A method for obtaining a petroleum distillate product is provided. The method includes subjecting a Fischer-Tropsch wax to a process of hydrocracking carried out at a pressure which is substantially lower than the pressure previously used. A catalyst including a noble metal is used in this method. An apparatus for carrying out the method is also provided.
HYDROCRACKING PROCESS FOR FABRICATING DISTILLATE FROM FISCHER-TROPSCH WAXES

TECHNICAL FIELD

[0001] This disclosure relates generally to hydrocracking technology, and more specifically, to catalytic hydrocracking processes for distillate production from paraffin-based waxes such as Fischer-Tropsch or slack waxes.

BACKGROUND INFORMATION

[0002] Fischer-Tropsch synthesis is known to yield a broad mixture of products including primarily paraffins, but also various olefins and oxygenated products. The individual compounds of such mixture can contain up to about 200 carbons, the number of carbons between about 20 and 150, with average number about 60 being typical. Such mixtures are known in the art as “Fischer-Tropsch” waxes. Usually, Fischer-Tropsch waxes comprise not more than trace amounts of sulfur- or nitrogen-containing products or aromatic compounds, and may contain substantial concentrations of oxygenates.

[0003] Heavy Fischer-Tropsch wax is one kind of stock that is often utilized in the catalytic hydrocracking processes for obtaining various petrochemical products such as light hydrocarbons, distillates such as kerosene fuel and diesel fuel, naphthas, and baseoils for lubricating oils, etc.

[0004] Hydrocracking is a process combining catalytic cracking and hydrogenation of heavy feedstock, which is cracked in the presence of hydrogen to produce lighter products, e.g., isobutane for alkylation feedstock, and various products used for obtaining high-quality distillates. The process is usually carried out under quite harsh conditions of high pressure and high temperature, and uses a catalyst. Traditional catalysts that are often employed include dual function catalysts that are useful for both acidic cracking (provided by a catalyst component that is an amorphous silica-alumina support or a crystalline zeolite material) and metal hydrogenation (provided by a base metal sulfide or a reduced noble metal component incorporating such metals as nickel, tungsten, cobalt or molybdenum, platinum and/or palladium finely dispersed on the support material).

[0005] The hydrocracking process can be briefly outlined as follows. First, preliminarily heated feedstock is mixed with fresh and/or recycled hydrogen and sent to a reactor, where sulfur- and nitrogen-containing compounds are removed after being converted into hydrogen sulfide and ammonia. Aromatic hydrocarbons are partially saturated. Limited conversion per pass may also occur at this stage. Next, the reactor effluent is run through a hydrocarbon separator. The hydrogen is recycled to the feedstock, and the liquid from the hydrocarbon separator is run through a fractionator. The fractionator bottoms may be, optionally, again mixed with the fresh feed and a hydrogen stream and the process may be repeated.

[0006] Accordingly, catalytic hydrocracking is useful for converting the high molecular weight components in heavy petroleum distillates and involves the processes of hydrogenation and carbon-carbon bond cleavage. At the same time, at least a majority of oxygen, sulfur, and/or nitrogen-containing compounds, if any are present, are removed, and olefins are typically saturated to yield paraffins.

[0007] Despite its many advantages, traditional catalytic hydrocracking is characterized by a number of drawbacks and deficiencies. For example, using high pressures is energy intensive, at times dangerous, and requires special machinery. Hydrocracking catalysts are subject to deactivation by both fouling and poisoning and coke laydown on the catalyst substrate, and special measures have to be taken to prevent such deactivation.

SUMMARY

[0008] To avoid or lessen the effects of the above-mentioned deficiencies, as well as for the purposes of improvement of the distillate selectivity and overall process efficiency, better hydrocracking processes are needed to be used with paraffin-based waxes, such as Fischer-Tropsch waxes or slack waxes.

