INFORME DE VIGILANCIA TECNOLÓGICA SECTORIAL

REUTILIZACIÓN DE AGUAS RESIDUALES DE PROCESOS DE RECUBRIMIENTOS METÁLICOS. TECNOLOGÍAS DE MEMBRANA

CÍRCULO DE INNOVACIÓN EN TECNOLOGÍAS MEDIOAMBIENTALES Y ENERGÍA (CITME)

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RESUMEN EJECUTIVO

España es el país con mayor déficit hídrico de la Europa continental. Numerosas y variadas son las alternativas e instrumentos que barajan los gestores para hacer frente a las necesidades de este recurso: captación de aguas superficiales o subterráneas, desarrollo de infraestructuras, desalación y reutilización de las aguas residuales. La reutilización es la única que conserva la virtud de la justicia con nuestras aguas y nuestro medio, y a la vez, es la más olvidada por nuestros políticos y dirigentes.

Para poder proceder a la reutilización de las aguas residuales, es necesario realizar un tratamiento previo, que dependerá tanto de las características del efluente como del uso al que se vaya a destinar este agua, pues requerirá de una calidad diferente según los casos.

Se han aprobado numerosas normas de carácter medioambiental cuya intención es la de proteger los recursos naturales y tratar los residuos de manera que su valorización sea efectiva. En este sentido la regulación de los vertidos de aguas residuales industriales a los sistemas públicos de saneamiento, tiene el objetivo de proteger las instalaciones que integran dichos sistemas y optimizar el funcionamiento de las mismas, además de conseguir la preservación del medio ambiente. La tendencia en Europa y, por tanto en España, especialmente tras la promulgación de la Ley 16/2002 de prevención y control integrado de la contaminación y la puesta en marcha del EPER-España (Registro Estatal de Emisiones y Fuentes Contaminantes), es reducir el vertido de algunos contaminantes específicos y emplear sistemas avanzados de tratamiento de aguas residuales “in situ”.

El tejido empresarial español cuenta con una gran diversidad de sectores industriales en los que se llevan a cabo actividades de recubrimientos metálicos como parte de su proceso productivo. Muchas de estas industrias se dedican en exclusiva a este conjunto de operaciones, pero también existen otras muchas cuya actividad principal no consiste en el tratamiento y acabado de superficies metálicas, sino que las tienen integradas en su proceso. Este es el caso de las instalaciones industriales de automoción, industria eléctrica, metalurgia, construcciones metálicas, equipos de menaje (cubertería y orfebrería), producción de neumáticos, muebles, aparatos eléctricos y siderurgia.

Dentro de las empresas dedicadas a la producción y transformación de metales, según datos de EPER para España, sólo las industrias de tratamiento de superficies que emplean procedimientos electroquímicos o químicos (con volumen de cubetas o líneas completas mayores de 30 m^3) fueron responsables, en 2004, del vertido de 1,4 t de metales pesados tóxicos y otros residuos orgánicos peligrosos directamente al mar y 24,5 t del mismo a través de un sistema de alcantarillado o depuradora externa municipal o industrial. Estos volúmenes de residuos nocivos se redujeron en 2006, a 0,8 t de emisiones directas y 8 t de emisiones indirectas al agua. No se dispone de información sobre el volumen de residuos vertido por el total de empresas que realizan alguna actividad de recubrimiento metálico, sin embargo la extrapolación de datos constataría que se alcanzan cantidades muy superiores a las que los ecosistemas acuáticos pueden asumir

Para la eliminación y/o recuperación de estos compuestos nocivos de las aguas residuales que los contienen, se requiere de la utilización de sistemas avanzados de tratamiento, entre los que están destacando las tecnologías de membranas, para generar un efluente acuoso depurado susceptible de ser reutilizado, en algunos casos directamente, y tras sufrir un tratamiento posterior en una EDAR (estación depuradora de aguas residuales) en otros.

Este documento, de interés para todas aquellas industrias en las que se realizan actividades de recubrimientos metálicos, tiene el objetivo de detectar las tecnologías de membranas efectivas para el tratamiento “in situ” de las aguas residuales producidas durante el proceso con vistas a su reutilización.

EXECUTIVE REPORT

Spain is the country with the highest water deficit in Continental Europe. The alternatives and instruments, which managers use to face the needs for this resource, are numerous and varied: superficial or ground water extraction, infrastructures development, desalinization and wastewater reuse. Reusing is the only one that conserves our water and environment and, at the same time, it is the most forgotten by our politicians and leaders.

It is necessary to carry out a previous treatment to proceed to the reuse of the wastewater, which will depend both on the effluent characteristics, and on the use to which water is going to be destined, since a different quality will be required depending on each case.

It has been approved numerous environmental regulations whose purpose is to protect the natural resources and to treat the wastes, in a way its worth could be effective. In this sense, the disposal regulation of industrial wastewater to the public systems of drainage has as main objectives, on the one hand, to protect the installations which integrate the above mentioned systems and, on the other, to optimize their operating process, as well as to achieve the environment conservation. The European trend, therefore the Spanish, especially after the promulgation of the Law 16/2002 of integrated pollution prevention and control (IPPC), and the setting of the European Pollutant Emission Register in Spain (EPER-Spain), is to reduce the disposal of some specific pollutants and to use advanced systems of wastewater treatment in situ.

The Spanish business network has a great diversity of industrial sectors in which activities of metallic coverings are carried out, as part of their productive process. Many of these industries exclusively devote to this set of operations, but there are many others whose principal activity does not consist of the treatment and metallic surfaces finish, but they have integrated them into their process. This is the case of the automotive, electrical industry, metallurgy, metallic constructions, household goods equipments (cutlery and goldwork), tires production, furniture, electrical devices and siderurgy industrial installations.

Within the companies dedicated to the production and metal transformation, according to EPER information for Spain, only the industries of surface treatment that use electrochemical and chemical procedures (with trays volume or complete major lines of 30 m3) were responsible, in 2004, for the disposal of 1.4 t/year of heavy toxic metals and other dangerous organic residues directly to the sea and 24.5 t/year through a drainage system or a local or industrial external sewage treatment plant. These volumes of harmful residues were diminished in 2006 to 0.8 t/year of direct emission and 8 t/year of indirect emission to the water. Any information was provided about the volume of residues spilt by the total of companies that carried out any activity of metallic covering. However, the extrapolation of information would affirm that quantities are grater to those that the aquatic ecosystems can assume.

To eliminate and/or recover these harmful compounds of the wastewater, it is necessary to use advanced systems of treatment: membranes are the outstanding technologies to generate a treated water effluent capable of being reused, in some

cases directly, and after suffering a later treatment in a WWTP (wastewater treatment plant) among others.

This document, concerned to all those industries devoted to metallic coverings activities, has the aim to detect effective membranes technologies for the treatment in situ of the wastewater produced during the process for a future reuse.

1.- INTRODUCCIÓN

El presente informe se centra en el tratamiento de las aguas residuales producidas por las industrias que realizan actividades de recubrimientos metálicos**,** con vistas a su reutilización dentro de la misma línea de producción o para otros usos no industriales.

El sector de Recubrimientos Metálicos es un sector heterogéneo que agrupa a un gran número de actividades, siendo las principales el revestimiento metálico y la pintura y barnizado de metales.

Según el Instituto Nacional de Estadística, los productos más importantes elaborados por el sector son:

- Revestimiento metálico
  - por inmersión en metales fundidos
  - por proyección térmica
  - de zinc por galvanizado electrolítico y procedimientos químicos
  - otros revestimientos (níquel, cobre, cromo, etc.)
- Plastificación
- Otros revestimientos (fosfatación, etc.)
- Tratamientos térmicos distintos del revestimiento metálico
- Pintura, barnizado
- Anodización
- Recubrimiento al vacío: Deposición química en fase de vapor (CVD) y Deposición física en fase de vapor (PVD)
- Otros tratamientos de superficies metálicas

Las empresas del sector de recubrimientos metálicos presentan una incidencia medioambiental por emisiones atmosféricas, vertidos de aguas residuales y generación de residuos peligrosos.

La contaminación específica de este sector se concreta fundamentalmente en el vertido de elevados volúmenes de agua, como consecuencia de los notables consumos en la etapa de enjuague; en la generación de residuos muy diversos (metales pesados, aniones, ácidos y álcalis, tensoactivos, aceites y grasas, solventes, disolventes, resinas, compuestos orgánicos volátiles) y un volumen importante de envases.

2.- PRINCIPALES OPERACIONES EN EL SECTOR DE RECUBRIMIENTOS METÁLICOS

En el sector de Recubrimientos Metálicos se distinguen tres tipos de procesos:

- Galvanizado en caliente
- Recubrimientos electrolíticos
- Recubrimientos químicos

El esquema productivo es similar en los tres tipos de procesos (Fig. 1) y existen etapas u operaciones comunes a los tres:

A) Desengrase

El desengrase es una operación de limpieza necesaria con las piezas que van a ser tratadas, ya que en éstas puede haber aceites y grasas en su superficie como consecuencia de un mecanizado anterior. La eliminación de estas impurezas se realiza empleando distintos compuestos químicos, como álcalis, silicatos, emulsionantes, tensoactivos o disolventes orgánicos.

B) Lavado

El lavado tiene como objetivo la eliminación de restos de las soluciones adheridas a las piezas en el proceso previo de desengrase. Generalmente, se realiza por inmersión de las piezas en agua o soluciones diluidas de compuestos químicos. También se usan lavados por aspersión.

C) Decapado

Esta operación permite preparar la superficie de las piezas metálicas eliminando los óxidos y el sarro del metal mediante el empleo de reactivos químicos. Estos compuestos se forman como consecuencia del contacto de la pieza lavada con el oxígeno atmosférico. Se realiza mediante inmersión de las piezas en solución acuosa en medio ácido (ácido sulfúrico, nítrico, fosfórico o clorhídrico). También se puede realizar en medio básico, dependiendo del tipo de productos a eliminar de las piezas y de la naturaleza de la siguiente operación.

D) Recubrimiento metálico

- **Galvanizado en caliente**: Previamente a la galvanización es necesario el **mordentado** ya que es imprescindible para disolver y absorber cualquier resto de impurezas que queden sobre la superficie metálica, garantizando la limpieza

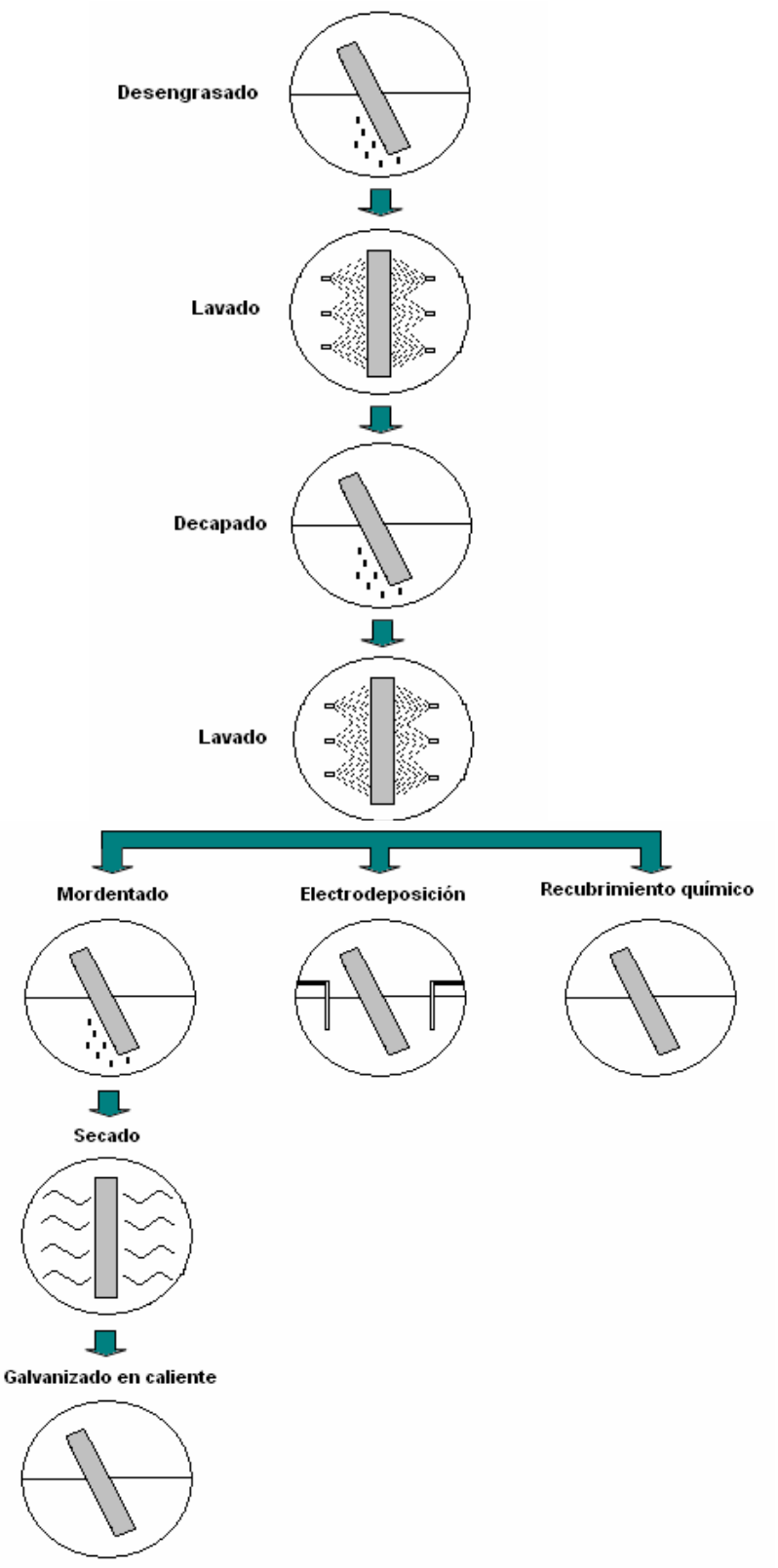


Figura 1.- Etapas de los distintos procesos de recubrimientos metálicos

de la superficie de hierro o acero que se pone en contacto con el zinc fundido. Se utilizan mordientes a base de cloruro de zinc y cloruro de amonio. El galvanizado en caliente es una técnica empleada para proteger las superficies metálicas de la corrosión mediante la inmersión de las piezas en un baño de zinc fundido a una temperatura variable entre los 445º y 460º C.

- **Recubrimiento electrolítico o galvanotecnia**: Este tratamiento, también denominado electrodeposición, consiste en depositar un metal sobre una superficie sumergiendo las piezas en un baño electrolítico, de manera que los iones metálicos disueltos se reducen recubriendo las piezas decapadas. Puede realizarse sobre acero o aluminio y también en materiales plásticos.
- **Recubrimiento químico**: Consiste en la deposición de metal sin fuente externa de corriente eléctrica. Los electrones para la reducción de los iones metálicos los suministra un reductor contenido en el electrolito.

3.- CONTAMINACIÓN DE LAS AGUAS POR ACTIVIDADES DE RECUBRIMIENTOS METÁLICOS

La contaminación de las aguas es el aspecto medioambiental más importante de las actividades de tratamiento y revestimiento de metales. Esta contaminación se debe fundamentalmente al vaciado de los baños de procesos agotados o contaminados y a las funciones de enjuague de las piezas entre baños de proceso consecutivos y en muchos casos al finalizar el mismo, dado que se produce un arrastre de los reactivos del baño al quedar depositados sobre la pieza.

Por término medio, una planta de recubrimientos metálicos produce un volumen de 2.000 m^3/día.

Las principales materias primas utilizadas en las actividades de recubrimientos metálicos son las propias piezas a recubrir y los productos químicos empleados en la formulación de los baños de pretratamiento y recubrimiento de las piezas.

La cantidad de productos químicos empleados en estas industrias es muy variable y dependen del material a recubrir, la tecnología utilizada y el producto final que se desea obtener. En la tabla 1 se muestran los productos químicos usados en los baños de chapado más habituales.

BAÑO	FÓRMULA DEL BAÑO
Níquel	300 gr/l sulfato de níquel + 60 gr/l cloruro de níquel + 45 gr/l ácido bórico
Cromo	397 gr/l ácido crômico + 4 gr/l ácido sulfúrico
Cobre (ácido)	202 gr/l sulfato de cobre + 49 gr/l ácido sulfúrico
Cobre (cianuro)	22 gr/l cianuro de cobre + 34 gr/l cianuro sódico + 15 gr/l carbonato sódico
Cobre (pirofosfato)	30 gr/l cobre + 217 gr/l pirofosfato sódico + 4% amonia
Cadmio	26 gr/l óxido de cádmio + 109 gr/l cianuro sódico
Zinc	60 gr/l cianuro de zinz + 42 gr/l cianuro de sódio + 75 gr/l hidróxido sódico
Bronce	30 gr/l cianuro de cobre + 9 gr/l cianuro de Zinc + 56 gr/l cianuro sódico + 30 gr/l carbonato sódico
Lata (alcalina)	120 gr/l estanato sódico+ 7gr/l hidróxido sódico + 15 gr/l acetato sódico
Plata (cianuro)	30 gr/l cianuro de plata + 30 gr/L cianuro sódico + 45 gr/l carbonato sódico

Tabla 1: Productos químicos más habituales usados en los baños de chapado.

Los baños de oro y otros metales preciosos constituyen un volumen pequeño del total de baños de chapado, sin embargo el tratamiento de sus aguas residuales, fundamentalmente encaminados a la recuperación de los valiosos metales presentes en los vertidos, resulta de gran importancia para mantener la viabilidad económica del proceso.

Los reactivos más frecuentes son:

- Ácidos: clorhídrico, sulfúrico, fosfórico, bórico, nítrico, etc.
- Álcalis: hidróxido sódico, hidróxido potásico, amoniaco, etc.
- Sales metálicas ácidas y alcalinas: sulfatos, carbonatos, fosfatos, cloruros, cianuros, etc.
- Óxidos metálicos.
- Disolventes.
- Tensoactivos.
- Productos auxiliares: humectantes, enmascarantes, inhibidores, abrillantadores, etc.

La mayoría de estos productos son sustancias peligrosas, tóxicas, persistentes y bioacumulables, lo que supone unas estrictas medidas de seguridad e higiene en el trabajo, dada la cantidad de productos manipulados.

Los procesos de recubrimiento metálico generan dos tipos de efluentes principales:

- Efluentes discontinuos y muy concentrados (elevada carga contaminante en volúmenes relativamente pequeños) procedentes del vaciado de baños de proceso agotados.
- Efluentes continuos y muy diluidos (poca carga contaminante en grandes caudales de agua) procedentes de los enjuagues o lavados de piezas entre etapas consecutivas y en algunos casos al final del proceso.

Es importante señalar la conveniencia, siempre que sea posible, de tratar estos efluentes por separado pues esto permite seleccionar el método de tratamiento más adecuado en función de las características del vertido.

Desde el punto de vista de su composición cualitativa, la naturaleza de los contaminantes presentes en las aguas de proceso es muy diversa ya que provienen de una gran variedad de operaciones (Fig. 2).

Los componentes más importantes de los efluentes de estas actividades son.

- Metales tóxicos pesados
- Cianuros
- Fluoruros
- Otros iones (cloruros, sulfatos, fosfatos, nitratos)
- Compuestos organoestánnicos
- Fenoles
- Compuestos organoclorados, cloro e hipoclorito
- Hidrocarburos aromáticos policíclicos
- Contaminantes orgánicos persistentes
- Surfactantes y agentes complejantes

También son importantes los aceites y grasas procedentes de la limpieza de las piezas tratadas.

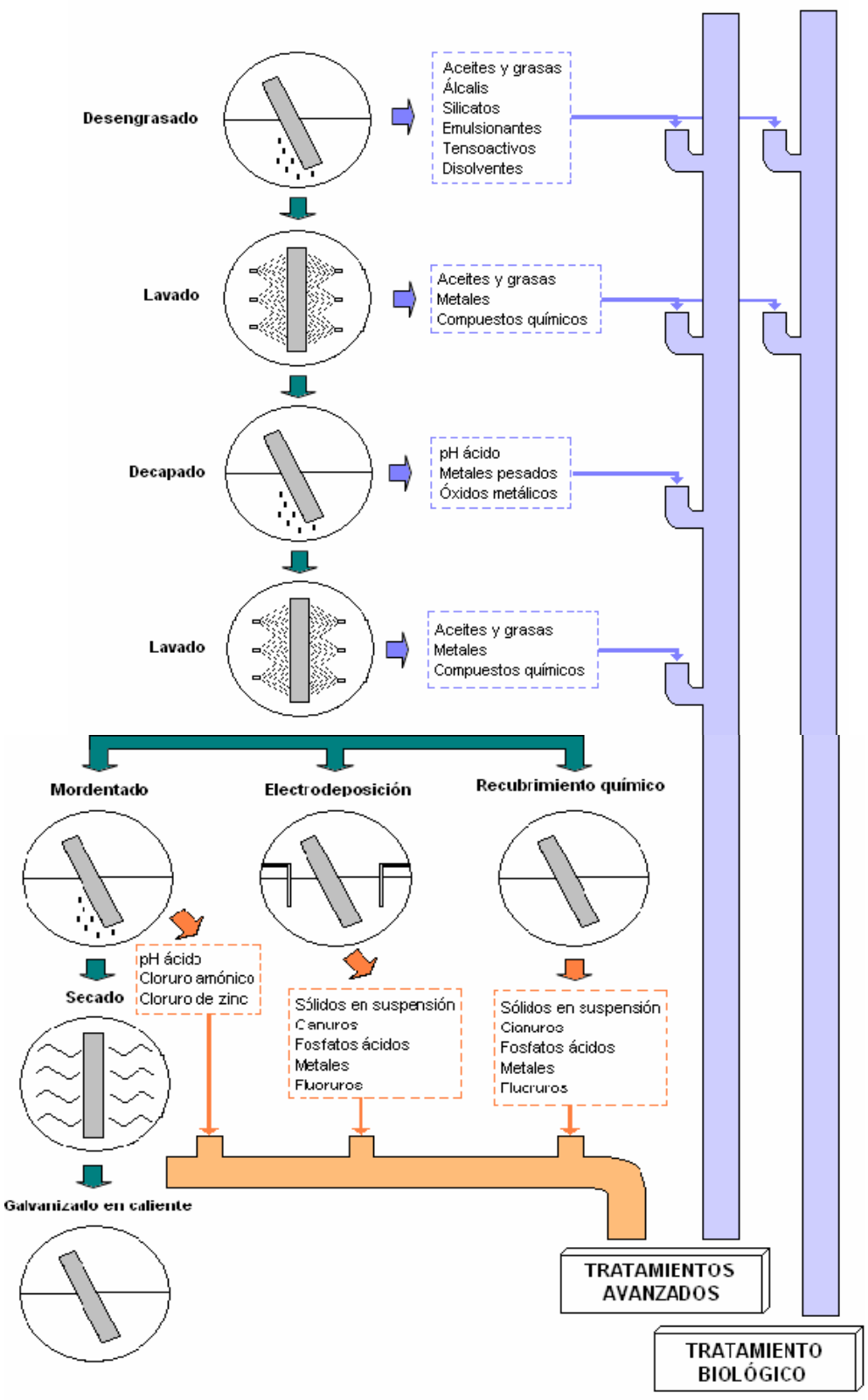


Figura 2.- Generación de aguas residuales en cada una de las etapas del proceso de recubrimiento metálico

La diferente naturaleza de los compuestos empleados hace conveniente, además, tratar de forma separa las aguas originadas en las distintas operaciones del proceso. De este modo los efluentes que presentan alto contenido de materia orgánica y pocos metales, como es el caso de los efluentes del desengrasado, pueden ser tratados de manera óptima mediante un proceso biológico de oxidación. Por el contrario, aquellos que presentan alto contenido en metales y bajo en materia orgánica, como los efluentes del decapado y los baños de recubrimiento, necesitan otro tipo de tratamientos más complejo.

La segregación de aguas residuales, en función de su origen y por tanto de la naturaleza de su contenido, conlleva la ventaja adicional de poder dirigir su tratamiento hacia la eliminación o valorización de los residuos. Resulta especialmente interesante la recuperación de los residuos de efluentes con alto contenido metálico, siendo fundamental en el caso de metales con alto valor añadido.

Los principales compuestos contaminantes en aguas residuales industriales del sector de recubrimientos metálicos, según *The European Pollution Emission Register*, se muestran en las tablas 2 y 3.

Compuesto	Metal tóxico pesado	Residuo peligroso
Arsénico y sus compuestos	**X**	
Cadmio y sus compuestos	**X**	
Cromo y sus compuestos	**X**	
Cobre y sus compuestos	**X**	
Cianuros		
Fluoruros		
Plomo y sus compuestos	**X**	
Mercurio y sus compuestos	**X**	
Níquel y sus compuestos	**X**	
Titanio y sus compuestos	**X**	**X**
Zinc y sus compuestos	**X**	
Fósforo (Total P)		
PM10 *		

* PM10: partículas de tamaño menor a 10 µm.

Tabla 2.- Principales compuestos contaminantes inorgánicos

Compuesto		Residuo peligroso
Benceno, Tolueno, Etilbenceno, Xileno	BTEX	**X**
Compuestos organoestánnicos		
Fenoles		
Hidrocarburos aromáticos policíclicos	PAH	**X**
Dioxinas y furanos		**X**
Pentaclorofenol	PCP	**X**
Tetracloroetileno	PER	**X**
Tricloroetileno	TRI	**X**
Carbono Orgánico Total	COT/TOC	
Compuestos orgánicos halogenados	AOX	
COV's sin metano	NMVOC	

Tabla 3.- Principales compuestos contaminantes orgánicos

4.- OBJETIVO DEL INFORME

Teniendo en cuenta

- ☑ que a diferencia de las aguas residuales domésticas, los efluentes industriales contienen con frecuencia sustancias que no se eliminan mediante un tratamiento convencional, bien por estar en concentraciones elevadas, o bien por su naturaleza química (muchos de los compuestos orgánicos e inorgánicos que se han identificado en aguas residuales industriales son objeto de regulación especial debido a su toxicidad o a sus efectos biológicos a largo plazo),
- ☑ que la tendencia en Europa y, por tanto en España, especialmente tras la promulgación de la Ley 16/2002 (BOE nº 157 de 2 de julio de 2002) de prevención y control integrado de la contaminación y la puesta en marcha del EPER-España (Registro Estatal de Emisiones y Fuentes Contaminantes), es

reducir el vertido de algunos contaminantes específicos y emplear sistemas avanzados de tratamiento de aguas residuales “in situ”,

- ☑ y que entre esos sistemas avanzados de tratamiento destacan las **tecnologías de membranas** (las membranas son barreras físicas semipermeables que separan dos fases, impidiendo su íntimo contacto y restringiendo el moviendo de las moléculas a través de ella, de forma selectiva, lo que permite la separación de las sustancias contaminantes del agua, generando un efluente acuoso depurado),

el objetivo de la VT es:

Detectar qué tecnologías de membranas son las efectivas para el tratamiento “*in situ*” de las aguas residuales producidas por las industrias que realizan actividades relacionadas con los recubrimientos metálicos, con vistas a su reutilización dentro de la misma línea de producción o para otros usos no industriales.

Este estudio se centra en conseguir agua de calidad, que permita su reutilización, por lo que no se hace referencia al tratamiento de los lodos o efluentes de residuos concentrados resultantes de las operaciones de depuración de las aguas residuales industriales. Estos requerirán tratamientos posteriores que permitan la recuperación de compuestos valiosos, su reutilización, valorización o eliminación sin riesgo para el medio ambiente.

5.- TECNOLOGÍAS EMERGENTES PARA EL TRATAMIENTO DE LAS AGUAS RESIDUALES PRODUCIDAS POR ACTIVIDADES DE RECUBRIMIENTOS METÁLICOS

Como ya se ha comentado, la producción de aguas residuales con una elevada carga contaminante y tóxica constituye el principal problema medioambiental de las industrias del sector.

A diferencia de las aguas residuales domésticas, los efluentes industriales contienen con frecuencia sustancias que no se eliminan mediante un tratamiento convencional, bien por estar en concentraciones elevadas, o bien por su naturaleza química. Los tratamientos convencionales son técnicas de tratamiento con larga tradición, mejoradas en su diseño a los largo de los años, pero que no han dejado de se técnicas imprescindibles a la hora de tratar aguas.

Muchos de los compuestos orgánicos e inorgánicos que se han identificado en aguas residuales industriales son objeto de regulación especial debido a su toxicidad o a sus efectos biológicos a largo plazo.

La tendencia en Europa y, por tanto en España, especialmente tras la promulgación de la Ley 16/2002 (BOE nº 157 de 2 de julio de 2002) de prevención y control integrado de la contaminación y la puesta en marcha del EPER-España (Registro Estatal de Emisiones y Fuentes Contaminantes), es reducir el vertido de algunos contaminantes específicos y emplear sistemas avanzados de tratamiento de aguas residuales "in situ".

Entre esos sistemas avanzados de tratamiento destaca las ***tecnologías de membranas***.

Las membranas son barreras físicas semipermeables que separan dos fases, impidiendo su íntimo contacto y restringiendo el movimiento de las moléculas a través de ella, de forma selectiva. Este hecho permite la separación de las sustancias contaminantes del agua, generando un efluente acuoso depurado.

La rápida expansión, a partir de 1960, de la utilización de membranas en procesos de separación a escala industrial ha sido propiciada por dos hechos: la fabricación de membranas con capacidad para proporcionar elevados flujos de permeado y la fabricación de dispositivos compactos, baratos y fácilmente intercambiables donde disponer grandes superficies de membrana.

Las características de los procesos de separación con membranas son:

- Permiten la separación de contaminantes que se encuentran disueltos (iones, moléculas, macromoléculas) o dispersos en forma coloidal
- Eliminan contaminantes que se encuentran a baja concentración
- Las operaciones se llevan a cabo a temperatura ambiente
- Procesos sencillos y diseños compactos que ocupan poco espacio
- Pueden combinarse con otros tratamientos
- No eliminan realmente el contaminante, únicamente los concentran en otra fase
- Pueden darse el caso de incompatibilidades entre el contaminante y la membrana

- Problemas de ensuciamiento de la membrana: necesidad de otras sustancias para llevar a cabo la limpieza, ajustes de pH, ciclos de parada para limpieza del equipo

Las membranas se pueden fabricar con materiales poliméricos, cerámicos o metálicos, y en forma de láminas planas, tubulares o del tipo denominado fibra hueca (estructuras capilares).

El desarrollo de materiales para la fabricación de membranas, que permitan separaciones eficientes, y su disposición en configuraciones o módulos de fácil instalación y sustitución, que puedan agruparse para conseguir superficies filtrantes de centenas o millares de m^2 han sido los hechos que han condicionada la utilización de membranas a escala industrial.

Las tecnologías de membranas más recomendadas para el tratamiento de aguas residuales producidas por las industrias del sector de Recubrimientos Metálicos son:

- Ultrafiltración
- Ósmosis inversa
- Electrodiálisis
- Reactores Biológicos de Membrana

Ultrafiltración (UF)

En esta tecnología las membranas actúan como tamices moleculares, es decir, producen la separación mecánica de partículas mediante un tamiz.

La ultrafiltración utiliza diferencias de presión transmembrana de 100 - 800 kPa, con un intervalo de tamaño de poro de 10 Å – 1.000 Å, pudiendo realizar separaciones de microsolutos como coloides y macromoléculas.

La duración media de las membranas de ultrafiltración es del orden de 2 – 3 años. Las membranas se suelen disponer en módulos de tipo placa-bastidor, tubulares, de membrana enrollada en espiral o de tipo fibra hueca. Los menores costes de los módulos membrana enrollada en espiral o de tipo fibra hueca han desplazado a las demás configuraciones.

La eliminación de las sustancias que habitualmente ensucian las membranas de ultrafiltración (restos de dispersiones coloidales y materiales gelatinosos), se lleva a cabo mediante ciclos de limpieza con una frecuencia y duración que dependerá de la

operación de separación que se esté llevando a cabo. Las etapas de un ciclo de limpieza estándar podrían ser:

a) enjuagados de las membranas con agua caliente y alta velocidad de flujo
b) lavado con ácido o base, dependiendo de la naturaleza de la membrana
c) lavado del sistema con un detergente en caliente
d) enjuagado del sistema con agua para eliminar los restos de detergente

Los costes de capital y de operación de *UF*, son todavía demasiado altos para que pueda aplicarse como única tecnología de tratamiento de grandes caudales de agua residual, pero sí tiene ya un importante campo de aplicación, en combinación con otras tecnologías, como es el caso de los reactores biológicos de membrana utilizados en depuración de aguas residuales urbanas, o como pretratamiento en los procesos de ósmosis inversa.

Como única tecnología se utiliza en el tratamiento de efluentes de aguas residuales de 2.5 – 25 m^3/día, sobre todo en aquellos casos como el tratamiento del agua caliente y recuperación de proteínas en la industria de la alimentación; recuperación de partículas de pintura del agua de los procesos de pintado de piezas industriales; recuperación de polímeros sintéticos en la industria textil; ruptura de emulsiones y recuperación de aceites presentes en las aguas de proceso de la industria metalúrgica, etc.; donde se plantea el doble objetivo de recuperar un producto valioso y/o reutilizar el agua. También se utiliza en el tratamiento físico-químico de aguas residuales, concretamente en la separación de sólidos tras la neutralización-precipitación, en sustitución del sedimentador (por ejemplo, se alcanzan niveles de concentración de niquel en el agua tratada inferiores a 0,1 mg/L, frente a 0.5 mg/L en un sedimentador).

Ósmosis inversa (OI)

El proceso de *RO* consiste en generar, mediante una membrana permeable al agua, una solución acuosa con bajo contenido en sal a partir de otra con alto contenido en sal. Es la tecnología utilizada para producir agua desalada a partir de agua de mar.

Igual que en *UF*, la causa que genera la fuerza impulsora para lograr la separación es una diferencia de presión transmembrana. Sin embargo, en la *OI* el proceso de separación se debe a las diferentes solubilidad y difusividad en la membrana de los componentes de la solución acuosa. Los valores de operación de la diferencia de

presión transmembrana y concentración de la solución son 7 – 70 bar y 200 – 30.000 ppm, respectivamente.

La ósmosis es el proceso que tiene lugar cuando una membrana, con permeabilidad selectiva al agua, separa dos soluciones salinas acuosas de distinta concentración, que se encuentran a la misma presión y temperatura. De forma natural el agua pasa (Fig. 3.A) de la solución más diluida a la más concentrada a través de la membrana. El fenómeno cesa (Fig. 3.B) cuando el aumento de presión hidrostática, en el lado de la membrana de la solución más concentrada, supone una resistencia suficiente para impedir el paso del agua proveniente de la solución diluida. La diferencia de presión entre las dos soluciones cuando se alcanza este estado de equilibrio se denomina diferencia de presión osmótica transmembrana ($\Delta\pi$). Si lo que se pretende es invertir el flujo de agua generado por la ósmosis (Fig. 3.C), es necesario aplicar, en el lado de la solución concentrada, una presión que origine una diferencia de presión transmembrana (Δp) superior a la presión osmótica. De esta forma se logra que el flujo de agua sea en el sentido de la solución concentrada a la solución diluida (*OI*), obteniéndose agua desalada a partir de soluciones acuosas salinas, de calidad suficiente para ser utilizada en el consumo humano o en otras aplicaciones.

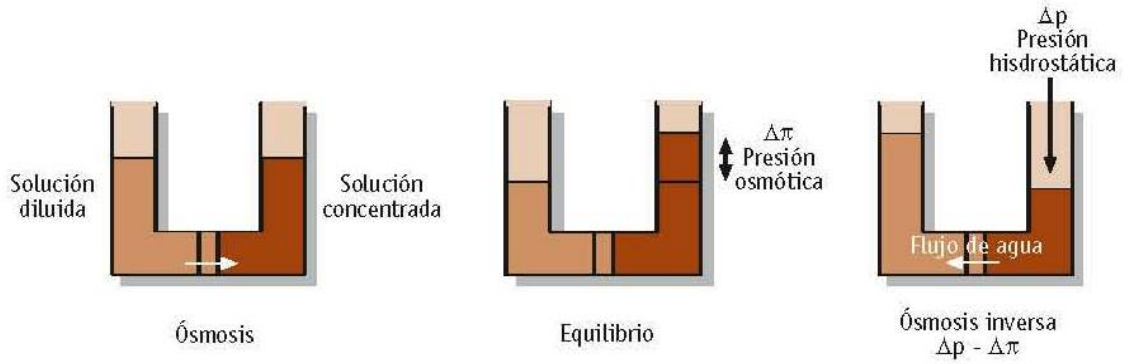


Figura 3. – Ósmosis inversa. (*Rodríguez Fernández-Alba et al, 2006*)

En *OI* se utilizan membranas densas, anisótropas, en configuraciones del tipo módulos enrollados en espiral, de 20 cm – 30 cm de diámetro y 100 - 150 cm de largo; que se disponen en número de 5 – 7 en el interior de carcasas de plástico reforzadas con fibra de vidrio. También se utilizan membranas del tipo fibra hueca, de 100 μm de diámetro, dispuestas en módulos que contienen 1.000 unidades.

La elección del tipo de membranas dependerá de las características del agua a tratar, ya que las configuraciones con membranas tipo fibra hueca presentan mayores problemas de ensuciamiento que las configuraciones tipo enrollamiento en espiral.

El ensuciamiento es la causa más importante del mal funcionamiento de las membranas. Las causas más frecuentes del ensuciamiento son debidas a:

a) Depósitos en la superficie de la membrana de costras o escamas de carbonato cálcico, sulfato cálcico, silicatos complejos, sulfato de bario, sulfato de estroncio, fluoruro cálcico, etc., dependiendo de la composición de la alimentación y como consecuencia de que las concentraciones de sal en el concentrado puedan sobrepasar el producto de solubilidad de la sal.

b) Sedimentos de partículas como coloides, productos de la corrosión del hierro de las conducciones, precipitados de hidróxido de hierro, algas, etc.

c) Bioensuciamiento debido al crecimiento de microorganismos en la superficie de la membrana, ya que algunos materiales de las membranas, como acetato de celulosa o poliamidas, pueden ser un sustrato utilizable por los microorganismos.

d) Ensuciamiento debido a compuestos orgánicos como aceites o grasas presentes en las aguas residuales industriales.

La forma de limpieza de las membranas estará en función de las características del agua de alimentación, del tipo de membrana y de la naturaleza del ensuciamiento. Como pauta general se puede proceder a alternar periodos de enjuagado de las membranas, haciendo circular las soluciones limpiadoras a alta velocidad por la superficie de las membranas, con periodos donde las membranas queden sumergidas en las soluciones limpiadoras.

Los agentes de limpieza habitualmente utilizados son:

- Ácidos clorhídrico, fosfórico o cítrico y agentes quelantes como EDTA, para eliminar las costras de precipitados salinos, y ácido oxálico para eliminar los sedimentos de hierro.
- Álcalis combinados con surfactantes para eliminar microorganismos, sedimentos y compuestos orgánicos
- Esterilización de las membranas con soluciones de cloro para eliminar microorganismos.

Las sucesivas limpiezas terminan por degradar las membranas. Dependiendo de la aplicación, el periodo de vida garantizado por el fabricante suele ser de 1 – 2 años.

Con un buen programa de limpieza la vida de las membranas se puede prolongar hasta 3 años, siendo improbables periodos de vida de 5 años.

En el tratamiento de aguas residuales la aplicación de ósmosis inversa está limitada por los altos costes de operación debido a los problemas de ensuciamiento de las membranas.

En el caso de las aguas residuales industriales, la OI se utiliza en aquellas industrias donde es posible mejorar la economía del proceso mediante la recuperación de componentes valiosos que puedan volver a reciclarse en el proceso de producción (industrias de galvanoplastia y de pintura de estructuras metálicas), o donde la reutilización del agua tratada signifique una reducción importante del consumo de agua (industria textil). En el tratamiento de aguas en galvanoplastia la combinación UF-OI se utiliza como tecnología de “descarga cero”. El agua obtenida como permeado en la OI se reutiliza como agua de proceso.

Electrodiálisis (ED)

Los procesos de separación basados en la electrodiálisis utilizan membranas donde se han incorporado grupos con cargas eléctricas, con el fin de restringir el paso de los iones presentes en una solución acuosa. En estos procesos la “fuerza impulsora” responsable del flujo de los iones, a través de la membrana, es una diferencia de potencial eléctrico.

Un equipo de electrodiálisis está formado por un conjunto de membranas aniónicas y catiónicas, dispuestas en forma alterna y separadas por espaciadores o placas, en una configuración semejante a los filtros prensa (configuración de placas y bastidores). Los espaciadores provocan turbulencias que evitan las deposiciones de materiales en la superficie de las membranas y homogeneizan la concentración. En la figura 4 se muestra un esquema de esta disposición.

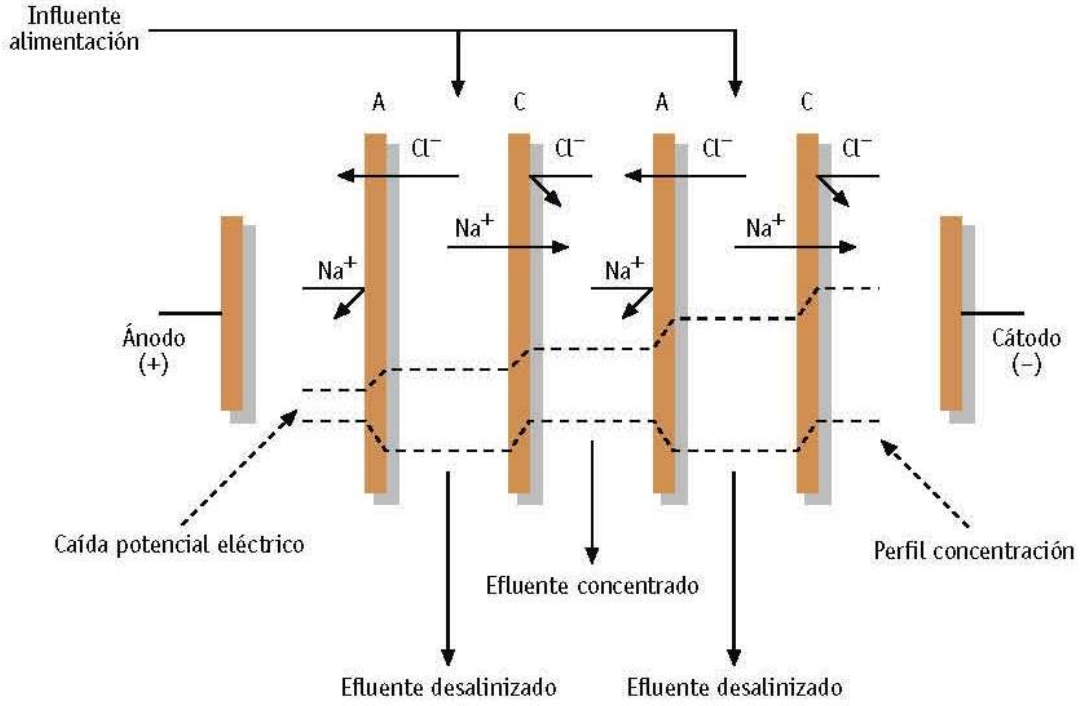


Figura 4.- Equipo de electrodiálisis. (*Rodríguez Fernández-Alba et al, 2006*)

El agua que se desea tratar se hace fluir en dirección longitudinal a las membranas, y el campo eléctrico creado por la diferencia de potencial provoca un flujo transversal de los iones positivos hacia el cátodo y de los iones negativos hacia el ánodo. Las membranas aniónicas, que se encuentran cargadas positivamente, permiten el paso de los iones negativos e impiden el de los positivos, de forma semejante las membranas catiónicas, que se encuentran cargadas negativamente, permiten únicamente el paso de los iones positivos. El número de celdas (parejas de membranas aniónicas y cationicas) que se disponen en los equipos de electrodiálisis es variable y generalmente superior a 100.

De esta forma, y debido a la alternancia de membranas catiónicas y aniónicas, el influente acuoso que se desea tratar se separa en dos efluentes, uno de ellos con una alta concentración de sal (concentrado) y el otro desalinizado.

La caída de potencial en cada celda es de 1 – 2 V y los valores de la densidad de corriente del orden de 40 mA/cm^2. Para un equipo estandar de 200 celdas, con 1 m^2 de superficie de membrana, la diferencia de potencial es de 200 – 400 V y la intensidad de corriente de 400 A.

La electrodiálisis necesita energía eléctrica continua, por ello la economía del proceso se basa en optimizar la energía eléctrica consumida en la separación del concentrado y el efluente desalinizado.

Las aplicaciones más importantes de la electrodiálisis son la desalinización de las aguas salobres y la producción de salmueras, con una incipiente presencia en la industria de la alimentación y en el tratamiento de agua industriales.

En el tratamiento de las aguas industriales, la electrodiálisis se emplea en la recuperación de ácidos de los baños de decapado y en la eliminación de metales pesados de las aguas de los procesos de galvanoplastia.

Reactores biológicos de membranas (MBR)

Los sistemas de tratamiento denominados *MBR* son consecuencia del desarrollo alcanzado en la tecnología de fabricación y en las aplicaciones de las membranas en los últimos 30 años.

Un *MBR* es un sistema biológico de tratamiento de agua residual, donde la membrana es el límite físico que separa la zona donde se produce la degradación biológica de los contaminantes y la zona del agua tratada, libre de contaminantes y microorganismos.

Las membranas puede estar dispuestas en el interior del reactor biológico (configuraciones con membranas sumergidas o integradas), en cuyo caso el efluente del reactor es el agua depurada (Fig. 5), o en su exterior (configuraciones con membranas externas o con recirculación), en cuyo caso el efluente del reactor se hace circular hasta una unidad de ultrafiltración con el fin de separar el agua depurada del concentrado (Fig. 6), recirculando éste al reactor. Los diseños con membranas sumergidas, al no tener que recircular grandes volúmenes de agua, consumen menos energía que los diseños con recirculación, sin embargo éstos son menos complejos de funcionamiento y pueden presentar ventajas en el tratamiento de aguas residuales a alta temperatura, altos valores de pH, alta carga orgánica y alta toxicidad.

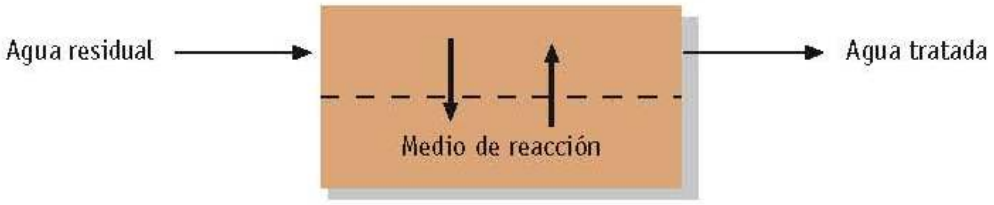


Figura 5.- Membrana dispuesta en el interior del reactor biológico. (*Rodríguez Fernández-Alba et al, 2006*)

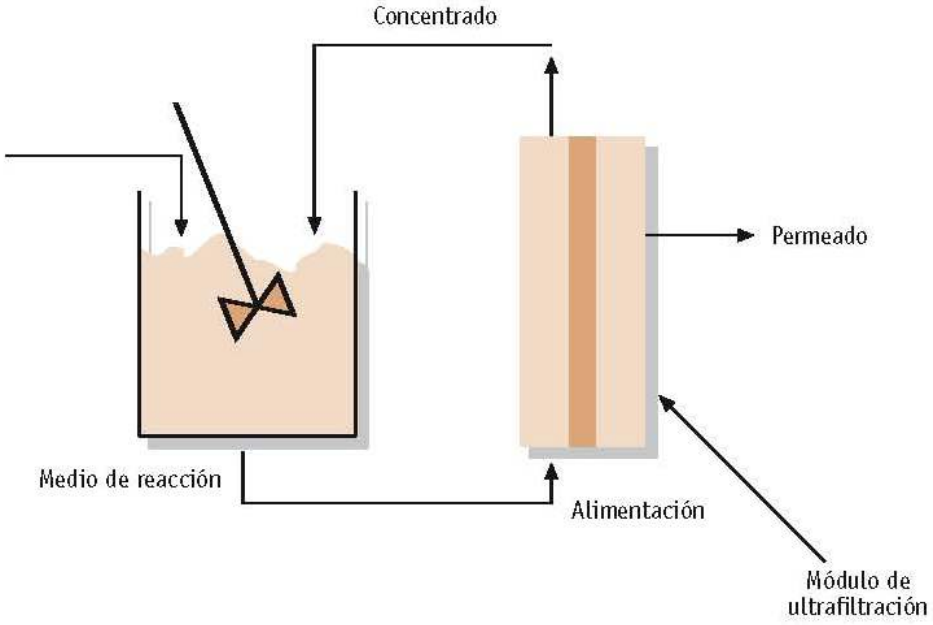


Figura 6.- Unidad de ultrafiltración. (*Rodríguez Fernández-Alba et al, 2006*)

Los *MBR* se utilizan en el tratamiento de aguas residuales industriales, urbanas y municipales con características especiales. Estos reactores pueden proporcionar un agua de calidad suficiente para cumplir los límites de vertido o bien ser apta para un tratamiento posterior que permita su reutilización. En la Tabla 4 se indican el grado de utilización de *MBR* en el tratamiento de aguas residuales industriales en Estados Unidos.

A diferencia de los sistemas biológicos aerobios tradicionales, los *MBR* actúan con concentraciones mayores de microorganismos: 10 g/l – 20 g/l y hasta 35 g/L en aplicaciones especiales como el tratamiento de lixiviados de vertedero de RSUs frente a los 3 g/l de los sistemas aerobios convencionales, y tiempos de retención de sólidos mayores. Como consecuencia la producción de fangos es menor y permiten el crecimiento de una mayor diversidad de microorganismos, ampliándose las posibilidades de degradación de la materia orgánica compleja y refractaria. Además,

se necesita menos terreno para la instalación de la planta de tratamiento, hecho importante en el caso de instalaciones en terreno urbano, y un menor tiempo de puesta en marcha del proceso.

origen del agua residual	Nº de plantas	capacidad de tratamiento (m^3/día)
Industrias de alimentación y bebidas	10	170 – 18.925
Plantas químicas	7	19 - 500
Industrias de automoción	5	114 – 8.706
Fabricación de fibra de vidrio	2	80 – 871
Industria metalúrgica	1	227
Industrias de alimentos perecederos	1	908
Lixiviados de vertederos controlados	1	114
Industria electrónica	1	1
Industria farmacéutica	1	72
Otras	10	19 – 3.785
TOTAL	39	

Tabla 4.- Características de la aplicación de MBR en EEUU

El interés de este documento se centra en el estudio de las tecnologías de tratamiento de efluentes industriales procedentes de procesos de recubrimientos metálicos, con el objetivo de reducir el vertido de determinados contaminantes y emplear sistemas de tratamiento de aguas residuales "*in situ*", que permitan alcanzar un vertido final cuya carga contaminante sea respetuosa con el medio ambiente. Tal es el caso de las tecnologías de membrana.

Sin embargo es necesario mencionar la existencia de otras tecnologías desarrolladas para el tratamiento de aguas residuales, cuya aplicación, en muchas ocasiones, se ha dirigido a la recuperación de los "residuos" para su valorización. Tal es el caso de la

fotocatálisis heterogénea y la recuperación de metales preciosos como el oro y/o la plata.

Nota: Estas tecnologías se encuentran ampliamente desarrolladas en el libro “VT nº 2: Informe de vigilancia tecnológica sobre tratamientos avanzados de aguas residuales industriales”

6.- MARCO LEGISLATIVO

A) Norma General

- Directiva 2008/1/CE del Parlamento Europeo y del Consejo, de 15 de enero de 2008, relativa a la prevención y al control integrados de la contaminación (Versión codificada) (DOUE n° L 24 de 29 de enero de 2008). Esta normativa recoge a la **Directiva IPPC** (Directiva 96/61/CE del Consejo, de 24 de septiembre de 1996, relativa a la Prevención y Control Integrado de la Contaminación (DOUE nº L 257 de 10 de octubre de 1996)), incorporando todas las modificaciones posteriores que ha sufrido.
- Real Decreto 509/2007, de 20 de abril, por el que se aprueba el Reglamento para el desarrollo y ejecución de la Ley 16/2002, de 1 de julio, de prevención y control integrados de la contaminación (BOE nº 96 de 21 de abril de 2008).
- Ley 16/2002, de 1 de julio, de Prevención y Control Integrados de la Contaminación (BOE nº 157 de 2 de julio de 2002).

B) Residuos

- Orden MAM/304/2002, de 8 de febrero, por la que se publican las operaciones de valoración y eliminación de residuos y la lista europea de residuos (BOE nº 43 de 8 de febrero de 2002).
- Directiva 1999/31/CE del Consejo, de 26 de abril de 1999, relativa al vertido de residuos (DOCE nº L 182, de 16 de julio de1999).
- Ley 10/1998, de 21 de abril de Residuos (BOE nº 96 de 22 de abril de 1998).

C) Aguas

- Directiva 2006/118/CE del Parlamento Europeo y del Consejo, de 12 de diciembre de 2006, relativa a la protección de las aguas subterráneas contra la contaminación y el deterioro (DOUE nº L 372 de 27 de diciembre de 2002).

- Orden MAM/1873/2004, de 2 de junio, por la que se aprueban los modelos oficiales para la declaración de vertido y se desarrollan determinados aspectos relativos a la autorización de vertido y liquidación del canon de control de vertidos regulados en el Real Decreto 606/2003, de 23 de mayo, de reforma del Real Decreto 849/1986, de 11 de abril, por el que se aprueba el Reglamento de Dominio Público Hidráulico, que desarrolla los Títulos preliminar, I, IV, V, VI y VII de la Ley 29/1985, de 2 de agosto, de Aguas (BOE nº 147 de 18 de junio de 2004).
- Directiva 2000/60/CE del Parlamento Europeo y del consejo, de 23 de octubre de 2000, por la que se establece un marco comunitario de actuación en el ámbito de la política de aguas (DOCE nº L 327 de 22 de diciembre de 2000).

7.- FACTORES CRÍTICOS DE LA VIGILANCIA TECNOLÓGICA

La identificación de los factores críticos de vigilancia, se refiere a aquellas cuestiones externas a la organización cuya evolución es crucial para su competitividad: tecnologías emergentes, competidores actuales y potenciales, desarrollos de los mercados y del entorno.

Como ya hemos visto en el apartado 5, entre los sistemas avanzados de tratamiento de aguas residuales, en concreto de aquellas producidas por las industrias del sector de Recubrimientos Metálicos, destacan las tecnologías de membranas, de tal modo que las alternativas a investigar son las siguientes:

- Reactores Biológicos de Membrana
- Ósmosis inversa
- Ultrafiltración
- Electrodiálisis

8.- METODOLOGÍA

Para la realización del presente informe, centrado en el tratamiento de las aguas residuales producidas por las industrias del sector de Recubrimientos Metálicos - y una vez identificada la temática de la VT como la detección de las tecnologías de membrana efectivas para el tratamiento "in situ" de estas aguas – se ha acudido a una serie de fuentes de información. A la hora de seleccionar las bases de datos (fuentes de información estructuradas) se han valorado los siguientes aspectos:

- Su cobertura temática, de modo que las bases de datos elegidas contengan información sobre el tema objeto de la búsqueda.
- El tipo de información indexada en la base de datos, para saber a quién está orientada la información, investigadores, empresas, público general, etc.

8.1.- Fuentes de información utilizadas

A) Búsqueda de artículos

- ISI Web of Kwowledge (http://portal.isiknowledge.com/portal.cgi): Web of Science
- Science Direct (http://www.sciencedirect.com/)

B) Búsqueda de proyectos I+D

- CORDIS (http://cordis.europa.eu/search/index.cfm): CORDIS Search
- Ministerio de Educación y Ciencia (http://www.mec.es/) en el apartado de ciencia y Tecnología, cuyo contenido compete en la actualidad al recién creado Ministerio de Ciencia e Innovación (http://www.micinn.es/planidi/index.html)

C) Búsqueda de patentes

- ISI Web of Kwowledge (http://www.accesowok.fecyt.es/login/): DERWENT Innovations Index
- Software Matheo Patent 8.2

D) Búsqueda de ofertas tecnológicas

- IRC Network (http://www.ircnet.lu/): Technology Database
- CORDIS (http://cordis.europa.eu/marketplace/): Technology Marketplace
- yet2.com (http://www.yet2.com). Las ofertas tecnológicas identificadas a través de este buscador no estan datadas, por lo que no se han incluído en este documento.

8.2.- Ecuaciones de búsqueda

Para llevar a cabo la búsqueda de información en las bases de datos mencionadas se han seleccionado una serie de términos o palabras clave que identifican la materia objeto de estudio. Mediante la combinación de estas palabras en inglés y castellano, se han constituido las siguientes ecuaciones de búsqueda:

- MEMBRANE BIOREACTOR AND WASTEWATER
- REVERSE OSMOSIS AND WASTEWATER
- ULTRAFILTRATION AND WASTEWATER
- ELECTRODIALYSIS AND WASTEWATER

Para la selección de documentos se han considerado estas tecnologías, aplicadas a la eliminación de los compuestos más importantes que se encuentran en efluentes de procesos de recubrimientos metálicos, mencionados en el capítulo 3.

9.- ANÁLISIS

A) ARTÍCULOS

El análisis bibliométrico permite identificar las publicaciones aparecidas, en un determinado campo de investigación, en revistas y comunicaciones a congresos.

La identificación de artículos científicos se ha realizado a través de las bases de datos ISi Web of Knowledge y Science Direct.

En total, se han identificado 65 artículos publicados en el período de estudio; 21 artículos en 2006, 22 artículos en 2007 y 23 durante los primeros 4 meses de 2008. La tendencia para este último año sugiere un aumento espectacular, en el número de artículos publicados, pues probablemente duplique el de los años anteriores.

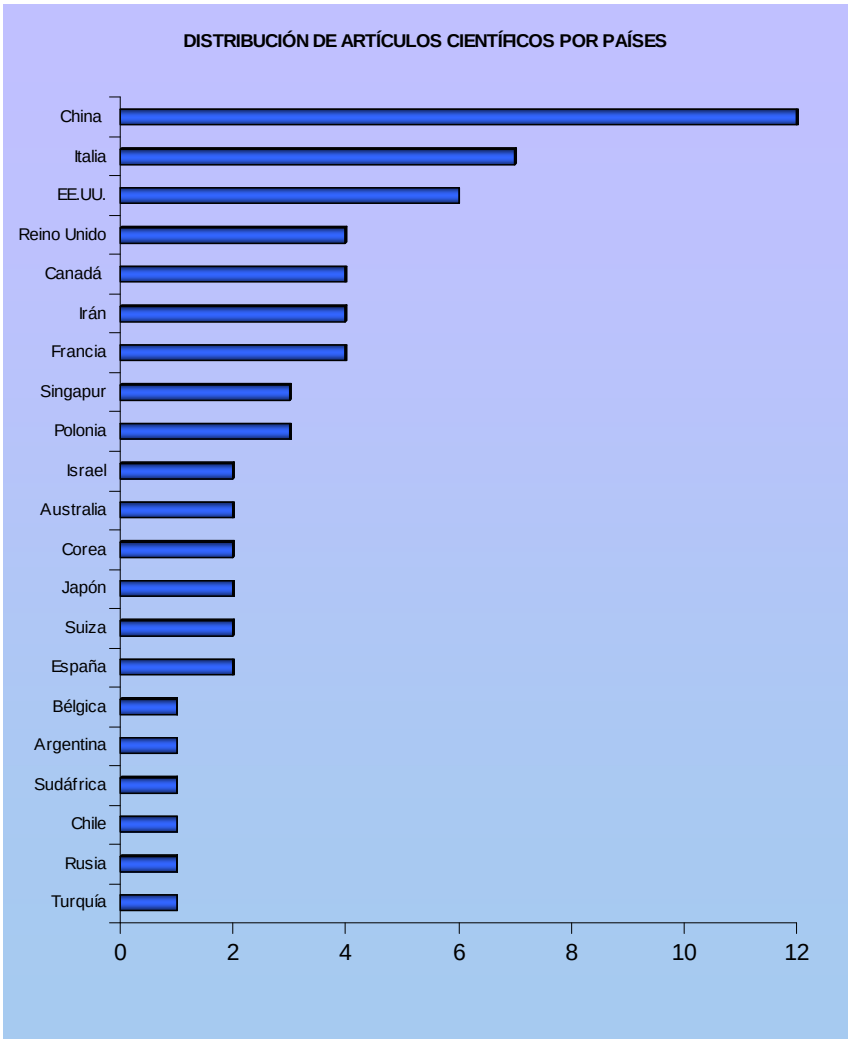


Figura 7.- Distribución de artículos científicos por países.

En la Figura 7, se puede observar que los países con más artículos científicos publicados son China, Italia y Estados Unidos, seguidos de Reino Unido, Canadá, Francia e Irán. Muchos de estos países, que se encuentran a la cabeza en el número de publicaciones pertenecen a la Unión Europea.

Agrupando los países por grandes regiones (Figura 8), destacan, por su producción científica, relativa a las tecnologías analizadas, las regiones de Europa y Asia.

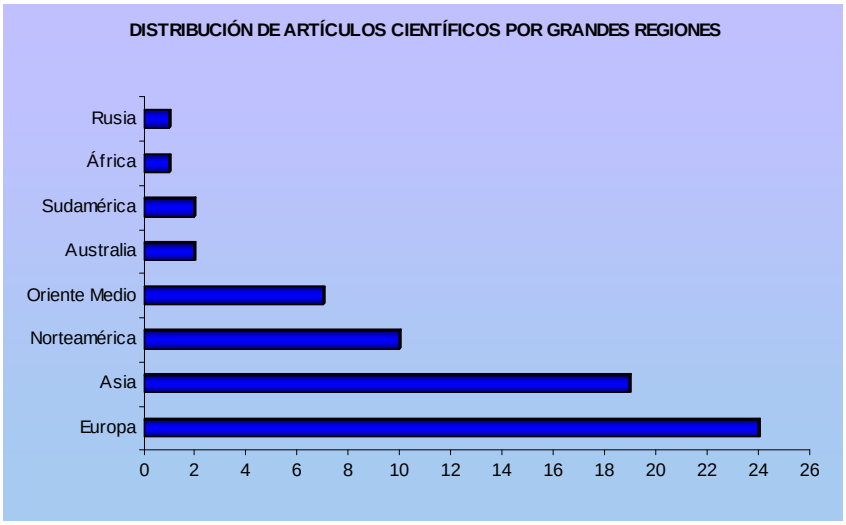


Figura 8. Distribución de artículos científicos por grandes regiones.

La Figura 9 muestra la distribución de artículos por tipo de tecnología y como se puede apreciar, la investigación está más dirigida hacia procesos con reactores biológicos de membrana.

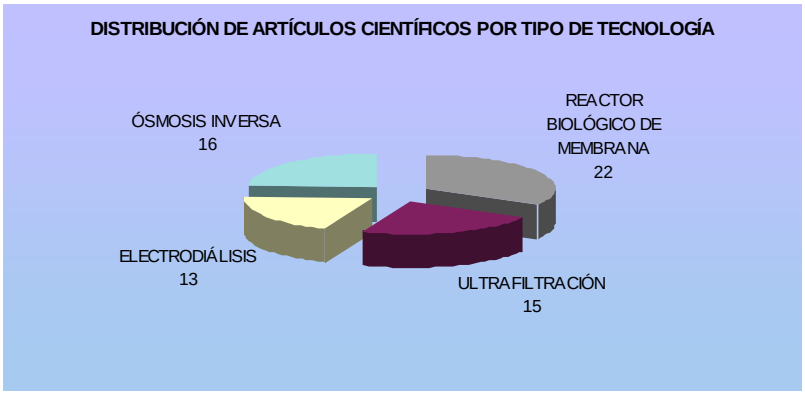


Figura 9.- Distribución de artículos científicos por tipo de tecnología.

El análisis de los países con publicaciones sobre reactores biológicos de membrana, muestra que esta línea de investigación está muy extendida, aunque el número de publicaciones en cada región es bajo. Destaca Singapur, con 3 artículos científicos sobre esta temática.

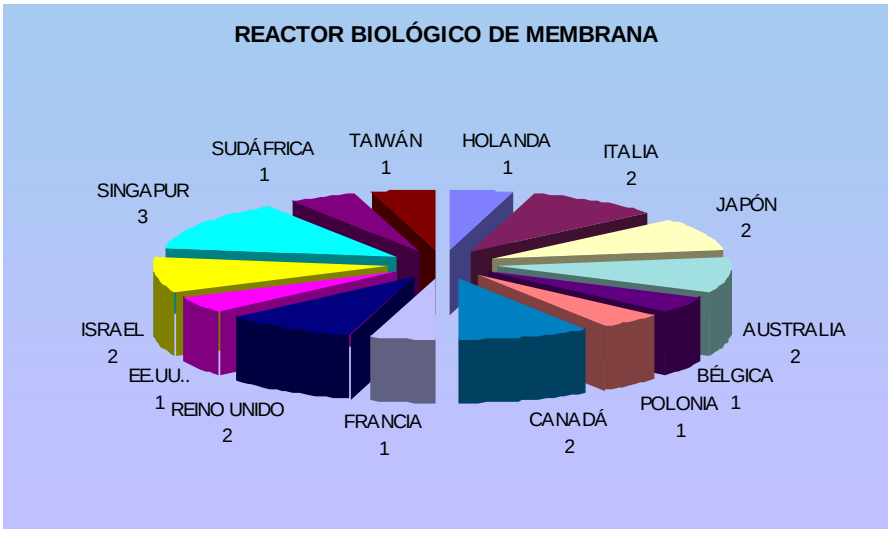


Figura 10.- Distribución por países de la investigación en reactores biológicos de membrana.

El análisis de los artículos científicos realizado, muestra que las regiones que presentan mayor interés a cerca de las tecnologías objeto de estudio son Europa y Asia. Mientras que en Europa la investigación se reparte entre varios países, encabezada por Italia, Reino Unido y Francia, en Asia las publicaciones se concentran fundamentalmente en China.

En los artículos encontrados, predominan los que tratan tecnologías basadas en reactores biológicos de membrana. Llama la atención el hecho de que esta línea de investigación se encuentra muy repartida a nivel mundial, sin embrago, cuenta con un número de artículos muy reducido en cada país (1 o 2 publicaciones). Incluso China, que presenta 12 publicaciones repartidas entre las cuatro tecnologías objeto de estudio, cuenta con una sola publicación sobre birreactores de membrana, en Taiwán.

B) PROYECTOS I+D

Los proyectos de I+D del Plan Nacional, vigentes desde el 2004, se obtuvieron de la base de datos del Ministerio de Ecuación y Ciencia y los proyectos europeos han sido localizados de la base de datos CORDIS de la Unión Europea.

1.- Plan Nacional

Se han identificado 13 proyectos vigentes, subvencionados por el Plan Nacional de I+D, que abarcan desde distintas perspectivas la investigación en el desarrollo de las tecnologías investigadas (ANEXO I). El 54 % de ellos corresponden a investigaciones en reactores biológicos de membranas.

Atendiendo a los proyectos vigentes en la actualidad, destaca el mayor número de proyectos subvencionados en 2007, con un total de 5, frente a los 4 de 2005 y de 2006. Sólo los proyectos aprobados con posterioridad al 2004, continúan siendo vigentes, pero en el análisis, se han incluido los datos de 2004 para reflejar que la tendencia no es la de aumentar, sino que se mantiene en los últimos 4 años (Figura 11).

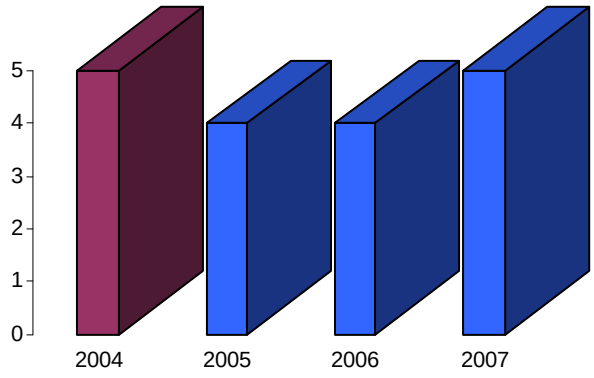


Figura 11.- Distribución de los proyectos del Plan Nacional de I+D por años. Los proyectos vigentes están representados en azul.

Por comunidades autónomas, destaca una mayor actividad investigadora en Cataluña (fundamentalmente en la Universidad Politécnica de Cataluña), seguido de la Comunidad de Madrid y Andalucía (Figura 12). La Comunidad Valenciana, Cantabria y Baleares, han contado con proyectos vigentes hasta el año pasado.

Figura 12.- Distribución de los proyectos del Plan Nacional de I+D por comunidades autónomas. Los proyectos vigentes están representados en azul.

2.- Proyectos Europeos

Se han identificado 10 proyectos europeos vigentes, con subvenciones que oscilan entre los 160.000 € y los cerca de 5.000.000 €.

El país más activo es Alemania, liderando la mitad de los proyectos (Figura 13).

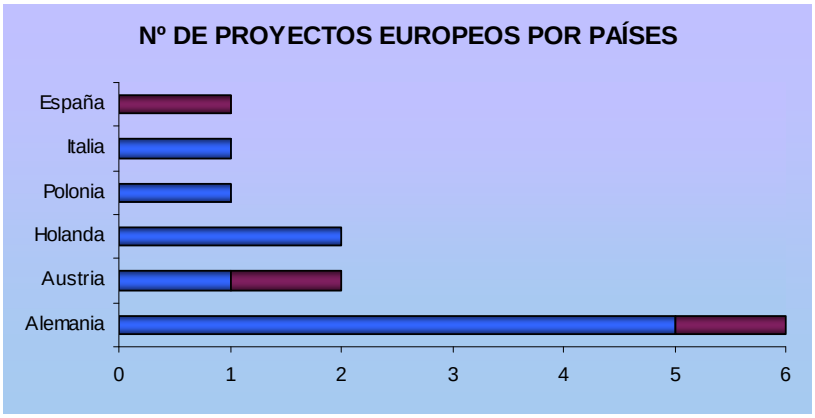


Figura 13.- Distribución de los proyectos europeos por países. Los proyectos vigentes están representados en azul.

Entre los proyectos europeos identificados, destaca INNOWATECH “Innovative and Integrated Technologies for the Treatment of Industrial Wastewater”. Este consorcio constituido por 17 socios, 16 procedentes de 8 países europeos y 1 Australiano, cuenta con una financiación cercana a los 5 millones de €.

INNOWATECH tiene la misión de investigar, evaluar y mejorar la potencialidad de las opciones tecnológicas prometedoras para el tratamiento de aguas residuales industriales, con el objetivo específico de proporcionar soluciones a medida para los usuarios atendiendo a una amplia gama de aguas residuales. Estas soluciones se basan fundamentalmente en la integración de las tecnologías investigadas y en mejoras tecnológicas con respecto a los componentes del sistema de tratamiento, funcionamiento y control.

Los objetivos del proyecto son:

- Investigar y mejorar las prestaciones de prometedoras tecnologías de tratamiento de aguas residuales industriales, como la granulación aerobia, los procesos de oxidación avanzada combinada con tratamientos biológicos, contactores de membrana y reactores químicos de membrana.
- Conseguir avances en el conocimiento fundamental y tecnológico.
- Lograr la sostenibilidad económica y ambiental de las tecnologías investigadas.
- Desarrollar soluciones a medida para los usuarios finales que operan en diferentes sectores industriales y favorecer su aplicación real para aumentar la competitividad de la industria del agua en la UE. Potenciar la transferencia del know-how a los posibles interesados y usuarios finales, dentro y fuera del ámbito del proyecto

En España, el Departamento de Química Ambiental del Instituto de Investigaciones Químicas y Ambientales de Barcelona (CSIC) ha liderado hasta julio de 2007 el proyecto EMCO con una subvención de 1.200.000 €.

El objetivo del proyecto EMCO ha consistido en el tratamiento de aguas residuales mediante tecnologías emergentes como reactores biológicos de membrana, ultrafiltración, ósmosis inversa y nanofiltración, sobre todo enfocadas a la eliminación

de los denominados contaminantes “nuevos” o “emergentes” (medicamentos, surfactantes, tintes, textiles, etc.).

C) PATENTES

La búsqueda en las distintas bases de datos ha permitido identificar 167 patentes publicadas durante los años 2004 – 2007 y los cinco primeros meses de 2008 (Anexo III).

Como se observa en la gráfica de la Figura 14, existe una tendencia clara hacia el mayor desarrollo de estas tecnologías, ya que en 2004, se patentaron 22 invenciones, en 2005 se patentaron 31, 48 en 2006, 53 en 2007 y 13 durante los cinco primeros meses de 2008. El número de patentes encontrado en los primeros meses de 2008 es orientativo, y seguramente esta cifra esté por debajo de la realidad, pues los datos recientes dependen de la frecuencia de actualización de las bases de datos de patentes, por parte de los diferentes países.

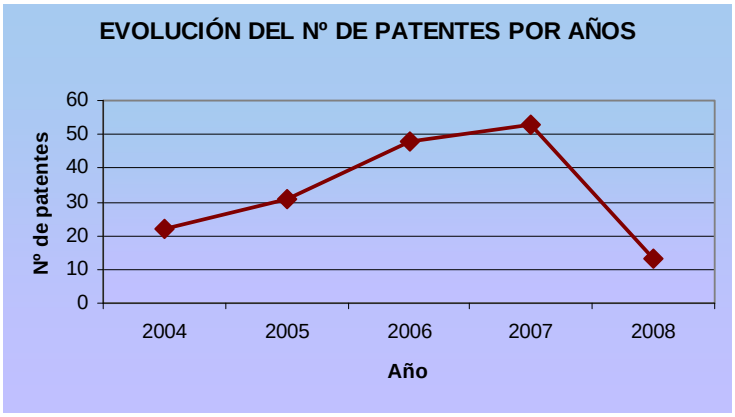


Figura 14.- Evolución del número de patentes por años.

La Figura 15 muestra como la mayoría de las patentes pertenecen a Japón y Estados Unidos. Destaca la evolución ascendente de China, que en el año 2007 se colocó a la cabeza mundial en número de patentes, donde atendiendo a los datos de los 5 primeros meses de 2008, se mantendrá este año. Se observa también una tendencia, con lo años, hacia la protección mundial de los derechos de propiedad industrial en la OMPI (Organización Mundial de la Propiedad Intelectual).

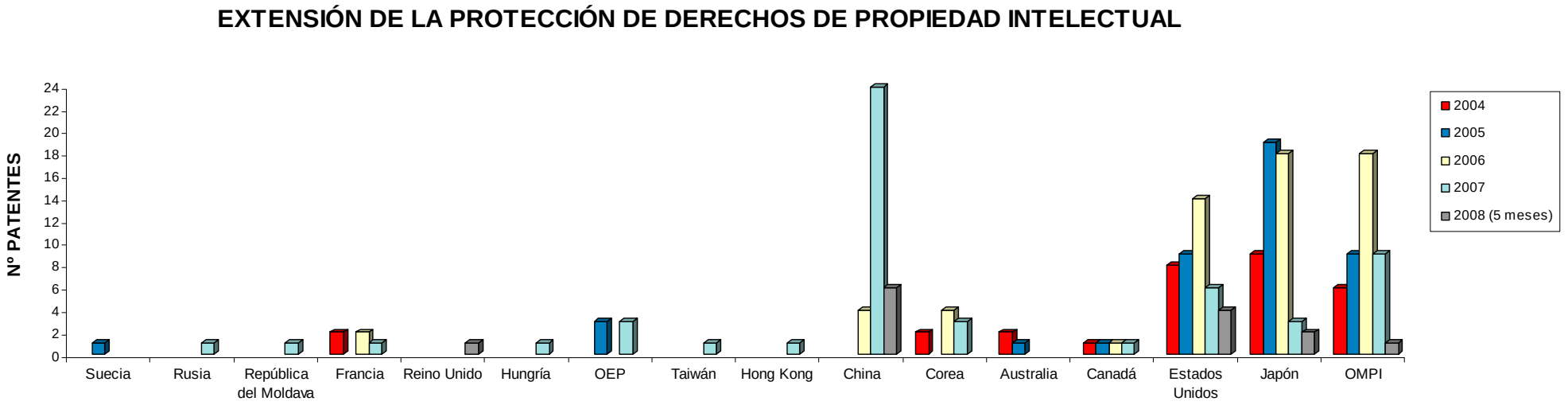


Figura 15.- Extensión de la protección de derechos de propiedad industrial.

En cuanto a las tecnologías más empleadas a la hora de patentar, el análisis de las invenciones patentadas durante los primeros meses de 2008 (Figura 16), muestra a la ósmosis inversa, seguida de la ultrafiltración, como tecnologías dominantes. Cabe destacar que en muchos casos (5) las patentes identificadas combinan el uso de estas dos tecnologías.

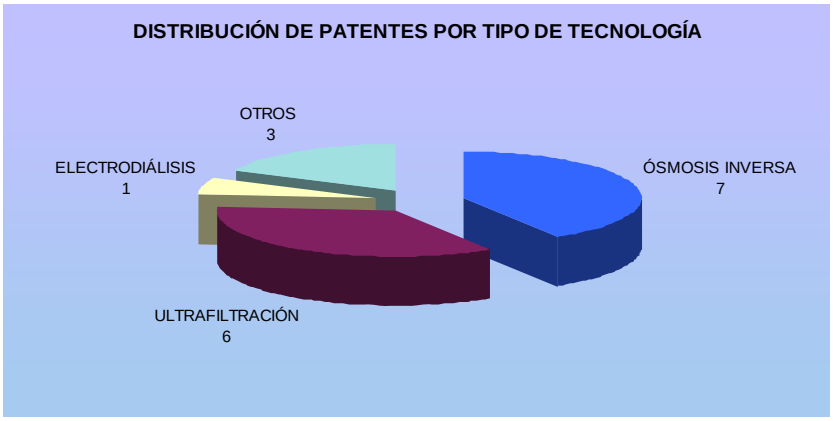


Figura 16.- Distribución de patentes (2008) por tipo de tecnología.

A continuación se incluye un pequeño resumen de las patentes para el tratamiento de aguas residuales industriales que contengan compuestos presentes en efluentes de procesos de recubrimientos metálicos (mencionados en el capítulo 3), correspondientes a los cinco primeros meses de 2008.

A technique and a device of recycling electroplating wastewater

Número de la patente: CN101024537-A

Inventor: WANG J.

NOVELTY A technique of recycling electroplating wastewater comprises following steps: The electroplating wastewater with chromium and nickel after reduction reaction and the organic electroplating wastewater after oxidation reaction are mixed with other electroplating wastewater to perform neutralization reaction and perform the coagulation reaction and deposit to get supernatant fluid; the supernatant fluid is processed by bag filtering, continuous micro-filtering, carbon filtering and micro-filtering; the transmission water is processed by primary reverse osmosis treatment and secondary reverse osmosis treatment. The transmission water processed by the secondary reverse osmosis treatment can be recycled in department production. The concentrate after the primary reverse osmosis treatment and the secondary reverse osmosis treatment is processed by the secondary chemical treatment, namely perform the neutralization reaction and the coagulation

reaction and deposit to get the supernatant fluid in accordance with discharge standard. A device of recycling electroplating wastewater comprises a chemical pre-treating system, a reverse osmosis recycling system, a reverse osmosis concentrate treating system and a sludge treating system. The chemical water treatment and the reverse osmosis membrane treatment of this technique are combined to recycle the electroplating wastewater. It can recycle 85% reusable filtrate from the electroplating wastewater.

A treating method of industrial waste water

Número de patente: CN101028958-A

Inventor: LIN B.

NOVELTY - A treating method of industrial waste water comprises following process flows. 1, Pretreatment, waste water-pH value regulation-waste water tank-raw water pump-quartz sand filtration-KDF filtration-secondary filtration-ultrafiltration; 2, a high pressure pump supplies the pretreated water with power to enter RO (NF) reverse osmosis system. This system improves the treating technology of traditional electroplating wastewater. The water resource can be recycled to reduce the environmental pollution. It is in accordance with strategy of sustainable development. It will bring the economic, environmental and social benefits.

Electroplating wastewater recycling technology

Número de patente: CN101041534-A

Inventores: LIU J., MA X., WU Z.

NOVELTY - This invention claims an electroplating wastewater recycling technology which uses methods of environmental friendly treatment, such as, oxidation reduction and chemical deposition and membrane technique (laminal filtration, ultrafiltration, nanofiltration and reverse osmosis) depth purification treatment. It effectively avoids accumulation of salinity in system because of high permeability of univalence salt and high interception of bivalence salt in ultrafiltration which means univalence salt is reverse osmosis desalinated in the final stage while bivalence is intercepted in environmental friendly treating system and continues deposition treatment. Concentrated water effectively removes BOD and COD accumulated in water after biochemical treatment, it is flexible and convenient as well as realizes zero discharge of wastewater. It can treat water with quantity, good water quality, it caters to requirement of water quality and quantity, with stable operation, convenient management and easy operation and control.

Metallurgy advanced wastewater treatment method by reclaiming wastewater, putting in milk of lime and powder active carbon, reducing content of chemical oxygen demand and introducing ultrafiltered water into reverse osmosis device

Número de patente: CN101066815-A

Inventores: WANG Z, REN Z, DONG J, CHEN X

NOVELTY - A metallurgy advanced wastewater treatment method involves reclaiming wastewater, inducing the middle water into retention pond; putting in milk of lime and powder active carbon, reducing the content of chemical oxygen demand (COD) and high valence ion; processing the middle water by ultrafiltration until the SDI is less than 3; letting the water which has been processed by ultrafiltration go into the reverse osmosis device so as to execute the desalinization process.

USE - A metallurgy advanced wastewater treatment method.

ADVANTAGE - The method can reduce the COD in water source, ensure the normal running of the reverse osmosis system and reduce the chemical cleaning times of the reverse osmosis; and has less one-off investment and lower energy consumption.

Electroplating wastewater recycling comprises separating wastewater into wastewater departments and bringing into uniform pool for treatment, bringing wastewater through filter, then through a recovery system

Número de patente: CN101070215-A

Inventor: XIAO Y

NOVELTY - An electroplating wastewater is recycled by separating wastewater into wastewater departments in electroplating workshop and bringing into uniform pool for treatment by deoxidization and oil-water separation. After deposition, the wastewater goes through a micro-filter, ultra-filter, and sodium filter for pretreatment, and then it goes through recovery system. Water is returned back to the workshop as production water supply.

USE - Method for recycling of electroplating wastewater.

ADVANTAGE - The method provides high coefficient of recovery, low operation cost, decreased cost for running water, and promotes environment protection.

Metallurgical sewage treatment involves recycling the sewage, sterilization with oxidizing bactericide, ultrafiltration treatment and sterilization with non-oxidizing bactericide, and reverse osmosis electrochemical desalination

Número de patente: CN101077816-A

Inventores: WANG Z, REN Z, DONG J, CHEN X

NOVELTY - A metallurgical sewage treatment comprises taking out the sewage from the sewer metallurgical industry, flocculating and depositing 100 mg/L suspended substance in effluent; filtering the wastewater through 1 mm grille filter, having a sterilization with the oxidizing bactericide (2-3 mg/L); reaching to the SDI under 3, having the second sterilization with the non-oxidizing bactericide (30-50 mg/L) in the water main pipe of the ultrafiltration, where the adding time is every 5-8 days and 60 minutes every time; and reverse osmosis electrochemical desalination in reverse osmosis device.

USE - For metallurgical sewage treatment.

ADVANTAGE - The method can reduce the running cost of the metallurgical sewage treatment, reduce the amount of the cleaning liquid and reduce the pollution for the environment by the emission of the waste cleaning liquid.

Treatment of wastewater from semiconductor producing plant, involves subjecting water having mineral acid ion and fluoride ion to electrodialysis, and obtaining fluorine-containing water and metal acid ion concentrated water

Número de patente: JP2007296444-A

Inventores: SASAKI Y, AKABORI S, NAKAGAWA S

NOVELTY - Wastewater (MFW) containing mineral acid ion and fluoride ion is processed by electrodialysis process. Fluorine-containing water (FW) containing low mineral acid ion, and mineral acid ion concentrated water (M) containing high concentration mineral acid ion are produced.

USE - For treating wastewater ejected from semiconductor manufacturing plant, flat panel display manufacturing plant and electronic component manufacturing plant (claimed), and producing fluorine ion concentrated water used for obtaining calcium fluoride used as raw material for manufacturing hydrofluoric acid.

ADVANTAGE - The wastewater is efficiently processed, and mineral acid ion content is reduced. The fluorine ion concentrated water is separated with high purity and recycled, and high purity calcium fluoride is produced.

Wastewater treatment of used alkaline electrolyzed water for cleaning metal portions, involves adjusting acidity of used water using acidic liquid, separating resulting water into fat-and-oils and drains, and removing fat-and-oils

Número de patente: JP2007330901-A

Inventores: KOGUCHI R, SAIDA K, TSUCHIYA H, TOGE Y, MURATA T, MIZUTA N

NOVELTY - Degreasing-cleaning of various components and equipments is performed using alkaline electrolyzed water (AE) produced by electrolysis. Used water is adjusted to acidity by injecting acidic

liquid into processing tank (10) into which used water is fed after degreasing-cleaning. Acidity-adjusted water is fed into oil-water separation filter (40), and separated into fat-and-oils and drains, such that effluent standard is optionally adapted. Floating-up is carried out, and fats-and-oil is removed. Thus, wastewater treatment is enabled.

USE - For processing used alkaline electrolyzed water ejected during cleaning of metal portions, electrical component and food-processing equipment.

ADVANTAGE - The used alkaline electrolyzed water is reliably and economically processed without using expensive filter such as ultrafiltration machine. The processed water attains effluent standard.

Wastewater treating system for removing pollutants of carbon, nitrogen and phosphorous, comprises sludge bed reactor, mixing reactor disposed at the rearward of sludge bed reactor, and another reactor disposed rearward of mixing reactor

Número de patente: US2007193949-A1

Inventores: YOU H, CHANG K, CHANG S, PERNG S, HSU S

NOVELTY - The wastewater treating system for removing pollutants of carbon, nitrogen and phosphorous, comprises a sludge bed reactor, a mixing reactor disposed at the rearward of the sludge bed reactor, another reactor disposed rearward of the mixing reactor, and a membrane separation reactor (4) disposed inside the another mixing reactor or the rearward of the another mixing reactor to separate microorganisms and treated effluent. The mixing reactor treats the effluent from the sludge bed reactor by denitrifying bacteria and phosphate accumulating organism.

USE - Useful for removing pollutants of carbon, nitrogen and phosphorous.

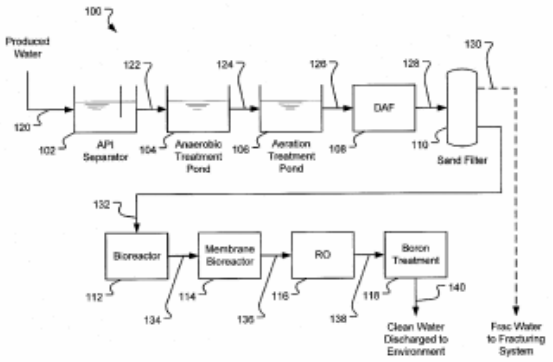
ADVANTAGE - The wastewater treating system is able to lower the production volume of the residual sludge, and consumes less power. The system is able to remove the organic pollutants effectively and avoids the scaling and the fouling on the surface of membrane.

System and method for treating water contaminated with methanol and boron

Número de patente: US2008053900

Inventores: SHAFER LEE L; JAMES JOHN W; RATH RICHARD D; EUBANK JESSE

Systems and methods have been developed for treating the waste water contaminated with methanol and boron in addition to other contaminants. The systems and methods allow specifically for the removal of the methanol and boron without the addition of significant chemicals to raise the pH. The water is treated by



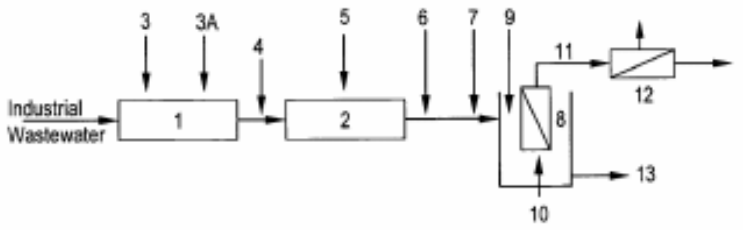
removing the methanol via biological digestion in a bioreactor, separating a majority of the contaminants from the water by reverse osmosis and removing the boron that passes through the reverse osmosis system with a boron-removing ion exchange resin.

Method of heavy metal removal from industrial wastewater using submerged ultrafiltration ormicrofiltration membranes

Número de patente: US2008060999

Inventores: MUSALE DEEPAK A; JOHNSON BRIAN S

Method of removing one or more heavy metals from industrial wastewater by use of a membrane separation process is disclosed. Specifically, the following steps are taken to remove heavy metals from industrial wastewater: (a) collecting an industrial wastewater containing heavy metals in a receptacle suitable to hold said industrial wastewater; (b) adjusting the pH of said system to achieve hydroxide precipitation of said heavy metal in said industrial wastewater; (c) adding an effective amount of a water soluble ethylene dichloride- ammonia polymer having a molecular weight of from about 500 to about 10,000 daltons that contain from about 5 to about 50 mole percent of dithiocarbamate salt groups to react with said heavy metals in said industrial wastewater system; (d) passing said treated industrial wastewater through a submerged membrane, wherein said submerged membrane is an ultrafiltration membrane or a microfiltration membrane; and (e) optionally back-flushing said membrane to remove solids from the membrane surface.



Porous membrane for water treatment and method of manufacturing the same

Número de patente: US2008078718

Inventores: TADA YASUHIRO; TANIGUCHI SHINGO; HINO MASAYUKI; TAKAHASHI TAKEO; SUZUKI KENICHI; MIZUNO TOSHIYA

A porous membrane for water treatment of the present invention is made of a resin composition containing 100 parts by weight of a polyvinylidene fluoride based resin, and 5 to 13 parts by weight of a polyvinyl alcohol based polymer having a degree of saponification of 10 to 80 mol %. The porous membrane has a permeation wetting tension of 38 to 72 mN/m, and a tensile strength of 7 to 20 MPa, and thus is characterized by having the excellent mechanical strength and wettability. This is a porous membrane for water treatment essentially containing the polyvinylidene fluoride based resin, which allows water treatment to be highly efficiently performed on raw water (river water, industrial waste

water, and the like), in particular. The porous membrane is manufactured, firstly, by melt-extruding a mixture composition containing a polyvinylidene fluoride based resin, a polyvinyl alcohol based polymer, a plasticizer, and a solvent, and then by extracting the plasticizer and the solvent from the substance thus extruded.

D) OFERTAS TECNOLÓGICAS

A través del IRC NETWORK se han detectado 18 ofertas tecnológicas (Anexo IV), en relación a las tecnologías analizadas, seis realizadas en el año 2006, 10 en 2007 y 2 en los primeros meses de 2008 (Fig.17)

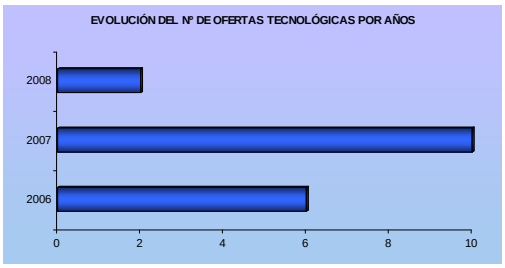


Figura 17.- Evolución del número de ofertas tecnológicas por años.

El país con mayor oferta tecnológica es Alemania seguido de Israel y España (Fig.18). Hay que destacar que en el caso de España, las tres ofertas proceden de universidades, a diferencia del resto, cuyo origen se encuentra, en la mayoría de los casos, en empresas.

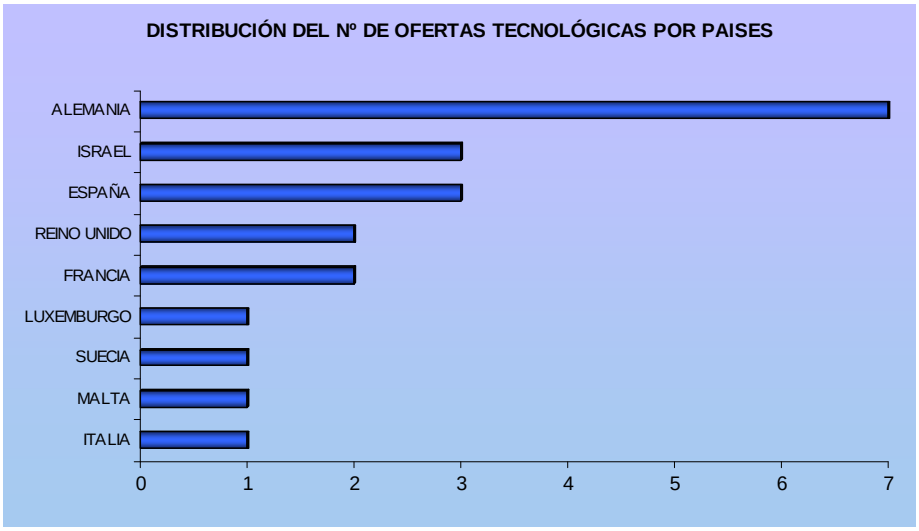


Fig. 18.- Distribución del número de ofertas tecnológicas por países

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11.- ANEXOS

ANEXO I.- PROYECTOS NACIONALES DE I+D

REFERENCIA	INVESTIGADOR PRINCIPAL	TÍTULO	AUTONOMÍA	ORGANISMO	CENTRO	€ TOTAL concedido
CTM2007-65052	RODELAS GONZALEZ, MARIA BELEN	EFECTO DE LA CONCENTRACION DE BIOMASA Y TEMPERATURA SOBRE LAS ACTIVIDADES ENZIMATICAS Y COMUNIDADES MICROBIANAS EN BIORREACTORES DE MEMBRANA SUMERGIDA (MBR)	ANDALUCIA	UNIVERSIDAD DE GRANADA	DPTO. MICROBIOLOGIA	162.140
CTQ2007-64327	BODALO SANTOYO, ANTONIO	DISEÑO, OPERACION Y MODELIZACION DE PROCESOS CONTINUOS BIORREACTOR ENZIMATICO-MODULO DE MEMBRANA. APLICACION A LA ELIMINACION DE CONTAMINANTES FENOLICOS DE EFLUENTES INDUSTRIALES.	MURCIA	UNIVERSIDAD DE MURCIA	FACULTAD DE QUIMICA	205.700
CTM2007-66216	GUTIERREZ LAVIN, ANTONIO	DESARROLLO DE REACTORES DE BIOMEMBRANA PARA RESIDUOS ACUOSOS DE BASE FENOLICA: ESTUDIO DE LAS ETAPAS DE REACCION Y TRANSFERENCIA	ASTURIAS	UNIVERSIDAD DE OVIEDO	DPTO. INGENIERIA QUIMICA Y TECNOLOGIA DEL MEDIO AMBIENTE	142.175
CTM2007-60577	BAHAMONDE SANTOS, ANA MARIA	TRATAMIENTOS CATALITICOS DE OXIDACION AVANZADA PARA LA ELIMINACION DE CONTAMINANTES AROMATICOS EN AGUAS RESIDUALES	MADRID	CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS	INSTITUTO DE CATALISIS Y PETROLEOQUIMICA (ICP)	106.480
CTQ2007-61748	CASAS DE PEDRO, JOSE ANTONIO	TRATAMIENTO DE AGUAS RESIDUALES CON CONTAMINANTES PERSISTENTES UTILIZANDO PROCESOS CATALITICOS DE OXIDACION AVANZADA Y HUMEDA.	MADRID	UNIVERSIDAD AUTONOMA DE MADRID	DPTO. QUIMICA FISICA APLICADA	239.580
CTM2006-12226	VILLARROEL LOPEZ, RAFAEL	ESTUDIOS AVANZADOS DEL COMPORTAMIENTO DE BIORREACTORES DISCONTINUOS SECUENCIALES COMBINADOS CON SISTEMAS DE MEMBRANAS PARA LA REUTILIZACION DE AGUAS RESIDUALES.	CANARIAS	UNIVERSIDAD DE LA LAGUNA	FACULTAD DE QUIMICA	114.950,00
CTM2006-13523-C02-01	SALGOT DE MARÇAY, MIQUEL	EVALUACION DE TECNOLOGIAS DE REGENERACION Y REUTILIZACION DE AGUAS RESIDUALES	CATALUÑA	UNIVERSIDAD DE BARCELONA	FACULTAD DE FARMACIA	50.820,00
DPI2006-15707-C02-01	RODRIGUEZ-RODA LAYRET, IGNASI	SISTEMA DE AYUDA A LA DECISION PARA EL CONTROL Y LA OPERACION REMOTA DE BIOREACTORES DE MEMBRANA PARA EL TRATAMIENTO Y REUTILIZACION DE AGUAS RESIDUALES	CATALUÑA	UNIVERSIDAD DE GIRONA	INSTITUTO DE MEDI0 AMBIENTE	105.270,00
DPI2006-15707-C02-02	SANCHO SEUMA, LUIS	SISTEMAS DE CONTROL ROBUSTO APLICADOS A LA OPERACION OPTIMA DE BIOREACTORES DE MEMBRANA	PAIS VASCO	CENTRO DE ESTUDIOS E INVESTIGACIONES TECNICAS DE GUIPUZCOA	CENTRO DE ESTUDIOS E INVESTIGACIONES TECNICAS DE GUIPUZCOA	84.700,00

CTM2005-03957	CALERO DE HOCES, FRANCISCA MONICA	APLICACION DE LA BIOSORCION MEDIANTE RESIDUOS AGRICOLAS PARA LA DEPURACION DE EFLUENTES INDUSTRIALES QUE CONTENGAN METALES PESADOS.	ANDALUCIA	UNIVERSIDAD DE GRANADA	DPTO. INGENIERIA QUIMICA	54.740,00
CTQ2005-04935	MÉNDEZ PAMPÍN, RAMÓN	DESARROLLO DE BIORREACTORES GRANULARES Y SISTEMAS DE MEMBRANAS PARA LA PRODUCCION DE EFLUENTES REUTILIZABLES	GALICIA	UNIVERSIDAD DE SANTIAGO DE COMPOSTELA	ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA	201.110
CTQ2005-08957-C02-01	CORTINA PALLAS, JOSÉ LUIS	DESARROLLO DE PROCESOS DE EXTRACCIÓN REACTIVA PARA LA ELIMINACIÓN Y RECUPERACIÓN DE MICRO-CONTAMINANTES INORGÁNICOS Y ORGÁNICOS EN EFLUENTES INDUSTRIALES	CATALUÑA	UNIVERSIDAD POLITÉCNICA DE CATALUÑA	ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA INDUSTRIAL DE BARCELONA	80.920
CTQ2005-08957-C02-02	DE LAS HERAS CISA, F. XAVIER	DESARROLLO DE PROCESOS DE EXTRACCIÓN REACTIVA PARA LA ELIMINACIÓN Y RECUPERACIÓN DE MICRO-CONTAMINANTES INORGÁNICOS Y ORGÁNICOS EN EFLUENTES INDUSTRIALES	CATALUÑA	UNIVERSIDAD POLITECNICA DE CATALUÑA	ESCUELA UNIVERSITARIA POLITÉCNICA. MANRESA	77.350
CTM2004-00337	FERNÁNDEZ MOHEDANO, ANGEL	EMPLEO DE REACTORES SECUENCIALES DISCONTINUOS (SBR) PARA EL TRATAMIENTO DE AGUAS RESIDUALES INDUSTRIALES CONTAMINADAS POR FENOLES Y CLOROFENOLES	MADRID	UNIVERSIDAD AUTONOMA DE MADRID	FACULTAD DE CIENCIAS	165.900
CTM2004-03056	PRATS RICO, DANIEL	OPTIMIZACIÓN DEL PROCESO DE ULTRAFILTRACIÓN PARA LA ELIMINACIÓN DE MATERIA ORGÁNICA EN AGUAS DE CONSUMO Y AGUAS RESIDUALES	COMUNIDAD VALENCIANA	UNIVERSIDAD DE ALICANTE	INSTITUTO UNIVERSITARIO DEL AGUA Y DE LAS CC. AMBIENTALES	236.650
CTM2004-03130	ALCAINA MIRANDA, MARIA ISABEL	GESTIÓN INTEGRAL DE EFLUENTES DE LA INDUSTRIA TEXTIL CON ALTO CONTENIDO SALINO MEDIANTE PROCESOS DE NANOFILTRACIÓN Y ÓSMOSIS INVERSA	COMUNIDAD VALENCIANA	UNIVERSIDAD POLITÉCNICA DE VALENCIA	ESCUELA TÉCNICA SUPERIOR INGENIEROS INDUSTRIALES - DPTO. INGENIERÍA QUÍMICA Y NUCLEAR	121.900
CTM2004-03348	TEJERO MONZÓN, IÑAKI	RBPM, REACTORES BIOPELÍCULA CON MEMBRANAS: TECNOLOGÍA AVANZADA DE DEPURACIÓN PARA LA REGENERACIÓN DE AGUAS RESIDUALES PARA SU REUTILIZACIÓN	CANTABRIA	UNIVERSIDAD DE CANTABRIA	ESCUELA TÉCNICA SUPERIOR DE ING. CAMINOS, CANALES Y PUERTOS - DPTO. CIENCIAS Y TÉCNICAS DEL AGUA Y DEL MEDIO AMBIENTE	132.250

CTQ2004-01201	CERDÁ MARTÍN, VÍCTOR	DESARROLLO DE MÉTODOS AUTOMÁTICOS EN FLUJO PARA LA MONITORIZACIÓN Y CONTROL DE BIORREACTORES Y DEPURADORAS DE AGUAS RESIDUALES	BALEARES	UNIVERSIDAD DE LAS ISLAS BALEARES	DPTO. QUÍMICA	92.050

Los proyectos marcados en color morado no se encuentran vigentes en la actualidad.

ANEXO II.- PROYECTOS EUROPEOS DE I+D

REFERENCIA	ACRÓNIMO	TITULO	ORGANIZACIÓN	FINANCIACIÓN	DURACIÓN
31773	PROMEMBRANE	PROMOTION AND FOCUSSING OF CURRENT RESEARCH ACTIVITIES OF MEMBRANE TECHNOLOGY IN WATER TREATMENT IN THE MEDITERRANEAN REGION	ALEMANIA	2.750.000 €	AGOSTO 2006 - AGOSTO 2008
36882	INNOWATECH	INNOVATIVE AND INTEGRATED TECHNOLOGIES FOR THE TREATMENT OF INDUSTRIAL WASTEWATER	ITALIA	4.802.811 €	NOVIEMBRE 2006 - OCTUBRE 2009
41896	BIOTRAC	BIOAVAILABILITY OF TRACE METALS IN ANAEROBIC GRANULAR SLUDGE REACTORS	HOLANDA	157.192 €	ENERO 2207 - DICIEMBRE 2008
33049	MESH	INTEGRATED WASTEWATER TREATMENT PROCESS USING MESH FILTER MODULES FOR DIRECT ACTIVATED SLUDGE SEPARATION	AUSTRIA	999.850 €	JULIO 2006 - SEPTIEMBRE 2008
508144	IWAPIL	INNOVATIVE WASTEWATER TREATMENT APPLICATIONS FOR ISOLATED LOCATIONS (IWAPIL)	ALEMANIA	509,966 €	MAYO 2004-ABRIL 2006
18328	AMEDEUS	ACCELERATE MEMBRANE DEVELOPMENT FOR URBAN SEWAGE PURIFICATION	ALEMANIA	3,034,663 €	OCTUBRE 2005-SEPTIEMBRE 2008
509173	RECOAL	REINTEGRATION OF COAL ASH DISPOSAL SITES AND MITIGATION OF POLLUTION IN THE WEST BALKAN AREA	AUSTRIA	699,118 €	DICIEMBRE 2004-DICIEMBRE 2007
3163	WATERNORM	MONITORING AND MITIGATION OF MINE WATER IMPACT IN UPPER SILESIA REGION ? INCREASING OF RESEARCH AND DEVELOPMENT POTENTIAL IN CENTRAL MINING INSTITUTE	POLONIA	895,020 €	SEPTIEMBRE 2004-AGOSTO 2008

15449	PURATREAT	NEW ENERGY EFFICIENT APPROACH TO THE OPERATION OF MEMBRANE BIOREACTORS FOR DESCENTRALISED WASTEWATER TREATMENT	ALEMANIA	899.986 €	ENERO 2006-DICIEMBRE 2008
21050	MBR-TRAIN	PROCESS OPTIMISATION AND FOULING CONTROL IN MEMBRANE BIOREACTORS FOR WASTEWATER AND DRINKING WATER TREATMENT	ALEMANIA	2.047.783 €	ENERO 2006-DICIEMBRE 2009
509567	BIOGEOLOGICAL ENGINE	NOVEL BIOGEOLOGICAL ENGINNERING PROCESSES FOR HEAVY METAL REMOVAL AND RECOVERY	HOLANDA	1.663.736 €	JUNIO 2004-MAYO 2008
509188	EMCO	REDUCTION OF ENVIRONMENTAL RISKS, POSED BY EMERGING CONTAMINANTS, THROUGH ADVANCED TREATMENT OF MUNICIPAL AND INDUSTRIAL WASTES	ESPAÑA	1.200.000 €	JULIO 2004-JULIO 2007
10927	LIQUIMEM	LIQUID MEMBRANES AND IONIC LIQUIDS FOR SELECTIVE DOWNSTREAM PROCESSING	ALEMANIA	158.198 €	DESDE MARZO 2005

Los proyectos marcados en color morado no se encuentran vigentes en la actualidad.

ANEXO III.- PATENTES

Nº PATENTE	TÍTULO	AÑO
CN101024537-A	A TECHNIQUE AND A DEVICE OF RECYCLING ELECTROPLATING WASTEWATER	2008
CN101028958-A	A TREATING METHOD OF INDUSTRIAL WASTE WATER	2008
CN101041534-A	ELECTROPLATING WASTEWATER RECYCLING TECHNOLOGY	2008
CN101066815-A	METALLURGY ADVANCED WASTEWATER TREATMENT METHOD BY RECLAIMING WASTEWATER, PUTTING IN MILK OF LIME AND POWDER ACTIVE CARBON, REDUCING CONTENT OF CHEMICAL OXYGEN DEMAND AND INTRODUCING ULTRAFILTERED WATER INTO REVERSE OSMOSIS DEVICE	2008
CN101070215-A	ELECTROPLATING WASTEWATER RECYCLING COMPRISES SEPARATING WASTEWATER INTO WASTEWATER DEPARTMENTS AND BRINGING INTO UNIFORM POOL FOR TREATMENT, BRINGING WASTEWATER THROUGH FILTER, THEN THROUGH A RECOVERY SYSTEM	2008
CN101077816-A	METALLURGICAL SEWAGE TREATMENT INVOLVES RECYCLING THE SEWAGE, STERILIZATION WITH OXIDIZING BACTERICIDE, ULTRAFILTRATION TREATMENT AND STERILIZATION WITH NON-OXIDIZING BACTERICIDE, AND REVERSE OSMOSIS ELECTROCHEMICAL DESALINATION	2008
JP2007296444-A	TREATMENT OF WASTEWATER FROM SEMICONDUCTOR PRODUCING PLANT, INVOLVES SUBJECTING WATER HAVING MINERAL ACID ION AND FLUORIDE ION TO ELECTRODIALYSIS, AND OBTAINING FLUORINE-CONTAINING WATER AND METAL ACID ION CONCENTRATED WATER	2008
JP2007330901-A	WASTEWATER TREATMENT OF USED ALKALINE ELECTROLYZED WATER FOR CLEANING METAL PORTIONS, INVOLVES ADJUSTING ACIDITY OF USED WATER USING ACIDIC LIQUID, SEPARATING RESULTING WATER INTO FAT-AND-OILS AND DRAINS, AND REMOVING FAT-AND-OILS	2008
US2007193949-A1	WASTEWATER TREATING SYSTEM FOR REMOVING POLLUTANTS OF CARBON, NITROGEN AND PHOSPHOROUS, COMPRISES SLUDGE BED REACTOR, MIXING REACTOR DISPOSED AT THE REARWARD OF SLUDGE BED REACTOR, AND ANOTHER REACTOR DISPOSED REARWARD OF MIXING REACTOR	2008
US2008053900	SYSTEM AND METHOD FOR TREATING WATER CONTAMINATED WITH METHANOL AND BORON	2008
US2008060999	METHOD OF HEAVY METAL REMOVAL FROM INDUSTRIAL WASTEWATER USING SUBMERGED ULTRAFILTRATION OR MICROFILTRATION MEMBRANES	2008
US2008078718	POROUS MEMBRANE FOR WATER TREATMENT AND METHOD OF MANUFACTURING THE SAME	2008
WO2008048594	MEMBRANE BIOREACTOR FOR PHOSPHORUS REMOVAL	2008
CA2532286	REMOVAL OF PHOSPHATES FROM WASTEWATER	2007
CN100999368	ELECTRIC DEIONIZATION METHOD USED FOR RECOVERING NOBLE METAL WASTE WATER AND ITS DEVICE	2007
CN101003396	SYSTEM AND METHOD FOR TREATING WASTEWATER OF CONTAINING COPPER FROM MICROETCHING PRINTED CIRCUIT BOARD	2007

CN101008090	METHOD FOR RECOVERING COPPER FROM CYANIDE-CONTAINING WASTE WATER AND RELATED WASTE WATER TREATMENT METHOD	2007
CN101008090	METHOD FOR RECOVERING COPPER FROM CYANIDE-CONTAINING WASTE WATER AND RELATED WASTE WATER TREATMENT METHOD	2007
CN101012091	TECHNIQUE FOR TREATING MINE WATER UTILIZING MINE UNDERGROUND TUNNEL SPACE	2007
CN101024537	ELECTRIC-PLATING WASTE WATER RECOVERING AND UTILIZING PROCESS AND APPARATUS	2007
CN101037243	HEAVY METAL TREATMENT METHOD OF ELECTROPLATING WASTEWATER	2007
CN101041485	METAL SMELTING FACTORY SEWAGE RECLAIMING METHOD BASED ON MEMBRANE FILTERING TECHNIQUE	2007
CN101041491	METHOD FOR TREATING INDUSTRIAL WASTEWATER / SEWAGE BY TWO-STAGE MAGNETIC ISOLATION TECHNIQUE	2007
CN101041534	ELECTROPLATING WASTEWATER TREATMENT RECLAIMING TECHNIQUE	2007
CN101050014	METHOD FOR TREATING WASTEWATER CONTAINING COPPER AND VANADIUM	2007
CN101050165	WASTEWATER TREATMENT FOR BENZOIC ALCOHOL, AND TECHNIQUE FOR RECOVERING BENZOIC ALCOHOL	2007
CN101070204	METHOD AND APPARATUS FOR TREATING WASTE WATER CONTAINING LOW-CONCENTRATION PERFLUORO AMMONIUM CAPRYLATE	2007
CN101070206	CHEMICAL COPPER-PLATING RINSING WASTE-WATER TREATMENT PROCESS	2007
CN101070214	METHOD FOR DISPOSING WASTE LIQUID FROM PROCESS OF REFINING TITANIUM TETRACHLORIDE BY COPPER WIRE VANADIUM REMOVAL	2007
CN101070215	ELECTROPLATING WASTE-WATER REUTILIZING PROCESS	2007
CN101081712	RECOVERY SYSTEM FOR METALLIC ION IN ELECTROPLATING POACHING WASTEWATER	2007
CN1796312-A; CN100341801-C	METHOD FOR RECOVERING NICKEL AND REMOVING IMPURITY FROM NICKEL-PLATED WASTEWATER	2007
CN1974437	WASTE WATER TREATING APPARATUS WITH CIRCULATING MEMBRANE BIOREACTOR	2007
CN1974439	METHOD OF INHIBITING MEMBRANE CONTAMINATION OF MEMBRANE BIOREACTOR	2007
CN1974445	METHOD AND SYSTEM FOR TREATING CONCENTRATED LIQUID FROM REVERSE OSMOSIS OF HIGH CONCENTRATION WASTE WATER	2007
EP1803688	MEMBRANE BIOREACTOR AND METHOD FOR THE BIOLOGICAL TREATMENT OF OILY WASTEWATER	2007
EP1820563	FILTER, CONVERSION KIT FOR A FILTER AND METHOD FOR FILTERING LIQUIDS	2007
FR2898889	PROCESS OF OBTAINING A COAGULANT PRODUCT FOR TREATING URBAN AND/OR INDUSTRIAL WASTEWATER, COMPRISES PREPARING A RAW MATERIAL CONTAINING MUD RESULTING FROM A TREATMENT OF DRINKING WATER AND AN ORE CONTAINING IRON AND/OR ALUMINUM	2007
HK1081517	MEMBRANE BIOREACTOR WASTE WATER TREATMENT METHOD	2007
HU0301522	PROCESS FOR REDUCTION OF WATER POLLUTIONS LIKE ARSENIC, IRON, MANGANESE AND ORGANICS	2007
KR2006105106-A	WASTEWATER TREATMENT METHOD AND APPARATUS FOR EFFECTIVELY REDUCING 1,4-DIOXANE	2007
MD3345F	PLANT FOR COMPLEX TREATMENT OF INDUSTRIAL WASTE WATERS	2007

US2007090057-A1; US7279103-B2	REMOVAL OF METALS AND SULFATES FROM ACIDIC WASTEWATERS BY PRECIPITATING METAL, INTRODUCING GAS CONTAINING HYDROGEN SULFIDE, ADDING AQUEOUS SOLUTION OF HYDROXIDE, AND TREATING IN HYDROGEN UTILIZING SULFATE REDUCING BACTERIA BIOREACTOR	2007
US2007163958	WATER TREATMENT TECHNIQUES	2007
WO2007042789-A1; GB2436426-A	TREATING WASTEWATER TO REMOVE E.G. PHOSPHORUS INVOLVES TREATING ANAEROBICALLY TREATED MIX OF WASTEWATER/SLUDGE IN AEROBIC AND ANOXIC CONDITIONS TO PRODUCE PART-TREATED MIX; AND REMOVING SOLIDS TO PRODUCE REDUCED-SOLIDS EFFLUENT	2007
WO2007131278	PROCESS FOR TREATMENT OF WATER TO REDUCE FLUORIDE LEVELS	2007
CN1843963-A	METHOD FOR TREATING CADMIUM-CONTAINING WASTE WATER BY INTENSIFIED ULTRAFILTRATION OF HOLLOW FIBER ULTRAFILTRATION MEMBRANE AND FOAM FLOATATION	2007
CN1868925-A	CIRCULATION UTILIZATION TECHNOLOGY AND EQUIPMENT FOR ELECTROPLATING WASTE WATER SEPARATED BY INTEGRATED MEMBRANE	2007
EP1726353-A1; WO2006127579-A2	MEMBRANE FILTRATION OF PRODUCT, E.G. MILK, IN MEMBRANE PLANT, INVOLVES RECOVERING CLEANING SOLUTION AFTER MULTISTEP CLEANING OF MEMBRANE SYSTEM IN PLANT; AND USING RECOVERED CLEANING SOLUTION FOR CLEANING MEMBRANE SYSTEM	2007
JP2007000788-A	MEMBRANE FILTRATION OF PRODUCT, E.G. MILK, IN MEMBRANE PLANT, INVOLVES RECOVERING CLEANING SOLUTION AFTER MULTISTEP CLEANING OF MEMBRANE SYSTEM IN PLANT; AND USING RECOVERED CLEANING SOLUTION FOR CLEANING MEMBRANE SYSTEM	2007
JP2007007655-A	ELECTRODIALYZER FOR ELECTRODIALYSIS PROCESS, HAS BUFFER CHAMBER COMPRISING ION EXCHANGER POSITIONED BETWEEN ION EXCHANGE MEMBRANES, FLUID SUPPLY PORT AND FLUID DISCHARGE PORT, ADJOINED AND PROVIDED AT POLE ROOM OF ELECTRODIALYZER	2007
JP2007083152-A	WATER COLLECTION FROM HIGH TOTAL ORGANIC CARBONCONTAINING CHEMICAL MECHANICAL POLISHING WASTE WATER, INVOLVES PERFORMING TWO-STAGE REVERSE OSMOSIS MEMBRANE SEPARATION PROCESSING ON SPECIFIC PH VALUES	2007
KR2006038097-A; KR621650-B1	APPARATUS FOR TREATING LEACHATE BY MEMBRANE BIOREACTOR PROCESS AND ELECTRO-OXIDATION PROCESS	2007
KR583005-B1	ADVANCED WATER AND WASTE WATER TREATMENT SYSTEM FOR REMOVING SOLID CONTAMINANTS AND MICRO-CONTAMINANTS CONTAINED IN WATER TO BE TREATED AT WATER TREATMENT FACILITIES MORE EFFECTIVELY	2007
RU2294794-C2	CLARIFIED WATER PRODUCTION PROCESS	2007
TW240647-B1	FIBROUS-ULTRAFILTRATION USED FOR PROCESSING CUTTING AND GRINDING WASTE WATER WITH SPECIFIC APERTURE SIZES OF FIBROUS FILTER AND ULTRAFILTER	2007
US2006283787-A1	INTEGRATED TREATMENT SYSTEM TO REMOVE CHEMICAL, BIOLOGICAL AND RADIOLOGICAL AGENTS AND PRODUCE PURE WATER COMPRISES PRE-TREATMENT UNITS, REVERSE OSMOSIS FILTER UNITS, ADVANCED SIMULTANEOUS OXIDATION PROCESS REACTOR AND POST-TREATMENT UNITS	2007
US2007060688-A1	POLYMERIC COMPOSITION FOR PRODUCING POLYMERIC MEMBRANE, COMPRISES SOLUTION OF POLYMER WITH SPECIFIC SOLUBILITY PARAMETER, IN SOLVENT MEDIUM COMPRISING SOLVENT(S) HAVING PRESET MELTING POINT	2007

US2007060688-A1	POLYMERIC COMPOSITION FOR PRODUCING POLYMERIC MEMBRANE, COMPRISES SOLUTION OF POLYMER WITH SPECIFIC SOLUBILITY PARAMETER, IN SOLVENT MEDIUM COMPRISING SOLVENT(S) HAVING PRESET MELTING POINT	2007
US7147777-B1	SYSTEM FOR SEWAGE TREATMENT COMPRISES PARALLEL MAIN PROCESS LINES HAVING ANOXIC AND AEROBIC ZONES AND MEMBRANE BIOREACTOR ZONES IN SERIES, WITH INFLOW DEVICE; AND ADDITIONAL SPECIAL PROCESS LINES FOR RECEIVING MIXED LIQUOR SUSPENDED SOLIDS	2007
WO2006132336-A1; JP2007014827-A	ELECTRODIALYZER FOR INDUSTRIAL WASTE WATER TREATMENT PLANT, CHANGES AMOUNT OF CONCENTRATION OF FLUORINE IONS IN WATER BEFORE AND AFTER DESALINATION, AND CIRCULATES PURE WATER AND EFFLUENTS THROUGH SEPARATE CHAMBER PATHS	2007
WO2006135188-A1	TREATMENT OF WASTE WATER INVOLVES SEPARATING INFLOW WASTE WATER INTO PRODUCT WATER AND CONCENTRATED WATER USING ELECTRODIALYSIS REVERSAL FACILITY AND DECOMPOSING CONCENTRATED WATER IN ELECTROCHEMICAL WASTE WATER TREATMENT FACILITY	2007
WO2006136672-A2	BIOREACTOR FOR TREATING EFFLUENTS BY ACTIVATED SLUDGE HAS FILTRATION MEMBRANE ASSEMBLY WITH PROTECTIVE SCREEN IN SLUDGE CHANNEL UPSTREAM OF AGITATOR	2007
WO2007004987-A1	TREATING WASTE WATER COMPRISING PROVIDING A BIOACTIVE MATERIAL IN WASTE WATER, MAINTAINING THE MATERIAL IN GRANULAR FORM, AND PASSING PORTION OF WATER THROUGH MEMBRANE SEPARATOR AND PREVENTING BIOACTIVE MATERIAL FROM PASSING THROUGH IT	2007
WO2007007343-A2	COMPOSITE MEMBRANE, USEFUL FOR WATER TREATMENT APPLICATIONS E.G. TREATMENT OF BRACKISH WATER, AND GAS APPLICATIONS, COMPRISES AN ELECTRONICALLY CONDUCTIVE ASYMMETRIC POROUS SUPPORT AND AN ELECTRO-POLYMERIZED SELECTIVE LAYER	2007
WO2007018561-A1	REVERSE OSMOSIS TAP WATER PURIFICATION SYSTEM HAS CONTROL BOX GENERATING ACTUATOR SIGNALS AT PRESET TIMING INTERVALS IN RESPONSE TO CONTROL SIGNALS, FOR SELECTIVELY OPENING AND CLOSING SOLENOID VALVES IN FLUID CONDUITS	2007
CN1701841-A	ULTRASONIC WAVE AUTOMATIC CLEANING TECHNOLOGY FOR HOLLOW FIBER SEPARATION MEMBRANE	2006
CN1769197-A	ZERO DISCHARGE AND CIRCULAR UTILIZATION METHOD OF INDUSTRIAL EFFLUENT IN REGENERATION TREATMENT	2006
FR2873311-A1	BIODEGRADABLE PRODUCT, USEFUL E.G. FOR ENVIRONMENTAL BIOTREATMENT AND TO TREAT BIOINCREASE OF INDUSTRIAL WASTEWATER IN SITUATION OF ACCIDENTAL TOXICITY, COMPRISES CONDITIONING LAYER, INTERNAL COATING AND AN AQUEOUS VOLUME OF CULTURE	2006
JP2005342635-A	RECOVERY OF PHOSPHORUS FROM SLUDGE SUCH AS HUMAN WASTE, INVOLVES ANAEROBICALLY PROCESSING SLUDGE, DISCHARGING PHOSPHORUS COMPONENT OF SLUDGE, AND PERFORMING SOLIDLIQUID SEPARATION USING MEMBRANE SEPARATOR OF CROSS-FLOW SYSTEM	2006
JP2006035035-A	TREATMENT OF NATURAL WATER E.G. INDUSTRIAL WASTEWATER, INVOLVES INJECTING WATER INTO FILTRATION FILM, BACKWASHING FILM, INJECTING BACKWASHED WASTEWATER INTO ANOTHER FILTRATION FILM, AND BACKWASHING SECONDARY FILTRATION FILM	2006

JP2006042655-A	DETECTOR OF TOXIC SUBSTANCE IN WATER, COMPRISES IMMOBILIZED FILM OF RECOMBINANT MICROORGANISMS THAT EXPRESS A FLUORESCENT PROTEIN ON CONTACT WITH A TOXIC SUBSTANCE, SAMPLE CONTAINER, EXCITATION LIGHT SOURCE, AND FLUORESCENCE DETECTOR	2006
JP2006051419-A	MANUFACTURE OF HOLLOW-FIBER POROUS MEMBRANE FOR PRODUCING PURE WATER, INVOLVES DISCHARGING STOCK SOLUTION OF FLUORIDE-TYPE RESIN FROM NOZZLE WITH CORE LIQUID, AND SOLIDIFYING DISCHARGED SOLUTION IN COOLING BATH AFTER PASSING THROUGH SPACE	2006
JP2006061861-A	PROCESSING APPARATUS OF ORGANIC SLUDGE HAS HIGHTEMPERATURE HIGH-PRESSURE PROCESSING APPARATUS, DEHYDRATION-TREATMENT APPARATUS, WATER-TREATMENT PLANT, PRESSURIZATION STEAM-SMOTHERING UNIT AND MEMBRANESEPARATOR	2006
JP2006198461-A	COMPOSITE REVERSE OSMOSIS MEMBRANE USED FOR WATER TREATMENT, HAS CROSSLINKED POLYAMIDE SEPARATION FUNCTIONAL LAYER CONSISTING OF GUANIDINE AS POLYFUNCTIONAL AMINE COMPONENT AND POLYFUNCTIONAL ACID HALIDE, ON SUPPORT	2006
JP2006224048-A	MODIFICATION OF SEPARATION MEMBRANE, SUCH AS REVERSE OSMOSIS MEMBRANE, INVOLVES PERFORMING PRESSURIZATION WATER FLOW OF WATER CONTAINING ORGANIC COMPOUND WHICH CONTAINS POLYPHENOL, IN MEMBRANE	2006
KR2005063478-A	ADVANCED WASTEWATER TREATMENT APPARATUS FOR FURTHER IMPROVING TREATMENT EFFICIENCY OF BIOLOGICALLY TREATED WATER BY COMPLETELY REMOVING SUSPENDED SOLIDS AND ESCHERICHIA COLI USING SUBMERGED MEMBRANE	2006
KR2005100833-A	ANTIMICROBIAL COMPOSITE HOLLOW FIBER MEMBRANE AND A MANUFACTURING METHOD THEREOF FOR IMPROVING BACTERIA ERADIATION AND FOULING RESISTANCE BY ADDING AN ANTIMICROBIAL AGENT	2006
US2006003210-A1; WO2006076031-A2	SOLID POLYMER ELECTROLYTE MEMBRANE FOR E.G. FUEL CELL, COMPRISES CO-PROCESSED MIXTURE OF SUBSTRATE POLYMER, E.G. HOMOPOLYMER OR COPOLYMER OF LIQUID CRYSTALLINE POLYMER, AND ION-CONDUCTING MATERIAL CONTAINING E.G. ION-CONDUCTING POLYMER	2006
US2006021936-A1; WO2006015496-A1; CA2477333-A1	TREATMENT OF WASTEWATER INVOLVES PROVIDING AT LEAST ONE OF HYDROGEN AND METHANE GAS TO HOLLOW INTERIORS OF FIBERS OF MODULE, AND THE GAS PENETRATES THE WALLS FOR FEEDING BIOFILM ON EXTERIOR SURFACE OF FIBERS	2006
US2006054552-A1	REACTOR FOR TREATING HOME, MULTI-RESIDENTIAL OR INDUSTRIAL WASTE WATER, E.G. BLACK OR GRAY WATER, HAS PROCESS TANKS OR ZONES FOR AEROBIC DIGESTION, (DE)NITRIFICATION, AND IMMERSED MEMBRANE TANK OR ZONE	2006
US2006144787-A1; WO2006074259-A2	MEMBRANE-BASED SYSTEM FOR TREATING CONTAMINATED LIQUID, CARRIES OUT REMOVAL OF INSOLUBLE PARTICLES FROM CONTAMINATED LIQUID, MIXING, FILTERING INSOLUBLE CONTAMINANTS, SEPARATING IONIC CONSTITUENTS, AND REMOVING DEIONIZED PRODUCT LIQUID	2006
US2006169636-A1	TREATMENT OF WASTEWATER SUCH AS INDUSTRIAL WASTEWATER, INVOLVES PRODUCING MEMBRANE REJECTION STREAM AND TREATED EFFLUENT PERMEATE STREAM BY FLOWING EFFLUENT STREAM GENERATED USING MIXED LIQUOR SUSPENDED SOLID STREAM, INTO MEMBRANE STAGE	2006

US2006177555-A1; JP2006218378-A	WATER-TREATMENT APPARATUS HAS PURIFYING SECTION, STERILIZING SECTION, WATER-STORING SECTION, AND WATERQUALITY DETECTION SENSOR WHICH DETECTS QUALITY OF STERILIZED WATER TO BE DISCHARGED TO THE OUTSIDE	2006
WO2005118116-A1	SUBMERGED MEMBRANE SYSTEM FOR FILTERING SURFACE/GROUND WATER, COMPRISES AERATOR, WHICH CAN GENERATE LIQUID VORTEX FLOW AROUND MULTIPLE DISPOSABLE MEMBRANE MODULE, TWO THREE-WAY VALVES CONTROLLING LIQUID FLOW DIRECTION, AND ALTERNATING RELAY	2006
WO2005120688-A1	INTRODUCING SOLUTION INTO AIR COOLER INVOLVES POSITIONING PERMEABLE MEMBRANE BETWEEN TWO SOLUTIONS HAVING DIFFERENT SOLUTE CONCENTRATIONS, INTRODUCING SECOND SOLUTION IN WHICH SOLVENT IS REMOVED BY EVAPORATION, AND RECYCLING SECOND SOLUTION	2006
WO2006001528-A1	POROUS MEMBRANE FOR TREATING RIVER WATER AND SEWAGE, HAS PRESET TENSION IN WETTING AND TENSILE STRENGTH, AND COMPRISES POLYVINYLIDENE FLUORIDE RESIN AND POLYVINYL ALCOHOL POLYMER HAVING PRESET DEGREE OF SAPONIFICATION	2006
WO2006017738-A1; US2006118485-A1	CONVERTING BIOLOGICAL MATERIAL INTO ENERGY RESOURCES INVOLVES APPLYING PULSED ELECTRIC FIELD TO BIOLOGICAL MATERIAL WITHIN TREATMENT ZONE IN PULSED ELECTRIC FIELD STATION; AND PROCESSING TREATED BIOLOGICAL MATERIAL IN BIOGENERATOR	2006
WO2006027560-A2	APPARATUS USEFUL FOR SEPARATION OF LIQUID FROM SOLID-LIQUID MIXTURE IN PURIFICATION OF WASTEWATER COMPRISES ARRAY OF MEMBRANES, LIQUID FLOW CHANNEL, LIQUID COLLECTING CHANNELS, AND GASEOUS FLUID SPACING DUCTS WITH ROW OF SPARGE HOLES	2006
WO2006038503-A1; JP2006130497-A	MANUFACTURE OF COMPOSITE REVERSE OSMOSIS MEMBRANE USED FOR PROCESSING INDUSTRIAL WASTEWATER, INVOLVES POLYMERIZING AQUEOUS SOLUTION CONTAINING AMINO COMPOUND AND ORGANIC SOLUTION CONTAINING POLYFUNCTIONAL ACID HALIDE ON POROUS SUPPORT	2006
JP2006224048-A	MODIFICATION OF SEPARATION MEMBRANE, SUCH AS REVERSE OSMOSIS MEMBRANE, INVOLVES PERFORMING PRESSURIZATION WATER FLOW OF WATER CONTAINING ORGANIC COMPOUND WHICH CONTAINS POLYPHENOL, IN MEMBRANE	2006
CN1769197-A	ZERO DISCHARGE AND CIRCULAR UTILIZATION METHOD OF INDUSTRIAL EFFLUENT IN REGENERATION TREATMENT	2006
KR2005100833-A	ANTIMICROBIAL COMPOSITE HOLLOW FIBER MEMBRANE AND A MANUFACTURING METHOD THEREOF FOR IMPROVING BACTERIA ERADIATION AND FOULING RESISTANCE BY ADDING AN ANTIMICROBIAL AGENT	2006
JP2006198461-A	COMPOSITE REVERSE OSMOSIS MEMBRANE USED FOR WATER TREATMENT, HAS CROSSLINKED POLYAMIDE SEPARATION FUNCTIONAL LAYER CONSISTING OF GUANIDINE AS POLYFUNCTIONAL AMINE COMPONENT AND POLYFUNCTIONAL ACID HALIDE, ON SUPPORT	2006
US2006177555-A1; JP2006218378-A	WATER-TREATMENT APPARATUS HAS PURIFYING SECTION, STERILIZING SECTION, WATER-STORING SECTION, AND WATERQUALITY DETECTION SENSOR WHICH DETECTS QUALITY OF STERILIZED WATER TO BE DISCHARGED TO THE OUTSIDE	2006

US2006169636-A1	TREATMENT OF WASTEWATER SUCH AS INDUSTRIAL WASTEWATER, INVOLVES PRODUCING MEMBRANE REJECTION STREAM AND TREATED EFFLUENT PERMEATE STREAM BY FLOWING EFFLUENT STREAM GENERATED USING MIXED LIQUOR SUSPENDED SOLID STREAM, INTO MEMBRANE STAGE	2006
US2006144787-A1; WO2006074259-A2	MEMBRANE-BASED SYSTEM FOR TREATING CONTAMINATED LIQUID, CARRIES OUT REMOVAL OF INSOLUBLE PARTICLES FROM CONTAMINATED LIQUID, MIXING, FILTERING INSOLUBLE CONTAMINANTS, SEPARATING IONIC CONSTITUENTS, AND REMOVING DEIONIZED PRODUCT LIQUID	2006
KR2005063478-A	ADVANCED WASTEWATER TREATMENT APPARATUS FOR FURTHER IMPROVING TREATMENT EFFICIENCY OF BIOLOGICALLY TREATED WATER BY COMPLETELY REMOVING SUSPENDED SOLIDS AND ESCHERICHIA COLI USING SUBMERGED MEMBRANE	2006
CN1701841-A	ULTRASONIC WAVE AUTOMATIC CLEANING TECHNOLOGY FOR HOLLOW FIBER SEPARATION MEMBRANE	2006
WO2006038503-A1; JP2006130497-A	MANUFACTURE OF COMPOSITE REVERSE OSMOSIS MEMBRANE USED FOR PROCESSING INDUSTRIAL WASTEWATER, INVOLVES POLYMERIZING AQUEOUS SOLUTION CONTAINING AMINO COMPOUND AND ORGANIC SOLUTION CONTAINING POLYFUNCTIONAL ACID HALIDE ON POROUS SUPPORT	2006
US2006054552-A1	REACTOR FOR TREATING HOME, MULTI-RESIDENTIAL OR INDUSTRIAL WASTE WATER, E.G. BLACK OR GRAY WATER, HAS PROCESS TANKS OR ZONES FOR AEROBIC DIGESTION, (DE)NITRIFICATION, AND IMMERSED MEMBRANE TANK OR ZONE	2006
WO2006027560-A2	APPARATUS USEFUL FOR SEPARATION OF LIQUID FROM SOLID-LIQUID MIXTURE IN PURIFICATION OF WASTEWATER COMPRISES ARRAY OF MEMBRANES, LIQUID FLOW CHANNEL, LIQUID COLLECTING CHANNELS, AND GASEOUS FLUID SPACING DUCTS WITH ROW OF SPARGE HOLES	2006
JP2006061861-A	PROCESSING APPARATUS OF ORGANIC SLUDGE HAS HIGHTEMPERATURE HIGH-PRESSURE PROCESSING APPARATUS, DEHYDRATION-TREATMENT APPARATUS, WATER-TREATMENT PLANT, PRESSURIZATION STEAM-SMOTHERING UNIT AND MEMBRANESEPARATOR	2006
JP2006051419-A	MANUFACTURE OF HOLLOW-FIBER POROUS MEMBRANE FOR PRODUCING PURE WATER, INVOLVES DISCHARGING STOCK SOLUTION OF FLUORIDE-TYPE RESIN FROM NOZZLE WITH CORE LIQUID, AND SOLIDIFYING DISCHARGED SOLUTION IN COOLING BATH AFTER PASSING THROUGH SPACE	2006
WO2006017738-A1; US2006118485-A1	CONVERTING BIOLOGICAL MATERIAL INTO ENERGY RESOURCES INVOLVES APPLYING PULSED ELECTRIC FIELD TO BIOLOGICAL MATERIAL WITHIN TREATMENT ZONE IN PULSED ELECTRIC FIELD STATION; AND PROCESSING TREATED BIOLOGICAL MATERIAL IN BIOGENERATOR	2006
JP2006042655-A	DETECTOR OF TOXIC SUBSTANCE IN WATER, COMPRISES IMMOBILIZED FILM OF RECOMBINANT MICROORGANISMS THAT EXPRESS A FLUORESCENT PROTEIN ON CONTACT WITH A TOXIC SUBSTANCE, SAMPLE CONTAINER, EXCITATION LIGHT SOURCE, AND FLUORESCENCE DETECTOR	2006
JP2006035035-A	TREATMENT OF NATURAL WATER E.G. INDUSTRIAL WASTEWATER, INVOLVES INJECTING WATER INTO FILTRATION FILM, BACKWASHING FILM, INJECTING BACKWASHED WASTEWATER INTO ANOTHER FILTRATION FILM, AND BACKWASHING SECONDARY FILTRATION FILM	2006

FR2873311-A1	BIODEGRADABLE PRODUCT, USEFUL E.G. FOR ENVIRONMENTAL BIOTREATMENT AND TO TREAT BIOINCREASE OF INDUSTRIAL WASTEWATER IN SITUATION OF ACCIDENTAL TOXICITY, COMPRISES CONDITIONING LAYER, INTERNAL COATING AND AN AQUEOUS VOLUME OF CULTURE	2006
US2006021936-A1; WO2006015496-A1; CA2477333-A1	TREATMENT OF WASTEWATER INVOLVES PROVIDING AT LEAST ONE OF HYDROGEN AND METHANE GAS TO HOLLOW INTERIORS OF FIBERS OF MODULE, AND THE GAS PENETRATES THE WALLS FOR FEEDING BIOFILM ON EXTERIOR SURFACE OF FIBERS	2006
WO2006001528-A1	POROUS MEMBRANE FOR TREATING RIVER WATER AND SEWAGE, HAS PRESET TENSION IN WETTING AND TENSILE STRENGTH, AND COMPRISES POLYVINYLIDENE FLUORIDE RESIN AND POLYVINYL ALCOHOL POLYMER HAVING PRESET DEGREE OF SAPONIFICATION	2006
US2006003210-A1; WO2006076031-A2	SOLID POLYMER ELECTROLYTE MEMBRANE FOR E.G. FUEL CELL, COMPRISES CO-PROCESSED MIXTURE OF SUBSTRATE POLYMER, E.G. HOMOPOLYMER OR COPOLYMER OF LIQUID CRYSTALLINE POLYMER, AND ION-CONDUCTING MATERIAL CONTAINING E.G. ION-CONDUCTING POLYMER	2006
WO2005118116-A1	SUBMERGED MEMBRANE SYSTEM FOR FILTERING SURFACE/GROUND WATER, COMPRISES AERATOR, WHICH CAN GENERATE LIQUID VORTEX FLOW AROUND MULTIPLE DISPOSABLE MEMBRANE MODULE, TWO THREE-WAY VALVES CONTROLLING LIQUID FLOW DIRECTION, AND ALTERNATING RELAY	2006
WO2005120688-A1	INTRODUCING SOLUTION INTO AIR COOLER INVOLVES POSITIONING PERMEABLE MEMBRANE BETWEEN TWO SOLUTIONS HAVING DIFFERENT SOLUTE CONCENTRATIONS, INTRODUCING SECOND SOLUTION IN WHICH SOLVENT IS REMOVED BY EVAPORATION, AND RECYCLING SECOND SOLUTION	2006
JP2005342635-A	RECOVERY OF PHOSPHORUS FROM SLUDGE SUCH AS HUMAN WASTE, INVOLVES ANAEROBICALLY PROCESSING SLUDGE, DISCHARGING PHOSPHORUS COMPONENT OF SLUDGE, AND PERFORMING SOLIDLIQUID SEPARATION USING MEMBRANE SEPARATOR OF CROSS-FLOW SYSTEM	2006
WO2005105272-A1; US2005252857-A1	APPARATUS FOR TREATING FLUID THAT INCLUDES IONS E.G. NITRATE IONS, FOR E.G. WATER PURIFICATION, COMPRISES MICROENGINEERED MEMBRANE, SYSTEM TO PRODUCE ELECTRICAL CHARGE ACROSS MEMBRANE, AND NANOPORES IN MEMBRANE FOR SELECTIVE PASSAGE OF IONS	2005
JP2005324118-A	TREATMENT OF WATER EJECTED FROM SEWAGE WORKS, INVOLVES ADDING OZONE TO TO-BE-PROCESSED WATER, PERFORMING OXIDATION UNDER ALKALINE CONDITION AND NEUTRAL CONDITION, AND PROCESSING OXIDIZED WATER BY REVERSE OSMOSIS MEMBRANE	2005
JP2005305299-A	EQUIPMENT FOR TREATING WASTEWATER, HAS BIOLOGICAL TREATMENT UNIT, ADSORPTION AND WASHING UNIT FOR REMOVING HORMONE SUBSTANCE OF WATER USING ORGANIC SOLVENT, UNIT FOR IRRADIATING SOLVENT CONTAINING ADSORBATE, AND MEMBRANE FILTRATION UNIT	2005
JP2005270845-A	PROCESSING OF HYDROPHILIC FLUORINE RESIN POROUS MEMBRANE USED FOR WATER TREATMENT, INVOLVES PERFORMING OXIDATION-RESISTANT WASHING OF POROUS MEMBRANE WITH HYDROPHILIC LAYER USING ALKALINE SOLUTION WITH OXIDIZING AGENT	2005
JP2005270707-A	SEPARATION MEMBRANE FOR WASTE WATER TREATMENT, CONTAINS ORGANIC POLYMER, AND INORGANIC MICROPARTICLES HAVING PRESET AVERAGE PARTICLE DIAMETER AND BULK DENSITY	2005

JP2005270708-A	LIQUID SEPARATION MEMBRANE FOR WATER TREATMENT, HAS STRUCTURE COMPRISING POLYETHYLENE VINYL ALCOHOL DISPERSED IN THERMOPLASTIC RESIN	2005
JP2005279447-A	TREATMENT OF INDUSTRIAL WASTEWATER, INVOLVES FEEDING LOW CONCENTRATED LIQUID OF BATCH-TYPE ACTIVATED SLUDGE TREATED LIQUID TO REACTION TANK, CIRCULATING SUPPLIED LIQUID BETWEEN MEMBRANE SEPARATOR, AND RETURNING CIRCULATED LIQUID	2005
JP2005270762-A	MANUFACTURE OF HOLLOW FIBER MEMBRANE USED IN FOODSTUFF INDUSTRY, INVOLVES IMMERSING FILM HAVING HOLLOW SHAPE IN WATER IN RELAXATION STATE FOR PRESET TIME AND TEMPERATURE	2005
JP2005254078-A	TREATMENT OF WASTEWATER, SUCH AS SEWAGE, INVOLVES MEASURING VISCOSITY OF ACTIVATED SLUDGE TREATED LIQUID MIXTURE AND MEMBRANE SEPARATED LIQUID MIXTURE, AND CONTROLLING CIRCULATING FLOW AMOUNT OF MIXTURE BASED ON VISCOSITY RATIO	2005
US2005194310-A1	INCLINED PLATE COUPLED MEMBRANE BIOREACTOR, USEFUL FOR BIOLOGICALLY TREATING E.G. MUNICIPAL WASTE WATERS, COMPRISES ANOXIC AND AEROBIC BIOREACTORS; A SINGLE OR AN ARRAY OF INCLINED PLATES; A SINGLE OR MULTIPLE WEIR SYSTEM; AND A MEMBRANE	2005
JP2005218904-A	WATER-TREATING UNIT FOR REMOVING NITROGEN COMPONENTS, HAS ELECTRO-LYSIS NITROGEN REMOVAL APPARATUS AND REVERSE-OSMOSIS APPARATUS WHICH SUPPLIES CONCENTRATED WATER TO NITROGEN REMOVAL APPARATUS	2005
JP2005218983-A	WASTE WATER TREATMENT INVOLVES DECOMPOSING ORGANIC MATTER AND POLLUTANT MATERIAL BY OXIDIZING SUBSTANCE IN ANODE REGION, SEPARATING CHLORINE GROUP IONS FROM TREATED WATER AND RETURNING ION-CONTAINING WATER IN ANODE REGION	2005
JP2005205300-A	PROCESSING OF POLLUTED WATER CONTAINING DECOMPOSITION-RESISTANT SUBSTANCE, E.G. DIOXINS, INVOLVES ADDING INORGANIC-TYPE ADSORPTION AGENT TO POLLUTED WATER, AND FILTERING RESULTING WATER WITH FILTRATION FILM	2005
WO2005070833-A1; JP2006192378-A; EP1707538-A1	PROCESSING OF DECOMPOSITION-RESISTANT SUBSTANCE-CONTAINING WATER, SUCH AS INDUSTRIAL WASTEWATER, INVOLVES ADSORPTION-TREATMENT PROCESS, MEMBRANE-FILTRATION PROCESS, AND CHEMICAL-DECOMPOSITION PROCESS	2005
JP2005179443-A	POROUS COMPONENT USED AS AQUEOUS-SOLUTION MEMBRANE FILTER, CONTAINS PRESET AMOUNT OF SPECIFIC POLYKETONE, AND POLYMER COMPOUND EXCLUDING POLYKETONE, AND HAS PORES HAVING PRESET AVERAGE PORE SIZE	2005
US2005126972-A1	OXIDATION REMOVAL MODULE FOR TREATING WASTEWATER GENERATED FROM FABRICATION OF E.G. LIQUID CRYSTAL DISPLAY, COMPRISES OZONE INJECTOR, OZONE DISSOLUTION TANK, DEGASSING SEPARATOR, ULTRAVIOLET REACTION TANK, AND RECYCLING MECHANISM	2005
JP2005144315-A	CLEANING OF MEMBRANE MODULE E.G. PRECISE-FILTRATION MEMBRANE MODULE, INVOLVES USING MIXED CHEMICAL SOLUTION CONTAINING INORGANIC ACID AND ORGANIC ACID	2005
US2005123727-A1; WO2005060425-A2; EP1689501-A2	MEMBRANE MODULE FOR USE IN MEMBRANE CASSETTE, HAS FLAT SHEET MEMBRANE UNITS, AND PRIMARY MANIFOLD PERMANENTLY ATTACHED TO MEMBRANE UNITS AND IN FLUID CONNECTION WITH INTERIOR PORTIONS OF MEMBRANE UNITS	2005

US2005109694-A1; CA2470450-A1; JP2005152878-A	WASTEWATER TREATMENT SYSTEM FOR USE E.G. IN DISPOSAL OF MUNICIPAL OR INDUSTRIAL WASTEWATER, COMPRISES ANAEROBIC BIOREACTOR, AEROBIC BIOREACTOR, AND MEMBRANE SEPARATION REACTOR	2005
JP2005125152-A	WATER TREATMENT METHOD FOR INDUSTRIAL LIQUID WASTE, INVOLVES CONTROLLING ADDITIONAL AMOUNT OF COAGULANT FROM MEASURED PHOSPHORUS CONCENTRATION OF NATURAL WATER, COAGULANT ADDED WATER AND/OR FILTERED WATER	2005
WO2005039742-A1; US2005126963-A1	LIQUID TREATMENT PLANT FOR TREATING WATER, E.G. WASTEWATER OR WATER FOR DRINKING, INCLUDES TRAINS OF CASSETTES OF MEMBRANE MODULES AD LOCATED IN SEPARATE MEMBRANE TANKS, AND COMMON MEMBRANE TANK INLET AND OUTLET CHANNELS	2005
JP2005118771-A	CYLINDRICAL CERAMIC POROUS COMPONENT, FOR CERAMIC FILTER, HAS MONO-LAYER OR MULTI-LAYERED INORGANIC POROUS SEPARATION MEMBRANE HAVING PRESET FILM THICKNESS, PORE DIAMETER AND POROSITY, FORMED ON CYLINDRICAL SUPPORT	2005
JP2005111430-A	TREATMENT OF WASTEWATER E.G. WASTE WATER FROM ELECTRONIC INDUSTRY, INVOLVES PERFORMING ACTIVATED CARBON TREATMENT OF WASTE WATER, ADJUSTING PH TO NEUTRAL AND PERFORMING REVERSE OSMOSIS MEMBRANE PROCESSING	2005
WO2005037714-A1; SE200302754-A; SE527145-C2	TREATMENT OF SLUDGE INVOLVES ADDING ACID E.G. AMMONIUM SULFATE TO SLUDGE AND SUBJECTING TO MEMBRANE FILTRATION PROCESS TO OBTAIN PERMEATE/CONCENTRATE INCLUDING ALUMINUM AND/OR IRON IONS IN SOLUTION WHICH ARE CRYSTALLIZED IN PRECIPITATION	2005
WO2005028379-A1; AU2003264549-A1	PROCESSING OF WASTEWATER PRODUCED DURING WATER WASH OF FLY ASH, INVOLVES ADJUSTING PH OF WASTEWATER, AND REMOVING DEPOSIT AND SUSPENDED SOLID FROM WASTEWATER USING SEDIMENTATION TANK AND MEMBRANE FILTRATION APPARATUS, RESPECTIVELY	2005
EP1518831-A1; WO2005028381-A1; EP1663878-A1	AEROBIC WASTEWATER TREATMENT INVOLVES FEEDING WASTEWATER TO REACTOR AND PASSING LIQUID CONTENTS OF REACTOR OVER PERFORATED SEPARATOR HAVING RELATIVELY LARGE PERFORATIONS	2005
US2005061725-A1; US7022236-B2	REACTOR FOR TREATING HOME, MULTI-RESIDENTIAL, COMMERCIAL, INSTITUTIONAL, OR INDUSTRIAL WASTEWATER, INCLUDES PROCESS TANKS, IMMERSED MEMBRANE TANK, CONDUITS OR PASSAGES FOR MIXED LIQUOR, INLET, OUTLET, AND LEVEL SENSOR	2005
JP2005066403-A	MANUFACTURE OF FILTRATION MEMBRANE FOR WATER TREATMENT, INVOLVES IMPREGNATING SOLUTION OF WATER-INSOLUBLE RESIN INTO NON-WOVEN FABRIC, DRYING, AND ADJUSTING PORE SIZE IN IMPREGNATED FABRIC LAYER BY HEATING AND COMPRESSING	2005
WO2005014266-A1	DEFECT-FREE SEMIPERMEABLE COMPOSITE MEMBRANE FOR USE IN FILTERING E.G. ORANGE JUICE CONTAINING SUSPENDED PARTICLES TO GIVE A CLEAR FILTRATE AND CONCENTRATED ORANGE JUICE, COMPRISES SUPPORT LAYER, BARRIER LAYER, AND MIDDLE LAYER	2005
WO2005009580-A2; US2006000766-A1; US7081273-B2	SEMIPERMEABLE COMPOSITE MEMBRANE FOR FILTERING ORANGE OR LEMON JUICE, COMPRISES SUPPORT LAYER, BARRIER LAYER, MIDDLE LAYER	2005

US2005000895-A1	FILTRATION OR TREATMENT OF WATER, E.G. WASTEWATER, TO PRODUCE WATER USEFUL AS E.G. DRINKING WATER, BY ADDING SPECIFIED AMOUNT OF POLYMERIC FLOCCULATION AID TO WATER TO BE FILTERED, AND TREATING WATER WITH MEMBRANE FILTRATION DEVICE	2005
JP2004283658-A	WASTEWATER TREATMENT EQUIPMENT FOR TREATING INDUSTRIAL WASTEWATER, HAS STORAGE PORTION FOR STORING TREATED WATER PROVIDED AT RANGE WHERE SUCTION IN SUCTION PUMP ATTAINS VAPOR LIQUID SEPARATION STATE IN DISTRIBUTION CHANNEL	2004
US2004180411-A1; WO2004081034-A2	MAKING MIXTURE OF PEPTIDES AND SURFACE-ACTIVE AGENTS, BY FERMENTING YEAST CELLS TO OBTAIN FERMENTATION PRODUCT CONTAINING PEPTIDES, DISRUPTING CELLULAR STRUCTURE OF YEAST CELLS, COMBINING PRODUCT FROM CELLS WITH SURFACE-ACTIVE AGENT	2004
JP2004249235-A	MEMBRANE SEPARATOR FOR ACTIVATED SLUDGE PROCESSING SYSTEM, HAS MAIN STRUCTURAL COMPONENT CONSISTING OF FILM ELEMENT, AND CIRCULATION CIRCUIT WHICH CIRCULATES SLUDGE, AND IS OPERATED SPECIFICALLY	2004
WO2004071973-A1; CA2458566-A1; US2004211723-A1	SUPPORTED BIOFILM APPARATUS FOR TREATING WATER, E.G. INDUSTRIAL OR MUNICIPAL WASTEWATER, HAS GAS PERMEABLE HOLLOW FIBERS HAVING OUTER SURFACES SEALED TO HEADER AND LUMENS COMMUNICATING WITH HEADER PORT THROUGH THE HEADER CAVITY	2004
WO2004064978-A1	FILTER ARRANGEMENT FOR LIQUIDS OR WASTEWATER CONTAINING SOLIDS, INCLUDES BRUSH ARRANGEMENT WITHIN CYLINDRICAL FILTER MEMBRANE, AND ADAPTED TO BE ROTATED ON AXIS CO-AXIAL WITH LONGITUDINAL AXIS OF CYLINDRICAL FILTER MEMBRANE	2004
KR2004035635-A; KR438510-B	METHOD FOR TREATING INDUSTRIAL WASTEWATER	2004
US2004149658-A1; US6858147-B2	DIALYSIS OF WASTEWATER FOR REMOVING HEAVY METAL IONS E.G. LEAD, MERCURY INVOLVES FLOWING COLLOIDAL SILICA IN OPPOSITE DIRECTION TO WASTEWATER THROUGH A POROUS MEMBRANE	2004
US2004149653-A1; US7014763-B2	ACTIVATED SLUDGE WASTEWATER TREATMENT COMPRISES OPERATING BIOCHEMICAL TREATMENT VESSEL AND CLARIFICATION VESSEL IN RESPECTIVE BATCH MODE CORRESPONDING TO RESPECTIVE CYCLE OF OPERATION COMMANDS	2004
US2004140200-A1; US6942766-B2	CHLORINE GENERATOR USEFUL FOR E.G. DRINKING WATER SUPPLY SYSTEM COMPRISES PIPE FITTINGS IN ANODE AND CATHODE COMPARTMENTS TO ALLOW ACCESS OF WATER AND SALT TO THE INTERIOR OF THE CELL AND ION SELECTIVE MEMBRANE.	2004
US2004108268-A1; US6863817-B2	REACTOR FOR TREATING WASTEWATER COMPRISES AEROBIC TANK, ANOXIC TANK AND IMMERSED MEMBRANE TANK CONTAINING MEMBRANE MODULE(S) WITH CONDUITS FOR CIRCULATING MIXED LIQUOR BETWEEN THEM TO PROVIDE AEROBIC DIGESTION AND FILTRATION	2004
JP2004141738-A	MEMBRANE FILTRATION METHOD FOR WASTEWATER, INVOLVES SUPPLYING RAW WATER FROM A RAW-WATER TANK INTO THE PRIMARY SIDE OF A FILTRATION MEMBRANE AND SUPPLYING WASH WATER MIXED WITH OXIDIZING AGENTS TO THE PRIMARY SIDE TO WASH THE CAKE LAYER	2004

JP2004136183-A	WATER TREATMENT METHOD OF WASTEWATER, SEWER WATER, ETC, INVOLVES OZONIZING WASTEWATER USING MEMBRANE MODULE FOR FILTRATION, PERFORMING MEMBRANE FILTRATION AND WASHING MEMBRANE MODULE USING OZONE-CONTAINING WATER OR OZONE GAS	2004
JP2004130197-A	WATER TREATMENT METHOD FOR REMOVING POLLUTANTS FROM WASTE WATER, INVOLVES FORMING COATING LAYER ON FILTRATION MEMBRANE OF MEMBRANE MODULE, CARRYING OUT MEMBRANE FILTRATION OF WATER TO BE PROCESSED AND BACK WASHING MEMBRANE MODULE	2004
JP2004089984-A	PROCESSING OF BETA-HALO ALCOHOL-CONTAINING AQUEOUS SOLUTION GENERATED BY PAPER MANUFACTURING PROCESSES, INVOLVES ADDING BASIC COMPOUND(S) AT PRESET AMOUNT WHEN ALCOHOL CONTENT DECREASES	2004
FR2844788-A1; WO2004028980-A1; AU2003279432-A1	REDUCING SLUDGE PRODUCTION IN WASTEWATER TREATMENT PLANTS COMPRISES USING SEPARATE MEANS DEDICATED TO SLUDGE REDUCTION AND PHOSPHORUS PRECIPITATION	2004
FR2844787-A1	REDUCING SLUDGE PRODUCTION IN WASTEWATER TREATMENT PLANTS COMPRISES USING SEPARATE MEANS DEDICATED TO SLUDGE REDUCTION AND PHOSPHORUS PRECIPITATION	2004
JP2004081973-A	PROCESSING OF ORGANIC WASTEWATER E.G. INDUSTRIAL WASTEWATER, INVOLVES ADDING WOOD VINEGAR, POLYPHENOL, AND ORGANIC ACID (SALT) TO TREATED WATER AND CONCENTRATED LIQUID, AND MAINTAINING CONCENTRATION OF ADDED COMPOUND	2004
WO2004018369-A1; JP2004074041-A; AU2003262247-A1	METHOD FOR RECOVERING FLUORINE USED FOR TREATING INDUSTRIAL WASTEWATER COMPRISES MIXING AN AQUEOUS SOLUTION CONTAINING DISSOLVED FLUORINE WITH CALCIUM CARBONATE AND/OR CALCIUM SULFATE SO AS TO FORM CALCIUM FLUORIDES	2004
JP2004073926-A	PROCESSING OF NITRATE- OR NITROGEN-CONTAINING WASTEWATER, INVOLVES CONTACTING RADICAL HYDROGEN AND NITRATE- OR NITROGEN-CONTAINING WASTEWATER IN PRESENCE OF CATALYST, AND REDUCING NITRATE OR NITROGEN TO NITROGEN	2004
WO2004009497-A2; US2004018583-A1; US6699684-B2	MONITORING BIOFOULING IN MEMBRANE SEPARATORS USED IN INDUSTRIAL PROCESSES, INVOLVES TREATING FLUOROGENIC AGENT WITH MICROBES AND CALCULATING CHANGE IN FLUORESCENT SIGNAL OF REACTED AGENT WITH RESPECT TO SIGNAL OF UNREACTED AGENT	2004
KR2003080485-A; KR444358-B	SURFACE MODIFICATION METHOD OF ACTIVATED CARBON FOR WASTEWATER TREATMENT	2004
US2004000521-A1; US6755975-B2	TREATING LIQUIDS CONTAINING ORGANIC COMPOUNDS AND WATER, USEFUL E.G. IN THE FOOD INDUSTRY, IN WASTEWATER TREATMENT, AND IN BIOETHANOL PRODUCTION, COMPRISES A PERVAPORATION STEP IN CONJUNCTION WITH A DEPHLEGMATION STEP	2004

ANEXO IV.- OFERTAS TECNOLÓGICAS

Innovative wastewater treatment system for heavy metals, removing metal ions by inducing sedimentation, without the use of any chemicals (Ref: 07 IL ILMI 0JFT) 03/01/2008

Abstract:

An Israeli SME, expert in the application of breakthrough and innovative technologies and solutions for industrial wastewater treatment, purification and recycling has developed a line of innovative patented systems designed to remove heavy metals including copper, zinc, chromium, cadmium, and nickel from manufacturing discharge waters without the use of chemicals, which enables a factory to reuse the water it employs in manufacturing. The company is seeking partners for joint ventures.

Description:

An Israeli company offers a breakthrough wastewater treatment system for heavy metals, which removes metal ions by inducing sedimentation, without the use of any chemicals. The cutting-edge heavy metal removal system is based on EC (electro coagulation) technology.
EC technology offers an alternative to the use of metal salts or polymers and polyelectrolyte addition for breaking stable emulsions and suspensions. The technology removes metals, colloidal solids and particles, and soluble inorganic pollutants from aqueous media by introducing highly charged polymeric metal hydroxide species.
Electro Coagulation is an electrochemical method of treating polluted water whereby sacrificial anodes corrode to release active coagulant precursors into the solution. Electro Coagulation has a long history as a water treatment technology, having been employed to remove a wide range of pollutants. The heavy-metal elimination system induces sedimentation and removes heavy metal ions from wastewater without using any chemicals. The different metals typically present in industrial wastewater in dangerous concentrations are dealt with simultaneously.
The system is the only one that uses this technology to treat an unlimited volume of industrial wastewater. The systems can be in either stationary or mobile configuration, tailored to the specific user's requirements. Recovered wastewater meets all requirements for use in recycling and/or sewage discharge.

Innovations and advantages of the offer

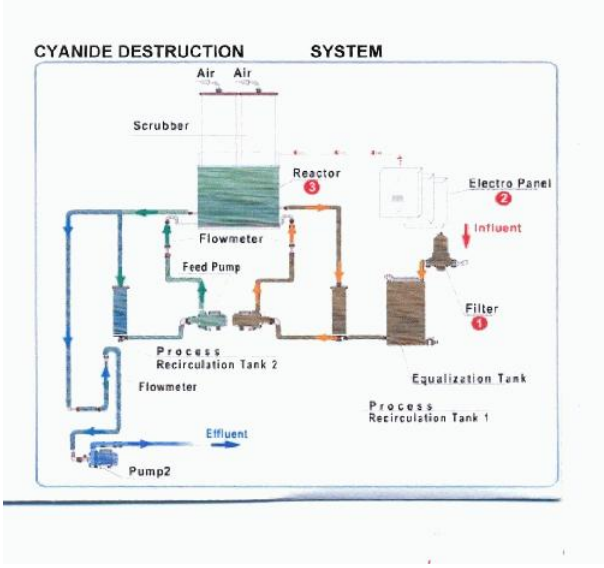
- Zero discharge.
- No chemicals.
- No sludge.
- Continuous-flow process.
- Low electric power consumption requirements. • Environmentally "clean".
• Low-cost operation with comparison to other technologies.
• Continuous-flow process - 24-hour operation capability.
• Fully automated.
• Ability to be in compliance with the latest environmental codes, regulations and guidelines worldwide.
• Very small surface/space requirements (small footprint).

Revolutionary cyanide removal system for treating industrial wastewater - absolute decontamination from cyanide without use of chemicals (Ref: 07 IL ILMI 0JBN) 03/01/2008

Abstract:

An Israeli leading-edge SME has developed an innovative patented system designed to remove cyanide from manufacturing discharge waters without using chemicals, which enables a factory to reuse the water it employs in manufacturing. The company seeks partners for joint venture.

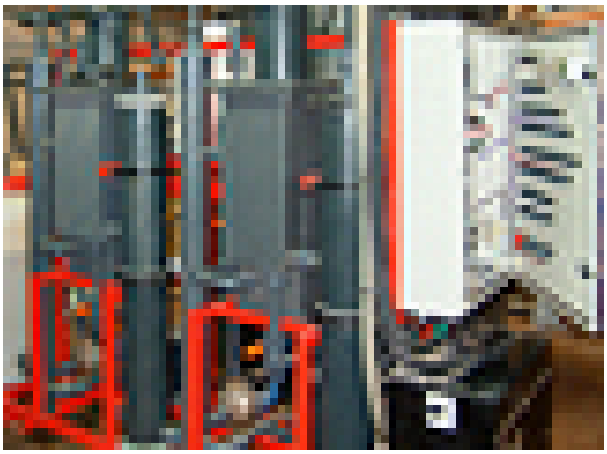
Description:



An Israeli SME, a recognised expert in the application of breakthrough and innovative technologies and solutions for industrial wastewater treatment, purification and recycling, has developed an innovative patented system designed to remove cyanide from manufacturing discharge waters without chemicals, which enables a factory to reuse the water it employs in manufacturing.
The cyanide system oxidises the cyanides and thus liberates nascent ozone, nascent chloride and their respective hydroxyl radicals. The results are carbon dioxide and nitrogen. No other technology today is capable of doing that without using chemical reagents and without producing sludge.
The system works with many and varied applications in a full range of industries including: gold and silver mining, jewellery producers (gold & silver), electronics & manufacturing production, lead-sensitive industries, cyanide-producing and electroplating.

The systems can be supplied in either stationary or mobile configuration, tailored to the specific user's requirements. In the case of a mobile system, the deployment at the customer's site is only a matter of hours. The system operation is simple, safe and fully automated, allowing for 24-hour non-stop use. Operational costs are low - including modest energy consumption - and maintenance is reduced to a minimum. All of the human errors of under-dosing or over-dosing that occur today in the industry because of manual detox of cyanide are absolutely avoided when using this system, due to the stable and predictable process.

Innovations and advantages of the offer



• No chemicals.
• No sludge.
• Zero discharge.
• Allowing 24 hour non-stop use.
• Ability to be in compliance with the latest environmental codes, regulations and guidelines worldwide. • Fully automated system.
• Continuous-flow process.
• Very small surface/space requirements.
• Low electric power consumption requirements.
• Small footprint.

Innovative liquid products and problem solutions for industrial wastewater treatment (Ref: 07 DE SDST 0I8R) 02/07/2007

Abstract:

A German SME offers innovative liquid products for industrial wastewater treatment. With the new products high concentrations of harmful contaminants (e.g. oil, fat, heavy metals) are discharged, set free, isolated and prepared for the following separation, which can be carried out with common techniques like sedimentation, flotation, filtration or centrifugation. The SME is looking for manufacturers of treatment plants that want to simplify their processes and reduce the costs.

Description:

A German SME develops, applies and distributes innovative liquid products, novel demulsifiers (emulsion breakers) and economic problem solutions for chemical demulsification and treatment of industrial water and wastewater.
In order to be able to find the best solution for each customer the SME examines the untreated emulsion or wastewater problem samples of the customers, and then supplies not only the best and most economical liquid product, but calculates the costs of the treatment as well.

According to application and efficiency the products are classified in four groups:
- Group 1: Demulsifiers to break emulsions (e.g. water, soluble lubricants) and to recover oil from wastes.
- Group 2+3: Coagulants to eliminate defined contaminants and clarify the water.
- Group 4: Heavy metal precipitation and decontamination with combi-products.

Moreover certain flocculants e.g. polymers are offered to increase the floc size for much quicker separation of the contaminants containing flocs from the water.
The liquid products work in such a way that critical and harmful contaminants in emulsions or in industrial water or wastewaters are discharged, set free, isolated and prepared for following separation from the water.

The contaminants are eventually prepared as, e.g.:
- Emulgated oil together with unsolved solids float by themselves on top of the water.
- Emulgated oil with heavy metals are inserted in a stable floc.
- Emulgated/dispersed oil or fat, unsolved particles, colloids or heavy metals, dyes or suspended solids are inserted in a stable floc.
- Rests of cyanide and nitrite are converted into harmless substances, rests of Chrome-6 will be reduced and precipitated together with possible present heavy metals in one step.

The separation of the isolated and prepared contaminants from the clear water can then take place in well-known wastewater treatment plants on the open market by using common techniques.

Innovations and advantages of the offer

Traditional chemicals can't be used successfully and economically in case of high concentrations of harmful substances or the presence of additional contaminants (e.g. tensides, dispersing agents and metal complexing agents). Likewise the limits set by the official regulations often can't be observed with traditional chemicals any longer.
The new products used in batch or continuous operations in nearly all cases comply with the regulations of the officials.

For older treatment plants, the quantity and the number of the traditional chemicals used are reduced

and, at the same time, the process is simplified.
For younger treatment plants, the investment costs are clearly reduced thanks to the more simple and reproducible process.
Moreover, most of the time, only one liquid product is required - at heavy metal precipitation maximal two.
The products can solve almost all problems of the organic demulsification and the treatment of industrial water and wastewater.
The liquid products work very well with the common techniques used within treatment plants, i.e. sedimentation alternatively flotation and filtration alternatively centrifugation.

Current and Potential Domain of Application

The products and processes are used by operators of treatment plants as well as by builders of treatment plants using the products with the 'technical application' for projection, building new plants and modernising the operation of older plants.

Electrolytic preparation of reactive metal powders for the specific reduction of heavy metals or nitrate anions in wastewater effluents (Ref: 06 FR IABI 0F2T) 04/05/2007

Abstract:

A French team developed an electrolytic preparation of reactive metal powders for the reduction of heavy metals, nitrate anions. Zinc and iron powders are prepared from bulk metal, in a homogeneous/heterogeneous medium, in an electrolytic reactor containing iron/zinc soluble anodes. Fresh powders offer a large surface and are very reactive in oxidant pollutants reduction. Technical cooperation for industrial tests regarding treatments wastewater effluents, hydrometallurgy process is sought.

Description:

A French electrochemistry team investigated methods to produce highly reactive metallic powders (copper, zinc or iron) by electrolysis. These powders are synthesised in a homogeneous or heterogeneous acidic medium in a reactor containing the corresponding soluble anodes. The electrolytic medium can be made heterogeneous thanks to the addition of various solid particles in the process. These particles help the formation of metal powder and its transfer out of the reactor. The metal powders which are synthesised are reductive reagents and are highly reactive because they are immediately used as soon as they are filtrated. Generally, these metal powders can selectively reduce oxidant pollutants in wastewater effluents. As an example, zinc or iron powder can be used in reduction of heavy metals following a cementation process. Zinc powder can also be used in nitrate anion reduction. This nitrate anion removal is therefore a specific reaction which is not the case for other current methods.
The French team is looking for technical cooperation with a company involved in treatments of wastewater effluents or in metals recovery in hydrometallurgy process.

Innovations and advantages of the offer

The metal powders are prepared from bulk metal by electrolysis, and they are immediately used as chemical reagents.
This fast use makes the powders very reactive with comparison to commercial powders, which are already oxidised on their surface.
The use of freshly prepared metal powders allows fast and specific reactions with heavy metals or nitrate anions in the treatment of wastewater effluents. The electro-generated metal powders are more efficient reagents than the commercial powders.
The uses of metal powders in reduction reactions allow indirect electrochemical processes that are more efficient than direct electrolytic ones.
The specificity of the redox reactions involved is a great advantage with comparison to other treatments like electro dialysis or ion exchange. For example, most treatments that are available on the market for nitrate anion removal are not as specific.

(Mobile) containerised wastewater treatment plants with membrane bioreactor technology (Ref: 07 DE NRXE 0HOZ) 17/04/2007

Abstract:

A German company offers Membrane Bioreactor Technology, which is suitable for application in containerised plants. Sewage treatment with this technology allows higher contents of dry solids and therefore less aeration tank volume. The easy controllable technology and the low demand of technical devices make it possible to construct the machine room in the container robust and simple. Partners are sought for commercial agreements with technical assistance.

Description:

A German company has a business focus on water and wastewater treatment and solid-liquid separation with membrane technology. In the water treatment division, the company manufactures micro- and ultrafiltration modules. They could be used as submerged filtration modules in wastewater treatment plants as well as for the filtration of surface water or for recycling of other resources.

The membrane technology allows cost reduction by use of decentralised, compact water and wastewater treatment plants. There is no need of extensive sewer system and further infrastructure. This innovative technology makes it possible to fulfil current and future legal requirements, it is easy to use and easy to monitor via remote control. Recycling of treated water is possible.

Innovations and advantages of the offer

Innovative aspects of the offer:
- Compact, space-saving and mobile design.
- No construction work on-site necessary.

Main advantages of the offer:
- Fully pre-assembled plant.
- Quick and easy to transport and to assemble/disassemble.

Current and Potential Domain of Application

All kinds of clients in industry and public services that are in need of water and wastewater treatment technology, i.e. communal wastewater treatment plants, military ships and bases, chemical industry, etc.

Total system solutions for cleaning, reclamation and recycling of industrial process liquids (Ref: 07 SE WSIV 0H1K) 05/04/2007

Abstract:

A Swedish SME in the environmental technology field offers a new technology for all types of industrial process water treatment, coolant treatment, swarf handling and briquette press systems. Environmental and economic profit is made through reduced wear and tear for company machines and prolonged life time for process liquids. The company is looking for partners for commercial agreement with technical assistance.

Description:

Recycling system for coolant works in following way: Contaminated coolant is pumped from machine tanks to a central cleaning unit which cleans coolant up to 10 Micron, a tramp oil separator and mixing equipment for soluble oil with automatic level control. The whole system is fully automatic and after the treatment process, coolant is returned to working machines.
Swarf handling is a part of the coolant treatment process: grinding and other forms of machining generally require a high surface finish and its known that the coolant must be free from particles of swarf as these can scratch the surface. The metallic swarf can be either centrifuged or pressed to dry easy- to- handle briquettes. Swarf handling is fully automatic.
The system has no limitations and can be installed in any type of workshop, no matter what size and how many working machines are at the place. Every solution is unique and the technical solution is customer applied. To invest in effective industrial water treatment is beneficial from many perspectives; not to mention the accessibility and efficiency.

Innovations and advantages of the offer

The company offer a new environmental friendly technology (ultra filtration using ceramics, reverse osmosis and ion exchangers) for all types of industrial process water treatment, coolant treatment and swarf handling briquette press. The all-round concept is adapted to suit anything from an individual plant to an entire closed system for processing chips, compressing briquettes, purifying cutting water, separating particles, and purifying and recycling impure process water using membrane, evaporation or ion-exchange techniques.

Current and Potential Domain of Application

Industrial waste water Engineering technology, Membrane technology, Coolant treatment technology, Swarf handling technology, Briquette press technology, Water treatment technology for single households, Flue gas condensate technology.

Membrane Technologies for industrial waste water treatment (Ref: 07 ES CACI 0HGF) 15/03/2007

Abstract:

A research group of a Catalan university (Spain) is working on the implementation of Membrane Technologies for industrial waste water treatment. The group is seeking a partner to improve their techniques simultaneously that offers their expertise and their laboratory and pilot plants to study particular cases where membrane technology may be useful to solve i.e. environmental problems. The researchers are looking for a technical cooperation and they are also open to any type of collaboration.

Description:

Membrane technology has proved useful for solving many environmental problems associated with the discharge of waste waters. On the other hand, membrane technology may be not only useful on solving end-pipe pollution problems but also on recuperating valuable products in the industrial internal processes.
Many times it is necessary to particularize the processes in order to reach the objectives of a particular demand. Our offering and novelty is to study and develop specific membrane processes for definite separations.
Innovative membranes and recent information about processes provides a great potential application of the membrane technology. Typical applications may be the recuperation and concentration of heavy metals, acids, dyes, and other valuables products in dilute industrial streams.
Several steps must be taken before a new membrane industrial process can be put into practice. These steps comprise the laboratory testing to set the viability of the desired separation and the experimental work on pilot plant to assure the performance of the industrial plant.
The group has a variety of lab devices to test different kind of membranes: flat-sheet polymeric membranes, tubular ceramic membranes and electro dialysis membranes. At the same time, different membranes processes can be analyzed: reverse osmosis, Nano filtration, ultra filtration, micro filtration and electro dialysis.
The lab devices can be operated at different temperatures and pressures (up to 50 bars).
Furthermore, the group has a pilot plant, which allows operating with industrial membrane modules for a large period of time with a production capacity of 30 L/h. All the process have been developed and improved with the personal expertise of the group, as their know-how.

Innovations and advantages of the offer

Nowadays, membrane technology feels a considerable expansion in detrimental of other conventional technologies as distillation, liquid extraction, liquid absorption, solid adsorption, etc. The advantage of the membrane technology is their simplicity, the easy scale up and the ability to operate at low temperatures with high energy efficiency.

- The main economic advantage membrane technology comes from their simplicity. However, the processes have to be adapted at the specific conditions of the requests. The group has developed particular solution for the phosphoric acid recuperation in rinse waters from anodizing plants, dealcoholisation of ethanol–water extracts (oils, aromas, etc.), colorant recuperation in rinse waters, etc. The group can make studies for particular cases where the membrane technology may provide valuable solutions.

Centrifugal Membrane Filter (Ref: 05 DE HRIM 0D6E) 15/03/2007

Abstract:

A German inventor has developed an apparatus for dynamic filtration of fluids or gases, which is able to efficiently counteract the deposit layer with minor energy. Thus, the block-up of the membrane as well as the disruption of the filtration process will be prevented. The lack of blocking is a great advantage as very high filter durability can be reached. The inventor is looking for licensees for production and distribution.

Description:

The newly developed apparatus for the filtration of fluids and gases - consisting of a rotationally symmetrical filter body where several filter discs are combined to one filter element in its rotation axis - will allow to efficiently counteracting the deposit layer with minor energy. Here, the principle of a cyclone will be applied by generating a primary and secondary turbulence within the body, thus causing a zone with high turbulent flow conditions, which will lead to the avoidance of blocking caused by adherent particles on the filter surfaces.

Innovations and advantages of the offer

Simple filter unit that can be used across the whole area of membrane filtration in many sectors of production and environment protection, such as for example in beverage industry, wastewater treatment, textile industry and much more, and therewith also covers micro-, ultra- and nano-filtration. The implementation of the invention will be possible even in the area of reverse osmosis.

Advantages:
• Simple modular structure without rotating parts.
• High turbulence with minor energy input.
• Decoupled arrangement of trans-membrane and stream pressure.
• Constant overflow of the membrane.
• Use of all membrane materials possible.
• Adequate for the use of especially stroke-sensitive membrane.
Materials as for example ceramic discs.
• Use at high temperature possible.

Water treatment technology for making clean, healthy and tasty potable water on a cost-effective basis (Ref: 07 DE HRTH 0H7G) 05/03/2007

Abstract:

A German company offers a water treatment plant with the possibility to process clean, healthy and tasty potable water from polluted water. This chemical-free water treatment needs very low energy, is easy to maintain and allows ideal utilisation of the existing water. These water treatment plants are self-contained systems for treatment of surface, rain, ground and secondary waters without chemicals. The basic model can be run as single or multiple applications.

Description:

A German company goes completely new ways of water treatment and water conditioning to get drinking/potable water quality under special consideration of conditioning free of chemistry, low energetic working set-up and far-reaching protection of the aquatic resources.
Starting point is a standard plant conditioning rain, surface and running waters. The set-up with a daily performance of up to 60 m^3/day only needs 750 watts of current per working hour. Thus it is possible to run this “mini water plant” also in areas with poor electricity supply, e.g. by solar energy or wind power.

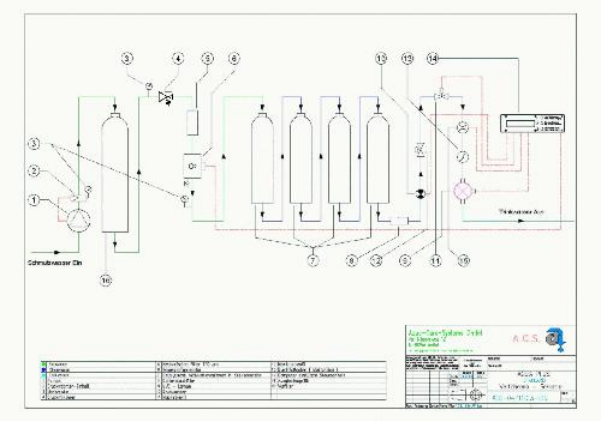
Except the classical, little absorbing salts, e. g. those on chloride and sulphate base in high concentrations (cooking salt, sea salt) nearly all material contents with high efficiency can be eliminated from the water with a tailor-made application of the plant. In order to produce clear water (not pure water) totally free of any salts a modified reverse osmosis (RO) can be additionally put to use according to the standard of technology and the demand of power - the standard plant is

combined with a RO system. Thus a high economic success is guaranteed.

In an electronically steered process with a 4-stage catalytic reactively working active carbon cascade these electro-chemically working units guarantee that clean and healthy water is available. Organic and inorganic dirt and suspended solids, contaminations and germs existing in bad tap water, grey water as well as rain water caught in tanks or in river water are removed. After another security step, by means of physical sterilisation by UV-C light, a drinking water quality according to the guidelines of the WHO is reached within a seven-minute processing time without the application of any chemicals.

Controls: the plant is equipped with several sensors and an electronic control unit (6). At each start up, every single step is checked automatically before the magnetic valve can open to release water. The red light signals a malfunction, the type of which will be indicated on the display of the control unit. In this case, the valve will remain closed. If one or several steps fail during water treatment, the system will automatically shut down and display the reason.

Innovations and advantages of the offer



The water treatment plant works highly economically and thus connects high profitability with responsible ecological thinking oriented to the future:
- Low production costs by standardised component technology.
- Customised adaptations for the highest effectiveness.
- Low servicing expense in long intervals.
- No costs for chemicals.
- Long investment lastingness.
- Amortisation times according to use purpose with 2 to 5 years.
- Working price according to normal use approx. 0,07 EUR per m³.
- Little space required.

New process for extraction of heavy metals from industrial wastewater (Ref: 05 IL ILMI 0C6K)
20/02/2007

Abstract:

An Israeli SME developed a unique, compact system, which may be produced as a modular and/or portable unit, enabling a continuous process for removing non-ferrous and heavy metals from industrial sewage and obtaining a high quality of treated water at a low-cost automatic operation. The company is looking for engineering companies involved in treatment of industrial waste effluents for the implementation of the technology to specific needs.

Description:

An Israeli SME developed a new process for treatment and extraction of heavy metals from industrial wastewater.
The system consists of a unique process to create a rapid and complete settling of metal ferrite from industrial sewage, at a relatively low reaction temperature. The reaction occurs in a specially designed continuous flow reactor that provides the magnetic field and creates a rapid mixing of the various incoming streams and the magnetite seed. The reaction rate is quite rapid allowing for the use of a compact continuous flow system.
The magnetic ferrite precipitate is crystalline and has a specific gravity of about five, allowing for relatively easy separation from the treated effluent. Further drying of the precipitate is simplified by the compact crystalline nature of the precipitate. This is in sharp contrast to the colloidal jelly like nature of the metal hydroxide precipitates.

Typical Effluent Purification by the new technology

METAL INITIAL CONCENTRATION TREATED EFFLUENT
mg/litre mg/litre
Cr. 140 0.04
Zn 50 0.08
Ni 20 0.08
Co 250 1.0
Cd 5 nd
Pb 5 <0.5

The metal ferrite are chemically stable and do not create any environmental influence. They can be recycled in the metallurgy and other industries, utilising the concentrated metal contents.

Innovations and advantages of the offer

The following combination of features:
1. Introduction of a small quantity of activated magnetite into the treatment stream.
2. Precipitation in the presence of a low-intensity magnetic field.
3. A rapid continuous-flow process.
4. A room-temperature low-pressure process.
5. Extremely low residual heavy metals regardless of the initial concentrations or combinations of metals present.
6. Precipitation occurs in alkaline solution over a wide range of pH. In many instances an alkaline bath requiting treatment already exists e.g. alkaline zinc wash water an be combined with chromate wash water to achieve the proper pH.

Main advatages:

- Heavy metal removal from industrial effluents as a crystalline ferrite.
- Simple separation and removal of solids from treated liquid.
- High quality of treated water.
- One pH-controlled treatment step.
- Minimal additional chemicals required.
- Low-cost automated operation.
- Consistent treated water quality independent of variations in input streams.
- Energy and disposal costs savings.

Current and Potential Domain of Application

Metal industries involved in surface treatment processes including plating, coating and galvanisation. Extraction of heavy metals from industrial effluents

Innovative process for the treatment of wastewater and sewage (Ref: 07 LU TSLU 0HDB) 08/02/2007

Abstract:

A company based in Luxembourg has developed a technology that provides the most efficient primary treatment of wastewater, which results in much smaller, less expensive and easier-to-operate plants. The company has simplified the wastewater treatment process through the usage of its patented solid/fluid separator, which achieves almost complete separation of solid materials from the wastewater. The company is looking for commercial agreements with technical assistance.

Description:

A conventional wastewater treatment plant requires several stages in order to separate all the solids from the water. The sedimentation tanks in conventional plants are often made too small because of limits to cash resources and available space. This has a negative impact on the entire purification process. The grit chamber and the primary sedimentation basin in conventional plants have a cleaning efficiency of only up to 85% of the solids that do not dissolve. A lot of this matter then goes into the next basin and has a negative impact on the biological treatment process. As a result, the activation basins of conventional plants have to be made much bigger. The proposed process replaces the sedimentation tank with a solid/fluid separator. This separator fulfils the function of the grit collector and the mechanical sedimentation tank and separates up to 99,9% of all "settleable"

solids. The company offers turnkey solutions for wastewater treatment plants for industrial companies and municipalities.

Innovations and advantages of the offer

By integrating the patented separation process into the wastewater treatment and by improving the primary treatment, municipal and industrial wastewater plants could eliminate virtually all solid materials from the wastewater, which would result in the ultrafiltration membranes not clogging or tearing.
The technology developed by the company offers many advantages:
- Cost-savings of up to 50%.
- Very low maintenance.
- Improved sludge treatment.
- Reduction in required surface area of up to 90%.
- A closed system without open water surfaces.
- No inconvenience from smell or noise.
- Re-circulation of treated water in industrial applications.

Current and Potential Domain of Application

The system is suitable for wastewater treatment plant for municipalities and industries. Other potential domains of application are:
• Dairies.
• Slaughterhouses.
• Agricultural businesses.
• Canneries.
• Sugar refineries.
• Breweries.
• Distilleries.
• Wineries.
• Tanneries.
• Wool cleaning facilities.
• Textile business and dye works.
• Flax roasting facility.
• Wood pulp processing plants.
• Paper factories.
• Waste disposal sites.
• Chemical industry.
• Mining.
• Metalworking shops.

Catalysts for removal of cyanide and chlorine-containing compounds from industrial wastewaters (Ref: OO/URJC/07) 10/11/2006

Abstract:

A Spanish university has developed a procedure for the preparation of catalysts used in the treatment of wastewaters polluted by cyanide and chlorine-containing compounds from industries related to precious metals mining, galvanisation, coal gasification, chemical or pharmaceutical plants. The catalytic system shows economical advantages compared with the commercial catalysts. The research group is looking for companies interested in commercial agreements with technical assistance.

Description:

The industrial wastewaters polluted by cyanide compounds are an important environmental problem due to high toxicity of these compounds. These polluted wastewaters are produced in industrial activities related to precious metals mining, galvanization and coal gasification. These wastewaters contain approximately 100 parts per million of cyanide compounds which have to be removed in the water treatment plants. The presence of chlorine-containing organic compounds, not only in wastewater but also in drinking water or untreated water, represents a serious risk for human health and, in general, for the environment, since these compounds are persistent and accumulative in the living organisms, besides toxic and/or carcinogenic.
One of the most efficient and economically feasible methods to purify these waters is photocatalytic oxidation. This process implies oxidation of the polluting compounds using light with the appropriate energy and one catalyst. The commercial catalysts are based on titanium dioxide. However the industrial application of these catalysts is restricted by the high filtration costs in order to recover the catalyst.
The developed technology consists of a method to deposit the titanium dioxide over a inert carrier of silica. This system shows a high catalytic activity in the removal of cyanide compounds, including free cyanide and complex cyanide compounds, and the filtration process is easily and cost-effectively done. The reaction is carried out at ambient temperature under the right light irradiation and nitrates and carbon dioxide are obtained as final products. A catalysts containing 20% of titanium dioxide shows the higher catalytic activity.
Another research project is the development of titania with mesoporous structure to increase the efficiency of the contact between the wastewater and the surface of the catalyst, allowing a better separation by filtration due to the higher particle size of the material.
The working group has wide experience in the development of catalytic materials and has worked in research projects along with a Spanish company involved in precious metal processing.

Innovations and advantages of the offer

The photocatalytic oxidation to remove cyanide compounds from wastewaters might be carried out using a commercial catalyst based on titanium dioxide. However, the application of this process is restricted due to the small particle size of the catalyst, which makes the filtration process after the reaction very difficult and expensive. The developed technology shows to be a feasible method to support the titanium dioxide over the silica carrier or to prepare mesostructured pure titania. These catalysts make the filtration process easier, and this way the costs are reduced, encouraging industrial application of these catalysts. With comparison to commercial catalysts, the application of catalysts supported on silica implies a high decrease of the costs of the photocatalytic purifying process.
Besides the environmental advantages are clear. Currently the water treatment plants remove the cyanide compounds using chemical treatments with sodium hypochlorite. However, this technology removes the free cyanide compounds but does not remove the complex cyanide compounds. This fact implies that the complex cyanide compounds can be present in the water after having been

treated in the plant.
The chlorine-containing compounds are usually removed by aerobic biological treatments, although they are appropriate in all cases. Thus, these pollutants stay in water or are treated in a second stage with anaerobic organisms, increasing notably the cost of the treatment. The technology developed allows removing these complex compounds in a cost-effective way, and so the complete removal of polluting cyanide compounds will be achieved.

Current and Potential Domain of Application

Companies in the field of precious metal processing.

Technical Know-how and Expertise for the production of Drinking Water and Process Water using Reverse Osmosis Technologies (Ref: TO-MLT-ENV-014) 19/09/2006

Abstract:

A Maltese micro consultancy firm offers specific know-how related to water, wastewater treatment and water recycling for beverage production, pharmaceutical, manufacturing and electronic industries. Treatment processes include seawater and brackish reverse osmosis systems, sand and activated carbon filtration, iron removal and disinfection with UV and ozonation. This firm seeks to assist any partner seeking technical solutions for existing challenges for future projects.

Description:

A Maltese consultancy firm provides know-how expertise in the various areas related to water treatment. These include reverse osmosis engineering, water treatment plant design, seawater and brackish water reverse osmosis systems, chemical and microbiological water analysis, and groundwater resource assessment. The specialisation is related to seawater and brackish water. Such specialisation is essential in regions where the availability of fresh water is scarce. In addition, since the know-how ranges over the various water treatment areas, comprehensive project solutions can be advised. In addition, initial environmental audits, studies and impact assessments can be undertaken.

Innovations and advantages of the offer

This is considered to be an innovative offer as currently this know-how in the practical use of membrane processes for the treatment and recycling of process water is not readily available. This know-how is based on years of experience backed by the local widespread use in Malta of reverse osmosis technology for the production of drinking water and process water. Drinking water is an essential to ensure life, and thus this know-how can be of vital importance in regions where this drinking water cannot be sourced otherwise. The advantage of this offer is that all projects related to drinking and process water treatment can be professionally addressed. In addition, this firm specialises in production of drinking water using reverse osmosis technologies with a special interest to the leisure industry. Hence a cost saving potential can be evaluated for those leisure centres, such as hotels, that are situated close to seawater or brackish water sources.

Current and Potential Domain of Application

Water and Waste Treatment;
Reverse Osmosis;
Desalination;
Irrigation Systems;
Well and Ground;
Production of Bottled water;
Industrial water treatment.

Ultra filtration membrane and process for water and wastewater treatment (Ref: 05 FR SOCM 0D5E) 01/09/2006

Abstract:

A French technology company, founded 8 years ago by two membrane specialists, has developed a full range of hollow-fibre membranes and modules especially designed for water and wastewater treatment. The applications of these innovative membranes, modules and processes are in the residential, commercial, industrial and municipal fields. The company seeks collaboration with distributors, OEM and/or water treatment companies, and is particularly interested in Eastern Europe.

Description:

A French technology company, founded 8 years ago by two membrane specialists, has developed a full range of hollow-fibre membranes and modules especially designed for water and wastewater treatment.

The company is involved in European and French research projects and programs, and is the partner of ESA for the construction of the wastewater treatment plant of the Concordia Antarctic International Scientific station.

The company seeks collaboration with distributors; OEMs (Original Equipment Manufacturers) and/or water treatment companies to introduce products market, and is particularly interested in Eastern Europe. Such collaboration is already in place in the USA for example.

The applications of these innovative membranes, modules and processes are in the residential, commercial, industrial and municipal fields:
- Treatment of natural water (ground water, surface water) for drinking water or process water production.
- Pre-treatment of soft and salty water before demineralization by reverse osmosis.
- Tertiary filtration of pre-treated wastewater.
- Combination of the membrane process with bioreactors: membrane bioreactors (proprietary process).

Innovations and advantages of the offer

The technology is the only Outside In full dead-end pressurised modules and process with true ultra filtration-resistant membranes.
- The new geometry of modules is more compact than the ones of competitors with a large membrane area in a low space and a competitive cost.
- The Outside In geometry of modules is able to treat water containing a high load of suspended solids.
- The module is simple with one entry and one outlet simplifying the construction of filtration systems.
- The process is simple and the filtration systems are so reliable and cheap to construct.
- The membrane modules are NSF (National Sanitation Foundation)/ANSI (American National Standards Institute) 61-certified.

Current and Potential Domain of Application

Ultrafiltration is more and more used in the water treatment field.
Municipal:

- Drinking water production
- Wastewater treatment (discharge/re-use)

Industrial:
- Water treatment
- Pre-treatment of reverse osmosis
- Wastewater treatment for discharge/re-use.

Electrochemical water treatment - contaminant removal (Ref: 06 GB WADA 0G9Z) 26/06/2006

Abstract:

A Welsh company has developed a continuous-flow electro-coagulation process to remove contaminants from water streams. The system has been tested for substances such as arsenic, cadmium & other heavy metals, commercial dyes, phosphate, hydrocarbons and other dissolved contaminants. Much less sludge is generated than with chemical methods currently used. Industrial and academic partners are sought for technology cooperation, research collaboration and potential new applications to be identified.

Description:

A Welsh SME has developed a continuous -flow electro-coagulation process to remove contaminants, particularly dissolved contaminants from water streams. The system is an easy-to-handle pre-packaged electrode system that has lower power consumption and reduces the generation of sludge. Its potential markets are wide and include:

- Phosphate removal (dairies, treated sewage)
- Mine water, acid mine waste
- Recycling or treating industrial effluent for reuse as process water or cheaper discharge to drain
- Pre-treatment for reverse osmosis or nano-filtration
- Removal of heavy metals with potential recovery
- Dye house effluent
- Cooling towers
- Waste from food and drink industries
- Treatment for drinking water applications
- Treatment of ship bilge water
- Landfill leachate

Industrial and academic partners are sought for licensing, technology cooperation, research collaboration and potential new applications to be identified.

Innovations and advantages of the offer

- Small footprint for the amount of liquid treated.
- Easy to service and maintain and minimal (or no) downtime.
- Modular system but scales up to large fixed system.
- Low power consumption; can be single-phase or run by photovoltaic or similar.
- Pre-packaged electrode system.
- Innovative method of speeding subsequent separation.
- Laboratory bench testing to establish suitability of effluent for treatment and optimum treatment level.
- Pilot plant available.
- Can be easily retrofitted.
- Remote monitoring available.

Wastewater treatment and recycle in the processes of wet textile dyeing (Ref: 06 IT TUPR 0FJ3) 13/06/2006

Abstract:

An Italian research Centre has developed an innovative process to treat wastewaters from textile dyeing, based on a physical-chemical treatment and an ultra-filtration technology utilising flat membranes. The technologies are applied in a pre-industrial scale prototype and allow partial reuse of treated wastewater during the production cycle. The centre is looking for partners interested in the realisation of full scale plants for applications in the textile and in other industrial sectors.

Description:

The research centre offers experience and know-how to develop a full scale industrial plant, based on physical-chemical processes and innovative membrane technologies, which allows the treatment and reuse of treated wastewater from textile dyeing processes. The pre industrial prototype is actually operating in a company that dyes mainly natural fabrics (cotton, flax, viscose) and only a little of synthetic fabrics (nylon, polyester). The production process foresees the use of reagents, direct, reactive and dispersed dyes, softeners, surfactants, salts, etc which constitute the pollution load in the daily charge of waste water (1000 m3). Treated fabrics are then utilised in clothing and furnishing industries.
In particular, the proposed depuration system is composed of the following sections: clarification, ultra-filtration and ozonisation.

- The clarification allows solid-liquid separation removing a considerable amount of colloids and suspended solids which are present in the processed wastewater. Upstream the depuration system, a self-cleaning mechanical drain is foreseen to remove fragments of fibres which separate from textile during the thermal, mechanical and chemical stresses during the production cycles. A balance tank is necessary to realise a qualitative and quantitative homogenisation of effluents.
The clarification section includes a coagulation tank and a sedimentation tank. In the first one the addition of chemical coagulants and flocculation agents facilitates the aggregation of the suspended colloidal materials. In the second tank the decantation process, made more efficient by using a lamellar pack, separates coagulum from the surfactant solution. The final part of the pre-treatment section is a system of sand filtration to remove parts of suspended materials which are hydraulically carried over from the sedimentation tank.

- The ultra-filtration section uses poly-vinyliden-fluoride flat membranes and the necessary trans-membrane pressure is obtained with a vacuum pump. To reduce the fouling processes a pump continuously re-cycles wastewater generating a turbulent flow on the external surface of the membranes. This unit does not allow the crossing of molecules bigger than 10 µm. In this way, the suspended solids, the bacteria, the viruses, the colloidal silica and the emulsion oils are retained.

- The ozonisation is realised in a column where ozone and liquid are mixed. Un-reacted ozone is reduced to oxygen through the use of a proper thermo-catalyst. A second sand filter is necessary to remove any suspended material generated during the ozone treatment.

The process is completely controlled by a PLC system which manages all the installed components and allows the continuous treatment of in-let wastewaters.

Innovations and advantages of the offer

The innovative aspects of this process consist of a combination of technologies that are commonly used for the treatment of industrial wastewater. These technologies are properly combined to obtain

progressive reduction of the pollutant load in wastewater from textile dyeing.
The cross-flow ultra-filtration unit, equipped with polymeric flat membranes, represents the heart of the process. The membrane technologies are assuming a primary role in urban and industrial wastewater treatment due to their limited operational costs, versatility and high efficiency to remove the pollution load without utilising chemicals. Ozonisation is another emerging technology of great interest, which assures complete oxidation of dyes, removal of smells, reduction of COD (Chemical Oxygen Demand) values and anti-bacteria properties without producing any dangerous by-product as it happens for chlorinated oxidant agents. In fact, the final products of ozonisation process are water and carbon dioxide.
Besides, the whole purification system represents in itself an innovation since it is characterised by high flexibility, transferability and reproducibility. The system can be successfully applied for the treatment of other effluents of the wet textile sector as, for example, finishing and washing or tested for the treatment of wastewaters from other industrial processes such as chemical, pulp and paper, tannery, pharmaceutical, etc. The set-up process allows reuse of the treated wastewater in the wet textile production cycle with a consequent reduction of water supply and pollution load at the discharge, with respect to the European Directive IPPC 96/61/CE.
The pollutant load of the in-let effluent is drastically reduced in terms of COD (average removal 70%), turbidity (average removal 94%), total suspended solids (average removal 90%), colour (average removal 94%) and surfactants (average removal 73%) allowing the reuse of treated wastewater in the production cycle. The full-scale process will allow the reutilisation in the production cycle of at least 40% of treated water.

Current and Potential Domain of Application

Industrial application of this process concerns the recycle of the textile dyeing effluents after their purification. The flexibility of the combined technologies could be successfully applied also to waste water from finishing and washing.

Hybrid biological reactor of membranes for sewage treatment (Ref: 05 ES NWCI 0CNZ) 01/06/2006

Abstract:

The Spanish University of Santiago de Compostela has developed a hybrid biological reactor for the treatment of industrial and urban sewage which can be used for:
-technologies of biological treatment and disposal processes of nitrogenous and organic contaminants
-systems of bio-reactors of membranes and hybrid reactors for the treatment of sewage.
The main advantages are the low levels of solids in suspension acquired in the refines effluent. The inventors are looking for a licence agreement

Description:

The hybrid biological reactor of membranes for the industrial and urban sewage treatment with organic and nitrogenous materials means an improvement in the systems for the biological treatment of sewage and hybrid reactors. It is built of three cameras: anoxic, aerobic and membranes filtration.Inside the three cameras the suspension mud is maintained and in the aerobic camera is confined in a granular and bumpy plastic support where a bio-film grows with an elevated fraction of nitrificant micro-organisms and it is fluidised by means of an application of air stream that it is distributed through the diffusers of the camera. The filtration camera includes ultra-filtration membrane modules of empty fibre, which is used to separate the treated water from the biological mud, circulating the mud to the anoxic camera with the goal of keeping a proper microbial concentration.

Innovations and advantages of the offer

With this invention, it is possible to use the system with a mud in suspension that contains an elevated fraction of precise heterotropic micro-organisms to denitrify in the anoxic camera and eliminate the leftovers of the soluble organic material that could reach the aerobic camera.
It can purify the sewage in hybrid equipment more compacted than the classical systems of active mud. The invention allows to manage the organic and nitrogenous load at different speeds, faster than other systems.
There is the possibility to transform plants of active mud already constructed in plants of hybrid systems realizing small modifications in the work and adding a proper support to increase the treatment capacity of the plant.

Submerged membrane bioreactor technology for wastewater treatment (Ref: 06 GB NIIN 0F40)
10/04/06

Abstract:

A UK SME offers their new technology for wastewater treatment based on submersible membranes. This technology can yield a 5/5 figure for suspended solids and Biological Oxygen Demand (BOD). They are seeking a commercial agreement with technical assistance and envisage a long term partnership with further products being developed rather than a "one off" exchange of technology.

Description:

The technology is specifically designed for industrial effluent treatment (e.g. dairy, pharmaceutical, and textile), landfill leachate treatment, and reuse of treated effluent, biomass removal, recovery and concentration. It will be particularly attractive to companies servicing the waste water treatment demands of small industrial or commercial premises in terms of low running costs ease of installation and long term reliability with low levels of maintenance.

Innovations and advantages of the offer

- Less than 5/5 (suspended solids/BOD).
- Disinfected effluent.
- Very small compact plant.
- Very low sludge volumes.
- PES membrane used. - Low running costs.
- Single step process with minimal controls and operator input.
- Can be used to upgrade existing plants.
- Very long life membrane.
- Easily cleaned.

ANEXO V.- EMPRESAS MADRILEÑAS DE DEPURACIÓN Y TRATAMIENTO DE AGUAS

Empresa	Actividad
ABS Tecnologías del Agua, S.A.	Proporciona soluciones efectivas para el tratamiento de aguas residuales
Acciona-agua	Capacidad para diseñar, construir y operar plantas de tratamiento de agua potable, depuradoras de aguas residuales, tratamientos terciarios para reutilización y plantas desalinizadoras por ósmosis inversa
aqualia (Grupo FCC)	Soluciones en todas las fases del ciclo integral del agua
Aguapura	Venta e instalación de los distintos sistemas de tratamiento y purificación del agua para el consumo humano o aplicaciones especificas a nivel residencial, comercial e industrial
Aguas de Alcalá	Abastecimiento y tratamiento del agua
Alfa Laval Iberia S.A.	Tecnologías de separación y manejo de fluidos
Aquaelecc 2001, SL	Todas las fases del ciclo del agua, desde la captación hasta su vertido final
ASTEISA, Tratamiento de Aguas, S.A.U.	Desarrollo de los métodos y técnicas de tratamiento: depuración y reutilización del agua. Mantenimiento y explotación de estas instalaciones
BIENDA S.A.	Soluciones para cualquier tema relacionado con el agua, como el diseño y fabricación de plantas de tratamiento de aguas y el desarrollo de productos para el tratamiento de las mismas
Biosistemas tratamiento de aguas residuales S. A.	Fabricación e instalación de estaciones de aguas residuales urbanas
Canal Extensia, S.A. (Canal de Isabel II)	Gestión de los procesos del ciclo integral del agua: captación o producción, aducción, tratamiento, conducción, elevación, almacenamiento, distribución, alcantarillado y saneamiento, depuración de aguas residuales y reutilización
Cosemar Ozono	Desinfección de agua: potabilización y reutilización de aguas residuales
D2000 Depuración y Reformas, S.L.	Construcción de plantas depuradoras de aguas residuales
Dafa tratamiento de agua S.L	Fabricación de equipos desmineralizadores e instrumentos de control en el tratamiento del agua, y la comercialización de otros equipos.
Depurnord, S.A.- Depuradoras de Agua	Depuradoras de aguas residuales urbanas e industriales
DRACE medioambiente (Grupo ACS)	Diseño, construcción, ejecución y gestión de todo tipo de infraestructuras relacionadas con el tratamiento de aguas
Filtramas S.A.	Manejo de fluidos con especial dedicación a la filtración y eliminación de residuos retenidos
Foerschler S.L.	Suministro de equipos e instalaciones para el tratamiento in situ de las aguas residuales

Genesys Membrane Products S.L.	Proveer productos y servicio técnico a la industria de la desalación
Gestagua	Servicios Integrales a poblaciones abarcando el ciclo completo del agua
Grupo Beta	Tratamiento integrado del agua en todos sus ámbitos de aplicación
Hidroser, Servicios Integrales del Agua, S.A.(Canal de Isabel II)	Ciclo integral del agua: captación o producción, aducción, tratamiento, distribución, alcantarillado, depuración, reutilización y vertido
Hispanagua S.A. (Canal de Isabel II)	Construcción, mantenimiento, y explotación de infraestructuras relacionadas con la gestión del agua.
HYDROCOMBUS, S.A.	Tratamiento de agua mediante productos químicos
Hydromarine S.L	Tratamiento de aguas de circuitos cerrados industriales
Intertramp,S.L.	Tratamiento y depuración de aguas, desde su captación hasta el vertido final
Koch Membrane Systems, Inc.	Desarrollo y fabricación de innovadores sistemas de filtración mediante membranas
MEJORAS ENERGÉTICAS de Recursos e Investigaciones	Distribuidos oficial en España, sistemas y equipos con la más avanzada tecnológica aplicada al ciclo del agua
Natural Biotec S.L.	Especialistas en la descontaminación de suelos y aguas mediante la utilización de tecnologías límpias
Oficina Técnica de Resinas	Desarrollo y aplicación de resinas, de poliuretano y epoxi fundamentalmente, en aquellos campos en los que el agua constituya un elemento siempre presente
Salher España	Fabricación de equipos de depuración de aguas residuales, prefabricados en PRFV (Poliester Reforzado con Fibra de Vidrio)
Sociedad española de tratamiento de aguas S.L (SETA)	Resolución de problemas de abastecimiento, de vertidos postproductivos y ambientales
RITASA Tratamientos de Agua	Empresa de tratamientos de agua que desarrolla su labor principalmente en aguas de consumo, aporte o proceso industrial
Remosa	Productos para el tratamiento de aguas residuales, separadores de hidrocarburos, regeneración de aguas y almacenamiento de líquidos
Tecnoman, S.A.	Filtración de grandes caudales de agua
Tesacua S.L. Tratamientos de agua	Ingeniería de tratamientos y depuración del agua en general, especializándose en las nuevas tecnologías de separación acuosa, basadas en resinas de intercambio iónico y membranas semipermeables de osmosis inversa, nanofiltración y ultrafiltración
Tramasa S.L.	Estudio de la más alta tecnología en técnicas para el tratamiento de aguas
UNIVAR Iberia SA	Distirbución de productos químicos para industrias, entre las que se encuentra la de tratamiento de agua
Urbaser	Gestión del agua
Valoriza Agua (Sacyr Vallehermoso)	Tratamiento y gestión integral del ciclo del agua

Veolia Water Solutions & Technologies Iberica	Soluciones tecnológicas para el tratamiento de agua para los municipios, las industrias y el sector terciario