

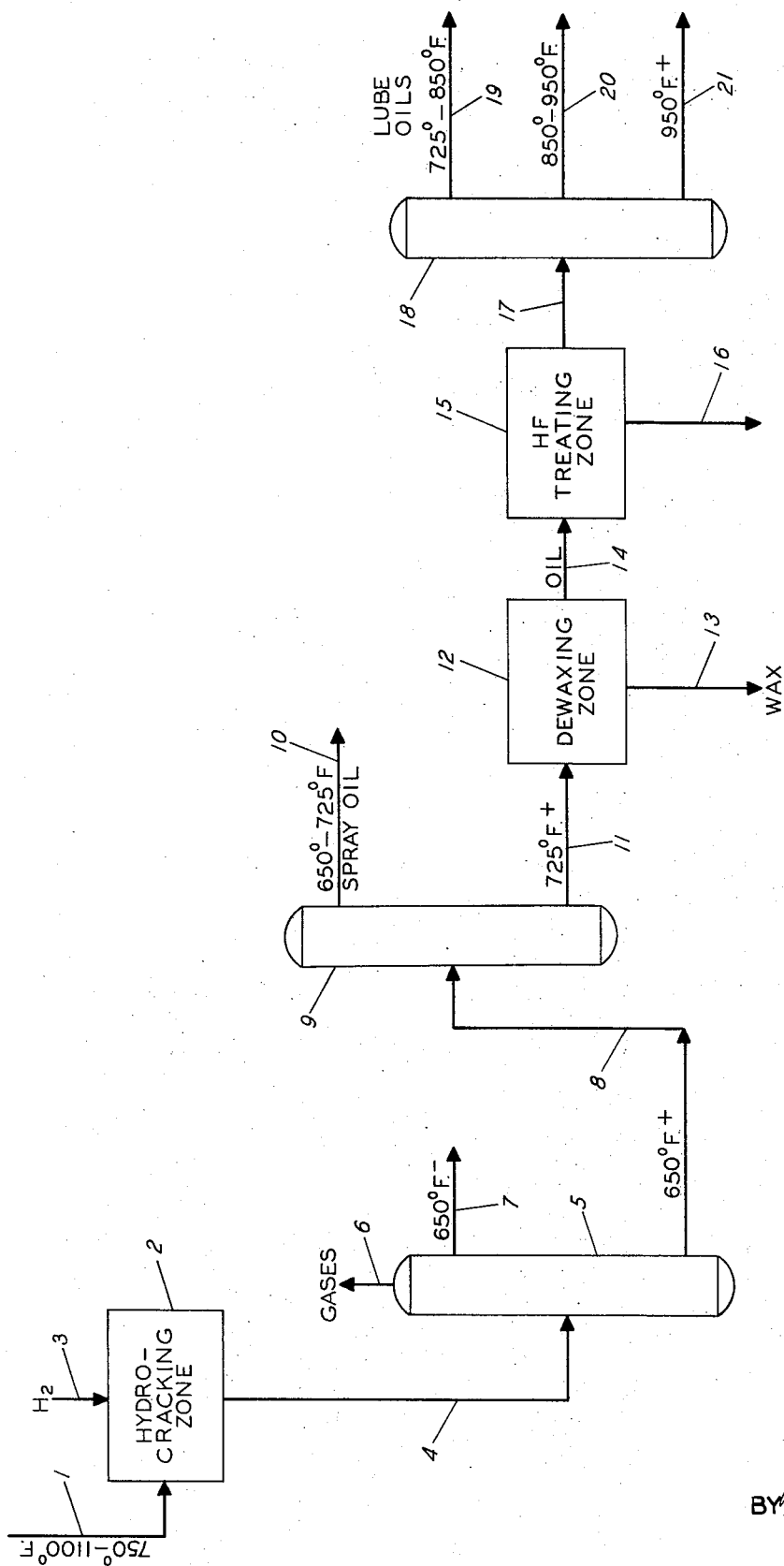
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R. J. WHITE

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HYDROCRACKING PROCESS FOR PRODUCING LUBRICATING OILS

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INVENTOR
 ROBERT J. WHITE
 BY *R. H. Davies*
C. J. Jenkins
 ATTORNEYS

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3,790,472

HYDROCRACKING PROCESS FOR PRODUCING LUBRICATING OILS

Robert J. White, Pinole, Calif., assignor to Chevron Research Company, San Francisco, Calif.

