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PATENT REQUEST: STANDARD PATENT

We, the Applicant/Nominated Person specified below, request we be granted a patent for the invention disclosed in the accompanying standard complete specification.

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[54] Invention Title:

Process for Upgrading a Hydrocarbonaceous Feedstock

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Basic Convention Application Details

[31] Application No	[33] Country	[32] Date of Application
EP92200272.0	GB	30 January 1992

Basic Applicant: Shell Internationale Research Maatschappij B.V

DATED 28 November, 1994

Shell Internationale Research Maatschappij B.V.

Registered Patent Attorney

IRN: 230155

INSTR CODE: 61750

[N:\LIBW]10517:TCW

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NOTICE OF ENTITLEMENT

I, Albertus Wilhelmus Joannes ZEESTRATEN, of Carel van Bylandtlaan 30, 2596 HR The Hague, the Netherlands, being authorised by the Applicant/ Nominated Person in respect of Application No. 32086/93 state the following:-

The Applicant/Nominated Person has entitlement from the actual inventor(s) as follows:-

The Applicant/Nominated Person is the assignee of the actual inventor(s).

The Applicant/Nominated Person is the applicant of the basic application(s) listed on the Patent Request.

The basic application(s) listed on the Patent Request is/are the application(s) first made in a Convention Country in respect of the invention.

DATED this 5th day of January, 199 3

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AUS

(54) Title
PROCESS FOR UPGRADING A HYDROCARBONACEOUS FEEDSTOCK

International Patent Classification(s)
(51)[5] **C10G 061/06** **C10G 061/08**

(21) Application No. : **32086/93** (22) Application Date : **28.01.93**

(30) Priority Data

(31) Number (32) Date (33) Country
92200272 **30.01.92** **EP EUROPEAN PATENT OFFICE (EPO)**

(43) Publication Date : **05.08.93**

(44) Publication Date of Accepted Application : **23.02.95**

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(57) Claim

1. Process for upgrading a hydrocarbonaceous feedstock substantially boiling in the gasoline range, which process comprises:

a) separating the feedstock into a first hydrocarbon feed stream comprising C_6 and smaller hydrocarbons, a second hydrocarbon feed stream comprising hydrocarbons of the C_6-C_{10} range and a third hydrocarbon feed stream comprising C_8 and greater hydrocarbons;

b) subjecting at least part of the third hydrocarbon feed stream to a reforming step to produce a reformate stream;

c) subjecting at least part of both the second hydrocarbon feed stream and the reformate stream to a separation treatment wherein normal paraffins and optionally mono-isoparaffins are separated from di-isoparaffins; and

d) recovering therefrom (a) hydrocarbon product stream(s) comprising normal paraffins and optionally mono-isoparaffins and (a) hydrocarbon product stream(s) comprising di-isoparaffins.

657036

S & F Ref: 230155

AUSTRALIA

PATENTS ACT 1990

COMPLETE SPECIFICATION

FOR A STANDARD PATENT

ORIGINAL

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Invention Title: Process for Upgrading a Hydrocarbonaceous Feedstock

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

PROCESS FOR UPGRADING A HYDROCARBONACEOUS FEEDSTOCK

The present invention relates to a process for upgrading a hydrocarbonaceous feedstock substantially boiling in the gasoline range.

One of the main objects in nowaday's oil refining is to produce gasolines fulfilling the increasing environmental demands on product quality and having a high octane number.

This means for gasoline that the octane specification has now to be established without lead-containing additives, less aromatics, in particular benzene, less olefins and lower gasoline vapour pressure.

Object of the present invention is to provide a process for the preparation of gasolines fulfilling both the increasing environmental demands on product quality and the high octane requirement.

It has now been found that gasolines can be produced having a high octane number and a reduced aromatics content, in particular benzene, when use is made of an upgrading process comprising a specific sequence of process steps.

