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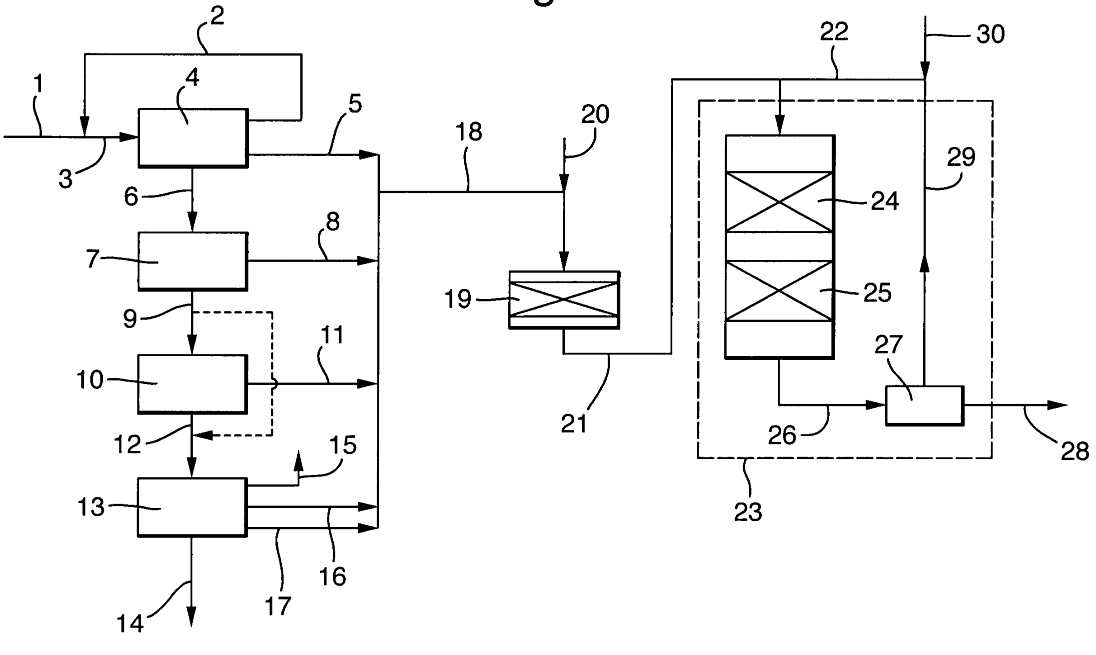
# (54) A PROCESS FOR UPGRADING A CRUDE OIL PRODUCT

(57) A process for upgrading a crude oil product comprising the following steps:
(a) distilling the crude oil product at atmospheric pressure to obtain at least one atmospheric distillate stream and an atmospheric residue as bottom stream;
(b) optionally vacuum distilling the atmospheric residue to obtain at least one vacuum distillate stream and a vacuum residue as bottom stream;
(c) supplying either the atmospheric residue or the vacuum residue to a solvent deasphalting unit and deasphalting the residue to obtain deasphalted oil and an asphaltic fraction;
(d) combining at least one atmospheric distillate stream obtained in step (a) and the deasphalted oil to obtain a combined hydrocracker feedstock; and
(e) supplying the combined hydrocracker feedstock to a hydrocracking unit and subjecting the feedstock to single-stage hydrocracking by contacting the combined feedstock with a hydrocracking catalyst in the presence of hydrogen at elevated pressure and temperature thereby effecting conversion of at least 25 wt% of the hydrocarbons in the feedstock boiling above 360 °C into hydrocarbons boiling below 360 °C, to obtain an upgraded crude oil product.

Fig.1.



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## Description

### Field of the invention

**[0001]** The present invention provides a process for upgrading a crude oil product, wherein the yield of upgraded distillate products from residual hydrocarbon oil is maximised.

### Background of the invention

**[0002]** Upgrading the residue of atmospheric or vacuum distillation units in a crude oil refinery in order to maximise the yield of upgraded or sweet distillate fractions is economic attractive.

**[0003]** It is known to recover valuable oils left in a vacuum residue by subjecting the residue to solvent deasphalting. The thus-obtained deasphalted oil may be converted into upgraded distillates by hydrocracking.