Continuation-in-part of application Ser. No. 260,933, June 8, 1972, which is a continuation-in-part of application Ser. No. 34,370, May 4, 1970, which in turn is a continuation-in-part of application Ser. No. 800,896, Feb. 20, 1969, all now abandoned. This application May 24, 1973, Ser. No. 363,778

Int. Cl. C01b 33/28; C10g 13/02, 13/14

U.S. Cl. 208—111

9 Claims

ABSTRACT OF THE DISCLOSURE

A process for producing lubricating oils which comprises hydrocracking in a hydrocracking zone at a temperature of 500° to 850° F. and a per-pass conversion of 20 to 90 volume percent a hydrocarbon feedstock containing a substantial amount of materials boiling above 700° F., in the presence of a hydrocracking catalyst comprising at least one hydrogenating component and a crystalline zeolitic molecular sieve cracking component selected from zeolite A, faujasite, zeolite X and zeolite Y, and further selected from components substantially in the decationized, ammonium or hydrogen form, and recovering from the hydrocracking zone a plurality of lubricating oil fractions boiling above 700° F. and having V.I.'s in the range of 90 to 120 and a V.I. spread of 10 units or less.

RELATED APPLICATIONS

This application is a continuation-in-part of U.S. application Ser. No. 260,933, filed June 8, 1972, which in turn is a continuation-in-part of U.S. application Ser. No. 34,370, filed May 4, 1970, which in turn is a continuation-in-part of U.S. application Ser. No. 800,896, filed Feb. 20, 1969, all now abandoned.

INTRODUCTION

This application relates to catalytic hydrocracking of petroleum distillates and solvent-deasphalted residua, to produce lubricating oils.

PRIOR ART

In recent years, hydroprocessing has been investigated as a means for producing lubricating oils. Two main types of hydroprocessing have been considered; hydrocracking and hydrogenation. Hydrogenation generally has been used as a finishing step in lubricating oil manufacture. Relatively mild hydrogenation conditions are used to treat raw oils, for example straight-run oils or oils from a solvent extraction process. A typical process is disclosed in U.S. Pat. 2,967,144, which is directed to hydrogenation to improve oxidation stability of a lubricating oil. Hydrocracking, which has been considerably less prominent in the lubricating oil production area, has been used primarily to produce certain specific types of lubricating oils. A typical single-stage process is disclosed in U.S. Pat. 2,960,458. Occasionally hydrogenation is used to upgrade lubricating oils produced by hydrocracking, as disclosed in U.S. Pats. 2,779,713, 2,787,582 and 2,917,448.

Until now, the hydrocracking catalysts used to produce lubricating oils, as opposed to merely dewaxing lubricating oils, have not contained a crystalline zeolitic molecular sieve cracking component. It has been thought that the utility of such catalysts did not extend to production of lubricating oils, and such catalysts were used primarily to produce gasoline and jet fuels, with diesel fuels being an occasional by-product. This has been understandable,

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in view of the unusually high cracking activity of the crystalline zeolitic molecular sieve component. Until now it would not have been expected that such catalysts were appropriate for lubricating oil production by hydrocracking. It has now been found that a lubricating oil product slate can be produced by hydrocracking, using a catalyst containing a cracking component selected from certain crystalline zeolitic molecular sieves, that is superior to the lubricating oil product slate obtainable with many of the conventional hydrocracking catalysts for producing lubricating oils. Contrary to certain lube oil dewaxing processes wherein waxy paraffins are hydrocracked very selectively to light gases, with little or no hydrocracking of other feed components and little or no other hydrocracked products, in the presently claimed process a full spectrum of hydrocracked products lighter than the feed is produced, including a plurality of lube oil products boiling above 700° F. and having V.I.'s in the range 90 to 120 and a V.I. spread of 10 units or less.

