UNIDAD DE TITULACIÓN ESPECIAL

FUENTES DE INFORMACIÓN

TRABAJO DE TITULACIÓN

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FACULTAD DE INGENIERÍA QUÍMICA

UNIVERSIDAD CENTRAL DEL ECUADOR

PARA LA MODALIDAD PROYECTO DE INVESTIGACIÓN

1. BASES DE DATOS DE LITERATURA CIENTIFICA

- **SCOPUS.-** La más grande base de datos mundial de ABSTRACTS y CITAS, de literatura científica arbitrada: Journals, literatura revisada por pares, libros y actas de congresos. http://www.scopus.com/

- **SCIENCEDIRECT .-**Artículos texto completo de más de 2.500 Journals y más de 33,000 títulos de libros de investigaciones científicas. http://www.sciencedirect.com. **SI REQUIEREN UN ARTÍCULO SOLICITARLO A LA UNIDAD DE INFORMACIÓN CIENTÍFICA Y TECNOLÓGICA.**
- **SCIELO.-** Información científica, principalmente para América Latina y El Caribe http://www.scielo.org/php/index.php?lang=es

BVSDE: Biblioteca virtual de desarrollo sostenible y salud ambiental. Información de América Latina y El Caribe.

- http://www.**bvsde**.paho.org

PUBCHEM: Base de datos con información validada de sustancias y compuestos químicos, y bioensayos. Rápida herramienta de búsqueda de similitud de estructuras químicas

- http://www.ncbi.nlm.nih.gov/pccompound

2. REVISTAS CIENTÍFICAS O JOURNALS

- Constituyen una publicación periódica que sale con regularidad
- Proporcionan información más reciente sobre los últimos avances de la ciencia.
- Proporcionan información sobre los nuevos métodos e inventos de la técnica.

REVISTAS INDEXADAS publicación periódica de investigación que denota *alta calidad* y ha sido listada en alguna base de datos de consulta mundial, lo que habitualmente trae aparejado que la revista tenga un elevado factor de impacto

EJEMPLOS DE REVISTA CIENTÍFICAS

- Brazilian Journal of Chemical Engineering: http://www.scielo.br/scielo.php?script=sci_serial&pid=0104-6632&lng=es&nrm=iso

- Chemical Engineering Magazine: http://www.chemengonline.com/the-magazine/

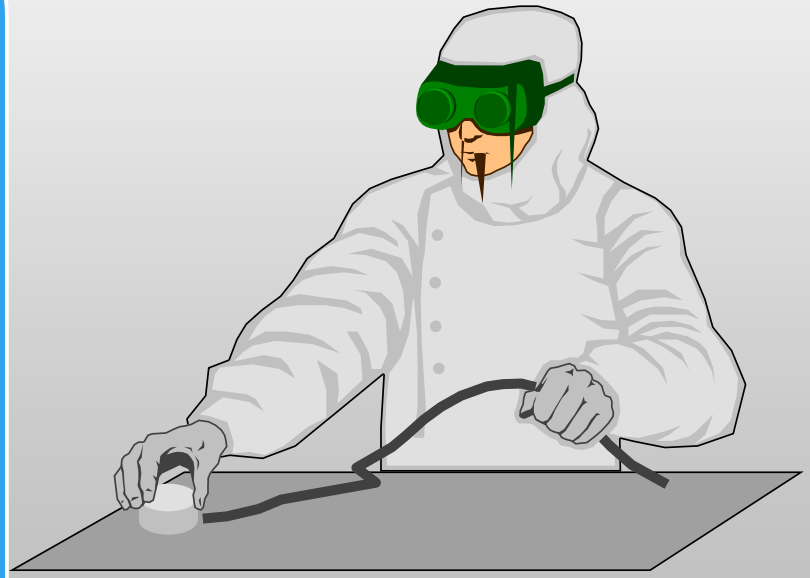
- POWER Magazine: http://www.powermag.com

3. LITERATURA GRIS.- Documentos NO publicados o inéditos que por su reproducción y distribución **NO** tienen una amplia difusión (<250 EJEMPLARES). Son valiosas fuentes de información:

- Diarios de laboratorio
- Informes científico-técnicos
- Hojas informativas
- Informes de conferencias
- **Tesis doctorales (REPOSITORIOS)**
- **Trabajos de Titulación (REPOSITORIOS)**
- Reseñas científicas (revisión por pares)

4. TESIS DOCTORAL

Documento que se presenta para obtener el grado científico de **DOCTOR ó Ph.D** y contiene la descripción de una investigación científica individual (APORTE AL CONOCIMIENTO).



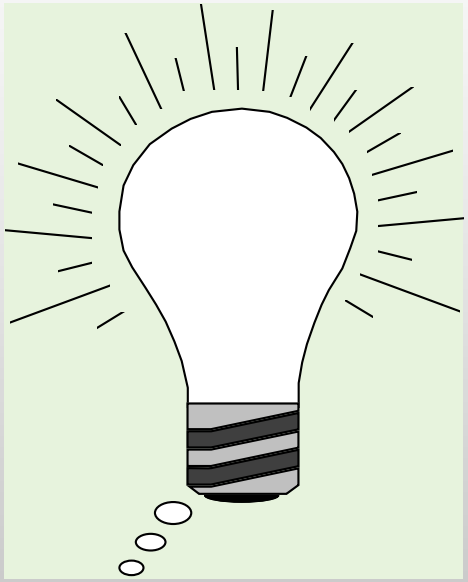
PARA TODAS LAS MODALIDADES DE TRABAJOS DE TITULACIÓN

BUSCAR Y CONSULTAR LOS TRABAJOS DE TITULACION PREVIOS DESARROLLADOS EN EL PAÍS, UTILIZANDO LOS REPOSITORIOS Y CATALOGOS BIBLIOGRÁFICOS INSTITUCIONALES.

TRABAJO DE TITULACIÓN.- Documento que presentan los graduados de un centro docente al finalizar sus estudios universitarios (tercer nivel), como requisito previo a la obtención de la licencia para ejercer la profesión.

PARA PROYECTOS DE INVESTIGACIÓN Y PROPUESTAS TECNOLÓGICAS

PATENTE DE INVENCIÓN Una **patente** es un conjunto de derechos exclusivos de explotación, concedidos por el Estado Ecuatoriano a un inventor o a su cesionario, por un período limitado de tiempo a cambio de la divulgación (*documento patente*) de su **INVENTO (PRODUCTO O PROCESO)**.



¿ QUÉ ES UN INVENTO ?

Es una solución nueva a un problema técnico, en cualquier campo de la tecnología.

Descubrimiento: El mercurio, metal pesado, densidad 13,59 g/cm^3 permanece en estado líquido entre temperaturas muy bajas y muy elevadas, desprende muy poco vapor, se dilata y se contrae a un ritmo muy igual con los cambios de temperatura

DESCUBRIMIENTOS NO SE PATENTAN

Invención: El termómetro de mercurio. *Físico alemán Daniel Gabriel Fahrenheit, año 1714.*

EJEMPLOS DE PATENTES

- LUZ ELÉCTRICA (patentes de Edison y Swan)
- PLÁSTICO (patente de Baekeland)
- BOLÍGRAFOS (patente de Ladislao José Biro)
- MICROPROCESADORES (patentes de Intel)
- MOTOR DIESEL (patente de Rudolf Diesel)
- FIBRA KEVLAR (patente de DuPont)

