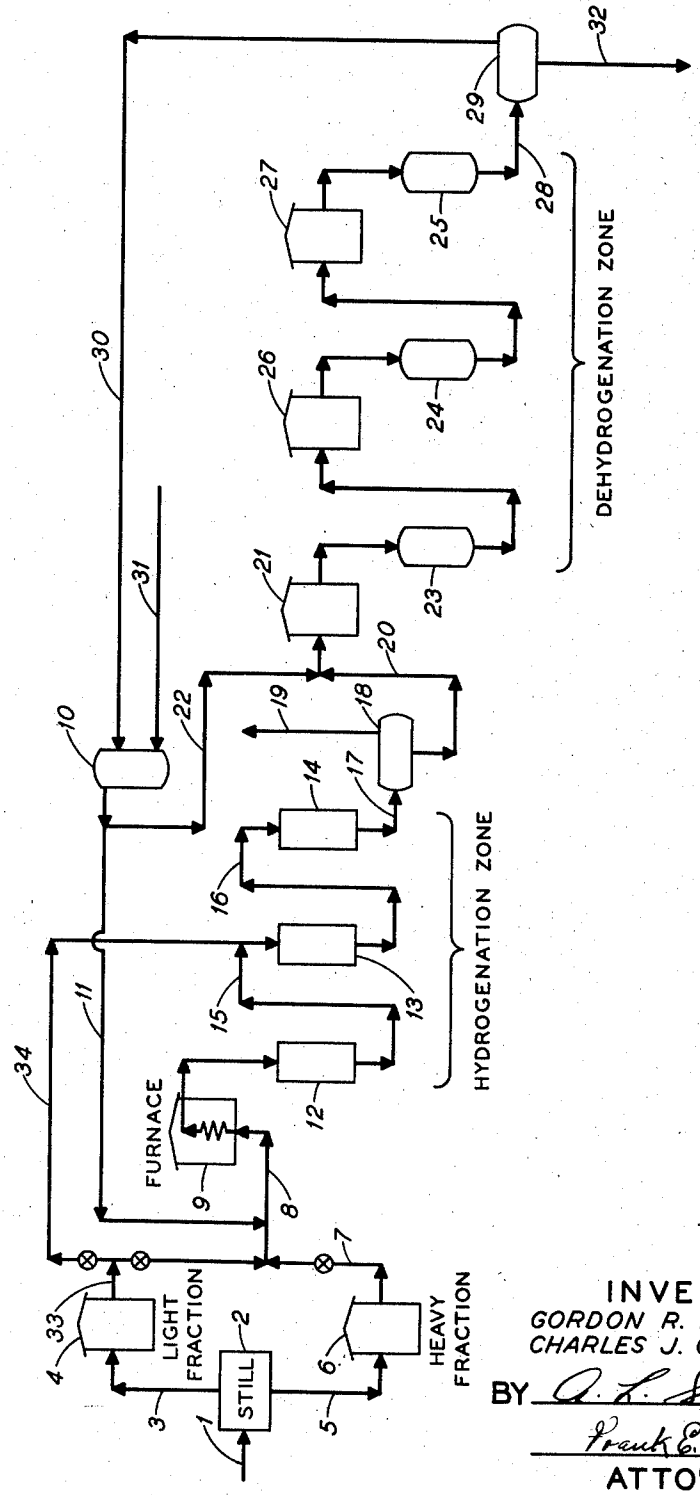
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HYDROCARBON CONVERSION PROCESS

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HYDROCARBON CONVERSION PROCESS

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This invention relates to a process for upgrading cracked naphtha.

Cracked naphthas, especially thermally cracked naphthas, are commonly characterized by a relatively high content of sulfur compounds and nitrogen compounds and by F–1 octane ratings in the range from 70 to 80. It is an object of the present invention to reduce the nitrogen and sulfur content of these stocks and to increase their octane ratings to levels above 80 and usually well above 85.