VISCOSITY AND VISCOSITY INDEX

Viscosity of a lubricating oil refers generally to its thickness at a given temperature. Viscosity index, or V.I., is a measure of the rate of change of viscosity of the oil with a change in temperature. If a first oil evidences a smaller viscosity change with a given change in temperature than does a second oil, the first oil has a higher V.I. This is important, for example, in cases in which it is required that an oil thin out to a minimum extent at a high operating temperature, and that it does not become too viscous at a low temperature. Oils that meet such requirements are called high-V.I. oils, and are premium oils. The best light oils are those with V.I.'s of at least 100, and the best heavy oils are those with V.I.'s of at least 95.

Heretofore, hydrocracking to produce lubricating oils has been effective in the simultaneous production of lubricating oils of different boiling ranges and viscosities, for example heavy oils and lighter oils with markedly different viscosities. However, the different oils have in many cases also had substantially different viscosity indices, i.e., there has been a substantial V.I. spread among the oils of different viscosities.

DRAWING

The present invention will best be understood, and further advantages thereof will be apparent, from the following detailed description when read in connection with the accompanying drawing.

The accompanying drawing is a diagrammatic illustration of apparatus and flow paths suitable for carrying out the process of the invention.

STATEMENT OF INVENTION

In accordance with the present invention there is provided a process for producing lubricating oils which comprises hydrocracking a hydrocarbon feedstock containing a substantial amount of materials boiling above 700° F. in a hydrocracking zone under hydrocracking conditions, including a temperature in the range of 500° to 850° F. and a per-pass conversion of 20 to 90 volume percent of said feedstock to products boiling below the initial boiling point of said feedstock, in the presence of a hydrocracking catalyst comprising at least one hydrogenating component and a crystalline zeolitic molecular sieve cracking component selected from zeolite A, faujasite, zeolite X and zeolite Y, and further selected from components substantially in the decationized, ammonium or hydrogen form, and recovering from said hydrocracking zone a plurality of lubricating oil fractions boiling above 700° F.

and having V.I.'s in the range 90 to 120, and having a V.I. spread of 10 units or less.

These lubricating oil fractions may be further treated, if desired, by being subjected to one or more treatments selected from catalytic dewaxing, acid treating generally, HF treating, and treating with dimethyl formamide, dimethyl sulfoxide or sulfolane, to produce a finished lubricating oil.

Said hydrocracking may be accomplished at hydrocracking conditions discussed hereinafter, with a hydrocracking catalyst as described in more detail hereinafter.

It will be found that a plurality of lubricating oil fractions, boiling above 700° F., preferably from 700° to 1100° F., more preferably from 720° F. to 1100° F., with similar viscosity indices may be recovered from said hydrocracking zone; that is, the V.I. spread among many of the fractions will not be large. For example, there will be a small V.I. spread between a 130 neutral (light) oil and an 800 neutral (heavy) oil. It should be noted that the V.I. of the lighter fractions (below 130) and of the heavy fractions (bright stock) may fall off in some cases, depending on the feedstock. However, the major portion of the lubricating oils produced will have V.I.'s in the range of 90 to 120 and a V.I. spread of 10 units or less, and preferably the V.I.'s of the major portion of the lubricating oils will be in the range of from 95 to 105.

It will also be found that a high-quality spray oil, boiling in the range 650°–720° F., preferably 670°–700° F., is produced in the hydrocracking zone concurrently with the production of lubricating oil, and may be recovered as a product.

HYDROCARBON FEEDSTOCKS

Suitable feedstocks for use in the process of the present invention may be selected from the group consisting of petroleum distillates, solvent-deasphalted petroleum residua, shale oils and coal tar distillates, provided that said feedstocks contain a substantial amount, for example more than 10 volume percent, of materials boiling above 700° F. Preferably the feedstock selected will boil in the range 700° to 1400° F., more preferably 750° to 1100° F.

Suitable feedstocks include those heavy distillates normally defined as heavy straight-run gas oils and heavy cracked cycle oils, as well as conventional FCC feed and portions thereof. Cracked stocks may be obtained from thermal or catalytic cracking of various stocks, including those obtained from petroleum, gilsonite, shale and coal tar. The feedstocks need not be subjected to a prior hydrofining treatment before being used in the process of the present invention. Feedstocks may contain as high as several thousand parts per million organic nitrogen, although preferably the organic nitrogen content will be less than 1000 parts per million organic nitrogen. Feedstocks also may contain several weight percent organic sulfur. In a particular embodiment of the process of the present invention, the process is carried out with no prior solvent treating or other hydrofining step, using a feedstock boiling in the range 700° to 1400° F., and containing a substantial proportion of aromatics as well as organic nitrogen in an amount of 50 to 1000 p.p.m.

