



AU9064628

(12) PATENT ABRIDGMENT (11) Document No. AU-B-64628/90
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 637148

- (54) Title
PROCESS FOR THE CATALYTIC CRACKING OF A HYDROCARBON OIL
- International Patent Classification(s)
(51)^s **C10G 011/00 C10G 011/20**
- (21) Application No. : **64628/90** (22) Application Date : **15.10.90**
- (30) Priority Data
- (31) Number (32) Date (33) Country
8923345 17.10.89 GB UNITED KINGDOM
- (43) Publication Date : **26.04.91**
- (44) Publication Date of Accepted Application : **20.05.93**
- (71) Applicant(s)
SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.
- (72) Inventor(s)
FRANK HSIAN HOK KHOUW; MARINUS JOHANNES SPIESSENS; MARTIN JEAN PIERRE CORNELIS NIESKENS; JOUKE JAN WOULDSTRA
- (74) Attorney or Agent
SPRUSON & FERGUSON , GPO Box 3898, SYDNEY NSW 2001
- (56) Prior Art Documents
EP 239171
US 3812029
- (57) Claim

1. Process for the catalytic cracking of a hydrocarbon oil wherein a gas/hydrocarbon oil mixture is introduced into the reactor by means of at least one device which comprises at least one supply means of which the wall comprises openings, the hydrocarbon oil is introduced into the supply means and mixed with an at least partly surrounding gas which enters under pressure the supply means through the openings in the wall thereof, which mixture is contacted with fluidized catalytic cracking catalyst in the reactor under catalytic cracking conditions.

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S & F Ref: 143135

FORM 10

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE:

Class Int Class

Complete Specification Lodged:
Accepted:
Published:

Priority:

Related Art:

Name and Address
of Applicant:

Shell Internationale Research Maatschappij B.V.
Carel van Bylandtlaan 30
2596 HR
The Hague
THE NETHERLANDS

Address for Service: Spruson & Ferguson, Patent Attorneys
Level 33 St Martins Tower, 31 Market Street
Sydney, New South Wales, 2000, Australia

Complete Specification for the invention entitled:

Process for the Catalytic Cracking of a Hydrocarbon Oil

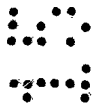
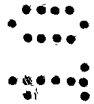
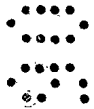
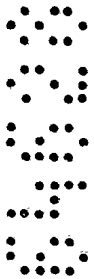
The following statement is a full description of this invention, including the best method of performing it known to me/us

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A B S T R A C T

PROCESS FOR THE CATALYTIC CRACKING OF A HYDROCARBON OIL

Process for the catalytic cracking of a hydrocarbon oil wherein a gas/hydrocarbon oil mixture is introduced into the reactor by means of at least one device which comprises at least one supply means of which the wall comprises openings, the hydrocarbon oil is introduced into the supply means and mixed with an at least partly surrounding gas which enters under pressure the supply means through the openings in the wall thereof.



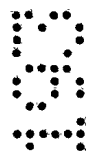
PROCESS FOR THE CATALYTIC CRACKING OF A HYDROCARBON OIL

The present invention relates to a process for the catalytic cracking of a hydrocarbon oil wherein a gas/hydrocarbon oil mixture is introduced into the reactor by means of at least one device which comprises at least one supply means of which the wall comprises openings, the hydrocarbon oil is introduced into the supply means and mixed with an at least partly surrounding gas which enters under pressure the supply means through the openings in the wall thereof, which mixture is contacted with fluidized catalytic cracking catalyst in the reactor under catalytic cracking conditions.

In this way the hydrocarbon oil is advantageously mixed with the gas before entering the reactor. As a result thereof an optimum distribution of hydrocarbon oil over the catalyst particles is obtained when the hydrocarbon oil is contacted with the catalyst particles in the reactor. Thus an excellent performance of a catalytic cracking unit can be established.

It has been found that suitable mixing of the hydrocarbon oil and the gas can be attained if the gas/hydrocarbon oil mixture comprises gas in an amount of 0.1-50 %wt on hydrocarbon oil, preferably 1-15 %wt on hydrocarbon oil.

Preferably, the mixing of the hydrocarbon oil and the gas is carried out in such a way that the gas/hydrocarbon oil flow velocity (m/s) ratio is in the range of 2-30, whereby the gas flow velocity is defined as the velocity of the gas calculated in the openings in the wall of the supply means. Preferably,



the gas/hydrocarbon oil flow ratio is in the range of 5-15.

The process according to the present invention is preferably carried out in such a way that the pressure of the gas entering the supply means is in the range of 2-15 bar, preferably in the range of 5-10 bar.