Pursuant to the invention, the cracked naphtha which ordinarily boils within and over a substantial portion in the range from 125 to 450° F. is fractionally distilled to separate an overhead fraction having an ASTM–D–86 90% point in the range from 275 to 350° F. and a bottoms fraction or higher boiling side-cut fraction having a 90% point well above 400° F. The overhead fraction and hydrogen and the bottoms fraction and hydrogen are separately contacted with a hydrogenation catalyst, for example, a cobalt-molybdenum catalyst, in a hydrogenation zone under conditions of temperature and space velocity sufficiently severe in each case to reduce the sulfur content and the nitrogen content of the liquid product produced below about 0.2% by weight and 5 parts per million, respectively, the conditions being substantially less severe in the case of the overhead fraction. The hydrogenated overhead fraction and hydrogen and the hydrogenated bottoms fraction and hydrogen are then separately contacted with a platinum catalyst in a dehydrogenation zone under dehydrogenating conditions sufficiently severe in each case to produce a liquid product having an F–1 clear octane rating above 80, the conditions being substantially less severe in the case of the hydrogenated bottoms fraction. A hydrogen-rich gas is separated from the product produced in the dehydrogenation step and returned to the hydrogenation zone where it is used to hydrogenate the cracked naphtha.

In some instances, especially where the whole naphtha feed has a relatively narrow boiling range, it may be desirable to pass the whole naphtha and hydrogen through the hydrogenation zone and fractionally distill the hydrogenated product to produce an overhead fraction having a 90% point in the range from 275 to 350° F. and a bottoms fraction, and these fractions together with hydrogen are separately contacted with the platinum catalyst in the dehydrogenation zone.

It is generally true that sulfur compounds and nitrogen compounds are concentrated in the bottoms fraction of the cracked naphtha and also that the nitrogen and sulfur compounds appearing in the bottoms fraction are somewhat more refractory than those appearing in the overhead fraction. In order to prevent rapid decline in the activity of the platinum catalyst employed in the dehydrogenation step, it is necessary to treat the cracked naphtha in the hydrogenation step with sufficient severity to reduce the sulfur content of the liquid product there produced below about 0.2% by weight and to reduce the nitrogen content of the liquid product below about

20 parts per million, and preferably below about 5 parts per million, by weight. The overhead fraction of the cracked naphtha having a 90% point in the range from about 275° F. to about 350° F. has a substantially higher bromine number than the bottoms fraction. During the hydrogenation step the exothermic heat of reaction is very large, imposing a difficult problem of temperature control. Since the nitrogen compounds and sulfur compounds present in the light naphtha fraction can be removed by relatively mild treatment, the catalyst in the hydrogenation zone is distributed in a plurality of serially-connected catalyst beds and only one-fourth to one-half of the light naphtha fraction is passed into the first of the serially-connected catalyst beds and the remainder is introduced into the hydrogenation zone at relatively low temperature downstream from the first catalyst bed. While the time during which the latter portion of the light naphtha is in contact with the catalyst is short, it is sufficient to accomplish the desired decomposition of the nitrogen and sulfur compounds. If it were attempted to treat the whole naphtha in this manner, the removal of nitrogen and sulfur compounds would be insufficient.

A further advantage of the process of the invention is found in the second-stage dehydrogenation treatment. When the whole hydrogenated naphtha is subjected to dehydrogenation in the presence of hydrogen, the heavier portion of the naphtha undergoes hydrocracking to produce low boiling paraffinic materials of low octane number. When the liquid product is fractionally distilled to obtain a low boiling blending stock for the production of premium gasolines, these paraffinic materials appear in this fraction and by dilution decreases its octane number. Increasing the severity of the dehydrogenation treatment of the whole naphtha with a view to increasing the octane rating of the light fraction is not a solution to this problem, since increased severity is accompanied by increased hydrocracking to increase paraffin formation so that little net gain in octane rating of the light fraction is achieved. These paraffinic materials cannot be separated from higher octane components boiling in the same range by distillation. When the naphtha is dehydrogenated in the second stage pursuant to the invention, the hydrogenated overhead fraction undergoes practically no hydrocracking and a very high octane liquid product is obtained. The bottoms fraction undergoes hydrocracking to produce low boiling, low octane materials, but these materials are readily separated from the higher octane, heavier components by fractional distillation.