Accordingly, the present invention relates to a process for upgrading a hydrocarbonaceous feedstock substantially boiling in the gasoline range, which process comprises:

a) separating the feedstock into a first hydrocarbon feed stream comprising C_6 and smaller hydrocarbons, a second hydrocarbon feed stream comprising hydrocarbons of the C_6-C_{10} range and a third hydrocarbon feed stream comprising C_8 and greater hydrocarbons;

b) subjecting at least part of the third hydrocarbon feed stream to a reforming step to produce a reformate stream;

c) subjecting at least part of both the second hydrocarbon feed stream and the reformate stream to a separation treatment

d) recovering therefrom (a) hydrocarbon product stream(s) comprising normal paraffins and optionally mono-isoparaffins and (a) hydrocarbon product stream(s) comprising di-isoparaffins.

In this way a direct octane enhancement of the resultant gasoline blending pool is established whilst a substantial reduction of aromatics content, in particular of the benzene content, is realized. In refineries with restriction on production of gasoline due to octane and/or capacity limitations, this octane enhancement can permit increased gasoline production.

Suitably, the second hydrocarbon feed stream comprises hydrocarbons of the C_6-C_8 range.

The three hydrocarbon feed streams which are derived from the hydrocarbonaceous feedstock substantially boiling in the gasoline range can suitably be obtained by distillation. Suitably, the three hydrocarbon feed streams are adjacent fractions obtained by distillation. Depending, of course, on the sharpness of the fractionation at the cutting points of the fractions chosen in the distillation some overlap may occur among the adjacent fractions. For instance, the first hydrocarbon feed stream may comprise C_7 hydrocarbons.

The hydrocarbonaceous feedstock boiling in the gasoline range can suitably be obtained by distillation of crude oil or from catalytic cracking although it may be obtained by other cracking processes such as thermal cracking, delayed coking, visbreaking and flexicoking. Such gasoline feedstocks usually contain unacceptable levels of sulphur and nitrogen and benefit from a hydrotreatment before they are subjected to the process according to the present invention.

A minor part of the second hydrocarbon feed stream, e.g. 10 %wt, may suitably be co-processed in step b) with the third hydrocarbon feed stream.

Suitably, at least part of the C_6-C_7 hydrocarbons fraction of the second hydrocarbon feed stream can be co-processed in step b) with the third hydrocarbon feed steam.

Suitably, at least part of the first hydrocarbon feed stream can be introduced into an isomerization unit. The isomerate obtained therefrom can subsequently be passed to the gasoline blending pool.

Suitably, at least part of the reformate stream can be separated, for instance by means of distillation, into a gaseous fraction, a light fraction comprising C_5-C_6 hydrocarbons and a gasoline fraction, prior to the separation treatment in step c). The light fraction can suitably be co-processed with the first hydrocarbon feed stream as described hereinbefore, whereas at least part of the gasoline fraction obtained can suitably be subjected to the separation treatment in step c).

In another suitable embodiment of the process according to the present invention, at least part of the gasoline fraction obtained is separated, for instance by means of distillation, into a light gasoline fraction comprising hydrocarbons of the C_6-C_{10} range and a heavy gasoline fraction comprising C_8 and greater hydrocarbons. At least part of the light gasoline fraction obtained is subsequently subjected to the separation treatment in step c), whereas at least part of the heavy gasoline fraction obtained is directly passed to the gasoline blending pool.

Preferably, in step c) at least part of both the second hydrocarbon stream and the reformate are subjected to the same separation treatment. In this way a first hydrocarbon product stream comprising normal paraffins can be recovered and a second hydrocarbon product stream comprising di-isoparaffins can be recovered.

In step c) the separation treatment can suitably be established by passing at least part of both the reformate and the second hydrocarbon stream to a separation zone comprising a shape-selective separatory molecular sieve having a pore size of 4.5 x 4.5 Å or smaller and being shaped to permit adsorption of

normal paraffins in a selective manner vis-à-vis mono-isoparaffins, di-isoparaffins, other multi-branched paraffins, cyclic paraffins and aromatic hydrocarbons. In this way the normal paraffins can selectively be separated from mono-isoparaffins and di-isoparaffins. Subsequently, the first hydrocarbon product stream comprising substantially normal paraffins and the second hydrocarbon product stream comprising di-isoparaffins can be recovered. At least part of the first hydrocarbon product stream can suitably be co-processed in step b) with the third hydrocarbon feed stream. Suitably, the complete first hydrocarbon product stream can be co-processed in step b). At least part of the hydrocarbon product stream(s) comprising normal paraffins can also suitably be applied as a preferred chemical feedstock. For instance, as a feedstock for a highly selective cyclization process.

