful as biofuel. In particular, P7 can convert CO to ethanol. Thus, this novel bacterium can transform waste gases (e.g. syngas and refinery wastes) into useful products. P7 also catalyzes the production of acetate and butanol. Further, P7 is also capable of directly fermenting **lignocellulosic** materials to produce ethanol and other substances

No Patente	*Título*	*Fecha de Publicación*	*Inventor*	*Solicitante*
56. WO200718442	EXPRESSION OF AN ACTIVE CARRIER FOR XYLOSE IN GENETICALLY MODIFIED SACCHAROMYCES CEREVISIAE	20050805	TRAVASSOS LEANDRO MARIA JOSE; THERIAGA MENDES BERNARDO GONCA; SPENCER VIEIRA MARTINS ISABEL	FUNDACAO DA FACULDADE DE CIENC SPENCER VIEIRA MARTINS ISABEL THERIAGA MENDES BERNARDO GONCA TRAVASSOS LEANDRO MARIA JOSE

Resumen:
The present invention confers to the fermentative yeast Saccharomyces cerevisiae, genetically modified by insertion of a nucleic acid sequence encoding a xylose and glucose active transporter, the ability to assimilate xylose using a system of co-transport with protons exhibiting a high affinity for xylose. The invention is useful for the production of bioethanol from plant biomass and other **lignocellulosic** materials, using genetically modified **microorganisms** for assimilating and fermenting xylose in mixtures of hexoses and pentoses resulting from raw material of industrial interest

57. FR2881753	Production of cellulase enzymes using the residues from ethanolic **fermentation** distillation of enzymatic hydrolysates from (ligno-)cellulosic materials	20050209	WARZYWODA MICHEL; BALLERINI DANIEL; MONOT FREDERIC	BALLERINI DANIEL INST FRANCAIS DU PETROLE Institut Francais du Petrole MONOT FREDERIC WARZYWODA MICHEL

Resumen:
Producing cellulolytic and/or hemicellulolytic enzymes by a cellulolytic **microorganism** comprises using the residue from the ethanolic **fermentation** of enzymatic hydrolysates of cellulosic or ligno-cellulosic materials. An independent claim is also included for a process for producing ethanol from cellulosic or ligno-cellulosic materials.

No Patente	**Título**	**Fecha de Publicación**	**Inventor**	**Solicitante**

58. US7344876	Kluyveromyces strains metabolizing cellulosic and hemicellulosic materials	20030124	LEVINE ROBERT P	ENOGEN INC PHAGE BIOTECHNOLOGY PHAGE BIOTECHNOLOGY INC

Resumen:

This invention relates to the use of **microorganisms** for the generation of ethanol from **lignocellulosic** waste materials. Yeast strains of the genus Kluyveromyces which have the capability to ferment cellulose, hexose sugars to ethanol are provided. Also provided are methods for converting cellulose, hexoses, or mixed hydrolysates of hexoses to ethanol by **fermentation** with Kluyveromyces strains. The invention also provides methods to isolate yeast strains which metabolize cellulose, pentoses, or hemicelluloses from waste materials.

59. US5733758	Tower reactors for bioconversion of **lignocellulosic** material	19970110	NGUYEN QUANG A	NGUYEN QUANG A

Resumen:

An apparatus for enzymatic hydrolysis and **fermentation** of pretreated **lignocellulosic** material, in the form of a tower bioreactor, having mixers to achieve intermittent mixing of the material. Precise mixing of the material is important for effective heat and mass transfer requirements without damaging or denaturing the enzymes or fermenting **microorganisms**. The pretreated material, generally in the form of a slurry, is pumped through the bioreactor, either upwards of downwards, and is mixed periodically as it passes through the mixing zones where the mixers are located. For a thin slurry, alternate mixing can be achieved by a pumping loop which also serves as a heat transfer device. Additional heat transfer takes place through the reactor heat transfer jackets.

No Patente	Título	Fecha de Publicación	Inventor	Solicitante
60. US5047332	Integrated process for the production of food, feed and fuel from biomass	19860903	CHAHAL DEVINDER S	FRAPPIER ARMAND INST INST ARMAND FRAPPIER UNIV OF Q

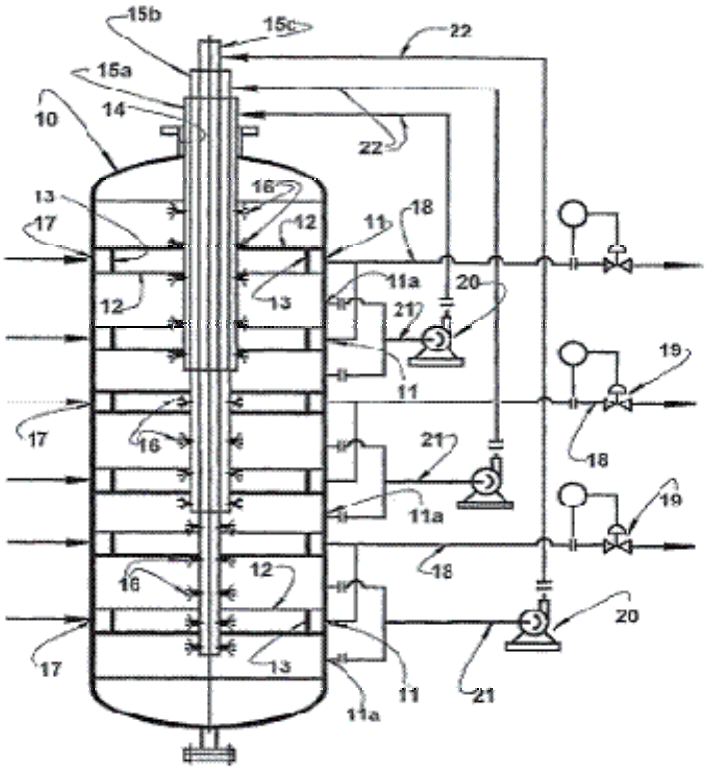
Resumen:
A feedstock containing a biomass such as **lignocellulosic** materials, e.g. forest biomass; agricultural residues; or manures, is pretreated and thereafter is fractionated into cellulose, lignin and hemicelluloses. New mutants are disclosed which include Chaetomium cellulolyticum IAF-101 (NRRL 18756), Aspergillus sp. IAF-201 (NRRL 18758), Penicillum sp. IAF-603 (NRRL 18759), and Trichoderma reesei QMY-1. With these new mutants and also known fungi including Pleurotus sajor-caju and other Pleurotus spp. unfractionated predetermined biomass is converted into feed. The same treatment can also be applied to hemicelluloses, and cellullose. Cellulose can also be hydrolyzed by means of a cellulase-system prepared from cellulose and Tricoderma reesei to prepare glucose which can be converted to alcohol with Saccharomyces cerevisiae, Kluyveromyces spp. and Zymomonas mobilis. The residual microbial biomass of these **microorganisms** from alcohol **fermentation** broth is also used as feed. The process is economical and non polluting.