[0009] We provide methods for obtaining a petroleum distillateproduct is provided. One method comprises subjecting a wax comprised of a substantially paraffin composition to hydrocracking carried out at a pressure between about 0 and about 20 Kg/cm² in the presence of a catalyst comprising one or more metals selected from a group consisting of a noble metal and/or a base metal and/or recovering the petroleum distillate product.

[0010] The wax subject to hydrocracking may be a Fischer-Tropsch wax. The wax subject to hydrocracking may also be a slack wax. The catalyst may be in the form of spherical beads. The catalyst may contain a noble metal(s), such as palladium, platinum or the like. The catalyst can also contain a base metal such as nickel, tungsten, molybdenum or the like. The metal(s) is supported on an amorphous or zeolite containing substrate.

[0011] We also provide systems for hydrocracking such a wax. One system comprises a reactor for hydrocracking the wax in the presence of the catalyst, in which a petroleum distillate and a spent catalyst are generated, wherein the reactor is adapted for the continuous removal of the spent catalyst, a continuous catalyst regeneration unit connected to the reactor, wherein the continuous catalyst regeneration unit is configured for continuously accepting and regenerating the spent catalyst, and a reactor circuit in fluid communication with the reactor, wherein the reactor circuit is designed to maintain the pressure between about 0 and about 20 Kg/cm² in the reactor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 illustrates schematically a system for catalytic hydrocracking of waxes according to one embodiment of the present invention.

DETAILED DESCRIPTION

[0013] The following definitions are used below, unless otherwise described:

[0014] The term “a Fischer-Tropsch wax” is defined as a mixture comprised of n-paraffins having the number of carbons between about 20 and about 150, the mixture also optionally containing a fraction of oxygenates, and optionally containing a trace amount of cyclopentanols and/or aromatic compounds.

[0015] The term “a slack wax” is defined as a crude wax produced by chilling and solvent filter-pressing wax distillate.

[0016] The term “hydrocracking” refers to a process of substantially comprising catalytic cracking and hydrogenation of heavier molecules into lighter molecules.
The term “a catalyst” is defined as a substance that changes the speed or yield of a chemical reaction without being itself substantially consumed or otherwise chemically changed in the process.

The term “a noble metal” refers to a metal that is highly resistant to corrosion or oxidation, and does not easily dissolve, as opposed to most base metals. Examples include, but are not limited to, platinum, palladium, gold, silver, and tantalum.

The term “a hydrocarbon” is defined as an organic molecule of which consists only of carbon and hydrogen.

The term “paraffin” is defined as a hydrocarbon identified by saturated carbon chains, which can be normal (straight), branched, or cyclic (“cycloparaffin”), and described by a general formula $C_nH_{2n+2}$ (for straight or branched paraffins) or by a general formula $C_nH_{2n}$ (for cyclo-paraffins), where $n$ is an integer.

The term “an olefin,” also known as “alkene” or “alkylene” is defined as compounds containing at least one carbon-carbon double bond (C=C).

The term “an aromatic compound” is defined to refer to a compound that includes a cyclically conjugated molecular entity with a stability, due to delocalization, significantly greater than that of a hypothetical localized structure, such as the Kekulé structure. Aromatic compounds can be monocyclic, bicyclic and polycyclic and examples of aromatic moieties include, without limitation, phenyl, biphenyl, naphthyl, dihydroxynaphthalenyl, tetrahydroxynaphthalenyl, indenyl, indanyl, azulenyl, anthryl, phenanthryl, fluorenyl, pyrenyl and the like.

The term “a cation” is defined as an organic cation having one less electron than a corresponding free radical, and having a positive charge that may be, but not necessarily is, localized on the carbon atom.

The term “a distillate” is defined as a product of petroleum distillation containing products in low- and the mid-boiling range, including light gases, naphtha, kerosene, jet fuel, diesel fuel and heating oil. The term “No. 2 distillate” refers to a specific distillate known to those skilled in the art.

The term “kerosene” is defined as a petroleum fraction containing hydrocarbons that are slightly heavier than those found in gasoline and naphtha, such as $C_{12}$-$C_{16}$ hydrocarbons, and having a boiling point at ambient pressure between about 150°C and about 300°C.

The term “naphtha” is defined as a petroleum fraction having the boiling point at ambient pressure between about 25°C and about 200°C, which, in the fractional distillation of petroleum comes off in before kerosene.

The abbreviation “CCR” refers to the term “continuous catalyst regeneration” which is defined as a process used to regenerate spent catalyst and to the apparatus, in which such a process is carried out. In one embodiment of the invention, spent spherical hydrocracking catalyst may be regenerated in the CCR process and CCR apparatus.

A petroleum distillate product may be obtained by catalytic hydrocracking of a paraffin-based wax, such as a Fischer-Tropsch wax, or, alternatively, a slack wax. The method of obtaining the petroleum distillate includes using a wax, e.g., a Fischer-Tropsch wax as feedstock and subjecting it to a process of hydrocracking, which includes reacting the wax with gaseous hydrogen, in the presence of a catalyst, such as an above-described catalyst containing noble or base metal on an amorphous or a zeolitic substrate. The process may be conducted at a selected pressure, as described below, and at an elevated temperature that can be selected by those skilled in the art.

One temperature range that can be used is between about 200°C and about 400°C. A desired rate of supply of hydrogen gas may be selected. For example, hydrogen gas can be supplied at a rate between about 170 and about 1,700 m³ per 1 m³ of the feedstock, i.e., of the Fischer-Tropsch wax used, more narrowly, a rate of between about 675 and about 1,180 m³ per 1 m³ of the wax and/or recycled unconverted wax.

Previously, typical pressure utilized in such processes was between about 60 and about 70 kg/cm². The stability of traditionally used catalysts, i.e., nickel-, tungsten-, cobalt- or molybdenum-based amorphous catalysts, is known to be markedly lower at lower pressures. Therefore, higher pressures were previously favored over lower pressures.

Now notwithstanding such previous practices, we discovered that hydrocracking can be carried out at substantially lower pressures. Without being bound by any particular theory, as discussed below, such possibility of reducing the pressure may be due to the fact that the process of hydrocracking of the Fischer-Tropsch waxes that are used is likely to proceed via formation of olefins and carbonium ions (see reaction schemes I-V below). Such pathway of conversion of these waxes is kinetically favored at lower pressures; in addition, the conversion is more selective at lower pressures.

Therefore, hydrocracking to accomplish conversion of paraffin-based waxes, such as Fischer-Tropsch waxes or slack waxes, can be carried out at a pressure between about 0 and 20 kg/cm², for example, at a pressure between about 7 and about 20 kg/cm². A catalyst with a noble metal or metals typically facilitates the hydrocracking process at the lower pressures.

A variety of catalysts can be used for conducting the above-described process of hydrocracking. Thus, the catalyst that is used may comprise one or more noble metal(s) on a substantially spherical base. More specifically, the catalyst may be in the form of substantially spherical beads having the diameter between about 1.5 and about 3 mm. The catalyst comprises an amorphous or a zeolitic substrate in a form of a shell having the noble metal, such as palladium and/or platinum incorporated within the shell. Alternatively, the catalyst may be based on some base metals, such as nickel, tungsten, molybdenum, combinations thereof, or the like.

To obtain such beads, the noble metal may be impregnated into the catalyst shell. Those skilled in the art can devise the most appropriate method of making the beads of catalyst. Using such catalysts may allow improvement of the selectivity of conversion of the Fischer-Tropsch waxes as well as to employ the catalysts that are more stable at lower pressures, compared to the traditional amorphous catalysts incorporating a non-noble metal such as cobalt or tungsten.

A variety of Fischer-Tropsch waxes can be used in the processes described herein, including, but not limited to, waxes available commercially from manufacturers such as Sasol Ltd. of South Africa, (e.g., Argo FT wax), ExxonMobil Corp. of Houston, Tex., and others. An acceptable Fischer-Tropsch wax that can be used may be comprised of substantially 100 mass % of a paraffin composition. The paraffin composition may include one or more straight-chained paraffin(s) and may in addition include at least one branched paraffin. Such straight-chained and branched paraffin(s) are the principal components of the paraffin composition. In
addition to straight-chained paraffin and branched paraffin(s) the paraffin composition can further comprises at least some quantity of oxygenates. Trace amounts of cycloparaffins, alkyl aromatic compounds and polyalkyl aromatic compounds may be also present in the Fischer-Tropsch waxes that can be used in some embodiments.

[0036] One representative process of hydrocracking is shown below schematically on the reaction schemes I-V to illustrate in some detail the conversion process of Fischer-Tropsch waxes comprised substantially of an n-paraffin. As can be seen, the mechanism of hydrocracking of an n-paraffin involves formation of a non-stable carbonium ion intermediate coupled with hydrogenation.

[0037] More specifically, initially, an olefin is formed as a result of dehydrogenation of an n-paraffin due to the presence of a metal of the catalyst, as shown schematically on the reaction scheme I:

\[
\begin{align*}
\text{C}_4\text{H}_{10} & \rightarrow \text{C}_4\text{H}_8 + \text{H}_2 \\
\text{C}_4\text{H}_8 + \text{Metal} & \rightarrow \text{HC} = \text{CH} + \text{CH}_3 \\
\end{align*}
\]

[0038] The olefin formed as shown above then rapidly reacts with the proton that is present at an acid site of the catalyst, followed by rearrangement to form a carbonium ion (reaction scheme II):

\[
\begin{align*}
\text{C}_4\text{H}_8 & \rightarrow \text{C}_4\text{H}_7 \text{CH}_2 \text{H}^+ \\
\text{C}_4\text{H}_8 + \text{H}^+ & \rightarrow \text{C}_4\text{H}_7 \text{CH}_2 \text{H}^+ \\
\end{align*}
\]

[0039] The carbonium ion formed as shown by the reaction scheme II, is inherently unstable and, to become more stable, immediately isomerizes to a different carbonium ion. Simultaneously, cracking of the original carbonium occurs at the \( \beta \) position to form another cation and an olefin. Secondary cracking occurs as the carbonium ion continues to isomerize and crack. These reactions of cracking and isomerization are illustrated schematically by the reaction scheme III:

\[
\begin{align*}
\text{C}_4\text{H}_9 & \rightarrow \text{C}_4\text{H}_8 \text{CH}_2 \text{H}^+ \\
\text{C}_4\text{H}_9 & \rightarrow \text{C}_4\text{H}_8 \text{CH}_2 \text{H}^+ \\
\end{align*}
\]

[0040] At the end of the process, the products obtained at the previous stage undergo further transformations such as reaction of a carbonium ion with an olefin (reaction scheme IV) followed by hydrogenation (reaction scheme V) to form a paraffin (e.g., isobutane, as shown by scheme V):

\[
\begin{align*}
\text{H}_2\text{C} & \rightarrow \text{H}_2\text{C} + \text{H}_2 \\
\text{H}_2 & \rightarrow \text{H}_2 \\
\text{HC} = \text{CH} & \rightarrow \text{HC} = \text{CH} \\
\end{align*}
\]

As mentioned above, the Fischer-Tropsch waxes useful for conversion can include at least some amounts of cycloparaffins, in addition to straight-chained and/or branched paraffins. If any such cycloparaffin portion is present in the wax, in addition to the process of conversion of n-paraffin portion shown by the reaction schemes I-V, the process of hydrocracking includes conversion of cycloparaffins as well. One mechanism of conversion of cycloparaffins is shown below schematically on the reaction schemes VI-X. The mechanism of hydrocracking of cycloparaffins involves formation of a non-stable carbonium ion intermediate coupled with hydrogenation.