**[0004]** In EP 683 218 for example is disclosed, a process for the conversion of a vacuum hydrocarbon oil residue, comprising the steps of:

(a) deasphalting the residual hydrocarbon oil producing an asphaltic fraction and a deasphalted oil (DAO);
(b) passing the DAO through a bed of a hydrodemetallisation catalyst in the presence of hydrogen under demetallising conditions, producing an upgraded DAO; and then directly
(c) blending the upgraded DAO with one or more flashed distillate fractions and subjecting the resulting blend stream to hydrocracking in the presence of an acidic catalyst, producing one or more distillate fractions.

**[0005]** In US 4,165,274 is disclosed a process for upgrading tar sand oil wherein tar sand oil is separated by vacuum distillation into a vacuum distillate and a vacuum residue. The vacuum distillate is catalytically hydrocracked. The vacuum residue is separated by deasphalting into a deasphalted oil and asphalt, and the deasphalted oil is first catalytically hydrodemetallised and thereafter catalytically hydrodesulphurised.

### Summary of the invention

**[0006]** It has now been found that the yield of upgraded distillates from a crude oil product, for example crude oil or tar sand-derived oil, can be further increased by subjecting a combined hydrocracker feedstock comprising atmospheric distillate obtained by atmospheric distillation of the crude oil product and deasphalted oil obtained by solvent deasphalting of either the atmospheric residue of the atmospheric distillation or the vacuum residue obtained by vacuum distillation of the atmospheric residue, to single-stage hydrocracking.

**[0007]** Accordingly, the present invention provides a process for upgrading a crude oil product comprising the following steps:

(a) distilling the crude oil product at atmospheric pressure to obtain at least one atmospheric distillate stream and an atmospheric residue as bottom stream;
(b) optionally vacuum distilling the atmospheric residue to obtain at least one vacuum distillate stream and a vacuum residue as bottom stream;
(c) supplying either the atmospheric residue or the vacuum residue to a solvent deasphalting unit and deasphalting the residue to obtain deasphalted oil and an asphaltic fraction;
(d) combining at least one atmospheric distillate stream obtained in step (a) and the deasphalted oil to obtain a combined hydrocracker feedstock; and
(e) supplying the combined hydrocracker feedstock to a hydrocracking unit and subjecting the feedstock to single-stage hydrocracking by contacting the combined feedstock with a hydrocracking catalyst in the presence of hydrogen at elevated pressure and temperature thereby effecting conversion of at least 25 wt% of the hydrocarbons in the feedstock boiling above 360 °C into hydrocarbons boiling below 360 °C, to obtain an upgraded crude oil product.

**[0008]** The process according to the invention can be distinguished from the process disclosed in EP 683 218 in that an atmospheric distillate is combined with the deasphalted oil in the combined hydrocracker feedstock. In the process of EP 683 218, one or more flashed distillates, i.e. vacuum distillates, are combined with the deasphalted oil. Since atmospheric distillates typically have hydrocarbons boiling at a lower temperature than those in flashed distillates, the combination of an atmospheric distillate with DAO will result in a hydrocracker feedstock with a wider boiling point range. The skilled person would therefore expect overcracking of the lower boiling hydrocarbons in such feedstock, if it were to be subjected to hydrocracking. It has, however, been found that a surprisingly high yield of distillates is obtained in the process according to the invention, i.e. if an atmospheric distillate is combined with deasphalted oil for combined single-stage hydrocracking.

### Brief description of the drawing

**[0009]** In Figure 1 is shown a process scheme of an embodiment of the process according to the invention.

### Detailed description of the invention

**[0010]** In the process according to the invention, a crude oil product is upgraded by first distilling it under atmospheric pressure to obtain at least one atmospheric distillate stream and an atmospheric residue (step (a)). The atmospheric residue may be vacuum distilled to obtain at least one vacuum distillate stream and a vacuum residue (step (b)). If the atmospheric residue is vacuum distilled, the thus-obtained vacuum residue is supplied to a solvent deasphalting unit and deasphalted to obtain deasphalted oil and an asphaltic fraction in step (c). Alternatively, the atmospheric residue is directly supplied to a solvent deasphalting unit and deasphalted to obtain deasphalted oil and an asphaltic fraction in step (c). The deasphalted oil is, optionally after hydrodemetallisation, combined with at least one atmospheric distillate stream obtained in step (a) and, in case the atmospheric residue is vacuum distilled, also with at least one vacuum distillate stream obtained in step (b) to obtain a combined hydrocracker feedstock (step (d)).