61. WO200912779	A METHOD AND A SYSTEM FORTHE **PRETREATMENT** OF **LIGNOCELLULOSIC** MATERIAL	20070725	FOSBOL PEDER; HANSEN PALLE	ATLAS STORD DENMARK FOSBOL PEDER HANSEN PALLE

Resumen:
The invention relates to a method and a system for the **pretreatment** of **lignocellulosic** material by thermal hydrolysis, in particular with a view to producing bioethanol, wherein the material is first admixed with water and is then passed to a reactor, in which the soaked material is subjected to a high temperature and a high pressure to such an extent that it is accessible for a subsequent treatment with enzymes, following which the treated material is separated into a liquid part and a solid part, where the solid component is subsequently used for the production of bioethanol by enzymation and fermentation. Exclusively steam is used in the method and the corresponding system for heating, stirring and transport, as e.g. the transport through the various elements of the system is provided by a pressure difference between the compartments of the elements. The material (30) is introduced through a gate (2) into a reactor (3) in which the hydrolysis takes place. After completed treatment, the material (32) is discharged to an economizer (4), in which a separator (5) separates the material into a solid part and a liquid part. The solid part (29) is discharged for use in the further process. The method is performed as a two step process, as the material (32) from the first reactor (3) is injected into the economizer (4) and from there further on (26) to an additional reactor (8) for an additional treatment step. A high efficiency is achieved, as all pressures are established by direct steam addition, and heating surfaces and mechanical elements, such as pumps, stirrers, stuffing boxes, bearings, etc. are avoided. The use of economizers (4, 9) improves the consumption of energy relative to previously known processes.

Anexo 2 Resumen de patentes, Brasil.

Resumen de Patente empresa DEDINI. Brasil



PN - WO2007051269 A1 20070510 [WO200751269]
STG: Publ. Of int. Appl. With int. Search rep
AP : 2006WO-BR00239 20061031
CA2613745 A1 20070510 [CA2613745]
STG: Application laid open
AP : 2006CA-2613745 20061031
AU2006308733 A1 20070510 [AU2006308733]
STG: Patent not preceeded by A1-lapsed
AP : 2006AU-0308733 20061031
BRPI0505212 A 20070807 [BR200505212]
STG: Patent Application
AP : 2005BR-0005212 20051101
AR057564 A1 20071205 [AR--57564]
STG: Independent patent application
AP : 2006AR-P104735 20061030
CN101223288 A 20080716 [CN101223288]
STG: Unexamined application
AP : 2006CN-80026130 20061031
FD : PCT PN: WO2007/051269 20070510 [WO200751269]
FD : PCT PAP: PCT/BR2006/000239 20061031 [2006WO-BR00239]
EP1945823 A1 20080723 [EP1945823]
STG: Public. Of applic. With search report
28/08/08 1 15*54*24
AP : 2006EP-0804597 20061031
TI - IMPROVEMENTS IN A PROCESS FOR RAPID ACID HYDROLYSIS OF LIGNOCELLULOSIC
MATERIAL AND IN A HYDROLYSIS REACTOR
OTI - (EP1945823)
VERBESSERUNG BEI EINEM VERFAHREN ZUR SCHNELLEN SAUREN HYDROLYSE VON

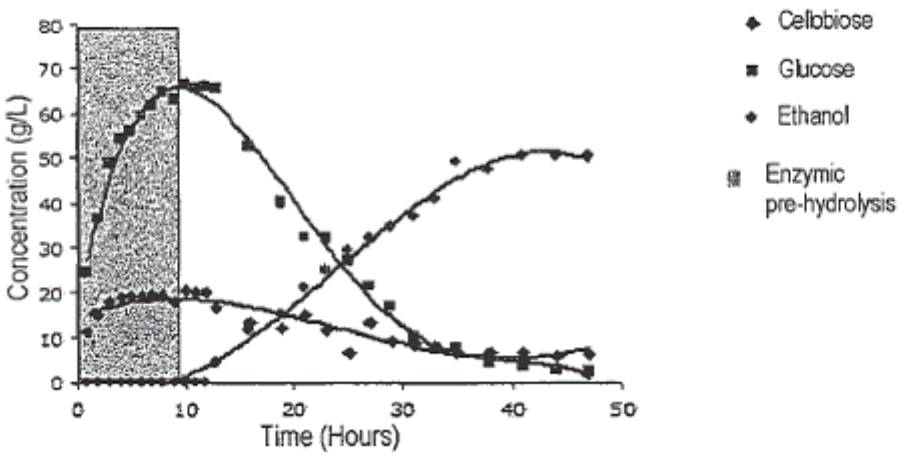
LIGNOCELLULOSEMATERIAL UND BEI EINEM HYDROLYSEREAKTOR
AMÉLIORATIONS CONCERNANT UN PROCÉDÉ POUR L'HYDROLYSE ACIDE RAPIDE DE
MATIÈRE LIGNOCELLULOSIQUE ET CONCERNANT UN RÉACTEUR D'HYDROLYSE
AMÉLIORATIONS CONCERNANT UN PROCÉDÉ POUR L'HYDROLYSE ACIDE RAPIDE DE
MATIÈRE LIGNOCELLULOSIQUE ET CONCERNANT UN RÉACTEUR D'HYDROLYSE
AMELIORATIONS CONCERNANT UN PROCEDE POUR L'HYDROLYSE ACIDE RAPIDE DE
MATIERE LIGNOCELLULOSIQUE ET CONCERNANT UN REACTEUR D'HYDROLYSE
aperfeiçoamentos em processo de hidrólise ácida rápida de material lignocelulósico e em reator
de hidrólise
PROCESO DE HIDROLISIS ACIDA RAPIDA DE MATERIAL LIGNOCELULOSICO Y UN REACTOR DE HIDROLISIS