Suitably, the gas/hydrocarbon oil mixture enters the reactor with a velocity of 20-400 m/s. In the process according to the present invention various gases can be applied. The gases which can suitably be applied in the process according to the present invention comprise for instance the hydrocarbon gases comprising four or less carbon atoms, refinery gases (including H₂S), steam and/or any mixture thereof. Preferably, use is made of steam.

Suitably, the present process is carried out using a device for the introduction of the hydrocarbon oil which comprises more than one supply means as described hereinbefore.

Suitably, the upstream end of the device for introducing the hydrocarbon oil is located above an inlet means for introducing catalyst particles.

The openings in the supply means of the device to be used in the process according to the present invention are suitably located near the upstream end of of the supply means.

Suitably, the openings are substantially regularly arranged in at least one plane perpendicular to the central longitudinal axis of the supply means. Preferably, the openings are symmetrically arranged in said plane(s). Preferably, at least 4 openings are symmetrically arranged in said plane(s).

Suitably, the device as applied in the process according to the present invention comprises tubular supply means.

In a preferred embodiment of the process according to the present invention the hydrocarbon oil is introduced by means of more than one device as described hereinbefore, for instance by four of these
5 devices.

If the hydrocarbon oil is introduced by means of more than one device, the devices are suitably substantially regularly arranged in at least one plane perpendicular to the central longitudinal axis of the
10 reactor. Preferably, the devices are symmetrically arranged in said place(s). Suitably, at least 4 devices are symmetrically arranged in said plane(s). Suitably, the devices are arranged in at least two of said planes. If the devices are arranged in more than two of
15 said planes, the planes are suitably substantially regularly spaced from each other along the length of the reactor. Preferably, the planes are arranged at substantially equal distances from each other.

Suitably, all the planes comprise the same number of
20 devices. Preferably, the devices are arranged in each plane in such a way that the devices of two neighbouring planes are staggeredly arranged with respect to each other.

The bottom part of a riser reactor comprising the
25 device to be used in the process according to the present invention and suitable embodiments of said device for introducing the hydrocarbon oil into the reactor are described hereinafter, using Figures 1-3 in which reference numerals relating to corresponding
30 parts are the same.

In Figure 1 a longitudinal section of the bottom part of a fluid catalytic cracking riser reactor is schematically shown which can suitably be used in the process according to the present invention.

In Figure 2 a longitudinal section of the upstream end part of the device for introducing the hydrocarbon oil into the reactor as depicted in Figure 1 is schematically shown in more detail.

5 In Figure 3 a cross-section at AA' of the device as depicted in Figure 2 is schematically shown.

The bottom part of the fluid catalytic cracking riser reactor as depicted in Figure 1 comprises a substantially vertically vessel (1) provided with an inlet means (2) for introducing catalyst particles, and
10 four devices (3) (of which only two have been shown) for introducing hydrocarbon oil into the riser reactor. The riser reactor furthermore preferably comprises fluidization means (4), for instance in the form of a ring-shaped or annular fluidization means, provided with regularly spaced fluidization gas openings (e.g. nozzles (5)) through which a fluidization gas, for instance steam, introduced via fluidization gas inlet means (6) emanates into the bottom section (12) of the
15 reactor.

20 In Figures 2 and 3 the upstream end part of the device (3) for introducing the hydrocarbon oil into the reactor is shown in more detail. The device (3) comprises tubular supply means (7) having openings (8) in their walls (9), and a space (10) arranged between the tubular supply means (7) and wall (11) of the device (3).
25

The process according to the present invention using the riser reactor of which only the bottom part is shown in Figure 1 is normally carried out as follows.
30

A stream of catalyst particles in a carrier gas (e.g. originating from a catalyst regenerator) is introduced through inlet means (2) into the bottom section (12) of
35 the riser reactor. The catalyst particles are fluidized

and transported upwardly by means of for instance steam introduced via line (6) into ring-shaped or annular fluidization means (4) provided with regularly spaced fluidization nozzles (5). A stream of a hydrocarbon oil is introduced into supply means (7) of the device (3) and mixed with a stream of steam which enters from space (10) under pressure with a high velocity the supply means (7). The upwardly flowing fluidized mass of catalyst particles is excellently mixed with the mixture of the hydrocarbon oil and steam obtained emanating with a high velocity from device (3).

The use of device (3) in the process according to the present invention results in a very uniform mixing of the fluidized catalyst particles and the hydrocarbon oil. As a result of this uniform mixing a very attractive performance of the catalytic cracking unit can be obtained.

In Figure 1 the devices (3) are arranged onto the wall of the vessel (1). It will be understood, however, that the device(s) (3) can also suitably be arranged differently, for instance substantially centrally in the bottom section (12) of the riser reactor or at other suitable places in the riser reactor or stripping zone of a catalytic cracking reactor.

In Figures 2 and 3 the tubular supply means (7) are arranged parallel with respect to each other. It will be clear, however, that the supply means (7) can also suitably be arranged in a different manner, for instance the supply means (7) may diverge from each other in the direction of the upstream end of the device (3).

The mixing of the gas and the hydrocarbon oil in the supply means (7) is preferably carried out at temperatures in the range of 50-600°C, more preferably in the range from 100-400°C.

The process for the catalytic cracking of a hydrocarbon oil according to the present invention is preferably carried out at a temperature from 400-800°C and pressure from 1-10 bar. It will be understood that the present process can suitably be carried out using any fluidized catalytic cracking catalyst, however, zeolite-containing catalysts are preferred.

The hydrocarbon oil which can suitably be converted in the process according to the present invention comprises heavy hydrocarbon oils, for instance atmospheric or vacuum distillates, cycle oils and slurry oils, deasphalted oils, atmospheric and vacuum residues, thermally cracked residues, asphalts originating from various kinds of deasphalting processes, synthetic residues and hydrocarbon oils originating from hydroconversion processes, tar sands and shale oils of any source, and/or any mixture thereof.

The present invention is illustrated by means of the following Example.

Example

A feed stream of a straight run heavy hydrocarbon oil (a Conradson carbon content of about 5 %wt) enters supply means (7), as depicted in Figures 2 and 3, of device (3) as depicted in Figure 1 at a temperature of 260°C and is mixed in the supply means (7) with a stream of steam fed to space (10) at a temperature of 260°C and a pressure of 6 bar which enters supply means (7) via openings (8). The resulting oil/stream mixture flows with a velocity of more than 70 m/s through the upstream end of supply means (7) into the reactor vessel (1), which is operated at a pressure of 3 bar and a temperature of 520°C. Regenerated zeolite Y based catalyst particles are introduced via inlet (2) at a temperature of 705°C into the reactor vessel (1)



wherein the catalyst particles are contacted with the oil/steam mixture.

The product yields on feed obtained in the above Example are summarized in the Table as shown

5 hereinbelow.

Table

product yields

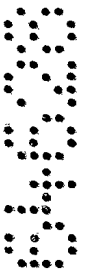
C ₁ -C ₄	%wt	17.8
C ₅ -221°C	%wt	51.0
221-370°C	%wt	17.0
370°C ⁺	%wt	7.2
coke	%wt	7.0

It will be clear from the results presented in the Table shown hereinabove, indicating an attractive yield of products in the gasoline range, that a heavy hydrocarbon oil can very suitably be subjected to the process according to the present invention.

10

The claims defining the invention are as follows:

1. Process for the catalytic cracking of a hydrocarbon oil wherein a gas/hydrocarbon oil mixture is introduced into the reactor by means of at least one device which comprises at least one supply means of which the wall comprises openings,
5 the hydrocarbon oil is introduced into the supply means and mixed with an at least partly surrounding gas which enters under pressure the supply means through the openings in the wall thereof, which mixture is contacted with fluidized catalytic cracking catalyst in the reactor under catalytic cracking conditions.
2. Process according to claim 1, wherein the gas/hydrocarbon oil mixture
10 comprises gas in an amount of 0.1-50 %wt of hydrocarbon oil.
3. Process according to claim 2, wherein the gas/hydrocarbon oil mixture comprises gas in an amount of 1-15 %wt of hydrocarbon oil.
4. Process according to any one of claims 1-3, wherein the gas/hydrocarbon oil
15 flow velocity ratio is in the range of 2-30 and the gas flow velocity has the meaning as defined hereinbefore.
5. Process according to claim 4, wherein the gas/hydrocarbon oil flow velocity ratio is in the range of 5-15.
6. Process according to any one of claims 1-5, wherein the pressure of the gas entering the supply means is in the range of 2-15 bar abs.
- 20 7. Process according to claim 6, wherein the pressure of the gas entering the supply means is in the range of 5-10 bar abs.



8. Process according to any one of claims 1-7, wherein the gas/hydrocarbon oil mixture enters the reactor with a velocity of 20-400 m/s.

5 9. Process according to any one of claims 1-8, wherein the gas comprises steam.

10. Process according to any one of claims 1-9, wherein the device comprises more than one supply means.

10 11. Process according to any one of claims 1-10, wherein the upstream end of the device for introducing the hydrocarbon oil is located above an inlet means for introducing catalyst particles.

15 12. Process according to any one of claims 1-11, wherein the openings in the wall of the supply means are located near the upstream end of the supply means.

13. Process according to any one of claims 1-12, wherein the openings are substantially regularly arranged in at least one plane perpendicular to the central longitudinal axis of the supply means.

20 14. Process according to claim 13, wherein the openings are symmetrically arranged in the plane(s) perpendicular to the central longitudinal axis of the supply means.

25 15. Process according to any one of claims 1-14, wherein the device(s) comprise(s) tubular supply means.