The process of the present invention makes possible the production of a very high octane gasoline either of the narrow boiling range characteristic of premium gasolines or of wide boiling range. When a feed of full boiling range is charged to the dehydrogenation step of the process, the yield drops off markedly as severity is increased. Morever, increased severity does not result in as much increase in octane number as would be expected, probably due to the cracking of higher boiling paraffins and naphthenes to form relatively low octane paraffins which are not readily converted to aromatics. By the split feed operation pursuant to the invention, low octane paraffins can be excluded from the product, permitting good yields of very high octane products which would be impossible to obtain charging the whole wide boiling naphtha.

The process of the invention will be more fully understood by reference to the appended drawing which is a diagrammatic illustration of apparatus and process flow suitable for the practice of the invention.

Thermally cracked naphtha boiling in the range from 206 to 420° F. was passed through line 1 into still 2 where it was fractionally distilled to separate a light overhead fraction having an ASTM–D–86 90% point

of 310° F. and a bottoms fraction. The overhead fraction was removed from the still through line 3 and passed into storage tank 4. The bottoms fraction was removed from the still through line 5 and passed into storage tank 6. The heavy fraction was withdrawn from storage tank 6 through line 7 and passed through line 8 into furnace 9. Hydrogen is passed from hydrogen storage tank 10 through line 11 into line 8, approximately 3 moles of hydrogen per mole of naphtha being introduced into furnace 9. The hydrogen and naphtha were heated in furnace 9 to a temperature of 690° F. and then passed into the hydrogenation zone. The hydrogenation zone consists of three reactors 12, 13 and 14 containing cobalt-molybdenum catalyst and serially connected by lines 15 and 16. The hydrogen and the heavy naphtha fraction pass successively through reactors 12, 13 and 14, where the naphtha is hydrogenated to produce a liquid product having a sulfur content of about 0.01% by weight and a nitrogen content of 5 parts per million. The temperature of the reaction mixture is raised by the exothermic heat of reaction during its passage through the hydrogenation zone and the temperature of the effluent product from reactor 14 is 775° F. The hydrogenation product is withdrawn from reactor 14 through line 17 and passed into gas liquid separator 18, which is held at a superatmospheric pressure of about 750 p. s. i. g. Fixed gases are separated from the liquid product and removed through line 19. This gas contains unreacted hydrogen, ammonia and hydrogen sulfide. The hydrogen sulfide and ammonia are separated from this gas and the hydrogen is returned for use in the process. The hydrogenated liquid product is passed from separator 18 through line 20 into furnace 21. Hydrogen is passed from storage tank 10 through line 22 into line 20 and into furnace 21 together with the hydrogenated liquid product. The hydrogenated liquid product and hydrogen are then passed through the dehydrogenation zone. The dehydrogenation zone consists of three reactors 23, 24 and 25 packed with a platinum catalyst. Since the dehydrogenation reaction is endothermic, interstage heating is provided by furnaces 26 and 27. The hydrogen and liquid feed are heated to have an inlet temperature of about 900 to 975° F. at each of reactors 23, 24 and 25. The average catalyst temperature in these reactors is about 850 to 900° F. and the pressure in the dehydrogenation zone is maintained at about 700 p. s. i. g. The effluent from the hydrogenation zone is passed from reactor 25 through line 28 into gas liquid separator 29 which is operated at about 650 p. s. i. g. A gas rich in hydrogen is separated from the dehydrogenation reaction product in separator 29 and passed through line 30 into hydrogen storage tank 10. Makeup hydrogen may be added to hydrogen storage tank 10 through line 31. The liquid product produced in the dehydrogenation zone is removed from separator 29 through line 32, following which it is debutanized and passed into storage. The treatment of the light overhead fraction pursuant to the invention is similar to the treatment of the bottoms fraction insofar as the process flow is concerned. Light naphtha is withdrawn from storage tank 4 through line 33. About one-third of the total naphtha is passed into line 8 and into furnace 9. The remaining two-thirds of the naphtha is passed through line 34 into reactor 13. In treating the light naphtha, the portion passed into furnace 9 is heated to about 500° F. and then passed into reactor 12. The average catalyst temperature in reactors 12, 13 and 14 is maintained at about 750° F. during the treatment of the light naphtha fraction. The portion of the light naphtha which is introduced into reactor 13 is preheated to a moderate temperature adapted to maintain the average catalyst temperature in the hydrogenation zone at about 750° F. During continuous operation of the process, periodic regeneration of the cobalt-molybdenum catalyst is desirable. Activity is maintained by withdrawing one of reactors 12, 13 and 14 from service while conducting the hydrogenation of the light fraction, regenerating the catalyst in the withdrawn reactor by burning coke from its surface with a free oxygen-containing gas, and returning it to service so that all of the reactors are available and in use during hydrogenation of the bottoms fraction.