OPERATING CONDITIONS

The hydrocracking zone in the process of the present invention is operated at a temperature in the range 400° to 950° F., preferably 500° to 850° F., a pressure in the range 800 to 3500 p.s.i.g., preferably 1000 to 3000 p.s.i.g., a liquid hourly space velocity in the range 0.1 to 5.0, preferably 0.5 to 5.0, and more preferably 0.5 to 3.0. The total hydrogen supply rate (makeup and recycle hydrogen) to said zone is 200 to 20,000 s.c.f., preferably 2000 to 10,000 s.c.f. of hydrogen per barrel of hydrocarbon feedstock. The hydrocracking zone is operated at a per-pass conversion of 20 to 90 volume percent, preferably 50

to 80 volume percent, of the feedstock to products boiling below the initial boiling point of the feedstock.

HYDROCRACKING CATALYST

The hydrocracking catalyst used in the process of the present invention may be any hydrocracking catalyst comprising at least one hydrogenating component and a crystalline zeolitic molecular sieve cracking component selected from zeolite A, faujasite, zeolite X and zeolite Y, in the decationized, ammonium or hydrogen form. A mordenite cracking component is not satisfactory or even operable in the present process, because it is so highly selective it hydrocracks essentially only normal paraffins to light gas products, and does not produce from heavier components any significant amounts of hydrocracked lube oil components. A mordenite cracking component is not effective in converting the feedstock used in the present process to products boiling below the initial boiling point of the feedstock at the conversion required in the present process. Preferably at least one Group VIII metal or metal hydrogenating component will be present. Suitable catalysts include those having the following constituents, prepared in the indicated manner:

Cracking component(s)	Hydrogenating component(s)	Method of preparation
Crystalline zeolitic molecular sieve.	Ni, or Pt, or Pd, or Ni+Mo, or Ni+W.	Impregnation.
Crystalline zeolitic molecular sieve in SiO ₂ -Al ₂ O ₃ matrix.	Ni, or Pt, or Pd, or Ni+Mo, or Ni+W.	Cogelation.

The indicated hydrogenating component or components may be present as the metal or a compound thereof. The crystalline zeolitic molecular sieve may be in a porous matrix.

Suitable matrix materials include inorganic oxides such as alumina, silica, alumina-silica, alumina-silica-magnesia, alumina-silica-zirconia, etc. Synthetic clays can also be used such as those described in U.S. Pat. 3,252,757, as well as clays such as bentonite, kaolinite, and montmorillonite. The amorphous inorganic oxides are particularly preferred because of their superior porosity, attrition resistance, and stability under reaction conditions.

The matrix materials listed above are characterized by cracking activity. Other porous materials may also be used as the matrix including matrix materials such as those described in U.S. Pat. 3,140,253 under the term "porous matrix." When in such a matrix the crystalline zeolitic molecular sieve may contain catalytic loading metals, or is preferably substantially free of any catalytic loading metal or metals. By "substantially free of any catalytic loading metal" is meant that the sieve contains less than 0.5 weight percent thereof, based on the sieve. The desired hydrogenation component(s) may be present in the matrix.

The matrix materials listed above are characterized by from 1 to 99.9 weight percent of the total catalyst, preferably 5 to 40 weight percent, and more preferably 10 to 20 weight percent. The balance comprises the hydrogenation component (present in an amount of from 0.1 to 35 weight percent calculated as the metal) and porous matrix material.

PREFERRED HYDROCRACKING CATALYST

A preferred, and particularly useful, catalyst for use in the process of the present invention comprises:

- (A) A gel matrix comprising:
- alumina,
 - nickel or cobalt, or the combination thereof, in the form of metal, oxide, sulfide or any combination thereof, in an amount of 1 to 10 weight percent, preferably 5 to 9 weight percent, of said matrix, calculated as metal,

(c) molybdenum or tungsten, or the combination thereof, in the form of metal, oxide, sulfide or any combination thereof, in an amount of 5 to 25 weight percent, preferably 10 to 20 weight percent, of said matrix, calculated as metal;

(B) A crystalline zeolitic molecular sieve, as described above, preferably substantially in the ammonium or hydrogen form, and preferably substantially free of any catalytic loading metal or metals, said sieve further being in particulate form and being dispersed through said matrix;

said catalyst composite being further characterized by an average pore diameter below 100 angstroms and a surface area above 200 square meters per gram.