16. Process according to anyone of claims 1 to 19, wherein the hydrocarbon oil is introduced into the reactor by means of more than one device as ^{defined} ~~described~~ hereinbefore.

30 17. Process according to claim 16, wherein the devices are substantially regularly arranged in at least one plane perpendicular to the central longitudinal axis of the reactor.

35 18. Process according to claim 17, wherein the devices are arranged in at least two planes.



19. Process for the catalytic cracking of a hydrocarbon oil substantially as hereinbefore described with reference to the Example.

20. Process for the catalytic cracking of a hydrocarbon oil substantially as hereinbefore described with reference to the accompanying drawings.

5 21. A catalytically cracked hydrocarbon oil whenever prepared according to a process as defined in any one of claims 1-20.

Dated 6 January, 1993

Shell Internationale Research Maatschappij B.V.

Patent Attorneys for the Applicant/Nominated Person
SPRUSON & FERGUSON

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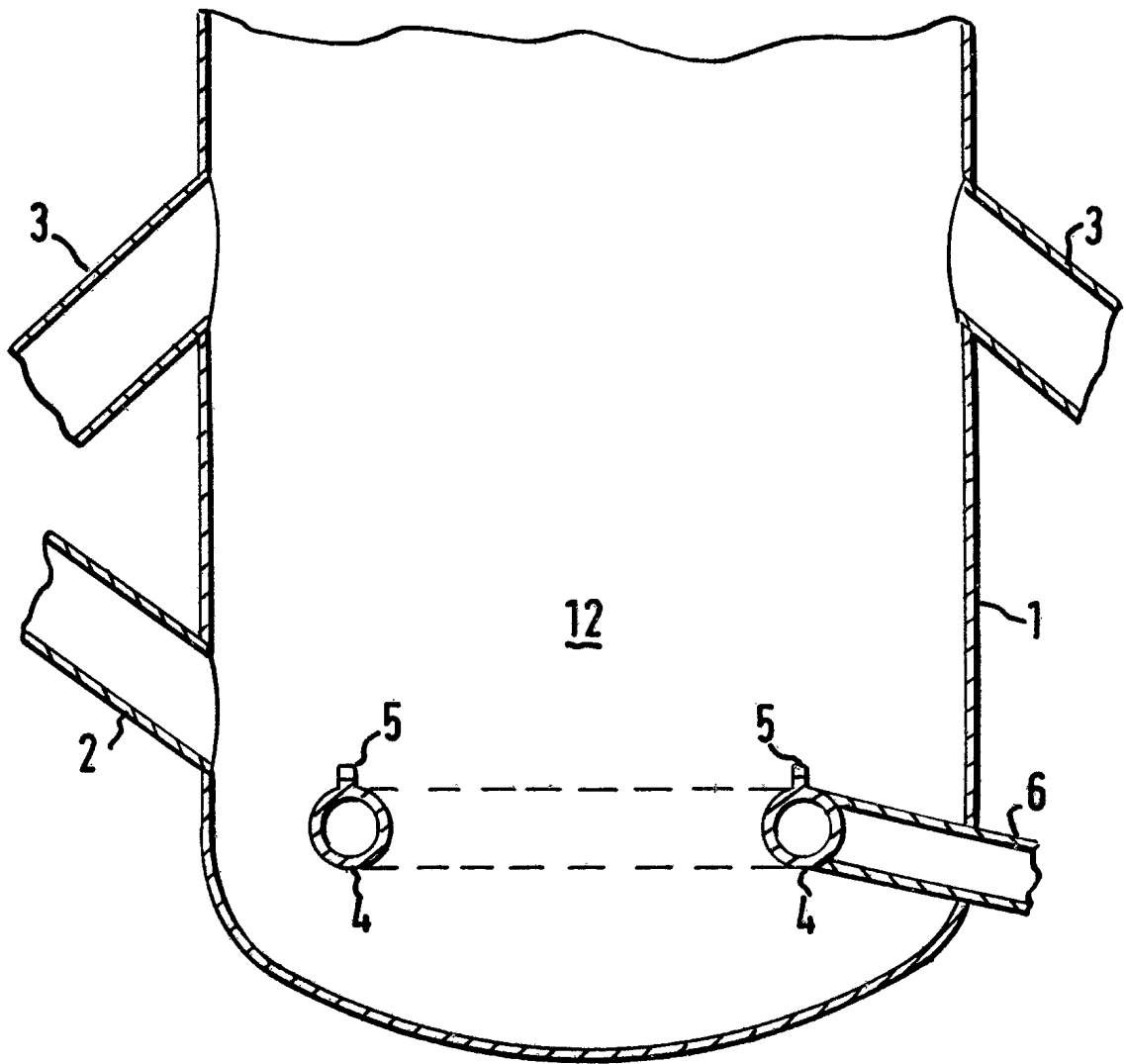


FIG. 1