[0041] To generally summarize the process of hydrocracking of the cycloparaffin portion of the paraffin composition comprising the wax, a high ratio of methylcyclopentane to cyclohexane is observed in the hydrocracked product of cycloparaffins, usually in excess of thermodynamic equilibrium. The primary paraffin product is isobutane.

[0042] More specifically, as can be seen from the reaction schemes VI-X, cycloparaffin hydrocracking typically includes cleaving reactions in which certain alkyl groups are selectively removed, while the integrity of the saturated ring itself is preserved. The mechanism of hydrocracking involving cycloparaffins is consistent with the mechanism previously described for normal paraffin hydrocracking. For illustration purposes, the reaction schemes VI-X use 1,2,3,4-tetramethylcyclohexane as the original cycloparaffin.

[0044] As shown below, first, an olefin (i.e., 1,2,3,6-tetramethylcyclohexene) is formed, as shown by the reaction scheme VI, followed by the formation of carbonium ions from this olefin intermediate during cycloparaffin hydrocracking, followed by isomerization to form a more stable carbonium ion, as shown on the reaction scheme VII:
0045. The carbonium ion 1 formed as shown on the reaction scheme VII then undergoes even further isomerization, via an intermediate carbonium ion 2 to form even a more stable carbonium ion 3, which is then cracked, to yield a cyclic olefin (i.e., 1-methylcyclopentene-1) and yet another carbonium ion 4, as shown on the reaction scheme VIII:

0046. At the final stages of the process, the cyclic olefin formed as shown by the reaction scheme VIII is becoming saturated by undergoing hydrogenation yielding a cycloparaffin (i.e., in this case, 1-methylcyclopentane) (see the reaction scheme IX). The carbonium ion formed as shown by the reaction scheme VIII loses a proton via the hydride ion transfer yielding an n-paraffin (i.e., in this case, isobutane) (see the reaction scheme X):

0047. As discussed above, the Fischer-Tropsch waxes of the present invention are typically free of aromatic compounds. However, even if aromatic compounds in some embodiments are present (e.g., in trace amounts), they can be also converted by catalytic hydrocracking. Hydrocracking of alkyl aromatic compounds (e.g., toluene) can potentially involve numerous reactions including isomerization, dealkylation, cleaving, cyclization and alkyl group migration, among others.

0048. Primary reactions involved in hydrocracking of alkyl aromatic compounds include dealkylation and alkyl group transfer, particularly with respect to various xylene products which undergo rapid alkyl transfer to form heavier aromatics. Cyclization reactions may occur typically only if the alkyl group side chain is large enough to form bicyclic compounds.

0049. The reaction mechanisms involved in the process of hydrocracking of polyalkyl aromatics is similar to the parring reactions typical of cycloparaffins, as described above, and minimum ring breakage and methane formation are anticipated with high yields of isobutane.

0050. Hydrocracking of polyolefinic aromatic involves very complex mechanisms that include the transfer of butyl groups formed as a result of partial hydrogenation and ring cleavage, and further include cyclization to higher ring intermediates, followed by subsequently cracking. Polycyclic aromatics may also undergo condensation to form polynuclear aromatics having a plurality of condensed rings.

0051. The final product of catalytic hydrocracking of any Fischer-Tropsch wax described above is a distillate, regardless of a particular composition of the wax, and regardless of the presence or the absence of cycloparaffins and various aromatic compounds. As discussed above, a distillate typically contains products in low- and the mid-boiling range, including light gases, naphtha, kerosene, jet fuel, diesel fuel and heating oil, including No. 2 distillate.

0052. The specific composition of a distillate, and the ratio between individual components contained therein will depend, among other factors, on the nature and the specific composition of the wax that is used. In one example, between about 80 mass % and about 90 mass % of the distillate comprises a composition consisting of kerosene fuel and diesel fuel.