Suitably, the process according to the present invention is carried out in such a way that both the normal paraffins and mono-isoparaffins are separated from the di-isoparaffins. This can suitably be established by passing at least part of both the second hydrocarbon feed stream and the reformate stream to a separation zone comprising a shape-selective separatory molecular sieve having a pore size intermediate 5.5 x 5.5 to 4.5 x 4.5 Å, but excluding 4.5 x 4.5 Å, the pore size being sufficient to permit entry of normal paraffins and mono-isoparaffins but restrictive to prohibit entry of di-isoparaffins, other multi-branched paraffins, cyclic paraffins and aromatic hydrocarbons. In this way the normal paraffins and mono-isoparaffins can selectively be separated from the di-isoparaffins. Subsequently, the first hydrocarbon product stream comprising both normal paraffins and mono-isoparaffins and the second hydrocarbon product stream comprising di-isoparaffins can be recovered.

Suitably, in step b) at least part of this first hydrocarbon product stream can be co-processed with the third hydrocarbon feed stream. Suitably, the complete first hydrocarbon product stream can be co-processed in step b). At least part of the first hydrocarbon

product stream can also suitably be applied as a preferred chemical feedstock as indicated hereinbefore.

Preferably, the normal paraffins are firstly separated from the mono-isoparaffins and di-isoparaffins, whereas the mono-isoparaffins are subsequently separated from the di-isoparaffins. To this end use can be made of a multiple select adsorbent molecular sieve system having particular separatory qualities. Preferably, the multiple separatory sieve system to be used comprises a first molecular sieve having a pore size of 4.5 x 4.5 Å or smaller and being shaped to permit adsorption of normal paraffins in a selective manner vis-à-vis mono-isoparaffins, di-isoparaffins, other multi-branched paraffins, cyclic paraffins and aromatic hydrocarbons and a second molecular sieve having a pore size intermediate 5.5 x 5.5 to 4.5 x 4.5 Å, but excluding 4.5 x 4.5 Å, being selected to permit adsorption of mono-isoparaffins (and any remaining normal paraffins) in deference to di-isoparaffins, other multi-branched paraffins, cyclic paraffins and aromatic hydrocarbons which can be passed directly to a refinery gasoline blending pool. In operation, at least part of both the second hydrocarbon feed stream and the reformate is firstly passed to a first separation zone comprising the first shape-selective separatory molecular sieve as defined hereinabove to produce the first hydrocarbon product stream comprising the normal paraffins and the second hydrocarbon product stream comprising both mono- and di-isoparaffins. The latter hydrocarbon product stream is subsequently passed to a second separation zone comprising the second shape-selective separatory molecular sieve as described hereinabove. Subsequently, a third hydrocarbon product stream comprising mono-isoparaffins can be recovered and a fourth hydrocarbon product stream comprising di-isoparaffins can be recovered. At least part of the first and third hydrocarbon product streams can suitably be co-processed in step b). Suitably, the complete first and third hydrocarbon product streams can be co-processed in step b). At least part of these streams may,

however, also suitably be used as a preferred chemical feedstock as indicated hereinbefore.

The multiple select adsorbent molecular sieve system as described hereinabove comprises at least two molecular sieves. These can be arranged in separate vessels, or they can be arranged in a stacked flow scheme within one vessel.

This first molecular sieve can be a calcium 5 Å zeolite or any other sieve of similar pore dimensions, i.e. pore dimensions of 4.5 x 4.5 Å. It is not necessary to size the first sieve to adsorb all of the normal paraffins, but it is preferred so that the second molecular sieve does not have to function as a normal paraffin adsorption sieve.

The second sieve in this process sequence is exemplified by a molecular sieve which has eight and ten member rings and pore dimensions intermediate 5.5 x 5.5 and 4.5 x 4.5 Å, but excluding 4.5 x 4.5 Å.

