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Description

This invention relates to a process for the hydrocracking of a hydrocarbonaceous feedstock having a tendency to form polynuclear aromatic (PNA) compounds, which can be carried out without excessively fouling the processing unit. More specifically, the invention relates to a process in which the problem arising from the effect of PNA compounds on a hydrocracking unit is solved by recycling these compounds to a fractionation zone preceding the hydrocracking unit.

US-A-4447315 discloses a method for hydrocracking a hydrocarbon feedstock having a tendency to form polynuclear aromatic compounds which includes contacting the hydrocarbon feedstock with a crystalline zeolite hydrocracking catalyst, contacting at least a portion of the resulting unconverted hydrocarbon oil containing polynuclear aromatic compounds with an adsorbent which selectively retains polynuclear aromatic compounds, and recycling unconverted hydrocarbon oil having a reduced concentration of polynuclear aromatic compounds to the hydrocracking zone.

US-A-3619407 discloses a process to prevent fouling of the equipment in a hydrocracking process unit which comprises partially cooling the effluent from the hydrocracking zone to condense a minor proportion of the normally liquid hydrocarbons therein, thereby forming a polynuclear aromatics-rich partial condensate and withdrawing a bleedstream of the partial condensate. That patent acknowledges as prior art that the fouling problem may also be solved by subjecting the recycle oil (the heavy portion of the hydrocracking zone effluent), or a substantial portion thereof, to atmospheric distillation or vacuum distillation to separate a heavy bottoms fraction containing polynuclear aromatic compounds.

The present invention provides a hydrocracking process which minimizes the fouling of the catalyst and the equipment used in the hydrocracking process unit with polynuclear aromatic compounds which can, if uncontrolled, precipitate on the equipment surfaces, particularly in the cooling equipment, and foul the pores of the catalyst. This is accomplished by subjecting unconverted hydrocarbon recovered from the hydrocracking zone, and containing trace quantities of polynuclear aromatic compounds, to vacuum fractionation, thereby recovering a substantial portion of the polynuclear aromatic compounds in a slop wax side stream, which significantly minimizes the introduction of the polynuclear aromatic compounds into the hydrocracking zone when these recovered hydrocarbons are recycled thereto.

One embodiment of the present invention relates to a catalytic hydrocracking process which comprises (a) introducing a reduced crude into a fractionation vacuum zone to produce a vacuum gas oil stream, containing compounds having a tendency to form polynuclear aromatic compounds in a hydrocracking zone, a slop wax side stream, and a vacuum distillation column bottoms; (b) contacting the vacuum gas oil stream in a hydrocracking zone with added hydrogen and a metal-promoted hydrocracking catalyst at elevated temperature and pressure sufficient to provide a substantial conversion to lower boiling products; (c) partially condensing the hydrocarbon effluent from the hydrocracking zone, and separating the same into a low boiling hydrocarbon product stream, a stream containing unconverted hydrocarbons boiling above 650 ° F (343 ° C), and trace quantities of polynuclear aromatic compounds; and (d) introducing at least a portion of the stream containing unconverted hydrocarbons and polynuclear aromatic compounds into the vacuum fractionation zone, thereby leading to recovery of a substantial portion of the polynuclear aromatic compounds in the slop wax side stream, which significantly minimizes introduction of the detrimental polynuclear aromatic compounds into the hydrocracking zone.

Another embodiment of the present invention relates to a process in which the vacuum distillation column bottoms are solvent deasphalted to produce a deasphalted oil stream which is passed to the hydrocracking zone with the vacuum gas oil stream.

Other embodiments of the present invention encompass further details such as types of feedstocks, catalysts, preferred fractionation and separation schemes, and preferred operating conditions including temperature and pressures, all of which are hereinafter disclosed in the following discussion of each of these facets of the invention.

The Drawing is a simplified process flow diagram of a preferred embodiment of the present invention.

It has now been discovered that a total recycle of unconverted oil can be maintained indefinitely in the above described hydrocracking process unit without encountering the above noted fouling or precipitation problems.

US-A-3619407 teaches that a small bleedstream of a polynuclear aromatic compound-rich partial condensate of the reactor effluent will minimize or eliminate the fouling or precipitation problem. However, the bleedstream contains unconverted charge stock, and when this stream is discarded, a portion of the potential recycle stream is lost, and the subsequent recovery of valuable lower boiling hydrocarbons, which could have been derived from the bleedstream, is forfeited.