AB - (WO200751269)

Improvements in a process for rapid acid hydrolysis of lignocellulosic material and in a hydrolysis
reactor, said lignocellulosic material being fed in different levels of a reactor (10) and contacted
with flows of lignin organic solvent, water and an extremely dilute solution of a strong inorganic
acid, for obtaining a liquid phase of hydrolysis extract and a solid phase of non-reacted and nondissolved
material. A controlled steam flow is injected into the different levels of the reactor (10),
so as to provide adequate temperatures of organic solvent and strong inorganic acid and forming
the desired products (sugars). A flow of the liquid phase is recirculated in different levels of the
reactor (10), the remainder thereof being withdrawn from the reactor (10), abruptly cooled with
the solvent submitted to evaporation to obtain a concentrate. The lignin is transferred by
decantation and the concentrate is transferred to subsequent process steps.
DS - (EP1945823)
DE SE
DS - (WO200751269)
AE AG AL AM AT AU AZ BA BB BG BW BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC
EE EG ES FI GB GD GE GH GM GT HN HR HU ID IL IN IS JP KE KG KM KN KP KR KZ LA LC
LK LR LS LT LU LV LY MA MD MG MK MN MW MX MY MZ NA NG NI NO NZ OM PG PH PL
PT RO RS RU SC SD SE SG SK SL SM SV SY TJ TM TN TR TT TZ UA UG US UZ VC VN ZA
ZM ZW
ARIPO patent : BW GH GM KE LS MW MZ NA SD SL SZ TZ UG ZM ZW
Eurasian patent : AM AZ BY KG KZ MD RU TJ TM
European patent : AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LT LU LV MC
NL PL PT RO SE SI SK TR
OAPI patent : BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG
FD - (CN101223288)
PCT PN: WO2007/051269 20070510 [WO200751269]
PCT PAP: PCT/BR2006/000239 20061031 [2006WO-BR00239]
PR - 2005BR-0005212 20051101
2006WO-BR00239 20061031
IN - HILST ANTONIO GERALDO PROENCA
PA - DE DINI BASIC INDUSTRIES [machine translation]

DEDINI S A IND DE BASE
DENDINI S A IND DE BASE
HILST ANTONIO GERALDO PROENCA
PA0 - DEDINI S/A. INDÚSTRIAS DE BASE; / Rodovia Rio Claro - Piracicaba - Km 26,3, Bairro Cruz
Caiada, 13412-900 Piracicaba - SP (BR) (except US)
HILST, Antonio Geraldo Proença; / Rua Félix de Lavalle, 161, Bairro Nova Piracicaba, 13405-
148 Piracicaba (BR) (only US)

Resumen de Patente empresa PetroBras. Brasil



PN - WO2008065433 A1 20080605 [WO200865433]
STG: Publ. Of int. Appl. With int. Search rep
AP : 2007WO-GB04618 20071130
BRPI0605017 A 20080715 [BR200605017]
STG: Patent Application
AP : 2006BR-0005017 20061130
TI - **PROCESS** FOR THE **FERMENTATIVE PRODUCTION** OF **ETHANOL** FROM **SOLID LIGNOCELLULOSIC** MATERIAL COMPRISING A STEP OF TREATING A **SOLID LIGNOCELLULOSIC** MATERIAL WITH ALKALINE SOLUTION IN ORDER TO REMOVE THE
LIGNIN
OTI - (WO200865433)
PROCÉDÉ POUR LA **PRODUCTION FERMENTATIVE** D'**ÉTHANOL** À PARTIR D'UNE MATIÈRE LIGNOCELLULOSIQUE SOLIDE COMPRENANT UNE ÉTAPE DE TRAITEMENT
D'UNE MATIÈRE LIGNOCELLULOSIQUE SOLIDE PAR UNE SOLUTION ALCALINE AFIN D'ÉLIMINER LA LIGNINE
processo para a produção de etanol a partir de materiais lignocelulósicos por via enzimática
AB - (WO200865433)
The present invention relates to a process for obtaining fuel ethanol by using agricultural and agroindustrial waste materials composed of lignocellulose, and especially sugar cane bagasse.
These residues have significant contents of carbohydrates in the form of polysaccharides (cellulose and hemicellulose), which can be hydrolysed by chemical and enzymic processes. The hemicellulose fraction is submitted to mild hydrolysis with sulphuric acid, and the solid material from this hydrolysis is submitted to a process of saccharif ication (enzymic hydrolysis)
with simultaneous rapid alcoholic fermentation under conditions which allow a significant increase in conversion to alcohol in a greatly shortened time.
DS - (WO200865433)

AE AG AL AM AT AU AZ BA BB BG BH BR BW BY BZ CA CH CN CO CR CU CZ DE DK DM
DO DZ EC EE EG ES FI GB GD GE GH GM GT HN HR HU ID IL IN IS JP KE KG KM KN KP
KR KZ LA LC LK LR LS LT LU LY MA MD ME MG MK MN MW MX MY MZ NA NG NI NO NZ
OM PG PH PL PT RO RS RU SC SD SE SG SK SL SM SV SY TJ TM TN TR TT TZ UA UG US
UZ VC VN ZA ZM ZW
ARIPO patent : BW GH GM KE LS MW MZ NA SD SL SZ TZ UG ZM ZW
Eurasian patent : AM AZ BY KG KZ MD RU TJ TM
European patent : AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LT LU LV MC
NL PL PT RO SE SI SK TR
OAPI patent : BF BJ CF CG CI CM GA GN GQ GW ML MR NE SN TD TG
PR - 2006BR-0005017 20061130
IN - SANTA ANNA LIDIA MARIA MELO; PEREIRA NEI; GOMES ABSAI DA CONCEICAI;
28/08/08 1 16*55*44
VASQUES MARIANA PENUELA
PA - BENSON JOHN EVERETT
GOMES ABSAI DA CONCEICAI
PEREIRA NEI
PETROLEO BRASILEIRO SA
SANTA ANNA LIDIA MARIA MELO
VASQUES MARIANA PENUELA
PA0 - PETROLEO BRASILEIRO S.A.-PETROBRAS; / Av Republica do Chile, No. 65, CEP-20031-912
Rio de Janeiro, RJ (BR) (as-indicated)
BENSON, John, Everett; / 14 South Square, Gray's Inn (GB) (as-indicated)
SANTA'ANNA, Lidia, Maria, Melo; / Rua Condominio Vale de Itaipu, Rua 03, Casa 332, Itaipu
(BR) (only US)
PEREIRA, Nei; / Rua Humberlo de Campos, No.410, Ap.503, Leblon (BR) (only US)
GOMES, Absai, Da Conceiçai; / Rua Himalaia, No. 396, Anchieta, CEP-21655-330 Rio de Janeiro, RJ (BR) (only US)
VASQUES, Mariana, Penuela; / Centro de Technologia - BI. C, Cidade Univesitaria, Ilha do Fundao (BR) (only US)
28/08/08 2 16*55*44

Anexo 3 Artículos científicos.

Artículos publicados sobre temas relacionados con la obtención de etanol a partir de residuos lignocelulósicos.

1. Thermoset phenolic matrices reinforced with unmodified and surface-grafted furfuryl alcohol sugar cane bagasse and curaua fibers: properties of fibers and composites. Trindade, W G / Hoareau, W / Megiatto, J D / Razera, I A T / Castellan, A / Frollini, E , Biomacromolecules, 6 (5), p.2485-2496, Sep 2005 Composites based on phenolic matrices and unmodified and chemically modified sugar cane bagasse and curaua fibers were prepared. The fibers were oxidized by chlorine dioxide, mainly phenolic syringyl and guaiacyl units of the lignin polymer, followed by ...

2. Hoareau, W. / Trindade, W.G. / Siegmund, B. / Castellan, A. / Frollini, E. , Polymer Degradation and Stability, 86 (3), p.567-576, Dec 2004 Sugar cane bagasse and curaua acidolysis lignins were used to get a better understanding of the mechanism involved in a new chemical modification of sugar cane bagasse and curaua fibres, consisting in a selective oxidation of lignin by...Sugar cane bagasse and curaua lignins oxidized by chlorine dioxide and reacted with furfuryl alcohol: characterization...

3. Thermo-Mechanical Behavior of Poly(vinyl alcohol) and Sugarcane Bagasse Composites. attivita' di ricerca [10K] Sep 2007 attività di ricerca Articolo in rivista Autori E. Chiellini, P. Cinelli, R. Solaro, M. Laus Titolo Thermo-Mechanical Behavior of Poly(vinyl alcohol) and Sugarcane Bagasse Composites Anno 2004 Lingua Inglese Rivista J.Appl.Polym.Sci. Volume 92 Pagina iniziale 426 Pagina finale 432 Numero http://brett.adm.unipi.it/cgi-bin/virmap/vmibo?doc_pub...] Perspectivas sobre la producción de Bioetanol en México http: //www.ciatej.net.mx/ Centro de Asistencia en Tecnología y Diseño de Jalisco.

4. Planeación estratégica de la agroindustria azucarera mexicana para la producción de biocombustibles. Colegios de Postgraduados. México.

5. Evaluation of inoculum of Candida guilliermondii grown in presence of glucose on xylose reductase and xylitol dehydrogenase activities and xylitol production during batch fermentation of sugarcane bagasse hydrolysate. da Silva, Débora Danielle Virgínio / das Graças de Almeida Felipe, Maria / de Mancilha, Ismael Maciel / da Silva, Sílvio Silvério , Applied biochemistry and biotechnology, 121-124, p.427-437, Apr 2005 The effect of glucose on xylose-xylitol metabolism in fermentation medium consisting of sugarcane bagasse hydrolysate was evaluated by employing an inoculum of...56 g/g) and productivity (0.46 g/[L.h]) after 48 h of fermentation.

6. Estudo de recuperação xilitol produzido por fermentação do hidrolisado de bagaço de cana-de-açucar utilizando zeolitas. Study ... Tihany Morita Antero dos Santos , Dec 2004 ...produced by fermentation of the hidrolisate one of bagasse of sugar cane-of-sugar...Xilitol , Fermentation , Separation...is a sugar alcohol with large...production from the fermentation of hemicellulosic...sugar cane bagasse hydrolysate...

7. Potential for reduction of alcohol production costs in Brazil Rosa, L.P. / Tolmasquim, M.T. / Arouca, M.C. , Energy, 23 (11), p.987-995, Nov 1998 ...hydrated alcohol) but also...The use of bagasse as a wood-subsdtute...method for fermentation and (iii) the use of bagasse as fuel...juice and bagasse. In distelle...or syrup fermentation at independent...hydrated alcohol (96 GL) and...

8. Optimized extraction by cetyl trimethyl ammonium bromide reversed micelles of xylose reductase and xylitol dehydrogenase from Candida guilliermondii homogenate. Cortez, Ely Vieira / Pessoa, Adalberto / das Graças de Almeida Felipe, Maria / Roberto, Inês Conceição / Vitolo, Michele , Journal of chromatography. B, Analytical technologies in the biomedical and life sciences, 807 (1), p.47-54, Jul 2004 The intracellular enzymes xylose reductase (XR, EC 1.1.1.21) and xylitol dehydrogenase (XD, EC 1.1.1.9) from Candida guilliermondii, grown in sugar cane bagasse hydrolysate, were separated by reversed micelles of cetyl trimethyl ammonium bromide (CTAB)

9. A survey of potential health and safety hazards of commercial-scale ethanol production facilities [PDF-8MB] Sep 2004 3 4456 0452033 5 ORML4TM-7817 Contract No. W-7405-eng-26 Health and Safety Research D i v i s i o n Environmental Sciences Division** In formation D iv i s i on* A SURVEY OF POTENTIAL HEALTH AND SAFETY HAZARDS OF COMMERCIAL-SCALE ETHANOL PRODUCTION FACILITIES A. P. Watson J. I;. Smith* J. L. http://www.ornl.gov/info/reports/1982/3445604520935.pd

10. Poster Presentation 3-35 [9K] Mar 2002 Research and development studies of alcohol fermentation technology have been conducted over the last decades to make alcohol production more efficient. In this context there are clear advantages in using surplus bagasse from ethanol plants as a raw material for the same end product. http://www.ct.ornl.gov/symposium/24th/index_files/post...]