**[0011]** In step (e), the combined hydrocracker feedstock is supplied to a hydrocracking unit and subjected to single-stage hydrocracking. Reference herein to single-stage hydrocracking is to a hydrocracking operation wherein the entire feedstock is contacted with a single catalytic zone comprising hydrocracking catalyst or with several catalytic zones in series of which at least one comprises hydrocracking catalyst. If several catalytic zones in series are used, the entire feedstock is contacted with the most upstream catalytic zone and the entire effluent of a zone is contacted with the subsequent catalytic zone. The catalytic zones in series may be in the form of different catalytic layers on top of each other in a single catalyst bed or in the form of different spaced apart catalyst beds in series in a single vessel or in multiple reactor vessels. Suitably, the entire feedstock is, in the hydrocracking unit, first contacted with a hydrotreating catalyst (pre-treat catalyst) for hydrodesulphurisation and/or hydrodenitrification of the feedstock and then with a hydrocracking catalyst. Optionally, the effluent of the hydrocracking catalyst is contacted with a further hydrotreating catalyst (posttreat catalyst) for hydrodearomatisation of the effluent of the hydrocracking catalyst.

**[0012]** In the hydrocracking unit, the entire combined feedstock, optionally after pre-treating with a hydrotreating catalyst, is contacted with a hydrocracking catalyst at hydrocracking conditions, i.e. in the presence of hydrogen at elevated pressure and temperature thereby effecting conversion of at least 25 wt% of the feedstock hydrocarbons boiling above 360 °C into hydrocarbons boiling below 360 °C, to obtain an upgraded crude oil product. Reference herein to conversion is to conversion per pass. The upgraded product may be fractionated in a fractionator to obtain several distillate fractions. Preferably, at most 80 wt% of the feedstock hydrocarbons boiling above 360 °C are converted into hydrocarbons boiling below 360 °C, more preferably in the range of from 40 to 70 wt% is converted.

**[0013]** If the deasphalted oil in the combined feedstock is not hydrodemetallised before being combined with the distillate streams, it is preferred that the combined hydrocracker feedstock is hydrodemetallised before being supplied to the hydrocracking unit.

**[0014]** Reference herein to a crude oil product is to crude oil or to crude oil products such as for example tar sand derived oil or shale oil. In the case of very viscous crude oil products, such as may be the case for tar sand derived oil, the crude oil product may be diluted with a hydrocarbon stream having a low viscosity, for example naphtha, to obtain a diluted crude oil product with a viscosity that is suitable for processing in an atmospheric distillation unit. The process according to the present invention is particularly suitable for upgrading crude oil products that have a relatively high content of hydrocarbons boiling above 520 °C, such as for example tar sand derived oil.

**[0015]** Atmospheric distillation of crude oil is commonly known in the art. Atmospheric distillation step (a) of the process according to the invention may be carried out by any conventional techniques and at conventional conditions used for crude oil atmospheric distillation. In atmospheric distillation step (a), at least one atmospheric distillate stream and an atmospheric residue (long residue) are obtained. More than one atmospheric distillate streams may be obtained, each having a different boiling point range. At least one distillate stream obtained in step (a) is combined with the deasphalted oil obtained in step (c) to form the combined hydrocracker feedstock. Preferably, all distillate streams obtained in step (a) are combined in the combined hydrocracker feedstock. Alternatively, one of the distillate streams may be used as diluent for the crude oil product, for example in case of a highly viscous crude oil product such as tar sand derived oil.

**[0016]** Preferably, the atmospheric residue obtained in step (a) is vacuum distilled in step (b). This vacuum distillation step (b) may be carried out by any conventional vacuum distillation techniques, using conventional vacuum distillation conditions known in the art. Suitable techniques then, include high vacuum distillation using steam ejectors and vacuum flash distillation. In step (b), at least one vacuum distillate stream and a vacuum residue (short residue) are obtained. At least one vacuum distillate stream obtained in step (b) is combined with at least one atmospheric distillate stream obtained in step (a) and the deasphalted oil obtained in step (c) to form the combined hydrocracker feedstock. Preferably, all distillate streams obtained in step (b) are combined in the combined hydrocracker feedstock.

**[0017]** Either the atmospheric residue obtained in step (a) or, in case the process comprises vacuum distillation step (b), the vacuum residue obtained in step (b) is deasphalted in a solvent deasphalting unit to obtain a deasphalted oil. The solvent deasphalting of the residue may be carried out in any conventional manner. Typically in solvent deasphalting, the hydrocarbon feed is treated countercurrently with an extracting medium which is usually a light hydrocarbon solvent containing paraffinic compounds. Commonly applied paraffinic compounds include $C_{3-8}$ paraffinic hydrocarbons, such as propane, n-butane, iso-butane, n-pentane, iso-pentane, hexane or mixtures of two or more of these. For the purpose of the present invention, it is preferred that $C_3$-$C_5$ paraffinic hydrocarbons, most preferably butane, pentane or a mixture thereof, are used as the extracting solvent. In general, the extraction depth increases at increasing number of carbon atoms of the extracting solvent. In this connection it is noted that the higher the extraction depth, the larger the amount of hydrocarbons being extracted from the hydrocarbon feed, the smaller and more viscous the asphaltene fraction and the heavier the asphaltenes being present in said asphaltene fraction.

**[0018]** In solvent deasphalting step (c), a rotating disc contactor or a plate column can be used with the hydrocarbon feed, i.e. the residue, entering at the top and the extracting solvent entering at the bottom. The lighter hydrocarbons which are present in the residue dissolve in the extracting solvent and are withdrawn at the top of the apparatus. The asphaltenes which are insoluble in the extracting solvent are withdrawn at the bottom of the apparatus. The conditions under which deasphalting takes place are known in the art. Suitably, deasphalting is carried out at a total extracting solvent to residual hydrocarbon oil ratio of 1.5 to 8 wt/wt, a pressure of from 1 to 50 bar and a temperature of from 160 to 230 °C.

**[0019]** The deasphalted oil obtained in solvent deasphalting step (c) is combined with at least one atmospheric distillate stream obtained in step (a) to obtain a combined hydrocracker feedstock. In case the atmospheric residue is vacuum distilled in step (b), the deasphalted oil is combined with at least one atmospheric distillate stream obtained in step (a) and at least one vacuum distillate stream obtained in step (b) to obtain the combined hydrocracker feedstock.

**[0020]** The combined hydrocracker feedstock has a broad boiling point range, since it includes atmospheric distillate and deasphalted oil. Preferably, the combined hydrocracker feedstock contains at least 10 wt% of hydrocarbons boiling below 360 °C, more preferably at least 20 wt%, and at least 5 wt% of hydrocarbons boiling above 700 °C.

**[0021]** Since deasphalted oil usually contains, in contrast to distillate streams, a relatively high amount of metals, it is preferred to hydrodemetallise the deasphalted oil obtained in step (c) before it is combined with the other streams to form the combined hydrocracker feedstock. Alternatively, the combined hydrocracker feedstock may be hydrodemetallised, before it is contacted with the hydrocracking catalyst in step (d). Hydrodemetallisation of the deasphalted oil or of the combined hydrocracker feedstock may be achieved by any well known hydrodemetallisation process wherein the hydrocarbon feed to be demetallised is passed at elevated temperature and pressure and in the presence of hydrogen in an upward, downward or radial direction, through one or more vertically disposed reactors containing a fixed or moving bed of hydrodemetallisation catalyst particles. Well known hydrodemetallisation operations are the bunker flow operation, the fixed bed operation, the fixed bed swing operation and the movable bed operation.

**[0022]** Suitable hydrodemetallisation catalysts usually consist of oxidic carriers such as alumina, silica or silica-alumina, on which one or more Group VIB or Group VIII metals or metal compounds may be deposited. Such hydrodemetallisation catalysts are commercially available from many catalyst suppliers. Particularly suitable hydrodemetallisation catalysts are those having as the active agent one of the combinations nickel/molybdenum (NiMo) or cobalt/molybdenum (CoMo), optionally promoted with phosphorus (P), on an alumina ($Al_2O_3$) carrier. Examples of particularly suitable catalysts are CoMo/$Al_2O_3$, CoMoP/$Al_2O_3$ and NiMo/$Al_2O_3$ and NiMoP/$Al_2O_3$ catalysts. It is well known that the type of catalysts described hereinbefore will, in practice, also exhibit some upgrading activity in terms of hydrodenitrification and/or hydrodesulphurisation, removal of heavy hydrocarbons and conversion of hydrocarbons having a boiling point above 520 °C into lower boiling components. Hydrodemetallisation is usually carried out at an operating pressure of 20-250 bar (absolute), a temperature of 300-470 °C, preferably 310-440 °C, and a space velocity of 0.1-10 $1.1^{-1}hr^{-1}$, preferably 0.2 to 7 $1.1^{-1}hr^{-1}$.

**[0023]** In step (e) of the process according to the invention, hydrocracking conditions known in the art may be applied. Suitable hydrocracking conditions are an operating pressure of 80-250 bar (absolute), preferably 100-200 bar (absolute), and a temperature in the range of from 300 to 500 °C, preferably of from 350 to 450 °C.

**[0024]** Any hydrocracking catalyst known in the art may be used. Common hydrocracking catalyst usually comprise one or more metals from nickel, tungsten, cobalt and molybdenum in elemental, oxidic or sulphidic form as hydrogenating component on a suitable oxidic carrier such as alumina, silica or silica-alumina, optionally in combination with a zeolitic component. There are many commercially available hydrocracking catalysts which can be suitably applied in the process of the present invention. Preferably, the hydrocracking catalyst is acidic, i.e. contains a silica-alumina and/or zeolitic component. Since hydrocracking step (e) is a single-stage hydrocracking step, i.e. with the entire feedstock or the entire effluent of a pre-treat catalyst passing the hydrocracking catalyst, the hydrocracking catalyst preferably does not comprise a noble metal as hydrogenating component.

**[0025]** An upgraded crude oil product is obtained as the liquid effluent of the hydrocracking unit. The hydrogen-comprising gaseous effluent may be recycled to the hydrocracking unit and/or the hydrodemetallisation catalyst. The liquid effluent may be fractionated in a fractionator to obtain different distillate fractions. Besides the distillate fractions there can also be obtained a heavy fraction in the fractionator. This heavy fraction may be recycled to the hydrocracking unit or to the coking unit. Alternatively, the heavy fraction may also be suitably applied as a feed for a fluidised bed catalytic cracking (FCC) unit or as a feedstock for lubricating oil manufacture. Of course, a combination of these options is possible as well. It is an advantage of the process according to the invention that recycling of such heavy fraction to the hydrocracking unit is not needed in order to obtain an optimum yield of upgraded distillates in the upgraded crude oil product. Thus, hydrocracking step (e) is preferably a once-through, single-stage hydrocracking step, i.e. without recycling of part of the upgraded crude oil product to the hydrocracking unit. Reference herein to the upgraded crude oil product is to the liquid effluent of the hydrocracking unit.

**[0026]** In order to achieve optimum demetallisation of the deasphalted oil in combination with optimum upgraded distillate yield from hydrocracking it is preferred that the hydrodemetallisation of the deasphalted oil or of the combined hydrocracker feedstock is carried out at an operating pressure which is at most 30 bar and suitably less than 20 bar higher than the operating pressure of the hydrocracking in step (e). Most suitably the operating pressure in hydrodemetallisation is from 0 to about 10 bar higher than the operating pressure in hydrocracking. In this connection it is particularly preferred to apply an operating pressure in the hydrodemetallisation zone in the range of from 150 to 200 bar (absolute). Accordingly, the operation pressure in the hydrocracking zone is suitably in the range of from 120 to about 200 bar (absolute), preferably from 140 to 180 bar (absolute).

**[0027]** Preferably, the process according to the invention further comprises a step (f), wherein at least part of the asphaltic fraction obtained in deasphalting step (c) is supplied to a coking unit and subjected to coking under coking conditions to obtain coke and at least one coker distillate stream. At least one coker distillate stream obtained in step (f) is then combined in step (d) with at least one atmospheric distillate stream obtained in step (a) and the deasphalted oil to form the combined hydrocracker feedstock. If more than one coker distillate stream is obtained in step (f), preferably all these streams are blended into the combined hydrocracker feedstock.