As indicated above, the light overhead fraction is less severely treated in the hydrogenation zone than the bottoms fraction and more severely treated in the dehydrogenation zone than the bottoms fraction. Representative conditions for both fractions in both zones are indicated by the following table.

TABLE

	Temp.	Pressure, p. s. i. g.	Space Velocity, v./v./hr.	Cu. Ft. H_2. Bbl.
Hydrogenation Zone:				
Overhead Fraction	750° F	800	3.0	3,000
Bottoms Fraction	780° F	800	2.0	3,000
Dehydrogenation Zone:				
Overhead Fraction	930° F. (inlet)	500	2.0	6,000
Bottoms Fraction	910° F. (inlet)	500-700	3.0	3,000

In general, the hydrogenation zone is operated at a temperature from 600 to 850° F. and at a space velocity in the range from 1 to 5 v./v./hr. in treating both the overhead fraction and the bottoms fraction of the cracked naphtha. However, either a higher temperature or a lower space velocity, or both, within the above ranges is employed when treating the bottoms fraction. In general, the dehydrogenation zone is operated at a temperature in the range from 850 to 980° F. and at a space velocity in the range from 1 to 3 v./v./hr. in treating both the hydrogenated overhead fraction and the hydrogenated bottoms fraction. However, either a higher temperature or a lower space velocity, or both, is employed during the treatment of the hydrogenated overhead fraction.

The catalyst employed in the hydrogenation zone may be any sulfactive hydrogenation catalyst, for example, tungsten sulfide, tungsten nickel sulfide, molybdenum oxide, molybdenum sulfide, or cobalt-molybdate. Preferably, the catalysts generally designated as cobalt-molybdenum catalysts are employed. These catalysts contain as their active catalytic components a mixture of cobalt oxide and molybdenum oxide which is sometimes described as cobalt-molybdate. The proportions of cobalt oxide and molybdenum oxide, however, need not correspond to stoichiometric proportions of cobalt and molybdenum oxide which can be combined to form cobalt-molybdate. The active catalytic material may also be a mixture of cobalt sulfide and molybdenum sulfide, and apparently the catalyst, after it has been in use when hydrogenating sulfur-containing stocks, consists largely of cobalt sulfide and molybdenum sulfide, even though it is prepared and charged to the reactor in the form of mixed oxides. These catalysts are prepared by impregnating a support with ammonium molybdate and cobalt nitrate and calcining the impregnated support to deposit the metallic oxides. Catalysts may also be prepared by

coprecipitating cobalt oxide and molybdenum oxide on alumina, dry alumina, or on an alumina gel.