Said gel matrix may comprise silica, preferably in an amount of at least 15 weight percent of said matrix; in such case it will be preferable for the matrix to contain alumina in an amount providing an alumina-to-silica weight ratio of 15/85 to 80/20.

Preferably said gel matrix comprises nickel and tungsten, in the form of the metals, oxides, sulfides or any combination thereof. Said molecular sieve may be present in an amount of 1 to 50 weight percent of said composite.

Said gel matrix advantageously also may contain titania, if desired.

The molecular sieve component, substantially in the ammonium or hydrogen form, may be maintained substantially free of any catalytic loading metal or metals, if desired, by dispersing the molecular sieve component in a slurry of the precursors of the other catalyst components at a pH of 5 or above. When a sodium form of molecular sieve component is one of the starting materials, it may be converted to the ammonium or hydrogen form by ion exchange prior to being combined with the other catalyst components. Alternatively, it may be combined with the other catalyst components and then converted to the ammonium or hydrogen form by ion exchange. In either case, the molecular sieve component should not be combined with the precursors of the other catalyst components at a pH below 5.

The finished catalyst may be sulfided in a conventional manner prior to use, if desired. If not presulfided, the catalyst will tend to become sulfided during process operation from any sulfur content that may be present in the hydrocarbon feed.

DETAILED DESCRIPTION

Referring now to the drawing, a hydrocarbon feedstock, which may now be in the range 750°–1100° F., is supplied through line 1 to hydrocracking zone 2, and is contacted therein with hydrogen supplied through line 3 and a hydrocracking catalyst comprising a crystalline zeolitic molecular sieve cracking component, as described above, and at least one hydrogenating component. The catalyst preferably comprises a silica-alumina gel matrix in which said molecular sieve is dispersed in particulate form, and a Group VIII hydrogenating component. The catalyst may also comprise a Group VI hydrogenating component.

The hydrocracking is accomplished in zone 2 at conditions previously given.

The effluent from zone 2 is passed through line 4 to separation zone 5, which may be a distillation zone, and is there separated into a light gas fraction, removed through line 6, a 650° F.— fraction, removed through line 7, and a 650° F.+ fraction, removed through line 8.

The 650° F.— fraction may be separated into product fractions or further processed, as desired.

The 650° F.+ fraction is passed through line 8 to separation zone 9, which may be a distillation zone, and is there separated into a 650°–725° F. fraction, which is withdrawn through line 10 as a superior spray oil, and a 725° F.+ fraction, which is withdrawn through line 11.

The 725° F.+ fraction in line 11 is passed to conventional dewaxing zone 12, where it is dewaxed in a con-

ventional manner. From zone 12, wax is withdrawn through line 13, and a dewaxed oil is passed through line 14 to conventional HF-treating zone 15.

In zone 15 the dewaxed oil is HF-treated under conventional conditions, to improve various characteristics of the oil. HF is removed through line 16. The treated oil is passed from zone 15 through line 17 to separation zone 18, which may be a distillation column.

In zone 18 the treated oil is separated into several lubricating oil fractions, including: (1) a 725°–850° F. fraction withdrawn through line 19; (2) an 850°–950° F. fraction withdrawn through line 20; and (3) a 950° F.+ fraction withdrawn through line 21. These three fractions have a very low V.I. spread, i.e., the V.I. of each is similar.

EXAMPLES

The following examples are given for the purpose of illustrating the preparation of catalysts for use in the process of the present invention, and the use thereof in the process of the present invention, compared with the preparation and use of a catalyst not comprising a molecular sieve component. The examples are not intended to limit the scope of the present invention.

Example 1

A cogelled catalyst (catalyst A) of the following composition was prepared.