As hereinabove acknowledged, the prior art has taught that the polynuclear aromatic compounds could be effectively removed from the unconverted hydrocarbon effluent from the hydrocracking zone by fractionation to produce a heavy bottom fraction containing polynuclear aromatic compounds. However, this method of polynuclear aromatic compound removal effectively precludes the use of the heavy bottom fraction to produce additional charge stock for the hydrocracking zone.

US-A-4447315 teaches the removal of polynuclear aromatic compounds from the unconverted hydrocarbon effluent before the unconverted hydrocarbon is recycled to the hydrocracking reaction zone, but does not teach or suggest the process of the present invention.

In accordance with the present invention, it has been discovered that when at least a portion of the unconverted hydrocarbon effluent from a hydrocracking reaction zone is introduced into the fractionation zone used to produce the original vacuum gas oil charge stock, a surprisingly unexpected amount of the polynuclear aromatic compound is recovered in a slop wax side stream which is removed from the fractionation zone. In a preferred embodiment of the present invention, the slop wax side stream is a vacuum distillation column side cut taken from a point below the draw-off point for the heavy vacuum gas oil but above the vacuum distillation column bottoms draw-off point. Traditionally, the slop wax stream is preferably characterized as a hydrocarbonaceous stream having a 90% boiling point above 1050° F (565° C) and an asphaltene concentration of at least 0.5 weight percent. As a result of this discovery, the relatively small slop wax stream containing the polynuclear aromatic compounds, which is a low value hydrocarbonaceous stream, may then be isolated from the hydrocracking unit, and thus any subsequent introduction and build-up of PNA compounds into the hydrocracking reaction zone may be conveniently prevented. Also, when a large proportion of the polynuclear aromatic compounds are removed from the fractionation zone via the slop wax stream, the fractionation zone bottoms stream becomes more suitable for upgrading into a deasphalted oil stream, which may then be suitably charged to the hydrocracking reaction zone.

In some instances when the concentration of foulants is small, only a portion of unconverted hydrocracking zone effluent oil may need to be introduced into the fractionation zone to recover a substantial portion of the polynuclear aromatic compounds in the slop wax stream in order to maintain the concentration of polynuclear aromatic compounds at a level below that which promotes precipitation and subsequent plating out on heat exchanger surfaces. The expression "trace quantities of polynuclear aromatic compounds" as used herein preferably means a concentration of less than 10,000 parts per million (PPM), and more preferably less than 5,000 PPM.

The hydrocarbon charge stock subject to processing in accordance with the process of the present invention is suitably a reduced crude. A reduced crude is generally prepared by the fractionation of a whole crude to produce a fractionator bottoms stream which boils at a temperature greater than 650° F (343° C).

In accordance with the process of the present invention, a reduced crude is introduced into a fractionation zone to produce a vacuum gas oil stream containing compounds having a tendency to form polynuclear aromatic compounds on a hydrocracking zone, and a slop wax stream. This vacuum gas oil stream may comprise a light vacuum gas oil stream and a heavy vacuum gas oil stream which are separately produced by the fractionation zone and are then subsequently mixed to produce the feedstock for the hydrocracking reaction zone. In a preferred embodiment of the present invention, the slop wax stream is a vacuum fractionation column sidecut taken from a point below the draw-off point for the vacuum gas oil as described hereinabove.

The resulting vacuum gas oil stream produced in the hereinabove described fractionation zone is introduced into a hydrocracking zone. Preferably, the hydrocracking zone contains a catalyst which comprises in general any crystalline zeolite cracking base upon which is deposited a minor proportion of a Group VIII metal hydrogenating component. Additional hydrogenation components may be selected from Group VIB for incorporation on the zeolite base. The zeolite cracking bases are sometimes referred to in the art as molecular sieves, and are usually composed of silica, alumina and one or more exchangeable cations, such as sodium, hydrogen, magnesium, calcium, rare earth metals, etc. They are further characterized by crystal pores of relatively uniform diameter between 4 and 14 Angstroms (10^{-10}m). It is preferred to employ zeolites having a relatively high silica/alumina mole ratio between 3 and 12, and even more preferably between 4 and 8. Suitable zeolites found in nature include for example mordenite, stilbite, heulandite, ferrierite, dachiardite, chabazite, erionite and faujasite. Suitable synthetic zeolites include for example the B, X, Y and L crystal types, e.g., synthetic faujasite and mordenite. The preferred zeolites are those having crystal pore diameters between 8 and 12 Angstroms, wherein the silica/alumina mole ratio is from 4 to 6. A prime example of a zeolite falling in this preferred group is synthetic Y molecular sieve.