0053. Various systems and apparatuses can be used for conducting the processes of hydrocracking of paraffin-based waxes, such as Fischer-Tropsch or slack waxes. At the relatively low pressures of the reaction system, some quantity of coke may form and be deposited and agglomerate on the surface of the catalyst. This may lead to the reduction of the metal effective surface area, and thus to the overall reduction of the effectiveness of the catalyst. Therefore, a system or an apparatus that is suitable may be selected, taking into account the above provided considerations. For example, a CCR system may be used which can be generally described as follows.

0054. Accordingly, we provide for a continuous catalyst regeneration system. Such CCR system provides for the substantially continuous removal of the spent catalyst from the reactor, followed by regeneration regenerated in and returned fresh back into the reactor. The CCR system helps overcome the catalyst’s stability constraints of a fixed bed process and allows the operation at the lower reactor pressure, the pressure being within the limits described above. As also pointed out above, using a low pressure kinetically favors hydrocracking of Fischer-Tropsch waxes and provides for better selectivity towards jet fuel and diesel fuel.

0055. One representative example of such low pressure hydrocracking system that can be used is shown by FIG. 1 and
can be described as follows. The system 100 includes the reactor 1, in which hydrocracking of the wax in the presence of hydrogen and a catalyst is conducted. The heat exchanger network 2 is provided to heat up the wax to be hydrocracked to a desired temperature described above, i.e., to between about 200°C and about 425°C, prior to the introduction of the wax W into the reactor 1. The heated wax is then introduced into the reactor 1 via the opening at point 3.

[0056] The hydrogen may be optionally separately heated in the same heat exchanger network 2 and then introduced into the reactor 1 as a stream separate from that of the heated wax. Alternatively, as shown by FIG. 1, hydrogen can be pre-mixed with the wax W, and optionally also with recycled unconverted wax RW, followed by heating the mixture and the introduction of the heated mixture into the reactor 1 as a combined feed, also via the opening at point 3. Hydrogen is introduced at a rate discussed above, such as at between about 675 and about 1,180 m³ per 1 m³ of the wax and/or recycled unconverted wax.

[0057] The reactor circuit unit 4 is a device connected to the reactor 1, which generates and maintains the desired pressure in the reactor 1. As discussed above, the pressure may be maintained at a level of between about 0 and about 20 Kg/cm², typically, between about 7 and about 20 Kg/cm². The catalyst may be introduced (not shown) into the reactor 1 via the opening 5, and the process of hydrocracking starts when the catalyst comes into contact with the wax/hydrogen feed that may be maintained at the desired temperature and pressure described above.

[0058] The process of hydrocracking described above generates a reaction effluent and spent catalyst. As mentioned above, at the level of pressures that is utilized in the present invention, coke may form and be deposited on the surface of the catalyst. Such agglomeration of coke is an undesirable event, which leads to the reduction of the effectiveness of the catalyst.

[0059] The hydrocracking system 100 is designed to alleviate this negative effect. Accordingly, the spent catalyst may be substantially continuously removed via the opening 6 in the reactor 1 and directed to the continuous catalyst regeneration unit 7 that is substantially continuously accepting and regenerating the spent catalyst. The spent catalyst is removed from the reactor 1, and regenerated in the continuous catalyst regeneration unit 7 is then returned fresh back into the reactor 1 via the opening 5.

[0060] As mentioned above, the reactor 1 generates a petroleum distillate, which is then subjected to further processing. More specifically, the reaction effluent is directed, via the opening 8 in the reactor 1, to the heat exchanger network 9, where the reaction effluent is cooled to reach a temperature optimally suitable for the subsequent process of gas/liquid separation. When the effluent becomes sufficiently cool, it is directed to the gas/liquid separator 10, where the process of separating of hydrogen, hydrocarbons and water takes place. The process of separation is conducted according to standard procedures and protocols and can be varied and adjusted as needed.