**[0028]** Coking of the asphaltic fraction may be done by any method known in the art, for example by delayed or fluid coking. The coking unit will typically comprise one or more coking reactors and a fractionator for fractionating the liquid and gaseous products of the coking reactor.

**[0029]** If the process according to the invention comprises coking step (f), part of the residue may by-pass the solvent deasphalting unit and be directly supplied to the coking unit, together with at least part of the asphaltic fraction. Preferably, less than 40 wt% of the residue by-passes the solvent deasphalting unit, more preferably less than 20 wt%, even more preferably none of the residue by-passes the solvent deasphalting unit.

**[0030]** Preferably, the process according to the invention further comprises a step (g) wherein at least part of the asphaltic fraction obtained in step (c) is partially combusted in a gasifying unit to a hydrogen-containing gas. The hydrogen-containing gas is so-called synthesis gas and further comprise carbon oxides and steam. Preferably, hydrogen is separated from the hydrogen-containing gas. This may for example be done by first converting the carbon monoxide in the synthesis gas by means of water-gas shift conversion into carbon dioxide and then separating the hydrogen from the carbon dioxide, for example by means of pressure swing absorption. The hydrogen separated from the hydrogen-containing gas may be supplied to the hydrocracking unit and/or the hydrodemetallisation catalyst to provide for at least part of the hydrogen needed in the hydrocracking and/or hydrodemetallisation step. More preferably, the amount of asphaltic fraction supplied to the gasifier is such that all make-up hydrogen needed in the hydrocracking unit and the hydrodemetallisation zone is produced in the gasifier. In that situation, no external hydrogen needs to be provided to the process according to the invention, once it is on stream.

**[0031]** The blending ratio of the deasphalted oil and the distillate streams in the combined hydrocracker feedstock is not particularly critical. Suitably, the weight ratio distillates to deasphalted oil is in the range of from 10/90 to 90/10, preferably 25/75 to 75/25 and more preferably 40/60 to 70/30. In order to maximise the yield of upgraded distillates, it is preferred that all distillate fractions obtained in steps (a), (b) and (f) and all deasphalted oil obtained in step (c) are combined in the hydrocracker feedstock and subjected to hydrocracking in step (e). Therefore, the amounts of the different streams in the combined hydrocracker feedstock, i.e. deasphalted oil, atmospheric distillate(s) and, optionally, vacuum distillate(s) and/or coker distillate(s), are mainly determined by the composition of the crude oil product.

## Detailed description of the drawings

**[0032]** The process according to the invention is further illustrated by means Figure 1. Tar sand derived oil 1 is diluted with naphtha 2 to obtain diluted tar sand derived oil 3, which is supplied to atmospheric distillation unit 4. In atmospheric distillation unit 4, diluted tar sand derived oil 3 is distilled and two atmospheric distillate streams, i.e. naphtha stream 2 and atmospheric gasoil stream 5, and atmospheric residue 6 are obtained. Atmospheric residue 6 is vacuum distilled in vacuum distillation unit 7. Vacuum gasoil stream 8 is obtained as distillate stream and vacuum residue 9 as bottoms stream. Vacuum residue 9 is supplied to solvent deasphalting unit 10 to obtain deasphalted oil 11 and asphaltic fraction 12. Optionally, part of vacuum residue 9 by-passes solvent deasphalting unit 10 and is directly combined with asphaltic fraction 12 (dotted line). Asphaltic fraction 12 is supplied to coking unit 13 and subjected to coking to obtain coke 14, fuel gas 15 and two distillate streams 16, 17. Distillate stream 5, 8, 16 and 17 are combined with deasphalted oil 11 to form combined hydrocracker feedstock 18. Combined feedstock 18 is hydrodemetallised in hydrodemetallisation unit 19 in the presence of hydrogen. The hydrogen 20 supplied to hydrodemetallisation unit 19 may be make-up hydrogen, hydrogen produced by partial combustion (not shown) of part of the asphaltic fraction 12 and/or recycle hydrogen from hydrocracking unit 23. The hydrodemetallised combined feedstock 21 and additional hydrogen 22 are supplied to hydrocracking unit 23 comprising a first catalytic zone 24 comprising a non-noble metal hydrotreating catalyst for hydrodesulphurisation of the feedstock and a second catalytic zone 25 comprising a non-noble metal hydrocracking catalyst. The effluent 26 of the second catalytic zone 25 is separated in gas/liquid separator 27 into upgraded crude oil product 28 and a hydrogen-rich gas stream 29 that is combined with make-up hydrogen 30 to form hydrogen stream 22 that is supplied to the first catalytic zone 24. Upgraded crude oil product 28 may be fractionated into several upgraded distillate fractions (not shown).