Component:	Wt. percent of total catalyst
NiO	10.0
WO ₃	24.5
Al ₂ O ₃	29.0
SiO ₂	25.5
Crystalline zeolitic molecular sieve, "Y" form	11.0
Total	100.0

The catalyst was prepared by the following steps, using sufficient quantities of the various starting materials to produce the above-indicated weight percentages of the components in the final catalyst:

(1) An aqueous acidic solution was prepared, containing AlCl₃, NiCl₂ and acetic acid.

(2) Three alkaline solutions were prepared: (1) a sodium silicate solution; (2) a sodium tungstate solution; and (3) an ammonia solution containing sufficient excess ammonia so that upon combining the alkaline solutions with the acidic solution coprecipitation of all of the metal-containing components of the solutions would occur at a neutral pH of about 7.

(3) The acidic and alkaline solution were combined, and coprecipitation of all of the metal-containing components of the solutions occurred at a pH of about 7, resulting in a slurry.

(4) Linde ammonium "Y" crystalline zeolitic molecular sieve in finely divided form was added to the slurry.

(5) The molecular sieve-containing slurry was filtered to produce a molecular sieve-containing hydrogel filter cake, which was washed repeatedly with dilute ammonium acetate solution, to remove sodium and chloride ionic impurities from both the hydrogel and the molecular sieve contained therein.

(6) The molecular sieve-containing hydrogel was dried in an air-circulating oven and then was activated in flowing air for 5 hours at 950° F.

The finished catalyst was characterized by a surface area of 417 m.²/g., a pore volume of 0.4 cc./g., and an average pore diameter of 38 angstroms, and a molecular sieve component substantially free of catalytic metals, that is, substantially all of the nickel and tungsten contained in the catalyst was located in the gel portion of the catalyst rather than in the molecular sieve component thereof.

Example 2

A cogelled catalyst (catalyst B) is prepared exactly as in Example 1, except that prior to incorporation in the slurry the molecular sieve is pre-soaked in an ammoniacal solution of NiCl_2 , to load the molecular sieve with nickel. The amounts of starting materials are selected to provide a final catalyst containing the same weight percentages of components as the catalyst of Example 1.

The catalyst thus differs from the catalyst of Example 1 only in that the nickel contained therein is located both in the gel component and in the molecular sieve component.

Example 3

A cogelled catalyst (catalyst C) is prepared exactly as in Example 1, except that no molecular sieve component is incorporated therein. The amounts of starting materials are selected to provide a final catalyst with the same proportions of nonmolecular sieve components as the catalyst of Example 1. The composition of the final catalyst is:

Component:	Wt. percent of total catalyst
NiO -----	11.2
WO ₃ -----	27.5
Al ₂ O ₃ -----	32.6
SiO ₂ -----	28.7
Total -----	100.0

It will be noted that the weight percentage of each non-molecular sieve component of catalysts A and B is 89% of the weight percentage of the same component of catalyst C, the additional 11 weight percent of catalysts A and B being contributed by the molecular sieve component.

Example 4

Portions of catalysts A, B and C of Examples 1-3, respectively, are separately used to hydrocrack separate portions of a Mid-Continent gas-oil feedstock, on a once-through basis.

The gas-oil feedstock has the following characteristics:

Boiling range, ° F. -----	850-1050
Gravity, ° API -----	20.6
Organic nitrogen content, p.p.m. -----	1270

The hydrocracking conditions are:

Total pressure, p.s.i.g. -----	2400
Total hydrogen rate, s.c.f./bbl. -----	5000
Liquid hourly space velocity, v./v./hr. -----	1.0
Per-pass conversion to products boiling below 850° F., volume percent -----	60
Starting temperature, ° F. -----	(1) 55

¹ As indicated below.

The hydrocracking activities of the three catalysts, as measured by the starting temperatures necessary to achieve the indicated per-pass conversion, are:

Catalyst:	Starting T., ° F.
A -----	765
B -----	770
C -----	775

The gasoline and jet fuel yields obtained with catalysts A and B are considerably higher than those obtained with catalyst C.

The yields of 500-750° F. boiling range materials obtained with catalysts A and B are considerably lower than those obtained with catalyst C.