The preferred second molecular sieve of this invention is exemplified by a ferrierite molecular sieve. It is preferred that the ferrierite sieve be present in a hydrogen form, but it alternatively can be exchanged with a cation of an alkali metal, or alkaline earth metal or transition metal cation. The molecular sieves of this invention include ferrierite and other analogous shape-selective materials with pore openings intermediate in dimensions to those of the calcium 5 Å zeolite and ZSM-5. Other examples of crystalline sieves include aluminophosphates, silicoaluminophosphates, and borosilicates.

The aluminophosphate, silicoaluminophosphate and borosilicate molecular sieves which can be used as a second molecular sieve will have a pore opening intermediate between 5.5 x 5.5 and 4.5 x 4.5 Å, but excluding 4.5 x 4.5 Å.

It is feasible that the molecular sieve comprises a large pore zeolite that has been ion exchanged with cations to diminish the effective pore size of the sieve to within the aforementioned range of dimensions.

When applying multiple select adsorbent molecular sieve systems, the sequence of the sieves, whether in discrete vessels or in a stacked variety, is very important. If the sieves are interchanged the process loses effectiveness because the larger sieve will rapidly fill with normal paraffins, prohibiting the efficient adsorption of mono-isoparaffins.

The respective sieves applied in a multiple select adsorbent molecular sieve system should be arranged in a process sequence to first provide adequate adsorption of the normal paraffin hydrocarbons, and then adsorption of the mono-isoparaffins Each of these respective sieves can be provided with a common desorbent stream or each sieve may have its own desorbent stream. The desorbent is preferably a gaseous material such as a hydrogen gas stream. Suitably, at least part of the reformate obtained is passed to a hydrogenation unit before being subjected to any of the separation treatments described hereinbefore.

In the processes according to the present invention as described hereinbefore, suitably the third hydrocarbon feed stream can, prior to the reforming step, also be subjected to a separation treatment wherein normal paraffins and optionally mono-isoparaffins are separated from di-isopraffins, and whereby a first separation effluent stream comprising normal paraffins is recovered and at least part of a second separation effluent stream comprising di-isoparaffins is subjected to the reforming step.

In this way it is established that the amount of gas make and the production of hydrocarbons having a low octane rating can substantially be reduced in the reforming step.

The separation treatment upstream the reforming step can suitably be established by passing at least part of the third hydrocarbon feed stream to a separation zone comprising a shape-selective separatory molecular sieve having a pore size of 4.5 x 4.5 Å or smaller and being shaped to permit adsorption of normal paraffins in a selective manner vis-à-vis mono-isoparaffins, di-isoparaffins, other multi-branched paraffins, cyclic paraffins and aromatic hydrocarbons. In this way the normal paraffins can

selectively be separated from mono-isoparaffins and di-isoparaffins. Subsequently, a first separation effluent stream comprising substantially normal paraffins can be recovered and a second separation effluent stream comprising di-isoparaffins can at least partly be subjected to the reforming step.

Suitably, the separation treatment upstream the reforming step can be carried out in such a way that both the normal paraffins and mono-isoparaffins are separated from the di-isoparaffins. This is suitably established by passing at least part of the third hydrocarbon feed stream to a separation zone comprising a shape-selective separatory molecular sieve having a pore size intermediate 5.5 x 5.5 to 4.5 x 4.5 Å but excluding 4.5 x 4.5 Å, the pore size being sufficient to permit entry of normal paraffins and mono-isoparaffins but restrictive to prohibit entry of di-isoparaffins. In this way the normal paraffins and mono-isoparaffins can selectively be separated from the di-isoparaffins, other multi-branched paraffins, cyclic paraffins and aromatic hydrocarbons. Subsequently, a first separation effluent stream comprising both normal paraffins and mono-isoparaffins can be recovered and a second separation effluent stream comprising di-isoparaffins can at least partly be subjected to the reforming step.

Preferably, the separation treatment upstream the reforming step is carried out in such a way that the normal paraffins are firstly separated from the mono-isoparaffins and di-isoparaffins, whereas the mono-isoparaffins are subsequently separated from the di-isoparaffins. To this end use can be made of a multiple select adsorbent molecular sieve system as described hereinbefore.

Suitably, at least part of the separation effluent streams comprising normal and/or mono-isoparaffins can be applied as a preferred chemical feedstock as indicated hereinbefore.