## Claims

1. A process for upgrading a crude oil product comprising the following steps:

   (a) distilling the crude oil product at atmospheric pressure to obtain at least one atmospheric distillate stream and an atmospheric residue as bottom stream;
   (b) optionally vacuum distilling the atmospheric residue to obtain at least one vacuum distillate stream and a vacuum residue as bottom stream;
   (c) supplying either the atmospheric residue or the vacuum residue to a solvent deasphalting unit and deasphalting the residue to obtain deasphalted oil and an asphaltic fraction;
   (d) combining at least one atmospheric distillate stream obtained in step (a) and the deasphalted oil to obtain a combined hydrocracker feedstock; and
   (e) supplying the combined hydrocracker feedstock to a hydrocracking unit and subjecting the feedstock to single-stage hydrocracking by contacting the combined feedstock with a hydrocracking catalyst in the presence of hydrogen at elevated pressure and temperature thereby effecting conversion of at least 25 wt% of the hydrocarbons in the feedstock boiling above 360 °C into hydrocarbons boiling below 360 °C, to obtain an upgraded crude oil product.

2. A process according to claim 1, wherein the combined hydrocracker feedstock contains at least 10 wt% of hydrocarbons boiling below 360 °C, preferably at least 20 wt%, and at least 5 wt% of hydrocarbons boiling above 700 °C.

3. A process according to claim 1 or 2, wherein the combined hydrocracker feedstock obtained in step (d) is contacted with a hydrodemetallisation catalyst in the presence of hydrogen under hydrodemetallisation conditions before contacting the combined feedstock with the hydrocracking catalyst.

4. A process according to claim 1 or 2, wherein the deasphalted oil obtained in step (c) is contacted with a hydrodemetallisation catalyst in the presence of hydrogen under hydrodemetallisation conditions before the deasphalted oil is combined with at least the atmospheric gasoil stream to obtain the combined hydrocracker feedstock.

5. A process according to any one of the preceding claims comprising vacuum distillation step (b), wherein at least one vacuum distillate stream obtained in step (b) is combined with at least one atmospheric distillate stream obtained in step (a) and the deasphalted oil in step (d) to obtain the combined hydrocracker feedstock and wherein the vacuum residue obtained in step (b) is supplied to the solvent deasphalting unit.