CARACTERÍSTICAS DOCUMENTOS DE PATENTES

- **DIVULGACIÓN TECNOLÓGICA ACTUALIZADA (ESTADO DE LA TECNICA).**
- **INFORMACIÓN TÉCNICA, REAL Y ÚTIL (APLICACIÓN INDUSTRIAL).**
- **ACCESIBLES, EN SU GRAN MAYORÍA, EN INTERNET Y POR LO GENERAL EN TEXTO COMPLETO:**
  - **HTTP://WORLDWIDE.ESPACENET.COM/ (90 MILLONES DE PATENTES)**
  - **HTTP://LP.ESPACENET.COM/**
  - **HTTP://WWW.WIPO.INT/PCTDB/ES/ (OMPI)**
  - **HTTP://WWW.GOOGLE.COM/PATENTS**
  - **HTTP://PATFT.USPTO.GOV/NETAHTML/PTO/SEARCH-BOOL.HTML (OFICINA DE PATENTES Y MARCAS DE ESTADOS UNIDOS**
- **INDICAN DATOS DEL SOLICITANTE, INVENTOR Y EL TITULAR PARA FACTIBILIZAR UN CONTACTO CON LOS SUMINISTRADORES DE TECNOLOGÍA CON FINES COMERCIALES.**
- **FÁCIL ACCESO, POR CUANTO TIENE UNA CLASIFICACIÓN INTERNACIONAL SISTEMATIZADA, CIP, LA CUAL SOLA O COMBINADA CON PALABRAS CLAVE, PERMITE RECUPERACIÓN RÁPIDA DEL DOCUMENTO.**
- **ESTRUCTURA NORMALIZADA Y UNIFORME DEL DOCUMENTO .**
- **PRIMERA FUENTE DE INFORMACIÓN DONDE APARECE PUBLICADA UNA INNOVACIÓN TECNOLÓGICA**

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(54) Rapid thermal processing of heavy hydrocarbon feedstocks in the presence of calcium compounds

(57) The present invention is directed to the upgrading of heavy petroleum oils of high viscosity and low API gravity that are typically not suitable for pipelining without the use of diluents. It utilizes a short residence-time pyrolytic reactor operating under conditions that result in a rapid pyrolytic distillation with coke formation. Both physical and chemical changes taking place lead to an overall molecular weight reduction in the liquid product and rejection of certain components with the byproduct coke. The liquid product is upgraded primarily because of its substantially reduced viscosity, increased API gravity, and the content of middle and light distillate fractions. While maximizing the overall liquid yield, the improvements in viscosity and API gravity can render the liquid product suitable for pipelining without the use of diluents. This invention particularly relates to reducing sulfur emissions during the combustion of byproduct coke (or coke and gas), to reducing the total acid number (TAN) of the liquid product, and to reducing the hydrogen sulfide content of one, or more than one component of the product stream by carrying out the pyrolysis and/or the regeneration of the heat carrier in the presence of a calcium compound. The method comprises introducing a particulate heat carrier into an up-flow reactor, introducing the feedstock at a location above the entry of the particulate heat carrier, allowing the heavy hydrocarbon feedstock to interact with the heat carrier for a short time in the presence of the calcium compound, separating the vapors of the product stream from the particulate heat carrier and liquid and byproduct solid matter, regenerating the particulate heat carrier in the presence of the calcium compound, and collecting a gaseous and liquid product from the product stream.