When use is made of a multiple select adsorbent molecular sieve system both upstream and downstream of the reforming step, firstly the initially present normal paraffins and mono-iso-paraffins are separated from di-isoparaffins, whereas subsequently

normal paraffins and mono-isoparaffins, which were still present in the second separation effluent stream or have been produced in the reforming step, are separated from di-isoparaffins.

The application of a multiple select adsorbent molecular sieve system both upstream and downstream of the reforming step is very attractive since it offers product flexibility together with product quality. The separation treatments upstream and downstream the reforming step can suitably be carried out in the same separation zone. Suitably, butane is added to the gasoline obtained in the gasoline blending pool in order to obtain an overall gasoline having the maximum allowable RVP (Reid Vapour Pressure) specification.

In the reforming step any conventional reforming catalyst can be applied. Preferably, in the reforming step a catalyst is used having a substantial (dehydro)cyclization activity. Exemplary of a conventional reforming catalyst is a platinum-containing catalyst with platinum present in for instance a range of 0.005 wt% to 10.0 wt%.

The catalytic metals associated with the reforming function are preferably noble metals from Group VIII of the Periodic Table of elements, such as platinum and palladium. The reforming catalyst can be present per se or it may be mixed with a binder material.

It is well appreciated that the application of noble metal(s)-containing reforming catalysts normally requires a pretreatment in the form of a catalytic hydrotreatment of the feedstock to be upgraded. In this way nitrogen-compounds and sulphur-compounds can be removed from the feedstock which compounds would otherwise reduce the performance of the reforming catalyst considerably.

The reforming step can suitably be carried out under conventional reforming conditions. Typically the process is carried out at a temperature from 450 to 550 °C and a pressure of 3 to 20 bar. The reaction section in which the reforming step is to be performed can suitably be separated into several stages or reactors.

The present invention will now be illustrated by means of the following Example.

Example

A process according to the present invention is carried out in accordance with the flow diagram as schematically shown in Figure 1.

A hydrocarbonaceous feedstock substantially boiling in the gasoline range and having the properties as set out in Table 1 is introduced via a line 1 into a distillation column 2 wherein the feedstock is separated into three hydrocarbon feed streams. A first hydrocarbon feed stream comprising hydrocarbons of the C_5-C_6 range is withdrawn via a line 3 and introduced into an isomerization unit 4. The isomerate effluent obtained therefrom is withdrawn via a line 5 and introduced into the gasoline blending pool 6, whereas a gaseous fraction is withdrawn via a line 7. A second hydrocarbon feed stream comprising hydrocarbons of the C_6-C_{10} range is withdrawn via a line 8. A third hydrocarbon feed stream comprising C_8 and greater hydrocarbons is withdrawn via a line 9 and introduced into a reforming reactor 10. The reforming is carried out at a temperature of 510 °C, a pressure of 10.6 bar, a weight hourly space velocity of 1.8 kg/kg/hr and a hydrogen/feed ratio of 510 Nl/kg. The commercially available reforming catalyst comprises platinum and tin on alumina. The reformate obtained is subsequently withdrawn via a line 11 and introduced into a distillation column 12. In the distillation column 12 the reformate is separated in a gaseous fraction, a light fraction comprising C_5-C_6 hydrocarbons and a gasoline fraction. The gaseous fraction is withdrawn via a line 13, the light fraction is co-processed with the first hydrocarbon feed stream via a line 14 and the gasoline fraction is withdrawn via a line 15. The second hydrocarbon feed stream is introduced via the line 8 into the line 15 and together with the gasoline fraction passed to a separation zone 16 containing molecular sieves 17 and 18. Molecular sieve #1 (17) is a commercial zeolite having pore size of from 4.5 to 4.5 Å or smaller. Molecular

sieve 18, referred to as molecular sieve #2, has a pore size intermediate 5.5 x 5.5 to 4.5 x 4.5 Å, but excludes 4.5 x 4.5 Å.