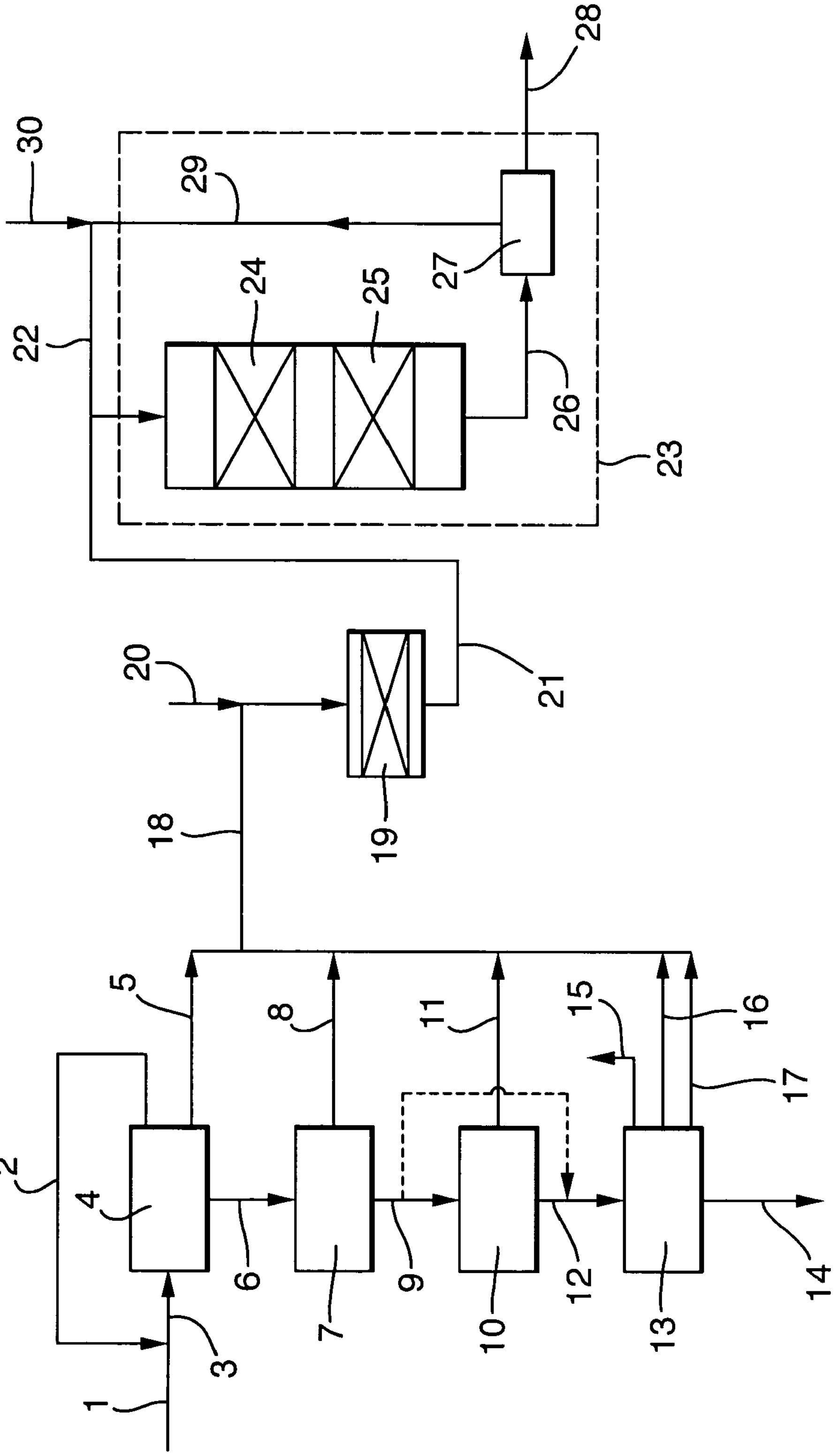
6. A process according to any one of the preceding claims, further comprising coking step (f) wherein at least part of the asphaltic fraction is supplied to a coking unit and subjected to coking under coking conditions to obtain coke and at least one coker distillate stream, in which process at least one coker distillate stream obtained in step (f) is combined with at least one atmospheric distillate stream obtained in step (a) and the deasphalted oil to obtain the combined hydrocracker feedstock.

7. A process according to any one of the preceding claims, further comprising gasifying step (g) wherein at least part of the asphaltic fraction obtained in step (c) is partially combusted in a gasifying unit to produce a hydrogen-containing gas.

8. A process according to claim 7, wherein hydrogen separated from the hydrogen-containing gas stream obtained in step (g) is supplied to the hydrocracking unit and/or the hydrodemetallisation catalyst.

9. A process according to any one of the preceding claims, wherein the combined feedstock is contacted with the hydrocracking catalyst at a temperature in the range of from 300 to 500 °C, preferably of from 350 to 450 °C, and a pressure of from 80 to 250 bar (absolute), preferably of from 100 to 200 bar (absolute).

Fig.1.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**European Patent Office**

# EUROPEAN SEARCH REPORT

Application Number
EP 05 10 5005

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.7) |
|---|---|---|---|
| X | US 4 454 023 A (LUTZ ET AL)<br>12 June 1984 (1984-06-12)<br>* column 5, lines 2-20; figures 1-4; tables *<br>* column 8, lines 18-21 *<br>* column 8, lines 49-54 *<br>* column 1, lines 64-66 *<br>----- | 1,2,5,6 | C10G67/04 |
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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 26 October 2005 | Bertin-van Bommel, S |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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O : non-written disclosure
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
........................................................................................................
& : member of the same patent family, corresponding document

## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 10 5005

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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