11. Novel Ethanol Fermentations from Sugar Cane and Straw Hartley, B. S. / Shama, G. , Philosophical Transactions of the Royal Society of London. Series A, Mathematical and Physical Sciences (1934-1990), 321 (1561), p.555-568, Apr 1987 doi:10.1098/rsta.1987.0032Most agree that it is ultimately desirable to produce bulk chemicals such as ethanol from

renewable resources; the questions focus on `where', `when' and `how'

12. Ethanol/water pulps from sugar cane straw and their biobleaching with xylanase from Bacillus pumilus. Moriya, Regina Y / Gonçalves, Adilson R / Duarte, Marta C T , Applied biochemistry and biotechnology, 137-140 (1-12), p.501-513, Apr 2007 The influence of independent variables (temperature and time) on the cooking of sugar cane straw with ethanol/water mixtures was studied to determine operating conditions that obtain pulp with high cellulose contents and a low lignin content.

13. Hydrolysis of Ammonia-pretreated Sugar Cane Bagasse with Cellulase, beta-Glucosidase, and Hemicellulase Preparations. Prior, Bernard A / Day, Donal F , Applied biochemistry and biotechnology, 146 (1-3), p.151-164, Mar 2008 Sugar cane bagasse consists of hemicellulose (24%) and cellulose (38%), and bioconversion of both fractions to ethanol should be considered for a viable process. We have evaluated the hydrolysis of pretreated bagasse with combinations of cellulase,

14. Study of the hydrolysis of sugar cane bagasse using phosphoric acid Gamez, S. / Gonzalez-Cabriales, J.J. / Ramirez, J.A. / Garrote, G. / Vazquez, M. , Journal of Food Engineering, 74 (1), p.78-88, May 2006 In the present work, samples of sugar cane bagasse were hydrolysed with phosphoric acid under mild conditions (H"3PO"4 2-6%, time 0-300min and 122^oC) to study the feasibility of using the liquid phase as fermentation media. Solid yield,...

15. Hydrolysis of sugar cane bagasse using nitric acid: a kinetic assessment Rodriguez-Chong, A. / Alberto Ramirez, J. / Garrote, G. / Vazquez, M. , Journal of Food Engineering, 61 (2), p.143-152, Feb 2004 Sugar cane bagasse was hydrolysed using nitric acid at variable concentration (2-6%), reaction time (0-300 min) and temperature (100-128 ^oC). The concentration of sugars released (xylose, glucose and arabinose) and degradation products...

16. Modeling of the hydrolysis of sugar cane bagasse with hydrochloric acid. Bustos, Guadalupe / Ramírez, José Alberto / Garrote, Gil / Vázquez, Manuel , Applied biochemistry and biotechnology, 104 (1), p.51-68, Jan 2003 Sugar cane bagasse was hydrolyzed under different concentrations of hydrochloric acid (2-6%), reaction times (0-300 min), and temperatures (100-128 degrees C). Sugars obtained (xylose, glucose, arabinose, and glucose) and degradation products (furfural ...

17. Kinetic study of the acid hydrolysis of sugar cane bagasse Aguilar, R. / Ramrez, J.A. / Garrote, G. / Vazquez, M. , Journal of Food Engineering, 55 (4), p.309-318, Dec 2002 Economic interest in xylitol production can be enhanced if the needed xylose solutions can be obtained from the hydrolysis of low-cost lignocellulosic

wastes. Sugar cane bagasse is a renewable, cheap and widely available waste in...

18. Measured kinetics of the acid-catalysed hydrolysis of sugar cane bagasse to produce xylose Lavarack, B.P. / Griffin, G.J. / Rodman, D. , Catalysis Today, 63 (2), p.257-265, Dec 2000 Experimental trials of the water hydrolysis of bagasse to produce xylose, arabinose and glucose were conducted using a temperature-controlled microwave digester. The experimental variables were temperature, ratio of water mass to bagasse...

19. Hydrolysis of Cane Sugar by d- and l-Camphor-$\beta \text{-Sulphonic}$ Acid Caldwell, Robert John , Proceedings of the Royal Society of London (1854-1905), 74 (-1), p.184-187, Jan 1904 doi:10.1098/rspl.1904.0101The Royal Society is collaborating with JSTOR to digitize, preserve, and extend access to Proceedings of the Royal Society of London. www.jstor

20. Studies of the Processes Operative in Solutions. XXI. The Hydrolysis of Cane Sugar by Dilute Acids Worley, F. P. , Proceedings of the Royal Society of London. Series A, Containing Papers of a Mathematical and Physical Character (1905-1934), 87 (599), p.555-563, Dec 1912 doi:10.1098/rspa.1912.0110The Royal Society is collaborating with JSTOR to digitize, preserve, and extend access to Proceedings of the Royal Society of London. Series A, Containing Papers of a Mathematical and Physical Character. www.jstor.

21. Studies of the Processes Operative in Solutions. XXII. The Hydrolysis of Cane Sugar by Sulphuric Acid; Also a Note on ... Worley, F. P. , Proceedings of the Royal Society of London. Series A, Containing Papers of a Mathematical and Physical Character (1905-1934), 87 (599), p.563-581, Dec 1912 doi:10.1098/rspa.1912.0111The Royal Society is collaborating with JSTOR to digitize, preserve, and extend access to Proceedings of the Royal Society of London. Series A, Containing Papers of a Mathematical and Physical Character. www.jstor

22. Enhancement of enzymatic hydrolysis of sugar cane bagasse by steam explosion pretreatment. Kling, S H / Neto, C C / Ferrara, M A / Torres, J C / Magalhaes, D B / Ryu, D D , Biotechnology and bioengineering, 29 (8), p.1035-1039, Jun 1987

23. Pretreatment of lignocellulosic material with fungi capable of higher lignin degradation and lower carbohydrate degradation improves substrate acid hydrolysis and the eventual conversion to ethanol. uhar, Sarika / Nair, Lavanya M / Kuhad, Ramesh Chander , Canadian journal of microbiology, 54 (4), p.305-313, Apr 2008 Phanerochaete chrysosporium, Pycnoporus cinnabarinus,and fungal isolates RCK-1 and RCK-3 were tested for their lignin degradation abilities when grown on wheat straw (WS) and Prosopis juliflora (PJ) under solid-state cultivation conditions. Fungal isolate

23.

24. Industrial Bioprocessing Alert. Polyethylene from Sugarcane Ethanol Ammonia Biomass Hydrolysis Pretreatment Computer Modeling A ... [35K] Nov 2007 Marrone Organic Innovations obtains a portfolio of natural product pesticide candidates from DuPont. Braskem will produce polyethylene sfrom sugarcane ethanol in Brazil. Michigan State researchers continue to investigate pretreatment of cellulose with ammonia before hydrolysis. Diversa generates[https://www.frost.com/prod/servlet/market-service-segm

25. BIOCONVERSION OF LIGNOCELLULOSIC MATERIAL INTO BIOFUEL (ETHANOL) PRETREATMENT, ENZYMATIC HYDROLYSIS, AND ETHANOL FERMENTATION [PDF-484K] Oct 2007 Biomass Refining CAFI Auburn University Soaking in Aqueous Ammonia (SAA) for Pretreatment of Corn Stover Tae Hyun Kim and Y. Y. Lee Department of Chemical Engineering Auburn University AIChE 2004 Annual Meeting Austin, TX. http://www.public.iastate.edu/~thkim/publication/prese...]

26. Bioetanol Lignocelulósico y switch grass http://www.pnas.org/search?fulltext=switch+grass+bioethanol+lignocelulosic&submit=yes&go.x=5&go.y=7

1.1. Información no Patente.

Se analizaron 26 artículos vinculados a usos en proyectos de investigación e información académica resumidos en el ANEXO 3.
En la figura No.10, mostramos la cinética de publicación de artículos científicos en los últimos 10 años.

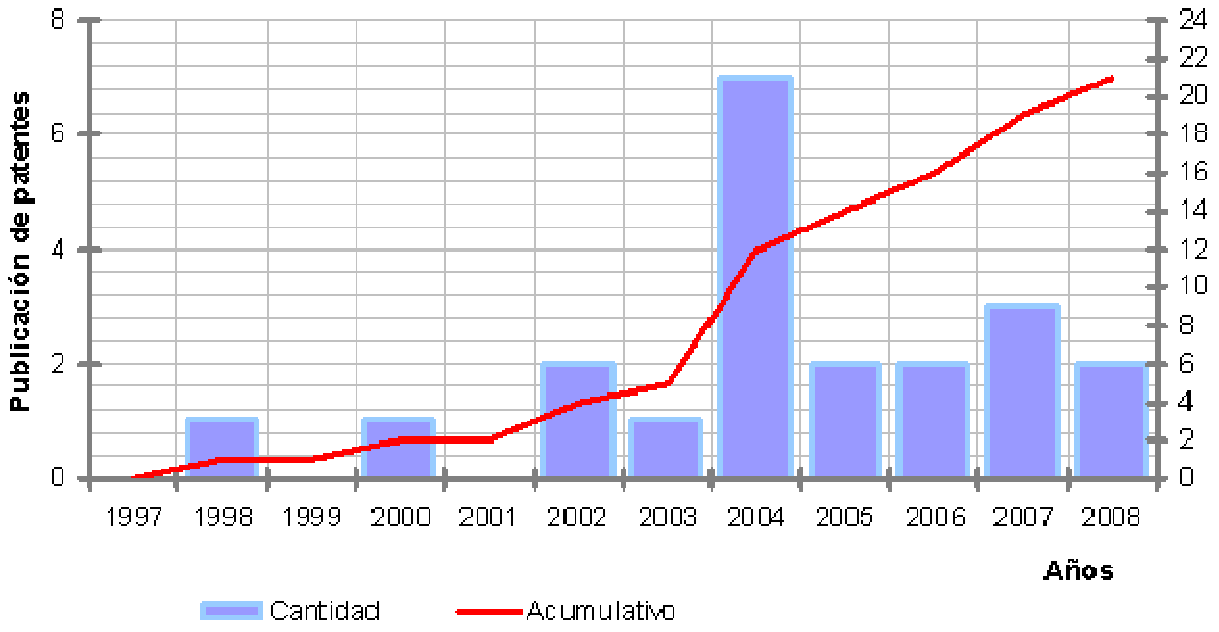


Figura No.11. *Publicación de artículos científicos.*

De todos los artículos encontrados, el 65% fueron publicados en los últimos 10 años. Es conveniente explicar que a su vez, se encontraron 3 artículos de principio de siglo XX relacionados con la hidrólisis ácida de la caña de azúcar, publicados en eventos de la revista "Royal Society of London".

En la siguiente tabla se relaciona la cantidad de publicaciones por revistas y año de publicación.

Tabla No.3. *Relación de publicación de artículos por Revistas.*

REVISTA	Cantidad de artículos	Año de la publicación
Applied Biochemestry and Biotechnology	1	2003
	1	2005
	1	2007

	1	2008
Journal of Food Engineering	1	2002
	1	2004
	1	2006
Biotechnology Bioengineering	1	1987
Catalysis Today	1	2000
Polymer Degradation and stability	1	2004
Applied Polymer Science	1	2004
Journal of Chromatography	1	2004
Biomacromolecules	1	2005
Canadian Journal of Microbiotechnology	1	2008

Nótese que las la gama de revista que han publicado sobre este tema es amplia y la que más publicaciones tienen, son la **Applied Biochemestry and Biotechnology** y la **Journal of Food Engineering,** dos publicaciones de alto impacto en la comunidad científica.

A continuación, en la tabla No 4 y la figura No 11 relacionamos las instituciones que más publicaciones han generado en los últimos 10 años. Se observa como las universidades Brasileñas acaparan el 30% del total de artículos, y las otras instituciones pertenecen a países productores de azúcar a partir de la caña, con excepción de España.

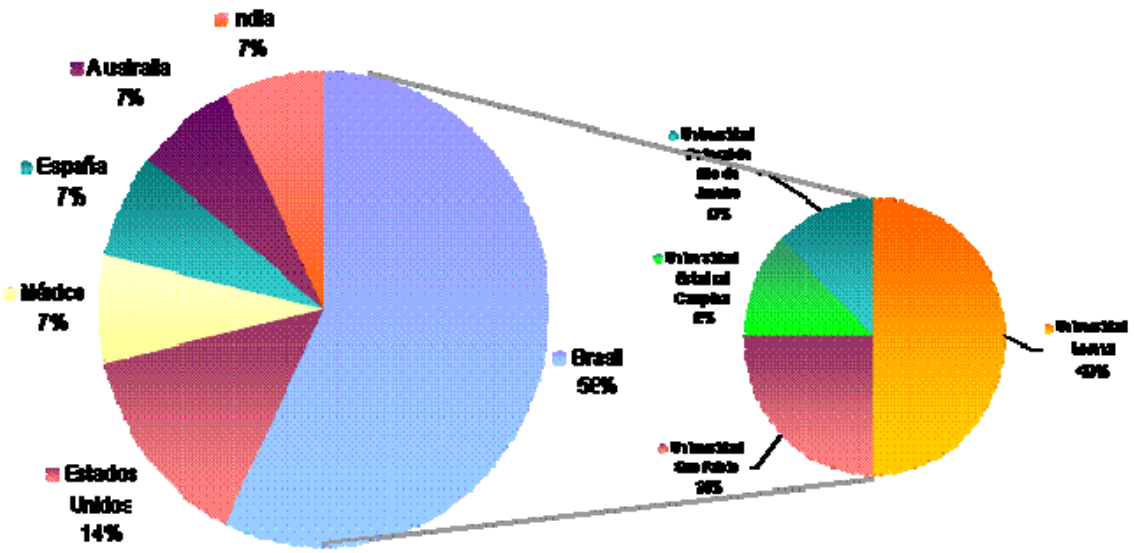


Figura No.12. *Distribución por países e Instituciones de artículos científicos publicados.*

Tabla No.4. *Distribución por países e Instituciones de artículos científicos publicados.*

INSTITUCIÓN	País	Cantidad de publicaciones
Universidad de Lorena	Brasil	4
Universidad de Sao Pablo		2
Universidad Estadual de Campina		1
Universidad Federal de Río de Janeiro		1
Universidad Auburn Texas	E.U.A	1
Instituto del Azúcar de Los Angerles		1
Universidad de Tamulipas	México	4
Universidad Santiago de Compostela	España	3
Instituto de Investigaciones azucareras de Australia	Australia	1
Universidad de Delhi	India	1

En el proceso de recuperación de información, quedó evidenciado que la mayor cantidad de información disponible se encuentra en los sitios de información científico-técnica y comercial de los países con mayor volumen de exportación de bioetanol, tomaremos a Brasil como ejemplo por ser el mayor exportador a nivel mundial de etanol a partir de caña de azúcar y a los Estados Unidos como el mayor productor de etanol a partir de maíz.

1.1.1. Brasil.

En Brasil el 45% de los carburantes que se usan para el transporte provienen de la caña de azúcar. El 1% de la tierra cultivable produce casi el 50% del combustible que se consume en el país", asegura Marcos S. Jank, presidente de la Asociación de la Industria Brasileña de la Caña de Azúcar (UNICA). La cosecha no cesa durante los 12 meses del año ya que existen variedades de caña adaptadas a las condiciones climáticas de las épocas secas y de lluvias.

En estos momentos se está implementando en los centrales y refinerías de azúcar y alcohol de Brasil una nueva tecnología desarrollada en el Centro de Tecnología (CTC) de la Cooperativa de Productores de Caña, Azúcar y Alcohol del Estado de São Paulo (Copersucar) de Piracicaba y del grupo empresarial DEDINI, uno de los mayores fabricantes de máquinas e implementos para el sector de azúcar y alcohol. Esta tecnología es capaz de hacer crecer la producción de alcohol alrededor de un 30% sin necesidad de plantar ni una caña más. Esto es resultado del aprovechamiento total de la biomasa de la caña, más precisamente del bagazo. Estos investigadores consiguieron comprobar que es posible

fabricar alcohol etílico (etanol) carburante partiendo del bagazo de la caña, mediante un proceso denominado Dedini Hidrólisis Rápida (DHR). El proceso DHR podrá suministrar alcohol a costos competitivos, utilizando una materia prima ya existente y liberando más caldo de caña para la producción de azúcar.

La tecnología está formada por un reactor, que opera a una presión de entre 25 y 27 kg/cm2 y a una temperatura próxima a los 190 grados, es continuamente alimentada con bagazo y con un hidrosolvente orgánico (etanol, preferentemente, pese a que otros, como la acetona, el ácido acético y el metanol pueden también emplearse) mezclado con ácido sulfúrico. Esa mezcla hará la transformación de la celulosa presente en el bagazo en glucosa. En seguida, el jarabe de glucosa es purificado, para retirar las sustancias indeseables, principalmente el ácido sulfúrico, y recibe la adición de nutrientes, resultando en un mosto fermentable que se mezclará al caldo y a la melaza utilizada normalmente para la fabricación del alcohol. El resto del proceso -fermentación y destilación- es realizado en las instalaciones ya existentes.