The first molecular sieve 17 selectively adsorbs normal paraffins in preference to mono-isoparaffins, di-isoparaffins, cyclic paraffins and aromatic hydrocarbons. A fraction comprising the normal paraffins is withdrawn via a line 19. The separation effluent stream substantially freed from normal paraffins is withdrawn via a line 20 and contacted with molecular sieve #2 (18). In this particular sieve, mono-isoparaffins are adsorbed while di-isoparaffins and other multi-branched paraffins, cyclic paraffins and aromatic hydrocarbons are passed through the sieve without adsorption. A fraction comprising mono-isoparaffins is withdrawn via a line 21, and the remaining separation effluent (di-isoparaffins fraction) which is now substantially freed from normal paraffins and mono-isoparaffins is withdrawn via a line 22 and introduced into the blending gasoline pool 6. The fractions withdrawn via the lines 19 and 21 are co-processed in the reforming step.

100 pbw of the feedstock in line 1 yields the various product fractions in the following quantities:

16.8 pbw first hydrocarbon feed stream (line 3)
51.0 pbw second hydrocarbon feed stream (line 8)
32.2 pbw third hydrocarbon feed stream (line 9)
59.8 pbw reformate fraction (line 11)
11.7 pbw gaseous fraction (line 13)
7.0 pbw light fraction (line 14)
41.1 pbw gasoline fraction (line 15)
21.8 pbw isomerate fraction (line 5)
2.0 pbw gaseous fraction (line 7)
12.9 pbw normal paraffins fraction (line 19)
79.2 pbw separation effluent stream (line 20)
14.7 pbw mono-isoparaffins fraction (line 21)
64.5 pbw di-isoparaffins fraction (line 22)

In the gasoline blending pool 6, 3.7 pbw of butane has been added to the gasoline obtained via a line 23. In this way 90.0 pbw

of an overall gasoline is obtained having the maximum allowable RVP specification.

The overall gasoline obtained in the blending gasoline pool 6 has the properties as set out in Table 2.

From Table 2 it is clear that a very attractive gasoline, in terms of octane number and content of aromatics, in particular benzene, can be obtained by applying the present invention. In conventional upgrading processes gasolines are obtained having a considerable higher content of aromatics, in particular benzene.

Table 1

C (%wt)	:	84.9
H (%wt)	:	15.1
S (ppm)	:	15
d (15/4)	:	0.729
I.B.P.(°C, ASTM)	:	50
10% wt rec.	:	82
30% " "	:	100
50% " "	:	110
70% " "	:	128
90% " "	:	149
F.B.P.	:	183
RON	:	55
naphthenes "	:	34
aromatics "	:	6

Table 2

Gasoline properties:	
RON	95.0
total aromatics (%vol)	34.0
benzene (%vol)	0.9
naphthenes (%vol)	23.4
RVP (kPa)	62

The claims defining the invention are as follows:

~~C L A I M S~~

1. Process for upgrading a hydrocarbonaceous feedstock substantially boiling in the gasoline range, which process comprises:

a) separating the feedstock into a first hydrocarbon feed stream comprising C_6 and smaller hydrocarbons, a second hydrocarbon feed stream comprising hydrocarbons of the C_6-C_{10} range and a third hydrocarbon feed stream comprising C_8 and greater hydrocarbons;

b) subjecting at least part of the third hydrocarbon feed stream to a reforming step to produce a reformate stream;

c) subjecting at least part of both the second hydrocarbon feed stream and the reformate stream to a separation treatment wherein normal paraffins and optionally mono-isoparaffins are separated from di-isoparaffins; and

d) recovering therefrom (a) hydrocarbon product stream(s) comprising normal paraffins and optionally mono-isoparaffins and (a) hydrocarbon product stream(s) comprising di-isoparaffins.

2. Process according to claim 1, wherein the second hydrocarbon feed stream comprises hydrocarbons of the C_6-C_8 range.

3. Process according to claim 1 or 2, wherein in step c) both the normal paraffins and mono-isoparaffins are separated from the di-isoparaffins.

4. Process according to claim 3, wherein firstly the normal paraffins are separated from the mono-isoparaffins and di-isoparaffins, and subsequently the mono-isoparaffins are separated from the di-isoparaffins.

5. Process according to any one of claims 1-3, wherein in step c) at least part of both the second hydrocarbon feed stream and the reformate are subjected to the same separation treatment, and wherein a first hydrocarbon product stream comprising normal

paraffins is recovered and a second hydrocarbon product comprising di-isoparaffins is recovered.

6. Process according to claim 5, wherein in step b) at least part of the first hydrocarbon product stream comprising normal paraffins is co-processed with the third hydrocarbon feed stream.

7. Process according to any one of claims 1-5, wherein at least part of the third hydrocarbon feed stream is, prior to the reforming step, firstly subjected to a separation treatment wherein normal paraffins and optionally mono-isoparaffins are separated from di-isoparaffins, and whereby a first separation effluent stream comprising normal paraffins is recovered and at least part of a second separation effluent stream comprising di-isoparaffins is subjected to the reforming step.

8. Process according to claim 7, wherein both the normal paraffins and mono-isoparaffins are separated from the di-isoparaffins.

9. Process according to claim 8, wherein firstly the normal paraffins are separated from the mono-isoparaffins and di-isoparaffins, and subsequently the mono-isoparaffins are separated from the di-isoparaffins.

10. Process for upgrading a hydrocarbonaceous feedstock substantially boiling in the gasoline range substantially as hereinbefore described with reference to the Example.

11. Upgraded hydrocarbon feedstock produced by the process of any one of claims 1 to 10.

Dated 28 November, 1994
Shell Internationale Research Maatschappij B.V.
Patent Attorneys for the Applicant/Nominated Person
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AUSTRALIA PATENT OFFICE

Process for Upgrading a Hydrocarbonaceous Feedstock

Abstract

Process for upgrading a hydrocarbonaceous feedstock substantially boiling in the gasoline range, which process comprises: a) separating the feedstock into a first hydrocarbon feed stream comprising C_6 and smaller hydrocarbons, a second hydrocarbon feed stream comprising hydrocarbons of the C_6-C_{10} range and a third hydrocarbon feed stream comprising C_8 and greater hydrocarbons; b) subjecting at least part of the third hydrocarbon feed stream to a reforming step to produce a reformate stream; c) subjecting at least part of both the second hydrocarbon feed stream and the reformate stream to a separation treatment wherein normal paraffins and optionally mono-isoparaffins are separated from di-isoparaffins; and d) recovering therefrom (a) hydrocarbon product stream(s) comprising normal paraffins and optionally mono-isoparaffins and (a) hydrocarbon product streams comprising di-isoparaffins.

A hydrocarbonaceous feedstock is introduced via a line (*1*) into a distillation column (*2*) wherein the feedstock is separated into three hydrocarbon feed streams. A first hydrocarbon feed stream is withdrawn via a line (*3*) and introduced into an isomerization unit (*4*). The isomerate effluent obtained therefrom is withdrawn via a line (*5*) and introduced into the gasoline blending pool (*6*), whereas a gaseous fraction is withdrawn via a line (*7*). A second hydrocarbon feed stream is withdrawn via a line (*8*). A third hydrocarbon feed stream is withdrawn via a line (*9*) and introduced into a reforming reactor (*10*). The reformate obtained is subsequently withdrawn via a line (*11*) and introduced into a distillation column (*12*). In the distillation column (*12*) the reformate is separated in a gaseous fraction, a light fraction and a gasoline fraction. The gaseous fraction is withdrawn via a line (*13*), the light fraction is co-processed with the first hydrocarbon feed stream via a line (*14*) and the gasoline fraction is withdrawn via a line (*15*). The second hydrocarbon feed stream is introduced via the line (*8*) into the line (*15*) and together with the gasoline fraction passed to a separation zone (*16*) containing molecular sieves (*17*) and (*18*).

A fraction comprising the normal paraffins is withdrawn via a line (*19*). The separation effluent stream substantially freed from normal paraffins is withdrawn via a line (*20*) and contacted with molecular sieve (*18*). A fraction comprising mono-isoparaffins is withdrawn via a line (*21*), and the remaining separation effluent (di-isoparaffins fraction) which is now substantially freed from normal paraffins and mono-isoparaffins is withdrawn via a line (*22*) and introduced into the blending gasoline pool (*6*). The fractions withdrawn via the lines (*19*) and (*21*) are co-processed in the reforming step.

Figure 1.

FIG.1