[0061] Following the process of separation, the stream of hydrocarbons 11 is then directed to a fractionator assembly (not shown), where various fractions of hydrocarbons are separated and recovered using the processes and equipment known in the art. Hydrogen recovered from the separator 10 is mixed with additional quantity of hydrogen introduced via the stream 12 to make up for hydrogen consumed during hydrocracking. The combined stream of hydrogen 13 is then recycled and directed back to the heat exchanger network 2, either separately or after being pre-mixed with the wax, as described above. The entire process of hydrocracking may be then repeated.

[0062] Although our methods and systems have been described with reference to the above-discussed reactions and structures, it will be understood that modifications and variations are encompassed within the spirit and scope of the disclosure as defined in the appended claims.

What is claimed is:

1. A method for obtaining a petroleum distillate product comprising:
   - subjecting a wax comprised of a substantially paraffin composition to hydrocracking carried out at a pressure between about 0 and about 20 Kg/cm² in the presence of a catalyst comprising a metal selected from a group consisting of at least one noble metal and at least one base metal, and
   - recovering the petroleum distillate product.

2. The method of claim 1, wherein the wax is a Fischer-Tropsch wax.

3. The method of claim 1, wherein the wax is a slack wax.

4. The method of claim 1, wherein the paraffin composition is comprised of at least one straight-chained paraffin and at least one branched paraffin.

5. The method of claim 4, wherein the paraffin composition further comprises at least one cycloparaffin.

6. The method of claim 1, wherein hydrocracking is carried out at the pressure between about 7 and about 20 Kg/cm².

7. The method of claim 1, wherein the catalyst comprises substantially spherical beads incorporating the metal.

8. The method of claim 7, wherein the spherical beads have a diameter between about 1.5 and about 3 mm.

9. The method of claim 1, wherein the catalyst comprises an amorphous or a zeolitic substrate and the metal is incorporated within the substrate.

10. The method of claim 1, wherein the noble metal is selected from the group consisting of palladium, platinum, and combinations thereof.

11. The method of claim 1, wherein the base metal is selected from the group consisting of iron, a group consisting of nickel, tungsten, molybdenum, and combinations thereof.

12. The method of claim 1, wherein the petroleum distillate product comprises light ends, LPG, naphtha, kerosene, or diesel fuel.

13. The method of claim 12, wherein between about 80 mass % and about 90 mass % of the petroleum distillate comprises a composition consisting of kerosene and diesel fuels.

14. The method of claim 1, wherein hydrocracking includes supplying hydrogen at a rate of between about 170 and about 1,700 m³ per 1 m³ of the wax and/or recycled unconverted wax.

15. The method of claim 14, wherein hydrogen is supplied at a rate of between about 675 and about 1,180 m³ per 1 m³ of the wax and/or recycled unconverted wax.

16. The method of claim 1, wherein hydrocracking is carried out at a temperature between about 200°C and about 425°C.

17. A system for hydrocracking a wax comprised of substantially a paraffin composition, the system comprising:
   - a reactor (1) for hydrocracking the wax in the presence of the catalyst, the reactor generating spent catalyst and
a petroleum distillate, wherein the reactor is adapted for the continuous removal of the spent catalyst;  
(b) a continuous catalyst regeneration unit (7) connected to the reactor (1), wherein the continuous catalyst regeneration unit is configured for continuously accepting and regenerating the spent catalyst; and  
(c) a reactor circuit in fluid communication with the reactor (1), wherein the reactor circuit is designed to maintain the pressure between about 0 and about 20 Kg/cm² in the reactor (1).  

18. The system of claim 17, wherein the pressure is between about 7 and about 20 Kg/cm².  
19. The system of claim 18, wherein the wax is selected from a group consisting of a Fischer-Tropsch wax and a slack wax.  
20. The system of claim 17, wherein between about 80 mass % and about 90 mass % of the petroleum distillate generated in the reactor comprises a composition consisting of kerosene and diesel fuel.  

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