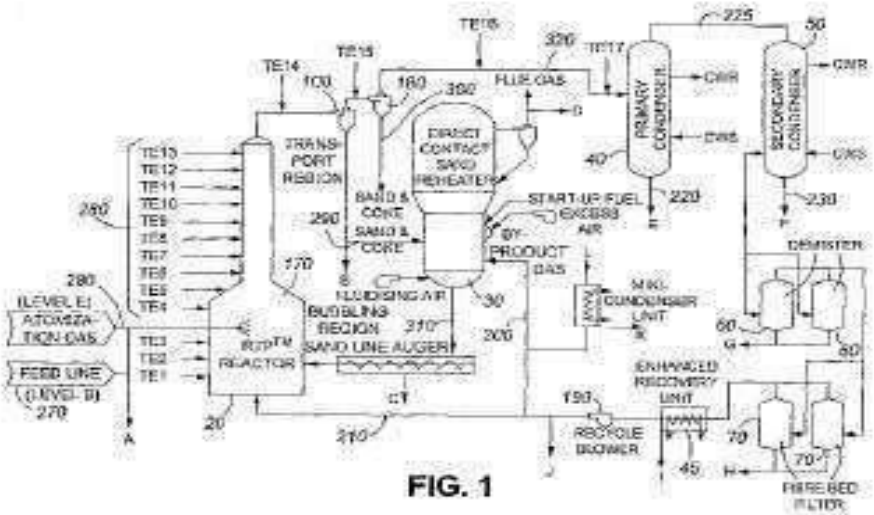

FIG. 1

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Description

[0001] The present invention relates to rapid thermal processing (RTP™) of a viscous oil feedstock. More specifically, the present invention relates to a method of reducing the hydrogen sulfide content of one, or more than one gas component of a product stream derived from rapid thermal processing of a heavy hydrocarbon feedstock and for reducing sulfur - based emissions in flue gas.

BACKGROUND OF THE INVENTION

[0002] Heavy oil and bitumen resources are supplementing the decline in the production of conventional light and medium crude oils, and production from these resources is steadily increasing. Pipelines cannot handle these crude oils unless diluents are added to decrease their viscosity and specific gravity to pipeline specifications. Alternatively, desirable properties are achieved by primary upgrading. However, diluted crudes or upgraded synthetic crudes are significantly different from conventional crude oils. As a result, bitumen blends or synthetic crudes are not easily processed in conventional fluid catalytic cracking refineries. Therefore, in either case further processing must be done in refineries configured to handle either diluted or upgraded feedstocks.

[0003] Many heavy hydrocarbon feedstocks are also characterized as comprising significant amounts of BS&W (bottom sediment and water). Such feedstocks are not suitable for transportation by pipeline, or refining due to their corrosive properties and the presence of sand and water. Typically, feedstocks characterized as having less than 0.5 wt. % BS&W are transportable by pipeline, and those comprising greater amounts of BS&W require some degree of processing or treatment to reduce the BS&W content prior to transport. Such processing may include storage to let the water and particulates settle, and heat treatment to drive off water and other components. However, these manipulations add to operating cost. There is therefore a need within the art for an efficient method of upgrading feedstock having a significant BS&W content prior to transport or further processing of the feedstock.

[0004] Heavy oils and bitumens can be upgraded using a range of processes including thermal (e.g. US 4,490,234; US 4,294,686; US 4,161,442), hydrocracking (US 4,252,634), visbreaking (US 4,427,539; US 4,569,753; US 5,413,702), or catalytic cracking (US 5,723,040; US 5,662,868; US 5,296,131; US 4,985,136; US 4,772,378; US 4,668,378, US 4,578,183) procedures. Several of these processes, such as visbreaking or catalytic cracking, utilize either inert or catalytic particulate contact materials within upflow or downflow reactors. Catalytic contact materials are for the most

acidity of the catalysts, for example amorphous alumina, alumina-silica or crystalline (zeolite) alumina-silica catalysts, used in these systems. However, calcium is readily removed from the product stream during rapid thermal processing and the calcium content of the product is low.

[0032] The processes described herein may be used to process a variety of different feedstocks so that a desired product is produced. For example, feedstocks characterized as having high TAN, and low sulfur content are processed by adding a calcium compound in the feedstock prior to processing. In doing so, the TAN of the product is reduced, as well as the hydrogen sulfide content of one, or more gas components of the product stream.

[0033] In order to reduce sulfur emissions during regeneration of the heat carrier, as well as the hydrogen sulfide content of one, or more than one gas component of the product stream, a calcium compound is added to the sand reheater and to the feedstock. Similarly, a feedstock characterized as having high TAN and high sulfur content is processed by adding a calcium compound to both the feedstock and the sand reheater, thereby reducing TAN in the product, reducing SO_x emissions in the flue gasses evolving from the sand reheater, and reducing the hydrogen sulfide content of one, or more than one gas component of the product stream.