The natural occurring zeolites are normally found in a sodium form, an alkaline earth metal form, or mixed forms. The synthetic zeolites are nearly always prepared first in the sodium form. In any event, for use as a cracking base, it is preferred that most or all of the original monovalent metals be replaced by ion-exchange with a polyvalent metal and/or ammonium salt, followed by heating to decompose the ammonium ions associated with the zeolite, leaving in their place hydrogen ions and/or exchange sites which have actually been decationized by further removal of water. Hydrogen or "decationized" Y zeolites of this nature are more particularly described in US-A-3130006.

Mixed polyvalent metal-hydrogen zeolites may be prepared by ion-exchanging first with an ammonium salt, partially back-exchanging with a polyvalent metal salt, and then calcining. In some instances, as in the case of synthetic mordenite, the hydrogen forms can be prepared by direct acid treatment of the alkali metal zeolites. The preferred cracking bases are those which are at least 10 percent, and preferably at least 20 percent, metal-cation-deficient, based on the initial ion exchange capacity. A specifically desirable and stable class of zeolites are those wherein at least 20 percent of the ion exchange capacity is satisfied by hydrogen ions.

The active metals employed in the preferred catalysts of the present invention as hydrogenation components are those of Group VIII, i.e., iron, cobalt, nickel, ruthenium, rhodium, palladium, osmium, iridium and platinum. In addition to these metals, other promoters may also be employed in conjunction therewith, including the metals of Group VIB, e.g., molybdenum and tungsten. The amount of hydrogenating metal in the catalyst can vary over a wide range. Broadly speaking, any amount between 0.05 and 30 percent by weight may be used. In the case of the noble metals, it is normally preferred to use 0.05 to 2 weight percent. The preferred method for incorporating the hydrogenating metal is to contact the zeolite base material with an aqueous solution of a suitable compound of the desired metal wherein the metal is present in a cationic form. Following addition of the selected hydrogenating metal or metals, the resulting catalyst powder is then filtered, dried, pelleted with added lubricants, binders or the like if desired, and calcined in air at temperatures of, e.g., 700 to 1200° F (371 to 648° C), in order to activate the catalyst and decompose ammonium ions. Alternatively, the zeolite component may first be pelleted, followed by the addition of the hydrogenating component and activation by calcining. The foregoing catalysts may be employed in undiluted form, or the powdered zeolite catalyst may be mixed and copelleted with other relatively less active catalysts, diluents or binders, such as alumina, silica gel, silica-alumina cogels, activated clays and the like in proportions between 5 and 90 weight percent. These diluents may be employed as such, or they may containing a minor proportion of an added hydrogenating metal, such as Group VIB and/or Group VIII metal.

Additional metal-promoted hydrocracking catalysts may also be utilized in the process of the present invention, for example, aluminophosphate molecular sieves, crystalline chromosilicates and other crystalline silicates. Crystalline chromosilicates are more fully described in US-A-4363718.

The hydrocracking of the hydrocarbonaceous feedstock in contact with a hydrocracking catalyst is conducted in the presence of hydrogen, and preferably at hydrocracking conditions which include a temperature from 450 to 850° F (232 to 454° C), a pressure from 500 to 3000 psig (3448 to 20685 kPa gauge), a liquid hourly space velocity (LHSV) from 0.2 to 20 hr. $^{-1}$, and a hydrogen circulation rate from 2000 to 10,000 standard cubic feet per barrel (355 to 1778 std m^3/m^3).

After the hydrocarbonaceous feedstock has been subjected to hydrocracking as hereinabove described, a product stream preferably boiling at less than 650° F (343° C) is separated and recovered, and a hydrocarbonaceous stream preferably boiling at a temperature above 650° F (343° C) is separated and recovered as a recycle stream. This separation and recovery is preferably conducted in a fractionation zone associated with the hydrocracking zone. At least a portion of the hereinabove described recycle stream is introduced into the hereinabove described fractionation zone utilized to produce the vacuum gas oil fresh feed. The amount thereof is typically selected to prevent the precipitation of PNA compounds on heat exchange surfaces of the hydrocracking unit, and in the preferred case substantially all of the recycle stream is passed back to the vacuum column.