In the case of the 750° F.+, or lube oil portion, of the product in each case, more surprising differences between the characteristics of the product obtained with

catalysts A and B on the one hand and catalyst C on the other hand, are indicated in the following table:

VISCOSITY AT 100° F. AND V.I. OF NEUTRAL OIL PRODUCT

Catalyst	Light (750°-850° F.)		Medium (850°-980° F.)		Heavy (980°-1,050° F.)	
	Vis. (S.S.U.)	V.I.	Vis. (S.S.U.)	V.I.	Vis. (S.S.U.)	V.I.
A -----	140	96	350	99	820	99
B -----	130	97	347	101	812	100
C -----	165	89	370	96	960	99

From the above table, these important points may be noted:

(1) Even though the product distribution of the 750° F.+ product is similar in each of the three cases, the V.I. difference, or spread, between the light neutral and heavy neutral oils is very much less in the case of catalysts A and B than in the case of catalyst C.

(2) The V.I. of the light neutral product obtained with catalyst C is 89. Acceptable lubricating oil preferably has a V.I. of at least 95. If the V.I. of the light neutral product of catalyst C were raised to 95, as by adjusting the hydrocracking conditions, the V.I. of the heavy neutral oil also would be raised, for example from 99 to over 105. The V.I. of an acceptable lubricating oil preferably should not be over 104-105, because additive solubility decreases with increasing V.I., and becomes too low at V.I.'s above 104-105.

(3) The V.I.'s of the light, medium and heavy neutral oils obtained with catalysts A and B are in the desired range of 95-105. Accordingly, only with catalysts A and B could a full-boiling-range slate of lubricating oils with the desired V.I.'s be prepared.

Although only specific embodiments of the present invention have been described, numerous variations can be made in these embodiments without departing from the spirit of the invention, and all such variations which fall within the scope of the appended claims are intended to be embraced thereby.

What is claimed is:

1. A process for producing lubricating oils which comprises hydrocracking a hydrocarbon feedstock containing a substantial amount of materials boiling above 700° F. in a hydrocracking zone under hydrocracking conditions including a temperature of 500° to 850° F. and a per-pass conversion of 20 to 90 volume percent of said feedstock to products boiling below the initial boiling point of said feedstock, in the presence of a hydrocracking catalyst comprising at least one hydrogenating component and a crystalline zeolitic molecular sieve cracking component selected from zeolite A, faujasite, zeolite X and zeolite Y, and further selected from cracking components substantially in the decationized, ammonium or hydrogen forms, and recovering from said hydrocracking zone a plurality of lubricating oil fractions boiling above 700° F. and having V.I.'s in the range of 90-120 and a V.I. spread of 10 units or less.

2. A process as in claim 1, wherein said lubricating oil fraction is dewaxed to produce a finished lubricating oil.

3. A process as in claim 1, wherein said hydrocracking conditions include a total pressure of 500 to 3500 p.s.i.g., a total hydrogen supply rate of 200 to 20,000 s.c.f. of hydrogen per barrel of said feedstock, and a liquid hourly space velocity of 0.1 to 5.0.

4. A process as in claim 1, wherein said crystalline zeolitic molecular sieve component is contained in a gel matrix comprising alumina.

5. A process as in claim 1, wherein a light neutral oil having a V.I. in the range 95 to 105 and a heavy neutral oil having a V.I. in the range of 95 to 105 are recovered as products.

6. A process as in claim 1 wherein said zeolitic molecular sieve cracking component is substantially free of catalytic loading material.

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7. A process as in claim 1 wherein said hydrocarbon feedstock has not been subjected to a prior hydrofining treatment.

8. A process as in claim 1 wherein said hydrocracking catalyst further comprises a porous matrix.

9. A process as in claim 1 wherein a plurality of lubricating oil fractions boiling above 700° F. and having V.I.'s in the range of 95-105 is recovered.

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DELBERT E. GANTZ, Primary Examiner

10 G. E. SCHMITKONS, Assistant Examiner

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U.S. Cl. X.R.

208—18, 38, 59, 89, 95, 98; 252—455 Z

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,790,472 Dated February 5, 1974

Inventor(s) ROBERT J. WHITE

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 4, line 30, " Al_3O_3 " should read -- Al_2O_3 --.

Col. 4, line 57, "The matrix materials listed above are characterized by from 1" should read --The crystalline zeolitic molecular sieve may constitute from 1--.

Col. 6, line 53, "solution" should read --solutions--.

Signed and sealed this 13th day of August 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents