

COMBUSTIBLES DERIVADOS DE RESIDUOS SÓLIDOS URBANOS

En los últimos años se ha puesto de manifiesto en Europa el interés creciente en la utilización de la fracción combustible de los residuos sólidos urbanos. Por un lado, los límites legales de deposición de residuos biodegradables en vertedero establecidos en los distintos países y la posibilidad/necesidad de valorización energética de residuos orgánicos persistentes (plásticos, papel, etc.) cuando ésta conlleve un menor impacto global que su reciclaje han contribuido a este hecho. Por otro lado, los residuos sólidos urbanos pueden considerarse una fuente de energía sostenible que ayude a cumplir con los objetivos europeos en materia energética y medioambiental.

Entre los combustibles derivados de residuos (RDFs, *Refused Derived Fuels*), los combustibles sólidos recuperados (SRFs, *Solid Recovered Fuels*) son aquéllos obtenidos a partir de residuos no peligrosos para su valorización energética en plantas de incineración y co-incineración (hornos industriales, centrales térmicas, plantas de cogeneración, etc.) que cumplen con la norma europea UNE-EN15359 respecto a capacidad calorífica y contenido de cloro y mercurio.

En este apartado se va a abordar un estudio bibliométrico en Web of Science (WoS) a nivel europeo sobre los combustibles sólidos recuperados y otros combustibles derivados de residuos sólidos urbanos obtenidos en las distintas plantas de tratamiento mecánico-biológico. El horizonte temporal explorado son los últimos diez años (2009-2018).

Atendiendo al análisis realizado, se han identificado trescientas publicaciones, observándose que los países líderes son Italia e Inglaterra, seguidos de Alemania y España (Figura 1).

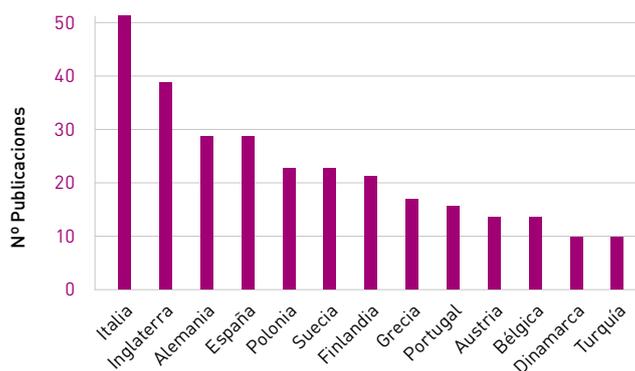


Figura 1. Países europeos líderes en publicaciones

En la Figura 2 se recogen las instituciones europeas con mayor número de publicaciones. Entre ellas cabe destacar la Universidad de Leeds (Inglaterra), el Centro de Investigación Técnica VTT (Finlandia) y la Universidad Católica de Leuven (Bélgica). En España destaca la Universidad Rovira y Virgili.

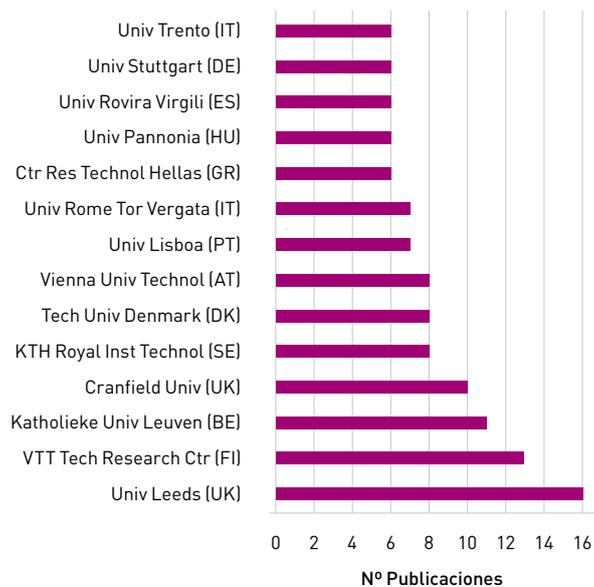


Figura 2. Instituciones europeas líderes en publicaciones (nº publicaciones >5)

En la Figura 3 se muestra la distribución del número de publicaciones por áreas de investigación resultante del análisis detallado de las mismas. Cabe resaltar que las publicaciones más numerosas son las relativas al aprovechamiento energético de los RDFs/SRFs en plantas incineradoras (19.0% de las publicaciones) y la generación de gas de síntesis en plantas de gasificación (18.4%). La obtención de combustibles del tipo aceites pirolíticos y chares mediante pirólisis representa el 11.6% de las publicaciones.

Los procesos de producción y caracterización de RDFs/SRFs también son objeto de intensa investigación, correspondiendo a un 12.9% y 12.2% de los artículos, respectivamente. Un tercio de los referidos a la caracterización cuantifica el contenido de carbono biogénico en los RDFs/SRFs.

Las cenizas generadas en los procesos de combustión y gasificación son el área de estudio del 11.9% de las publicaciones, de modo que el 6.8% se refiere a cenizas volantes y el 5.1% a cenizas de fondo/escorias. La determinación del contenido de PCDDs (policlorodibenzodioxinas) y PCDBFs (policlorodibenzofuranos) en cenizas y gases de escape, así como la investigación de distintas alternativas que contribuyan a disminuir su formación son temáticas de gran interés. Entre ellas destacar el uso de catalizadores o la combinación de los RDFs/SRFs con otros materiales de partida tales como lodos de depuradora. El estudio de los procesos de corrosión originados por estos compuestos clorados representa el 4.1% de las publicaciones.

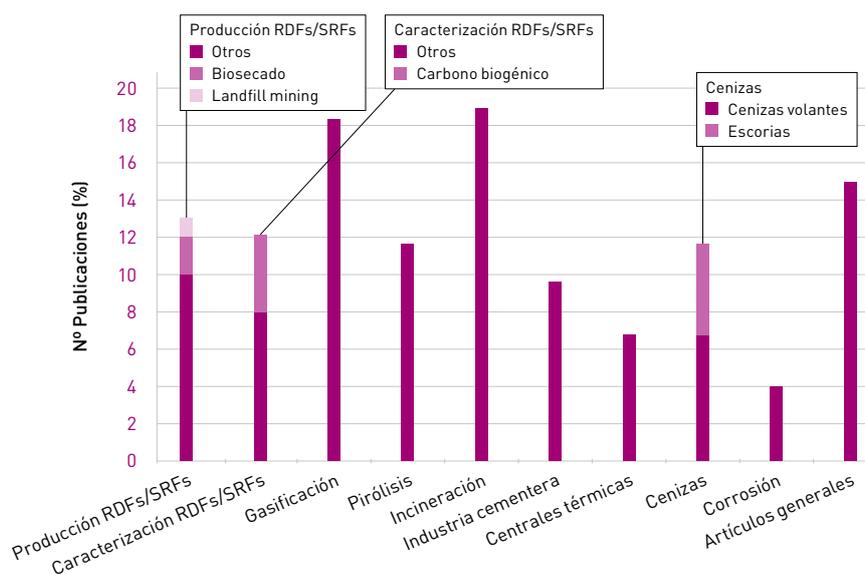


Figura 3. Distribución del número de publicaciones por áreas de investigación

La co-combustión de RDFs/SRFs con carbón, fundamentalmente, en la industria cementera y en centrales térmicas es, asimismo, muy representativa. Así, el 9,5% de las publicaciones se dirige a la industria cementera, donde no se generan ni escorias ni cenizas, al incorporarse éstas al clinker de forma permanente, manteniéndose las garantías ambientales y de calidad del producto.

En la Tabla 1 se recogen las áreas de investigación de las instituciones europeas más representativas de acuerdo a la clasificación de la Figura 3.

Tabla 1. Áreas de investigación de las instituciones europeas más representativas (Nº publicaciones)

Institución	Producción RDFs/SRFs	Caracterización RDFs/SRFs	Gasificación	Pirólisis	Incineración	Industria cementera	Centrales térmicas	Cenizas	Corrosión
Aalto Univ (FI)	3								
Abo Akad Univ (FI)					5		1	4	2
AMRA Scarl (IT)			3						
Cranfield Univ (UK)	5	3			1		1	1	
Ctr Res Technol Hellas (GR)		2	2	1	1		3		
Delft Univ Technol (NL)	3						1	1	
Inst Chem Proc Coal (PO)		4	1						1
Inst Motori, CNR (IT)			3						
Istanbul Tech Univ (TK)			3	3					
Katholieke Univ Leuven (BE)			4	2	3			4	
KTH Royal Inst Technol (SE)			5	6	1				
Lassila Tikanoja PLC (FI)	3								
Parthenope Univ Naples (IT)			3						
Sapienza Univ Rome (IT)	5		1				1		
Tech Univ Denmark (DK)	1		1		3	1	2	3	
Tubitak MRC (TK)						3			
Univ Cassino (IT)			3						
Univ della Campania Vanvitelli (IT)			5						
Univ Leoben (AT)	2	3				1			
Univ Leeds (UK)			5	6	1		1		
Univ Lisboa (PT)			4	4				2	2
Univ Pannonia (HU)				4		2			
Univ Rome Tor Vergata (IT)		1	4		3			4	
Univ Rovira Virgili (ES)		1	3	1		1			
Univ Stuttgart (DE)			1				4	1	
Univ Trento (IT)	3				1				
Vienna Univ Technol (AT)		7	1						
VTT Tech Research Ctr (FI)	4	1	1		5		1	4	2
Wroclaw Univ Environm & Life Sci (PO)				3					

ANÁLISIS DE PATENTES

Durante el primer trimestre de 2019 se han identificado en la base de datos WPI (World Patent Index) 233 familias de patentes sobre tecnologías de conversión de la biomasa para la producción de energía, excluyéndose las invenciones con ámbito de protección exclusivamente asiático. Cabe señalar que el 76.8% de las familias se refiere a tecnologías termoquímicas. El 21.0% y el 5.6% hacen referencia a tecnologías bioquímicas y químicas, respectivamente. La tecnología de combustión es la que cuenta con mayor número de resultados, 39.5% del total, seguida de la de pirólisis/gasificación, con el 38.6% (Tabla 2).

Tabla 2. Número de familias de patentes clasificados por tecnologías

Tipos de tecnologías de conversión de la biomasa	Nº Familias
Tecnologías termoquímicas	179
Combustión directa	92
Gasificación/pirólisis	90
Tecnologías bioquímicas	49
Digestión anaeróbica	27
Fermentación de azúcares	22
Tecnologías químicas (transesterificación, Fischer-Tropsch, síntesis de metanol)	13
Nº TOTAL FAMILIAS DE PATENTES	233

Nota: Alguna invención puede incluirse en más de una tecnología

En la Tabla 3 se muestra la distribución de documentos por ámbitos de protección. En el primer lugar del ranking se encuentran las solicitudes internacionales (PCT), con 75 documentos; en segundo lugar se encuentra EE.UU., con 70. En tercer lugar y a gran distancia, se encuentra Brasil, con 23 documentos. En España, en el periodo analizado, se publicaron 2. En la Tabla 4 se recogen los ámbitos de protección más representativos de las invenciones correspondientes a las distintas tecnologías.

Tabla 3. Ranking por países

	País	Nº Documentos
1	PCT	75
2	EE.UU. (US)	70
3	Brasil (BR)	23
4	Alemania (DE)	17
	EP	17
6	Rusia (RU)	16
7	Canadá	9
	Francia	9

Tabla 4. Ámbitos de protección más solicitados por tecnologías

	Tipos de Tecnología (Nº Documentos)		
	Termoquímicas	Bioquímicas	Químicas
PCT	56	20	4
EP	12	6	0
Alemania (DE)	17	0	0
Brasil (BR)	16	4	3
Canadá (CA)	6	4	0
EE.UU. (US)	55	13	4
España (ES)	2	0	0
Francia (FR)	7	2	1
Polonia (PL)	7	2	0
Rusia (RU)	13	2	1

En los Apartados posteriores se presenta una selección de los documentos de patente identificados este trimestre.

TECNOLOGÍAS TERMOQUÍMICAS

Patentes

COMBUSTIÓN DIRECTA		
Nº Publicación	Solicitante (País)	Contenido técnico
WO2019041014	Carlos Pereira Filho Alberto (BR)	Reactor for a process of advanced combustion for burning biomass and waste. The present patent envisages equipment for treating solid waste in general, the prior art of which anticipates various types of reactors for thermal treatment of solid waste, said equipment being formed of a reactor, in which combustion is carried out by means of a thermal cyclone effect produced by air injectors.
EP3415849	CS Thermos SRL (IT)	Hot air apparatus for fast drying fruit trees and crops in general. A hot air apparatus designed to quickly dry fruit plants and crops in general, comprising at least one burner, which is inserted in a brazier or combustion chamber where solid fuel is sent, such as pellets or biomass; the solid fuel is primed and lit thanks to the insertion of forced pressure air inside the brazier and thanks to the ignition of electric resistance. Moreover, a combustion fan is used to push the flame produced in the brazier outside the burner and towards a terminal wall of the apparatus, where one or more adjustable bulkheads are arranged, which convey and direct the flame sideways.
WO2018230715	Daio Seishi KK, et al. (JP)	Fuel pellets, system for utilizing biomass as fuel source, and method for producing biomass-derived fuel pellets. Provided are: biomass-derived fuel pellets which have a high calorific value and rarely deteriorate boilers; a system for utilizing a biomass as a fuel source; and a method for producing biomass-derived fuel pellets. The following steps are included: a crushing step of crushing a raw material composed of palm empty fruit bunches in such a manner that the elution of potassium from the raw material can be promoted, and then mashing the resultant fibers; a washing step of washing a crushed product produced by the crushing in the crushing step with warm water to remove potassium from the crushed product; a drying step of reducing the water content in a washed product from which potassium has been removed in the washing step to produce a dried product; a carbonization step of removing chlorine from the dried product in which the water content has been reduced in the drying step to further reduce the water content, thereby carbonizing the dried product; and a granulation step of granulating a carbonized product that has been treated in the carbonization step in the form of a fuel.
ES2694591	Estefano Lagarrigue Roberto, et al. (ES)	Método para el aprovechamiento de biomasa. Método para el aprovechamiento de biomasa con una caldera que usa pinaza como combustible generando, dióxido de carbono y vapor de agua para obtener energía térmica, mecánica y eléctrica, así como gas carbónico y/o hielo seco mediante etapas de: alimentación de la caldera con la pinaza seca, combustión y expulsión de dióxido de carbono y vapor de agua generados; regulados mediante control electrónico; conducción de vapor de agua a una turbina para secar la pinaza en silo que alimenta la caldera, y para mover un eje de un grupo generador; y conducción de dióxido de carbono a un proceso de purificación para generar gas carbónico y/o hielo seco. Adicionalmente, comprende etapas de obtención de bicarbonato de sodio y cloruro de hidrógeno (con dióxido de carbono de la combustión de la pinaza en la caldera).
DE202018107261	Gebra Nonfood Handelsgesellschaft M B H & Co Kg (DE)	Fire bowl. A fire bowl for the combustion of wood, charcoal and similar fuels, wherein a bowl base is provided with an upper shell opening and wherein a guard arranged on the shell base is provided, the guard the shell opening covering only in its edge region and in the central region of the shell opening or above the central region of the shell opening has a recess or a central recess, characterized in that in the central recess a fuel basket is inserted for receiving fuel.

Nº Publicación	Solicitante (País)	Contenido técnico
US2019078790	Kodila Mark A (US)	Method and apparatus for burning items. An apparatus is provided comprising a first wheelbarrow tray having an inner chamber; a second wheelbarrow tray having an inner chamber; and a means for connecting the first and second wheelbarrow trays, so that the inner chamber of the first wheelbarrow tray and the inner chamber of the second wheelbarrow tray are spaced apart and face each other. The first wheelbarrow tray may have a bottom surface; and the bottom surface of the first wheelbarrow tray may have an opening which is covered by a screen connected to the first wheelbarrow tray. The means for connecting the first wheelbarrow tray to the second wheelbarrow tray may include first, second, third, and four elongated beams. A method is also provided including placing one or more combustible items in an inner chamber of a first wheelbarrow tray of such an apparatus; and causing the one or more combustible items to ignite.
ES2693843	Natural Fire SL (ES)	Quemador de biomasa. Quemador de biomasa, que comprende una cámara de combustión, con una entrada de introducción de biomasa a quemar y una salida de proyección de llama para suministrar el calor de la combustión de la biomasa, en donde la cámara de combustión comprende un tambor rotatorio dispuesto en montaje giratorio en una estructura soporte, con la entrada de introducción de la biomasa a quemar en relación con un extremo de dicho tambor rotatorio y la salida de proyección de llama en el extremo opuesto.
US10222092	Original Pellet Grill Company Llc (US)	High-capacity sparkless mobile double-insulated wood pellet burner unit. Embodiments of the inventive concept provide a high-capacity, sparkless, mobile, double-insulated wood pellet burner unit. The wood pellet burner unit is safely operated on a wood floor or deck. The wood pellet burner unit produces a large radiant flame that enhances the surrounding area, free from dangerous sparks and smoke. The ash and coals from the fire are enclosed within a double-insulated housing. A wind break radiant heat reflector protects the flame from being distorted, enhances the flame so that it remains in a substantially upright column, and reflects some of the heat outwardly toward the users. Casters disposed on the bottom of the wood pellet burner permit easy and convenient movement of the unit. The wood pellet burner unit disclosed herein produces a larger and fuller flame than a pure gas fire pit based on a balanced multi-directional flow of heated combustion air flow through the unit.
US10228142	Sanders Carroll J (US)	Wood-burning stove with internal baffles for increased burn times. A wood-burning stove includes a first baffle spaced apart from the stove's front wall and extending from the stove's floor towards its ceiling to a height in a range of (0.65-0.75) of the stove's internal height. An air intake chamber is defined between the stove's front wall and first baffle. A firebox is defined between the first baffle and the stove's back wall. A second baffle is coupled to the stove's back wall at a position thereon below the stove's flue port. The second baffle extends from the back wall towards the first baffle to a second baffle depth of (0.7-0.85) of the stove's firebox depth. The second baffle terminates at an outboard edge that is spaced apart from the stove's ceiling to define a flow area in a range of 0.5-1.0 times a cross-sectional area of the flue port.
WO2019015572	Shenzhen Enesoon Science & Tech Co Ltd (CN)	Biomass combustion exhaust treatment system and process. The treatment system comprises: a biomass combustion device, an SCR device connected to the biomass combustion device, and further comprises an electronic control unit, an oxygen sensor, a NOx sensor, a first flow controller, and a second flow controller respectively connected to the electronic control unit. The biomass combustion exhaust treatment system and process ensures that biomass in the biomass combustion device burns at a stoichiometric point, and enables automatic adjustment of the NOx content in the combustion exhaust, such that nitrogen oxides and volatile organic gas components from the biomass in the combustion exhaust discharged from the biomass combustion device are significantly reduced. When combined with a corresponding adsorption device and catalyst, the removal rate of NOx and volatile organic components in the biomass combustion exhaust increases to 95% or higher.

Nº Publicación	Solicitante (País)	Contenido técnico
WO2019033044	United States Stove Company (US)	Biomass pellet combustion system. A biomass pellet combustion system includes a primary burn chamber, a coal burn chamber, and a gas burn chamber. The primary burn chamber is configured to receive pellets from a drop tube of the biomass pellet combustion system. The coal burn chamber is configured to receive coals from the primary burn chamber. The gas burn chamber is configured to receive combustible gases from both the primary burn chamber and the coal burn chamber, wherein a secondary combustion process converts secondary combustion air and the combustible gases into exhaust gases in the gas burn chamber.
BR102014025318	Univ do Estado do Rio de Janeiro (BR)	Production of briquettes of leftover wood and / or high particle lignocellulosics using food residues as binders. The present invention is related to the production of briquettes by the developed technique of "hermetic batch briquetting", a technique which is capable of producing briquettes of wood leftovers (and / or lignocellulosics) with a grain size greater than current techniques and with a less energy requirement in the operation. In addition, this technique allows the incorporation of food additives and residues as organic binders in the mix, improving the quality of the briquettes produced and giving an ecological end to these residues. The technique of "hermetic batching briquetting" uses an apparatus basically constituted in its simplified model of a piston, the mold body with a heating system, the mold base with or without a hole, a pin and a feed funnel. Where the use of water and binders, food residues, in the mixing of material with the wood leftovers, together with the seal created between the piston and the mold of the equipment, increases the efficiency in briquette agglutination, producing briquettes cylindrical or rectangular with or without through holes.
BR102017010102	Univ Federal de Itajuba (BR)	Biomass particulate burner with combustible gas matrix. The present invention contemplates a biomass particulate burner with combustible gas matrix for disposal of biomass solid waste wood dust compounds in sawmills and shells and food films in processing centers. It is an object of the present invention to provide a novel biomass particulate burner with a combustible gas matrix designed to prevent a high accumulation of solid biomass residues in sawmills and grain processing centers which could cause fires to produce damage to essential elements of the installations. In addition, the biomass particulate burner with focus gas fuel matrix serves to eliminate a large part of the biomass particulate generated in the process and, difficult to eliminate, which contributes to the impact of sawmill facilities and beneficiation centers to the environment.

PIRÓLISIS/GASIFICACIÓN

Nº Publicación	Solicitante (País)	Contenido técnico
WO2019022743	Anellotech Inc (US)	Efficient recovery of valuable components from biomass catalytic pyrolysis effluent. A process comprising separating from a biomass catalytic pyrolysis process effluent, a naphthalene-rich oil phase, a phenolic oil and a vapor phase containing off gas, water and BTX, whereby said vapor phase can be condensed to separate liquid water and liquid hydrocarbons from gaseous off gas and BTX.

Nº Publicación	Solicitante (País)	Contenido técnico
RU2678215	Ayubov Mansur Elmyrzaevich (RU)	Pyrolysis disposal plant. The invention relates to devices for disposal of garbage through process of pyrolysis and can be used for disposal of solid household and industrial waste. Assembly comprises furnace, retort, pipe for removal of gas, the drive, additionally comprises reactor, frame on which there are three coolers, water pump, aquafilter, vacuum pump, cooling tower, pyrolysis gas passage pipeline, water cooling pipeline, while the reactor is made in form of metal cylinder, upper part of which is made in form of hemisphere with a hole, on the edges of which a sealing gasket is attached, diameter of the reactor opening is 2-3 cm larger than outer diameter of retort, inner wall is lined with fireclay bricks, lower part has a furnace in form of two nozzles on liquid fuel and pyrolysis gas burner, retort is made of heat-resistant stainless steel in form of metal cylinder with a flange, to which removable cover is tightly fastened by means of tightening locks, on which lifting rings are located, outlet with flange is welded to the center of the cover, to which pipe with a flange is attached to divert pyrolysis gas, coolers are made in form of steel cylinders of equal volumes with removable flanges installed in the lower part with drain valves, with $d=0.5d$, $d=0.5d$, have a rigid mount with a frame, manometers and thermometers are installed on each cooler, a second vacuum cooler, a retort, coolers are mounted on the second cooler, aqua-filter and pyrolysis gas burner are interconnected successively with pipeline for passage of pyrolysis gases, with upper connections being rigid, and lower flanges, pipe for removal of pyrolysis gases is connected to the pipeline for passage of pyrolysis gases by means of an adapter, the coolers in the lower part have branches connected to the storage of pyrolysis liquid, which is equipped with shut-off valve, at the same time, oil level sight glass of accumulation of pyrolysis fluid is mounted at the outlet of the third cooler, water cooling pipeline has a closed loop and made in form of steel pipes connected to coolers, cooling tower and water pump, while connection with coolers in the upper part is welded, in lower part it is made in form of shut-off flange valve, pressure gauge is installed on the pipeline, pipe for filling with water is installed on aqua-filter, and drain valve is installed in the lower part, a vacuum pump is connected to pipeline of pyrolysis gases through pipe and valve. EFFECT: technical result is pyrolysis process at a low temperature with the possibility of affordable repair and maintenance work. 1 cl, 4 dwg
US2019071606	Battelle Memorial Institute (US)	Combined Hydrothermal Liquefaction and Catalytic Hydrothermal Gasification System and Process for Conversion of Biomass Feedstocks. A combined hydrothermal liquefaction (HTL) and catalytic hydrothermal gasification (CHG) system and process are described that convert various biomass-containing sources into separable bio-oils and aqueous effluents that contain residual organics. Bio-oils may be converted to useful bio-based fuels and other chemical feedstocks. Residual organics in HTL aqueous effluents may be gasified and converted into medium-BTU product gases and directly used for process heating or to provide energy.
US2019055168	Board of Supervisors of Louisiana State Univ and Agricultural and Mechanical College (US)	Biochar Fertilizer and Related Methods. Compositions including a biochar, and related methods are described herein. The composition can be produced by contacting a biomass with a pretreatment agent including an alkali metal or an alkaline earth metal to form a pretreated biomass, and pyrolyzing the pretreated biomass under conditions sufficient to form a biochar. A related method includes contacting soil with the composition thereby increasing a soluble plant available silicon content in the soil.
WO2019025436	Entrade Energie Systeme AG (DE)	Process for processing of organic solids as a fuel for fixed bed gasifiers and a process for operating a fixed bed gasifier for producing a product gas with such processed organic solids. Proposed is a process for treatment of fibrous organic waste products (EFB, empty fruit bunches) so that the EFB may be used for producing product gas (wood gas) in fixed bed gasifiers. Also proposed is a process for operating a fixed bed gasifier for producing a product gas from such pretreated fibrous waste products (EFB). In untreated form fibrous organic waste products as fuels have poor properties in terms of ash content and ash melting point. To bring about a melting point increase a process for leaching was developed in which comminuted EFB is immersed for a predetermined duration in heated seawater to which burnt lime, limestone and/or kaolin are added. This leaching aims to deplete the EFB of critical, low-melting point ash components so that the fuel properties are improved. The use of seawater instead of drinking water or distilled water makes the process particularly environmentally friendly and cost-effective. Obtained after drying is a fuel for fixed bed gasifiers which no longer melts even at a temperature of 1100°C and has an ash content of less than 10 percent by weight.

Nº Publicación	Solicitante (País)	Contenido técnico
WO2019014778	Facey Roderick Michael, et al. (CA)	Enhanced distillate oil recovery from thermal processing and catalytic cracking of biomass slurry. A method for thermal processing and catalytic cracking of a biomass to effect distillate oil recovery can include, particle size reduction, slurring the biomass with a carrier fluid to create a reaction mixture, slurring a catalyst with a carrier fluid to create a catalyst slurry, heating the reaction mixture and/or the catalyst slurry, and depolymerizing the reaction mixture with the catalyst. The reaction mixture can undergo distillation and fractionation to produce distillate fractions that include naphtha, kerosene, and diesel. In some embodiments, thermal processing and catalytic cracking includes vaporization of the biomass followed by distillation and fractionation. In some embodiments, a resulting distillate can be used as a carrier fluid. In some embodiments, the method can include desulfurization, dehydration, and/or decontamination.
RU2668681	Kochetov Oleg Savelevich (RU)	Mobile installation for burning organic waste on solid waste landfills. The invention is intended for thermal neutralization and utilization of organic waste at the places of their direct formation or collection with direct exit from there and disposal of waste on the road. Mobile unit consists of a pyrolysis furnace body, a module for supplying air and energy to the combustion chamber of the furnace, contains a waste gas recycling system and consists of the following main units: chassis of the vehicle with a control cabin sprung against the chassis by the cabin amortization system, on which a platform with a vibration isolation system is disposed relative to the vehicle chassis, wherein the rotation of the furnace can be provided, for example, by means of a gear or chain transmission, the rotation of which is set from the shaft, the rotating wheel on which it is fixed, the shaft rotating from the drive of an electric or diesel engine, and in the center of the end surface of the housing there is provided a seat for mounting the burner and the outer connection of the burner is connected by means of a rotatable detachable connection along the axis of symmetry of the cup with the pipeline of supply to the burner of the fuel mixture, while the furnace design is a metal cup-like container, which is the furnace body, which can also contain a hinged cover for loading waste, and the inner surface is made of heat-resistant steel, resistant to an aggressive environment, which has screw projections on its inner surface. Moreover, the burner of the fuel mixture contains a hollow body with a channel for supplying a liquid in which a diffuser is mounted in the form of oppositely arranged vertices and axisymmetric hollow conical swirlers: upper and lower, the conical shell of the lower swirl is fixed by means of at least three spokes fixed at one end to the conical shell of the lower swirler in its upper part and the other end to the annular groove of the nozzle channel formed on its inner surface, and the vertex of conical surface of conical shell of the upper swirl is fixed in a circular perforated plate installed in the annular groove of the nozzle channel and supported by the vertex of the lower swirl fixed in the nozzle channel by means of spokes, while on the external surfaces of the hollow cone swirls through-screw threads are made, and the throttling effect of the atomizer is generally determined by the total throughput of its constituent elements, in order to obtain a finely dispersed spray, the total throughput of the upper swirler and the perforated plate is greater than that of the lower swirler, and a diffuser with a circular perforated plate mounted on its cut is fixed to the lower end surface of the cylindrical hollow body.EFFECT: increased productivity of thermal detoxification and utilization of organic waste both at the places of their direct location or collection, and with direct departure from there and waste disposal on the road.1 cl, 3 dwg
WO2019001921	Mitsubishi Hitachi Power Systems Europe GmbH (DE)	Method and device for generating coal from biomass by means of hydrothermal carbonisation. In a method for generating coal from biomass by means of hydrothermal carbonisation in an autoclave, wherein the reaction chamber inside the autoclave is filled with biomass to be carbonised in batches at the beginning of every carbonisation cycle involving the conversion of the biomass into coal, wherein the carbonisation reaction of the biomass in the autoclave is carried out in an atmosphere at least predominantly formed of water vapour, and the carbonisation is caused by increased-pressure water vapour introduced into the biomass, a solution is created which provides improved steam generation for carrying out a hydrothermal carbonisation of biomass to form coal in an autoclave. This is achieved in that the increased-pressure water vapour causing the carbonisation of the biomass is generated during the respective carbonisation cycle, at least periodically in the reaction chamber of the autoclave arranged inside the autoclave and filled with biomass to be carbonised, by means of at least one evaporator arranged and designed therein.

Nº Publicación	Solicitante (País)	Contenido técnico
RU2678089	Obshchestvo S Ogranichennoj Otvetstvennostyu Prometej (RU)	<p>Industrial complex for the production of charcoal without waste method of low-temperature pyrolysis from briquette wood waste. The invention describes an industrial complex for the production of charcoal from briquetted wood waste, including a heat carrier preparation site, a ground wood waste preparation site, a wood drying site equipped with a drying device, briquetting site, low-temperature pyrolysis site, characterized in that the site for preparing the gaseous heat carrier is made in the form of a complex heat generator equipped with a combustion chamber for receiving flue gases, with a combustion unit for recycled pyrolysis gases, as well as an input unit in the generated coolant for at least part of the gas-vapor mixture with low oxygen content and high content of steam returned from the drying area; site for the preparation of shredded wood waste, located in front of the drying area, includes at least one receiving hopper of raw materials, crushing and grinding equipment, at least one storage hopper, located in front of the inlet channel of the drying unit and equipped with a feeder; area of wood drying is equipped with a drying device operating in co-circulation in suspension of the vapor-gas coolant and shredded wood within the working area, made in the form of a looped channel, while the drying device includes a node for introducing wood particles, a node for introducing a coolant with low oxygen content, node output of wood particles vapor-gas flow, made with the possibility of full output of particles, as well as their full or partial return to an additional drying cycle, and the output node is designed to prevent the penetration of oxygen into the working area of the drying device; section for separating the mixed stream coming out of the drying device into a vapor-gas mixture and shredded wood is made with the possibility of recovering at least part of the vapor-gas mixture in the complex heat generator of the section for the preparation of a gaseous heat carrier and includes at least one cyclone and one receiving bin, located downstream of the drying device, moreover, the pipeline in front of the cyclone is equipped with a device for controlling the target moisture content of wood particles by condensing moisture from the vapor-gas stream; the separation section also includes a chimney for dispersing at least a part of the drying exhaust gases, equipped with control valves and / or dampers, moreover, their positioning provides such a level of pressure inside the complex, which suppresses the leakage of oxygen into the system, but at the same time allows at least part of the exhaust gases to leave the system; the briquetting section is equipped with at least one press, preferably of an extrusion type; section of low-temperature pyrolysis, operating in a heat-stabilized mode, is equipped with at least two devices for producing charcoal, each of which includes a thermally insulated casing with a system of gas ducts, moreover, the working area of each device is made in the form of a looped channel, equipped with a gas-permeable recuperator installed inside the looped channel, a heat-resistant fan and a rotary gate, system of gas ducts is made with the possibility of transporting pyrolysis gases to the complex heat generator of the site for preparing the gaseous coolant, and also the section of pyrolysis is equipped with removable devices for loading and unloading briquettes. EFFECT: technical result achieved with the use of the complex is that the problem of efficient molding of strong briquettes is solved, which in the process of further fast low-temperature pyrolysis are not only not subject to destruction, but significantly increase their mechanical strength, maintaining the geometry of the briquette from the moment of its receipt until burning at the consumer; the resulting briquettes are distinguished by high consumer properties: environmental friendliness, high calorific value, and from the point of view of storage and transportation, hydrophobicity and high mechanical strength.10 cl, 1 dwg</p>
WO2019034799	Sener Ingenieria y Sist SA (ES)	<p>System for generating electrical energy from the combustion of solid urban waste and assimilable waste. The invention relates to a method for generating electrical energy from the combustion of solid urban waste and assimilable waste, which comprises a first step of heating water using an incineration boiler for solid urban waste that operates below 400 °C, and a second step of heating using a boiler that uses synthesis gas as fuel, which gas is generated by means of gasification and subsequent cleaning. Thus, better performance is achieved while minimising the problems of corrosion.</p>

Nº Publicación	Solicitante (País)	Contenido técnico
WO2019008934	Sintokogio Ltd (JP)	Biomass gasification device. The purpose of the present invention is to provide a biomass gasification device that, in a space in which a biomass raw material is gasified, biomass raw material residue does not accumulate and pipes are unlikely to be blocked. As a result of the present invention, a biomass gasification device 1 can be provided that comprises: a furnace main body 14 capable of heating the interior thereof; a double pipe 22 having an inner cylinder 24 and an outer cylinder 26 and being arranged so as to extend in the vertical direction inside the furnace; a connecting section 40 that is arranged below the double pipe and connects an internal space of an inner cylinder 28 and a space 30 between the inner cylinder and the outer cylinder; and a residue discharge pipe 42 connected to the connecting section and externally discharging biomass raw material residue from the connecting section. Either the internal space of the inner cylinder or the space between the inner cylinder and the outer cylinder is a space in which biomass raw material is gasified. The other out of the internal space of the inner cylinder and the space between the inner cylinder and the outer cylinder is a space through which the gas after gasification flows.
US2019055122	Syngas Tech Llc (US)	Torrefaction of biomass feed with steam stripping. A process for optimizing a biomass feedstock for gasification for the production of syngas. The biomass feed, which is preferably a lignocellulosic material, is subjected to controlled torrefaction followed by steam stripping of the torrefied solids. The biomass undergoes a weight loss of about 10% to 15% on a dry ash free basis. This increases the energy density and friability of the stripped torrefied biomass and results in higher efficiency on subsequent densification or gasification.
WO2019020513	Topsoe Haldor AS (DK)	Method for the preparation of synthesis gas. Method for the preparation of synthesis gas based on a combination of the ATR process or partial oxidation of hydrocarbon feed stock using oxygen from the electrolysis of water and an air separation unit to produce the synthesis gas.
WO2019030689	Univ Degli Studi di Bari Aldo Moro, et al. (IT)	Fast pyrolytic process with low environmental impact based on controlled reforming of produced syngas. The invention relates to a process for the pyrolytic treatment of micronizable materials, comprising the following steps: - low-temperature pyrolytic treatment of a flux of micronized material; - controlled reforming of the syngas against the micronized material by means of the application of energy coming from renewable or recovered sources.
US10202558	VRC Tech Llc (US)	Gasification feedstock treatment methods and apparatus. The inventive technology includes methods and apparatus for the generation and application of segregated catalytic additives for the pre-combustion treatment of carbonaceous fuel and/or feedstocks. The application of such segregated additives results in the reduction of environmentally harmful emissions during combustion as well as gasification processes. Specifically, pre-combustion treatment of carbonaceous materials with the inventive additives results in the reduction of NOx and/or mercury emissions by least 20% and 40% respectively.

TECNOLOGÍAS BIOQUÍMICAS

Patentes

DIGESTIÓN ANAERÓBICA		
Nº Publicación	Solicitante (País)	Contenido técnico
W02019038561	Clayton Hall Farm Biogas Products Ltd (GB)	Improved method for hydrolysis of biomass. The present invention relates to an improved method for the production of biogas. In particular, it involves the digestion of a feedstock by a microbial composition in a mixture comprising a superabsorbent polymer, and an aqueous solution. The method is particularly useful in the production of biogas, but also other high-value chemicals, such as sugars, alcohols and/or carboxylic acids, such as volatile fatty acids.
RU2678673	Federalnoe Gosudarstvennoe Byudzhethnoe Obrazovatelnoe Uchrezhdenie Vyshego Obrazovaniya Irkutskij G (RU)	Anaerobic fermentation installation. The invention relates to the organic waste containing wastewater from agricultural production anaerobic fermentation devices, and can be used in the industrial enterprises and utilities wastewater with organic inclusions treatment. Anaerobic fermentation installation contains the methane digester tank, the livestock waste supply and the fermentable substrate removal branch pipes, the livestock waste supply pump, the anaerobic biomass immobilized carrier, biogas removal branch pipe, gasholder, the biogas to consumers supply bypass branch pipe, the perforated pipe, the hydraulic lock and the trigger. At the inlet the trigger is connected to the drain line through the valve, and at the outlet it is connected to the pump, configured to supply biogas from the gas holder through the branch pipe to the perforated pipe located at the methane digester tank bottom. At the inlet the hydraulic lock is connected to the methane digester tank, and at the outlet it is to the gasholder. EFFECT: invention allows to simplify the installation design and its operation, as well as increase the methane digester efficiency.
US2019062682	Hitachi Zosen Inova AG (CH)	Process for optimizing the operation of a plug-flow fermenter for the anaerobic fermentation of organic wastes. A process for optimizing the operation of a plug-flow fermenter for the anaerobic fermentation of organic wastes, wherein the plug-flow fermenter comprises a horizontally oriented fermenter tank and a stirrer, which stirrer comprises a stirrer shaft which traverses the interior of the fermenter tank in an axial manner and multiple paddles which are arranged on the stirrer shaft and protrude radially and also a drive, and the fermentation material is moved in the fermenter tank by means of the stirrer.
EP3438268	ISF GmbH (DE)	Use of iron hydroxide in biogas production as hydrogen sulphide additive for biomass. Use of iron hydroxide in biogas production as hydrogen sulfide precipitating addition to the biomass, characterized in that in addition zeolite is used as the reaction rate of precipitation of the hydrogen sulfide by iron hydroxide-increasing additive to the biomass.
FR3069552	Methaventures (FR)	Système digesteur en voie liquide conteneurisé modulaire a brassage hydraulique. The present invention relates to a device for recovering methane from organic material or bio waste comprising a control and pumping module, digester modules installed in parallel on a supply pipe, a recovery module receiving the methane from recovery pipes connected in parallel to the digester modules, characterized in that the modules of the recovery device are housed in containers, the containers are placed on a single slab or on longitudinal rods, the digester modules maintain by means of said side holding means a flexible digestion bag inside the container, which is hydraulically stirred through a supply pipe which is a hydraulic mixing pipe fed by the control and pumping module, the supply of methane is via a chimney which passes through the ceiling of the container.
EP3415472	Murgia Ilaria (IT)	Process and integrated plant for biogas production from organic wastes, nutrients recovery, and purification of produced biogas. The present invention relates to an improved process for biogas production from organic substrates, preferably zotechnical sewages, with an improved degradation efficiency, and to a plant for the actuation of said process. In a preferred embodiment, the present invention allows the purification of produced biogas and the recovery of nutrients from the digestate.

Nº Publicación	Solicitante (País)	Contenido técnico
CA2970368	Nadon Gilles (CA)	Apparatuses for the functioning of a floating methanization system. The invention entitled Apparatuses for the functioning of a floating methanization system, is in the field of the treatment of wastewater or other organic waste by the process of methanization that transforms it into biogas and fertilizer by anaerobic digestion. Some existing problems, concerning structure, mixing, and heating, have been described in a previous application for an invention entitled Floating methanization system (Canadian application 2,875,345). What is being claimed here is a continuation and improvement of the previous invention, and concerns several different apparatuses for the functioning of a floating methanization system. The main apparatuses involved are two new types of valves (swivelling valves and rotary valves), different types of new pumps (an inlet pump, swivelling valve exhaust pumps, air pumps, hydraulic pumps, rotary diaphragm pumps), heat exchangers, rotary steam engines, and a double network of hoses for the disposal of the end products of the methanization process.
BR202018001662	Nicola Isidoro Martorano Filho (BR)	Integrated set of technologies for the treatment of effluents with bio-methane production by bio-digestion of organic matter. Model designed to operate effluent treatment plants with biomethane generation by anaerobic biodigestion provided with coarse residues retention box coupled to the picker and hammer mill, desalination box, anaerobic decanter tank subdivided into interconnected modules with continuous upward and downward flow with controlled velocity, flow and pressure that will promote the precipitation and decantation of biosolids, anaerobic bioreactors to process the biomass with biomethane generation and temperature and pressure coupled to the inoculum tank, reactor with electrolytic cells with alternating and continuous electric currents of controlled intensities connected to the microwave generator and electromagnetic radiation, purifying filter with filtering stages for retention of microparticles, centrifuge and a storage tank that of biomethane. The sludge retained in the bioreactors will generate the biomethane that can be used in the plant itself. the complete and controlled management of the effluent treatment process from the requirements necessary for different types of effluents, will promote the disintegration of the pollutant molecules present in the water molecule. to optimize the biometization process will be used inoculum of methanogenic archaeobacteria. the system is modular, compact and automated ensuring low operating cost.
WO2019043031	Suez Groupe (FR)	Method and equipment for digesting a biodegradable liquid filtrate. The invention relates to the field of waste treatment and hydrothermal carbonization and concerns a method for digesting a biodegradable liquid filtrate, comprising: - a step of hydrothermal carbonization of a biomass in a hydrothermal carbonization unit, to obtain a product of hydrothermal carbonization; - a step of dewatering of the product of hydrothermal carbonization into a ultra-dewatered biomass and the biodegradable liquid filtrate; the method further comprising a step of feeding a first anaerobic digester with at least a part of the biodegradable liquid filtrate to generate biogas and a digestate. The invention also concerns an equipment for digesting a biodegradable liquid filtrate.
EP3441472	Sukhmeet Singh Anand (ES)	MICRO ALGAE TO BIO METHANE. The invention relates to efficient use and control of thermal energy and carbon dioxide in the process of producing microalgae for methane (CH ₄) production through fermentation. The microalgae is grown in a controlled environment with the aid of light, carbon dioxide, CO ₂ and heat. The invention includes a feature to store heat collected by the microalgae ponds during daytime. The heat is used to keep the algae pond and fermentation tank at an optimal temperature for micro algae yield (25 to 30C) and the fermentation tank (32-40C). An additional feature of the invention is that biogas is scrubbed using microalgae water solution for effective upgrading of the biogas to biomethane and carbon dioxide source for the microalgae growth.
PL421577	Univ Warszawski, et al. (PL)	Method for amplification of methanation, method for obtaining a composition for amplification of methanation, composition for amplification of methanation and application of halloysite for amplification of methanation. The solution concerns the development of mixed preparations to strengthen the sewage sludge methanation process. The method of strengthening methanation involves the use of halloysite for the biogas production process from plant substrates and organic waste materials (eg sewage sludge) and reducing the amount of fermented sludge and post-fermentation liquid, preferably by using halloysite as a carrier of microorganisms involved in the biogas production process, preferably bacteria hydrolysing the breakdown of proteins and fats, preferably propagated on a medium containing molasses or other waste materials. The subject of the application is also the use of halloysite to improve the quality of produced biogas, through direct sorption of H ₂ S in the fermentation chamber, without the need to use external capture filters and the use of halloysite to capture and neutralize organic and inorganic compounds toxic to microorganisms involved in methane fermentation.

FERMENTACIÓN DE AZÚCARES

Nº Publicación	Solicitante (País)	Contenido técnico
WO2019020849	Abengoa Bioenergía Nuevas Tecnologías SA (ES)	Cellulases with improved cellulolytic activity. The present invention relates to cellulase variants which comprise a proteolysis-resistant binding region or linker for binding the cellulose-binding domain (CBD) and the catalytically active domain (CAD), and which also have greater cellulolytic activity. The invention also relates to a gene construct, a host cell and an enzyme composition comprising said variants. The invention further relates to a method for producing fermentable sugar and to a method for producing a bioproduct, such as bioethanol, from cellulose material with the cellulase variants, the host cell or the enzyme composition comprising said variants.
WO2019046308	Domtar Paper Company Llc (US)	Production of biofuels, biochemicals, and microbial biomass from cellulosic pulp. Methods for production of alcohol, biomolecules, and/or microbial biomass using cellulosic pulp as a feedstock are provided. Cellulosic pulp is contacted with an enzyme composition to produce fermentable sugars, which are used as a carbon source for a microorganism to produce alcohols or biochemicals by fermentation and/or to produce only microbial biomass.
PL422196	Kosecka Wioletta (PL)	Method for wasteless obtaining of bioethanol, fodder yeast and carbon dioxide and the system for production of these products. The subject of the application is a waste-free method for obtaining bioethanol, feed yeast and carbon dioxide using vegetable biomass hydrolysis, characterized by the separation of carbohydrates in the initial hydrolysis of hemicelluloses and after dissolution of simple carbohydrates contained in the biomass, and the remaining mass is hydrolysed by the alkaline method. Then, by acidic method for maximum hydrolysis of cellulose to simple sugars and together with previously separated sugar solution, it is subjected to alcoholic fermentation, and the decoction after ethanol distillation, is transferred to yeast culture. After the cultivation, the yeast is separated, and the solution is purified by acidifying with o-phosphoric acid and then made alkaline with limestone milk, the precipitate is separated, and the solution is acidified with carbon dioxide from ethanol fermentation or yeasting. The precipitate is separated, the mass is added after acid hydrolysis and is used as fertilizer lime, the solution obtained at the same time is used for the preparation of raw materials and in the cooling node. The application also includes a system for the production of bioethanol, feed yeast and carbon dioxide, characterized in that it has a junction node (01) connected through the hydrolysis node I (02) with the filtration unit I (03) through the ethanol fermentation block (07) and a distillation block (08) which through the yeast culture block (11) and further the yeast filtration and drying block (12) is connected to the filtrate and wastewater purification unit (13) at the outlet connected to the product IV block. The filtration block I (03) is connected to the hydrolysis node II (04) at the outlet and through the filtration block II (05) with the neutralization block (06) connected to the ethanol fermentation block (07) and has a scrubber block (09) connected at the entrances with blocks (05) and (07) and on outputs with blocks (08) and CO2 condensing node (10).
WO2019046232	Novozymes AS (DK), et al.	Combined use of an endo-protease of the m35 family and an exo-protease of the s53 family in the fermentation of starch. The present invention relates to improved processes for producing ethanol from starch-containing materials by the combined use of at least one endo-protease and at least one exo-protease in an SSF process, and wherein the endo-protease is selected from a family M35 endo-protease and the exo-protease is selected from a family S53 exo-protease. More particularly the exo-protease should make up at least 5% (w/w) of the protease mixture.
WO2018236540	Orouke Res Group Inc (US)	Sustainable growing system and method. In one embodiment, a sustainable hydroponic growing system comprises at least one hydroponic growing unit, an algae growing unit configured to produce an algae biomass, a biofuel system configured to process the algae biomass to produce a bioethanol fuel and a solid oxide fuel cell configured to use the bioethanol fuel as at least one source of fuel to produce electrical power for use by the at least one hydroponic growing unit. In one embodiment, the solid oxide fuel cell is further configured to produce steam that serves as a water source for the at least one hydroponic growing unit and/or the algae growing unit.

TECNOLOGÍAS QUÍMICAS

Patentes

Nº Publicación	Solicitante (País)	Contenido técnico
WO2019014602	Battelle Memorial Institute (US)	Lignin to liquid fuels and polyols using biomass-derived solvents. A process of producing a distillate fuel from lignin includes: preparing a biomass-derived lignin solvent; dissolving the lignin in the biomass-derived solvent; and separating undissolved lignin and mineral matter to produce a syncrude. In certain embodiments, the process further includes subjecting the syncrude to a hydrotreatment/hydrogenation process to produce a distillate fuel. A process to improve direct lignin liquefaction includes: using a non-hydrogenated lipid in a direct lignin liquefaction process to facilitate lignin depolymerization. A process for using a biomass-derived feedstock as a hydrogen donor includes: providing a biomass-derived feedstock; modifying the feedstock to improve its usefulness as a hydrogen donor; and conducting a transfer hydrogenation process using the modified feedstock as a hydrogen donor.
BR102017003031	Centro de Gestao de Tecnologia e Inovacao-CGTI, et al. (BR)	Process of combining the use of alcohols in supercritical conditions activated by high frequency electromagnetic fields to obtain biodiesel in a continuous stream. Biodiesel production process from any glyceride based grease without the use of catalysts, using supercritical conditions and microwaves; monitored, controlled and automated by an operation center (32) and a specialist software (31) that makes it a continuous production for the optimal obtaining of the desired reaction products. uses alcohol (1) as solvent and a mixture of fatty material / alcohol (4) which after being pumped and subjected to high pressures, temperatures and microwave-like radiation (5) makes the supercritical alcohol (3) / alcohol (4), which after mixing in a given molar ratio with microwaves irradiations under supercritical pressure and temperature conditions makes the mixture supercritical / fatty alcohol / alcohol (6), and after having its pressure and temperature (9) is introduced in the upper stage, the biodiesel (10) in the intermediate phase and the glycerol (11) in the lower phase is introduced into the separator (8).
RU2676485	Federalnoe Gosudarstvennoe Byudzhethnoe Obrazovatelnoe Uchrezhdenie Vyshego Obrazovaniya Irkutskij N (RU)	Method of obtaining biodiesel fuel in medium of supercritical dimethyl carbonate. The invention relates to the field of chemical technology, in particular to a method for producing biodiesel fuel from vegetable oils, and can find application in industries that use diesel engines. Method for producing biodiesel in supercritical dimethyl carbonate includes the methylation of vegetable oil. Process is carried out in one stage using a non-toxic methylating agent (NTMA), and the transesterification is carried out with dimethyl carbonate under supercritical conditions at a temperature of 225-325 °C and pressure of 20-30 MPa for 3-20 minutes.EFFECT: increase the degree of transesterification of the oil.1 cl, 7 ex.
FR3066929	IFP Energies Now (FR)	Process for hydrotreating distillate slices using a catalyst based on an amorphous mesoporous alumina prepared without drying grows. A process for the hydrotreatment of at least one hydrocarbon feed having a weighted average temperature (TMP) greater than 380 °C using at least one catalyst comprising at least one Group VIB metal and / or at least one Group VIII metal is described of the periodic table and a support comprising an amorphous mesoporous alumina having a total pore volume greater than 0.75 ml / g, said alumina having been prepared according to a specific process, said hydrotreatment process operating at a temperature of between 250 °C. and 430 °C, at a total pressure of between 3 MPa and 20 MPa with a volume ratio of hydrogen per volume of hydrocarbon feedstock of between 200 and 2000 liters per liter and at a Hourly Volumetric Velocity (VVH) defined by the ratio of volume flow rate of liquid hydrocarbon feedstock by the volume of catalyst charged to the reactor between 0.3 and 5 h ⁻¹ . Hydroprocessing of hydrocarbon feedstock e.g. vacuum distillate, effluent resulting from catalytic unit of fluid catalytic cracking unit, light diesel fuel resulting from catalytic unit of cracking unit, cutting oil, paraffin effluent resulting from Fischer-Tropsch synthesis, effluents resulting from flash distillation, effluent resulting from liquefaction of coal, effluent resulting from biomass, effluent resulting from conversion of biomass, and aromatic extract

Nº Publicación	Solicitante (País)	Contenido técnico
BR102016020837	Petroleo Brasileiro SA, PETROBRAS (BR)	Integrated process of biodiesel production by enzymatic transesterification. The present invention describes the conversion of macauba oil to biodiesel through the use of a biocatalyst obtained by solid state fermentation (FES) of macauba cake derived from the extraction of macauba oil and transesterification.
BR132016019561	Reynaldo Dias de Moraes e Silva (BR)	Continuous process of manufacturing ethyl esters (biodiesel) by heterogeneous photocatalysis. Continuous process for manufacturing heterocyclic photocatalytic (biodiesel) esters of the patent of invention - Patent 0406233-7 relates to an oxidative hydrolysis process by heterogeneous photocatalysis with ultraviolet uv of vegetable oils in an apparatus having three fluorescent uv lamps of 115 watts each, 253.7 nanometer wave beams orthogonally fixed to titanium oxide-coated polished stainless steel plates (coated titanium oxide) coating the plates after 24 hours at a temperature of 400 ° in an autoclave, placed at an angle of 45 ° alternately, which cascade successively producing energy greater than the bandgap energy of the titanium oxide (titanium oxide) and activating the energy of the semiconductor by causing the hydroxyls released from the bv - valence band to migrate to the bc band conduction, creating positive gaps in the bv and electrons h + in the bc - conduction band, resulting in the formation free radicals of highly oxidizing ohradicals by adsorption of the water ionization molecules from the emulsion component of the oil emulsified mixture of 1: 1 vegetable oil and 40 ° gl ethanol at the temperature of 60 ° C and passed in a piston homogenizer, which radicals acting on the semiconductor produce the hydrolysis of the vegetable oil resulting in ethyl esters (biodiesel) partially dissolved in ethanol and glycerin dissolved in excess water. the separation of the mixture is done through a centrifuge and then by concentration in vacuo.
WO2018226087	Univ Putra Malaysia (MY)	Method of producing fatty acid methyl ester. The present invention relates to an improved method of producing a fatty acid methyl ester for use in biofuel production from a domestic waste grease. The method comprises steps of conducting esterification (4) reaction to the domestic waste grease in a first microwave radiation catalyzed with a solid acid catalyst for producing an esterified domestic waste grease and conducting transesterification reaction to the esterified domestic waste grease under a second microwave radiation catalyzed with a solid base catalyst for producing the fatty acid methyl ester.
WO2018226088	Univ Putra Malaysia (MY)	Solid acid catalyst and solid base catalyst for biofuel and method thereof. The present invention relates to an improved method of producing a sulphated-ferric(III) oxide/alumina oxide solid acid catalyst and a potassium/silica oxide solid base catalyst. The method of preparing the sulphated-ferric(III) oxide/alumina oxide solid acid catalyst includes impregnating an ammonium ferum (III) sulphate hexahydrate onto an aqueous alumina oxide. The method of preparing the potassium/silica oxide solid base catalyst includes impregnating a potassium carbonate onto an aqueous silica oxide. The sulphated-ferric(III) oxide/alumina oxide solid acid catalyst and potassium/silica oxide base catalyst solid base catalyst produced by the method of the present invention is reusable for up to 10 times, thus reducing biofuel production cost.

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