As a result of the discovery that a significant isolation and recovery of polynuclear aromatic compounds is unexpectedly achieved by the removal of a slop wax stream from the vacuum fractionation zone, the bottoms stream from the fractionation zone thereby becomes a more highly desirable stream for the production of a deasphalted oil, which is a suitable component of the charge stock for the hydrocracking reaction zone. It is preferred that a slop wax stream containing more than 50 percent of the polynuclear aromatic compounds introduced into the fractionation zone is produced and removed. In a preferred embodiment of the present invention, at least a portion of the bottoms stream from the fractionation zone is introduced into a solvent deasphalter, in order to produce a deasphalted oil which is subsequently charged to the hydrocracking reaction zone, and a pitch stream.

The art of solvent deasphalting is well-known to those skilled in hydrocarbon processing. In essence, solvent deasphalting is the countercurrent extraction of an asphaltene-containing oil with a solvent, to prepare a deasphalted oil and a hydrocarbonaceous stream rich in asphaltenes and commonly referred to as pitch. In accordance with the present invention, the fractionation zone bottoms stream is preferably countercurrent contacted with a hydrocarbon-selective solvent, in a solvent deasphalting zone, under deasphalting conditions selected to produce a solvent-lean asphaltic stream and a solvent-rich deasphalted hydrocarbonaceous stream. The resulting solvent-rich deasphalted hydrocarbonaceous stream is fractionated to separate and recover the selective solvent, which may be recycled if so desired. The solvent-free deasphalted hydrocarbonaceous stream is then charged to the hydrocracking zone.

The solvent deasphalting zone is preferably conducted at a temperature in the range of 50 to 600° F (10 to 315° C), at a pressure from 100 to 1000 psig (689 to 6895 kPa gauge), and with a solvent/charge stock volumetric ratio from 2:1 to 10:1. Suitable temperature and pressure conditions are preferably selected to maintain the deasphalting operations in liquid phase. Recently, solvent deasphalting zones have been operated at conditions wherein the solvent is in the supercritical state.

Suitable solvents include light hydrocarbons including ethane, propane, butane, isobutane, pentane, isopentane, neopentane, hexane, isohexane, heptane, the mono-olefinic counterparts thereof, and mixtures thereof.

In the Drawing, the process of the present invention is illustrated by means of a simplified flow diagram in which such details as pumps, instrumentation, heat-exchange and heat-recovery circuits, compressors and similar hardware have been deleted as being non-essential to an understanding of the techniques involved. The use of such miscellaneous details is well known to one skilled in the art. With reference now to the Drawing, a crude oil feedstream is introduced into the process via conduit 12 and passed into atmospheric crude distillation column 13 to produce a gasoline stream which is removed via conduit 14, a kerosene stream which is removed via conduit 15, a diesel stream which is removed via conduit 16, and a reduced crude stream which is removed via conduit 1. The reduced crude stream is introduced via conduit 1 into vacuum distillation column 2. A hydrocarbonaceous recycle stream which is derived in a manner hereinafter described is introduced into vacuum distillation column 2 via conduit 10. A vacuum gas oil stream is removed from vacuum distillation column 2 via conduit 3 and is introduced into hydrocracking zone 8 via conduit 3 and conduit 7. A hydrocarbonaceous slop wax stream containing polynuclear aromatic compounds is removed from vacuum distillation column 2 via conduit 11. A vacuum distillation column bottoms stream is removed from vacuum distillation column 2 via conduit 4 and is introduced into solvent deasphalter 5. A deasphalted oil stream is removed from solvent deasphalter 5 via conduit 7 and is introduced into hydrocracking zone 8. A heavy pitch stream is removed from solvent deasphalter 5 via conduit 6. A hydrocarbonaceous product stream is removed from hydrocracking zone 8 via conduit 9. An unconverted hydrocarbonaceous recycle stream is removed from hydrocracking zone 8 via conduit 10 and is introduced into vacuum distillation column 2 as hereinabove described.

The following example is given to illustrate further the hydrocracking catalyst of the present invention.

EXAMPLE

100 Kg/hr of a reduced crude having the properties presented in Table 1, and 24.5 Kg/hr of a hereinafter described recycle stream were introduced into a vacuum distillation column to produce 77.0 Kg/hr of vacuum gas oil, 5.5 Kg/hr of slop wax and 42.0 Kg/hr of vacuum distillation column bottoms.

Table 1 - Reduced Crude Properties

Gravity, specific	0.9633	
Distillation, Volume Percent		
IBP, °F (°C)	637	(336)
10	772	(411)
20	830	(443)
30	869	(465)
40	921	(494)
50	970	(521)
60	1054	(568)
End Point, Recovery 66%	1107	(597)
Sulphur, weight percent	2.5	
Nitrogen, weight percent	0.15	

The resulting vacuum gas oil stream having a specific gravity of 0.9100, boiling in the range of 518 to 1049 °F (270 to 565 °C) was introduced into a hydrocracking zone in admixture with 17.5 Kg/hr of a hereinafter described deasphalted oil and hydrogen in an amount of 1300 std m^3/m^3 of feedstock. The vacuum distillation column bottoms stream was subjected to solvent deasphalting to produce the hereinabove mentioned 17.5 Kg/hr of deasphalted oil stream. The feedstock comprising gas oil and deasphalted oil, and hydrogen was then contacted with two fixed beds of catalyst in a hydrocracking zone. The first bed of catalyst comprises a silica-alumina support containing nickel and tungsten and is operated at a liquid hourly space velocity of 0.4 and an average catalyst temperature of 734 °F (390 °C). The second bed of catalyst comprises an alumina-silica zeolite Y support containing nickel and tungsten and is operated at a liquid hourly space velocity of 1 and an average catalyst temperature of 660 °F (349 °C). Both beds of catalyst are operated at a pressure of 2400 psig (16548 kPa gauge). The effluent from the catalyst beds is cooled to 120 °F (49 °C) and then is passed to a high pressure separator which is maintained at 2000 psig (13790 kPa gauge). A hydrogen-rich gaseous stream is removed from the high pressure separator and recycled together with fresh make-up hydrogen to the hydrocracking catalyst zone. The liquid hydrocarbons from the high pressure separator were charged to a fractionator wherein 68.8 Kg/hr of normally liquid hydrocarbons boiling below 650 °F (343 °C) were separated and withdrawn as product. The hydrocarbons boiling at a temperature greater than 650 °F (343 °C) in an amount of 24.5 Kg/hr and containing 115 weight parts per million (WPPM) of polynuclear aromatic compounds are withdrawn from the fractionator and recycled to the vacuum distillation column.

A survey was conducted of selected hydrocarbon streams and the identity of the stream and the corresponding concentration of polynuclear aromatic compounds are presented in Table 2.

Table 2 - Polynuclear Aromatic Compound Concentration

Hydrocarbon Stream	PNA Concentration (PPM)
Reduced Crude Charge Stock	0
Vacuum Gas Oil	12
Vacuum Distillation Column Bottoms	3
Recycle to Vacuum Distillation Column	115
Vacuum Distillation Column Slop Wax	190

This survey demonstrates that the reduced crude charge stock contains no detectable level of polynuclear aromatic compounds, while the recycle stream to the vacuum distillation column from the hydrocracking zone contained 115 ppm. It becomes apparent then that the hydrocracking zone generates polynuclear aromatic compounds which are known to be detrimental to the successful operation of the hydrocracking zone if they were to be introduced into the hydrocracking zone via the recycle of unconverted vacuum gas oil.

According to the teachings of US-A-3619407, the resulting polynuclear aromatic compounds may be at least partially isolated and removed by the partial condensation of a portion of the normally liquid hydrocarbons leaving the hydrocracking catalyst zone. The resulting polynuclear aromatic-rich partial condensate contains unconverted hydrocarbons, which will not be available to produce a valuable distillate product stream and therefore the loss of potentially valuable product represents a disadvantage of this prior art process. Another prior art technique teaches that the fouling problem may be solved by subjecting at least a portion of the recycle oil to distillation to separate out a heavy bottoms fraction containing polynuclear aromatic compounds.

It has now been discovered, as shown hereinabove that only a very small percentage of the polynuclear aromatic compounds is actually recovered in the heavy bottom fraction of a fractionator and that surprisingly and unexpectedly a major proportion of the polynuclear aromatic compounds is recovered in a fractionator sidecut stream, commonly referred to as a slop wax stream. The slop wax stream is a heavy, asphaltene-containing hydrocarbonaceous stream and, therefore, the removal of polynuclear aromatic compounds together with the slop wax stream minimizes, if not avoids, the disposal of gas oil and thereby permits the conversion of the gas oil in the hydrocracking zone, to provide valuable hydrocarbon product streams. Additionally, in accordance with the present invention, a greater proportion of the polynuclear aromatic compounds is purged from the system by discarding the slop wax stream than by discarding the fractionator bottoms. In accordance with one embodiment of the present invention, since the fractionator bottoms have been found to contain only trace quantities of polynuclear aromatic compounds, this bottoms stream may then be deasphalted to provide a deasphalted oil stream which may then be charged to the hydrocracking zone in order to maximize the overall production of valuable hydrocarbon product.

The foregoing description, Drawing and example clearly illustrate the advantages encompassed by the process of the present invention and the benefits to be afforded with the use thereof.

Claims

1. A catalytic hydrocracking process which comprises:

(a) introducing a reduced crude into a vacuum fractionation zone to produce a vacuum gas oil stream containing compounds having a tendency to form detrimental polynuclear aromatic compounds in a hydrocracking zone, a slop wax side stream, and a vacuum bottoms and

(b) contacting the vacuum gas oil stream in a hydrocracking zone with added hydrogen and a metal-promoted hydrocracking catalyst at elevated temperature and pressure sufficient to gain a substantial conversion to lower boiling products and to form trace quantities of polynuclear aromatic compounds; characterized by

(c) partially condensing the hydrocarbon effluent from the hydrocracking zone and separating it into a low boiling hydrocarbon product stream and a stream containing unconverted hydrocarbons boiling

above 650 ° F (343 ° C) and the polynuclear aromatic compounds; and
(d) introducing at least a portion of the stream containing unconverted hydrocarbons and polynuclear aromatic compounds into the vacuum fractionation zone.

2. A process according to Claim 1 characterized in that said hydrocracking zone is maintained at a pressure from 500 to 3000 psig (3448 to 20685 kPa gauge) and at a temperature from 450 to 850 ° F (232 to 454 ° C).

3. A process according to Claim 1 or 2 characterized in that the metal-promoted hydrocracking catalyst comprises synthetic faujasite, nickel and tungsten.

4. A process according to any one of Claims 1 to 3 characterized in that the slop wax side stream contains more than 50 percent of the polynuclear aromatic compounds introduced into the fractionation zone.

5. A process according to any one of Claims 1 to 4 characterized in that the vacuum bottoms is subjected to solvent deasphalting to produce a deasphalted oil stream which is subsequently charged to hydrocracking step (b).

6. A process according to Claim 5 characterized in that the solvent deasphalting is conducted at a temperature from 50 to 600 ° F (10 to 315 ° C), a pressure from 100 to 1000 psig (689 to 6895 kPa gauge) and a solvent to charge stock volumetric ratio from 2:1 to 10:1.

7. A process according to Claim 5 or 6 characterized in that the solvent deasphalting is conducted with a solvent selected from ethane, propane, butane, isobutane, pentane, isopentane, neopentane, hexane, isohexane, heptane, mono-olefinic counterparts thereof, and mixtures thereof.

Revendications

1. Procédé d'hydrocraquage catalytique, qui comprend :
(a) l'introduction d'un brut réduit dans une zone de fractionnement sous vide pour produire un courant de gazole sous vide, contenant des composés ayant tendance à former des composés aromatiques polynucléaires nuisibles dans une zone d'hydrocraquage, un courant latéral de rejet paraffineux et un résidu de fractionnement sous vide; et
(b) la mise en contact, dans une zone d'hydrocraquage, du courant de gazole sous vide avec de l'hydrogène ajouté et un catalyseur d'hydrocraquage à promoteur métallique à une température et une pression élevées suffisantes pour réaliser une conversion substantielle en produits de plus bas points d'ébullition et former des traces de composés aromatiques polynucléaires ; caractérisé par
(c) la condensation partielle de l'effluent d'hydrocarbures issu de la zone d'hydrocraquage et sa séparation en un courant de produit consistant en hydrocarbures de bas point d'ébullition et un courant contenant des hydrocarbures non convertis bouillant au-dessus de 650 ° F (343 ° C) et les composés aromatiques polynucléaires ; et
(d) l'introduction d'au moins une partie du courant contenant les hydrocarbures non convertis et les composés aromatiques polynucléaires dans la zone de fractionnement sous vide.

2. Procédé selon la revendication 1, caractérisé en ce que ladite zone d'hydrocraquage est maintenue à une pression de 500 à 3000 psi (3448 à 20 685 kPa) au manomètre et à une température de 450 à 850 ° F (232 à 454 ° C).

3. Procédé selon la revendication 1 ou 2, caractérisé en ce que le catalyseur d'hydrocraquage à promoteur métallique comprend de la faujasite synthétique, du nickel et du tungstène.

4. Procédé selon l'une quelconque des revendications 1 à 3, caractérisé en ce que le courant latéral de rejet paraffineux contient plus de 50 pour cent des composés aromatiques polynucléaires introduits dans la zone de fractionnement.

5. Procédé selon l'une quelconque des revendications 1 à 4, caractérisé en ce que le résidu de fractionnement sous vide est soumis à un désasphaltée au solvant pour produire un courant d'huile désasphaltée qui est ensuite envoyé à l'étape d'hydrocraquage (b).

6. Procédé selon la revendication 5, caractérisé en ce que le désasphaltage au solvant est conduit à une température de 50 à 600°F (10 à 315°C), une pression de 100 à 1000 psi (689 à 6895 kPa) au manomètre et un rapport volumétrique du solvant à la charge de 2:1 à 10:1.

7. Procédé selon la revendication 5 ou 6, caractérisé en ce que le désasphaltage au solvant est conduit avec un solvant choisi parmi l'éthane, le propane, le butane, l'isobutane, le pentane, l'isopentane, le néopentane, l'hexane, l'isohexane, l'heptane, leurs contreparties monooléfiniques et leurs mélanges.

Ansprüche

1. Ein Verfahren zum katalytischen Hydrocracking mit folgenden Schritten:
   (a) Reduziertes Rohöl wird in eine Vakuumfraktionierzone eingeleitet, so daß es einen Vakuumgasölstrom erzeugt, der Verbindungen enthält, die dazu neigen, schädliche mehrkernige aromatische Verbindungen in einer Hydrocracking-Zone zu bilden, einen Slop-Wax-Seitenstrom und Vakuumablagerungen, und
   (b) der Vakuumgasölstrom wird in einer Hydrocracking-Zone mit zugesetztem Wasserstoff und einem Hydrocracking-Katalysator mit metallischem Promotor bei einer Temperatur und einem Druck in Berührung gebracht, die hoch genug sind, um eine weitgehende Umwandlung zu Produkten mit niedrigerem Siedepunkt zu erreichen, und um Spurenmengen mehrkerniger aromatischer Verbindungen zu erzeugen, dadurch gekennzeichnet, daß
   (c) der aus der Hydrocracking-Zone ausströmende Kohlenwasserstoff teilweise kondensiert wird und in einen Strom eines Kohlenwasserstoffproduktes mit niedrigem Siedepunkt und einen Strom aus nicht umgewandelten Kohlenwasserstoffen mit einem Siedepunkt über 343°C und mehrkernigen aromatischen Verbindungen geteilt wird, und
   (d) wenigstens ein Teil des Stroms, der die nicht umgewandelten Kohlenwasserstoffe und die mehrkernigen aromatischen Verbindungen enthält, in die Vakuumfraktionierzone eingeleitet wird.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Hydrocracking-Zone auf einem Druck von 3448 bis 20685 kPa und einer Temperatur von 232 bis 454 °C gehalten wird.

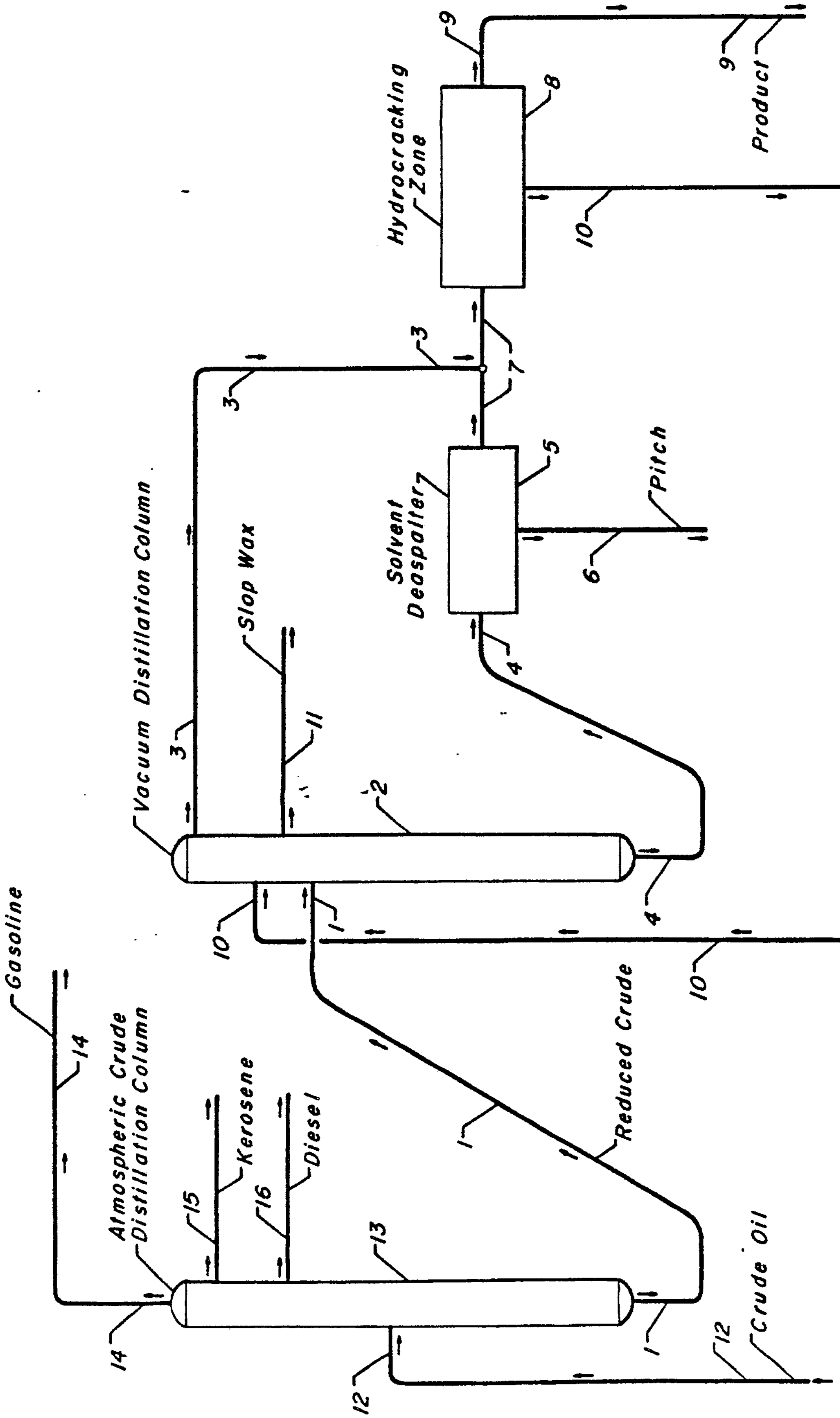
3. Verfahren nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der Hydrocracking-Katalysator mit metallischem Promotor synthetischen Faujasit, Nickel und Wolfram enthält.

4. Verfahren nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß der Slop-Wax-Seitenstrom über 50 % der in die Fraktionierzone eingeleiteten mehrkernigen aromatischen Verbindungen enthält.

5. Verfahren nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die Vakuumablagerungen mit Lösungsmitteln entasphaltiert werden, so daß man einen entasphaltierten Ölstrom erhält, der anschließend dem Hydrocracking-Schritt (b) unterzogen wird.

6. Verfahren nach Anspruch 5, dadurch gekennzeichnet, daß das Entasphaltieren mit Lösungsmitteln bei einer Temperatur von 10 bis 315 °C, einem Druck von 689 bis 6895 kPa und einem Volumenverhältnis von Lösungsmittel zu Beschikkungsmaterial von 2:1 bis 10:1 durchgeführt wird.

7. Verfahren nach Anspruch 5 oder 6, dadurch gekennzeichnet, daß das Entasphaltieren mit Lösungsmitteln durchgeführt wird mit einem Lösungsmittel, das ausgewählt wurde aus Ethan, Propan, Butan, Isobutan, Pentan, Isopentan, Neopentan, Hexan, Isohexan, Heptan, monoolefinen Gegenstücken derselben und Mischungen derselben.


Gasoline
14
Atmospheric Crude Distillation Column
15
Kerosene
16
Diesel
13
14
12
1
Crude Oil
12
Reduced Crude
1
10
1
10
Vacuum Distillation Column
3
11
Slop Wax
2
4
1
4
Solvent Deaspalter
5
Pitch
6
10
3
3
7
7
Hydrocracking Zone
8
9
9
Product
10