La gran ventaja del proceso DHR es su rapidez, según criterio del ingeniero químico Antônio Hilst, consultor de Dedini que inventó la técnica, la cual queda protegida en una patente que hicimos referencia en el acápite **4.1 Patente**. La transformación se produce en apenas diez minutos, en cuanto que los procesos clásicos de hidrólisis que recurren a ácidos concentrados o diluidos demoran por lo menos cinco horas. El bagazo permanece dentro del reactor el tiempo necesario para que se produzca la disolución de la lignina y la hidrólisis de la celulosa llegando a un rendimiento de alrededor de un 60% sobre el azúcar contenido en el bagazo lo cual garantizar una fermentación y una destilación completamente viables desde el punto de vista económico.

La glucosa es tan solo una de las sustancias resultantes del beneficiado. Al margen de ésta, se extraen del bagazo otros subproductos, como el metanol, el ácido acético, la lignina y el furfural, cuyo uso comercial podrá elevar aún más la rentabilidad del proceso.

1.1.2. Estados Unidos

Entre los artículos encontrados comentaremos el del científico Jay J. Cheng el cual es profesor de la Universidad NC State, en Carolina del Norte. Este artículo contempla el estudio energético del switch grass , un tipo de pasto que habitualmente está destinado a la alimentación del ganado y que hoy es considerado de menor impacto ambiental que la producción de maíz. Cheng manifiesta que para explotar el switch grass no es necesario tener una tierra fértil; porque crece en cualquier superficie. Un informe científico publicado por la revista Proceedings of the National Academy of Sciences muestra que el switch grass produce más de energía que la que se requiere para procesarlo en la obtención de etanol.

Una de las ventajas de este pasto es que absorbe del dióxido de carbono de la atmósfera durante su crecimiento. Aunque el desarrollo de esta fuente está menos avanzada que el de los cereales, es una energía viable. Por eso, hay grupos de investigación en el mundo que alientan los estudios del switch grass y de los materiales lignocelulósicos: residuos agrícolas, agroindustriales y forestales. Por otro lado, Cheng colabora con la Universidad Pontificia Católica de Ecuador en un proyecto dirigido por el científico Javier Carvajal, jefe del área de levaduras del Laboratorio de Bioquímica dedicado a impulsar los estudios de

materiales lignocelulósicos. Su equipo está produciendo, a escala de laboratorio, etanol a partir de papel reciclado. Decidieron utilizar papel, porque en la Universidad ya existe un proyecto llamado de Reciclaje pro Ambiente para recoger el papel y el cartón generado en las oficinas. Señala que el rendimiento energético de la producción de etanol a partir de maíz, en EE.UU. es, en el mejor de los casos, del 25%. Eso significa que se obtiene menos energía de la invertida. En cambio, con el etanol lignocelulósico, el rendimiento es del 45%, es decir, se obtiene más energía de la que se invierte. Javier Carvajal dice que en el futuro no solo se buscará obtener etanol del papel, sino de desechos vegetales que hay en abundancia: desechos de plátano, palmito y de caña de azúcar. Incluso de los desechos urbanos ya clasificados. El etanol de maíz contabiliza pequeñas emisiones de gases efecto invernadero, lo que no ocurre con el obtenido a partir del etanol de la celulosa.

El científico Cheng señala que el Congreso estadounidense aprobó una ley para que la producción de etanol lignocelulósico llegue a 1000 millones de galones hasta el 2020. Dice que hay un interés creciente por estudiarlo más. **[Proceedings of National Academy of Science ,**2008**]**

Por otro lado, la compañía española Abengoa Bioenergía ha logrado producir etanol a partir de biomasa en su planta piloto situada en el estado de Nebraska (Estados Unidos), donde ha invertido más de 35 millones de dólares. La planta se dedicará a la investigación y desarrollo de los procesos de producción de biocombustible a partir de biomasa lignocelulósica, la materia prima orgánica más abundante en la tierra y forma parte del acuerdo firmado con el DOE (Ministerio de Energía estadounidense) en 2003. Ubicada en las instalaciones de producción de etanol de Abengoa Bioenergía en York (Nebraska), la planta piloto de la empresa española investigará y probará una tecnología patentada de conversión de biomasa a etanol para su uso a nivel comercial, no se ofrecen detalles sobre la tecnología referida, aunque por nuestra investigación Abego no presenta patentes sobre el tema. Las innovaciones tecnológicas obtenidas se pondrán en práctica en la biorrefinería de biomasa que Abengoa Bioenergía está construyendo en Kansas y que será pionera en su género.

La planta piloto inaugurada por Abengoa Bioenergía en Estados Unidos es única en su género; servirá de plataforma para la prueba de nuevos equipos, sistemas y catalizadores necesarios para descomponer varios compuestos orgánicos y procesarlos, como materias herbáceas y leñosas, optimizando en varios procesos de obtención de etanol. Será también un núcleo de investigación y de capacitación para otros equipos dentro de Abengoa Bioenergía mientras la empresa evalúa y prueba productos adicionales, equipos y otros procesos en cuyo diseño se está trabajando actualmente para mejorar los procesos orgánicos de biomasa.

Además, durante el transcurso del acto, Javier Salgado ha anunciado que ha firmado un contrato de colaboración con el Departamento de Energía de Estados Unidos (DOE) por importe de 38 millones de dólares para el diseño y desarrollo de la primera planta mundial a escala comercial de producción de etanol a partir de biomasa en Hugoton, Kansas.

Esta planta de biomasa procesará 700 toneladas métricas de biomasa al día para producir anualmente 44 millones de litros de etanol, además de otras formas de energía renovable en forma de electricidad y vapor. La planta de biomasa tendrá anexa una planta de etanol convencional a partir de cereal de 88 millones de galones (más de 300 millones de litros), que permitirá a ambas disfrutar de las sinergias de una capacidad combinada de 100 millones de galones (más de 400 millones de litros). La inversión conjunta superará los 300 millones de dólares. Abengoa Bioenergía presente en Estados Unidos, Brasil y Europa,

invertirá más de 500 millones de dólares en los próximos cinco años en su programa tecnológico de producción de etanol a partir de biomasa lignocelulósica.