[0034] The gas components having a reduced hydrogen sulfide content do not require any appreciable cleaning or conditioning and are, therefore, useful in post processing combustion systems, for example, in a steam boiler or a thermal combustion system. Alternatively, the gas components having a reduced hydrogen sulfide content can be recycled for use in the rapid thermal pyrolysis reactor, or can be collected and stored for future use. The gas components having a reduced hydrogen sulfide content are particularly useful in remote areas, where systems for cleaning and conditioning gas are not available.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035] These and other features of the invention will become more apparent from the following description in which reference is made to the appended drawings wherein:

FIGURE 1 is a schematic drawing of a system for the pyrolytic processing of feedstocks. Lines A-D, and I-L indicate optional sampling ports.

in the presence of a calcium compound.

[0106] Aspects and processes of the invention will be further illustrated in the following examples. However it is to be understood that these examples are for illustrative purposes only, and should not to be used to limit the scope of the present invention in any manner.

Example 1: Heavy Oil (Single Stage)

[0107] Pyrolytic processing of Saskatchewan Heavy Oil and Athabasca Bitumen (see Table 1) were carried out over a range of temperatures using a pyrolysis reactor as described in US 5,792,340.

Table 1: Characteristics of heavy oil and bitumen feedstocks

Compound	Heavy Oil[1]	Bitumen[2]
Carbon (wt%)	84.27	83.31
Hydrogen (wt%)	10.51	10.31
Nitrogen (wt%)	<0.5	<0.5
Sulphur (st%)	3.6	4.8
Ash (wt%)	0.02	0.02
Vanadium (ppm)	127	204
Nickel (ppm)	43	82
Water content (wt%)	0.8	0.19
Gravity API°	11.0	8.6
Viscosity @ 40°C (cSt)	6500	40000
Viscosity @ 60°C (cSt)	900	5200
Viscosity @ 80°C (cSt)	240	900
Aromaticity (C13 NMR)	0.31	0.35

1) Saskatchewan Heavy Oil
2) Athabasca Bitumen (neat)

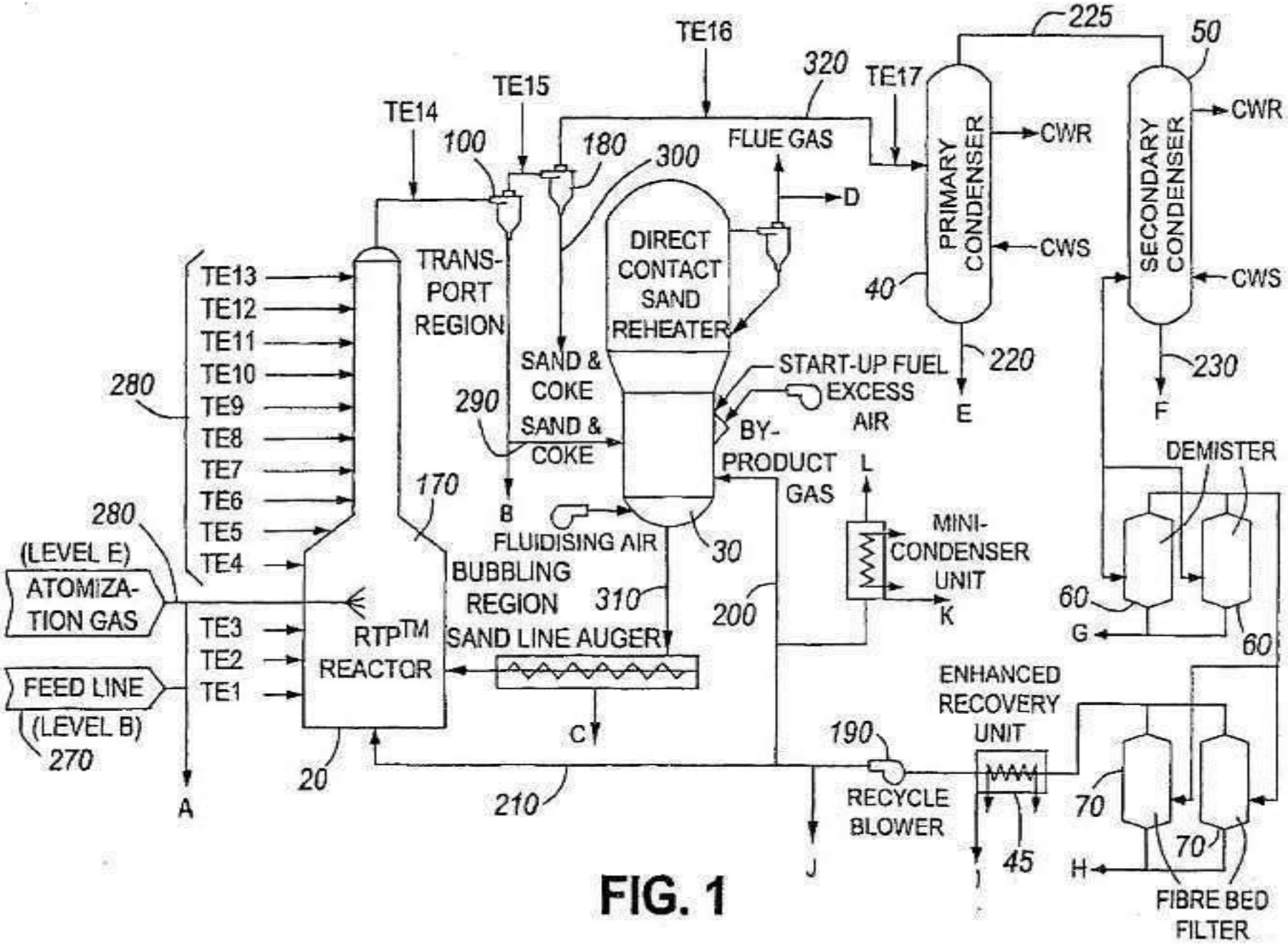
TE16
320
TE17
225
50
TE15
TE14
100
180
300
FLUE GAS
CWR
PRIMARY CONDENSER
SECONDARY CONDENSER
CWR
D
CWS
CWS
TRANS-PORT REGION
DIRECT CONTACT SAND REHEATER
40
TE13
TE12
TE11
TE10
TE9
TE8
TE7
TE6
TE5
TE4
280
SAND & COKE
START-UP FUEL
EXCESS AIR
220
230
290
SAND & COKE
BY-PRODUCT GAS
E
F
DEMISTER
L
170
B
FLUIDISING AIR
30
MINI-CONDENSER UNIT
280
(LEVEL E)
ATOMIZA-TION GAS
BUBBLING REGION
310
200
K
60
G
60
TE3
TE2
TE1
RTP™ REACTOR
SAND LINE AUGER
ENHANCED RECOVERY UNIT
FEED LINE
(LEVEL B)
270
C
190
70
70
20
210
RECYCLE BLOWER
45
H
A
J
FIBRE BED FILTER

FIG. 1

EXPERIENCIA DE LA FACULTAD DE INGENIERÍA QUÍMICA EN EL USO DE PATENTES

TRABAJOS DE GRADO:

- EXTRACCIÓN DE POLIFENOLES A PARTIR DE LAS ALMENDRAS DEL CACAO, MEDIANTE AGITACIÓN.
- APROVECHAMIENTO DEL EXTRACTO DE LAS ESPECIES VEGETALES DE CABUYA BLANCA Y NEGRA COMO AGENTE TENSOACTIVO.
- HIDRÓLISIS ALCALINA DE LA VIRUTA DE CROMO GENERADA DURANTE EL PROCESAMIENTO DEL CUERO.
- OBTENCIÓN DE PLÁSTICO A PARTIR DE LA CASEÍNA.

MUCHAS GRACIAS

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