The catalyst employed in the dehydrogenation step is a platinum catalyst such as those described in U. S. Patents Nos. 2,479,110 and 2,478,916. These platinum catalysts may be generally described as containing from 0.1 to 1% by weight of metallic platinum dispersed on an alumina carrier. Platinum on silica-alumina may also be employed.

The process of the invention may be more clearly illustrated by the following examples.

A cracked naphtha feed having an A. P. I. gravity of 48.5, a sulfur content of 0.79% by weight, a nitrogen content of 140 parts per million, containing 23 volume percent olefins and having on the ASTM–D–86 distillation a 10% point of 235° F., a 50% point of 294° F. and a 90% point of 369° F., was fractionally distilled to separate an overhead fraction and a bottoms fraction. The overhead fraction had an A. P. I. gravity of 51.7, a sulfur content of 0.73% by weight, a nitrogen content of 112 parts per million, containing 34 volume percent olefins, and on the ASTM–D–86 distillation had a 10% point of 224° F., a 50% point of 266° F. and a 90% point of 407° F. The bottoms fraction had an A. P. I. gravity of 35.7, a sulfur content of 0.88% by weight, a nitrogen content of 520 parts per million, contained 14 volume percent of olefins, and on the ASTM–D–86 distillation had a 10% point of 363° F., a 50% point of 378° F. and a 90% point of 413° F.

Example 1

The overhead fraction above described and hydrogen were contacted with a cobalt-molybdenum catalyst. Operating conditions were as follows: pressure, 700 p. s. i. g.; liquid hourly space velocity, 2 v./v./hr.; catalyst temperature, 750° F.; and 3000 cubic feet of hydrogen per barrel of feed. The liquid product had an A. P. I. gravity of 55.1, a sulfur content of 0.01%, a nitrogen content of 1 part per million, contained no olefins, and on the ASTM–D–86 distillation had a 10% point of 221° F., a 50% point of 261° F. and a 90% point of 308° F.

Example 2

The bottoms fraction above described and hydrogen were contacted with a cobalt-molybdenum catalyst. The operating conditions were as follows: pressure, 800 p. s. i. g.; temperature, 780° F.; liquid hourly space velocity, 2 v./v./hr.; and 3000 cubic feet of hydrogen per barrel of feed. The liquid product had an A. P. I. gravity of 38.9, a sulfur content of 0.03 by weight, a nitrogen content of 5 parts per million, and contained no olefins.

The catalyst employed in Examples 1 and 2 was a cobalt-molybdenum catalyst supported on alumina. The catalyst was prepared by coprecipitating molybdenum oxide and alumina, drying the precipitate, grinding, pelleting and calcining the dry precipitate to obtain a molybdenum-alumina catalyst having a molybdenum oxide content of 12% by weight. The pellets were then impregnated with cobalt by treating them with a cobalt nitrate solution. After impregnation, the pellets were recalcined to decompose the cobalt nitrate and give a final catalyst containing 2% by weight of cobalt oxide.

Example 3

A hydrogenated overhead fraction, similar to that produced in Example 1, and having the following inspections: A. P. I. gravity, 56.6; aniline point, 126; on an ASTM–D–86 distillation, a 10% point of 216° F.; a 50% point of 253° F.; a 90% point of 310° F.; and an F–1 clear octane number of 54.7, was dehydrogenated with a platinum catalyst containing 0.3% by weight platinum on alumina. The operating conditions were as follows: pressure, 500 p. s. i. g.; liquid hourly space velocity, 2 v./v./hr.; average catalyst temperature, 870° F.; and 6000 cubic feet of hydrogen per barrel of feed. The liquid product had the following inspections: A. P. I. gravity, 50.0; aniline point, 61; on an ASTM–D–86 distillation, a 10% point of 197° F.; a 50% point of 252° F.; a 90% point of 326° F.; and an F–1 clear octane number of 86.7. The product recovered containing 5 or more carbon atoms per molecule amounted to 88 volume percent of the feed.

Example 4

A hydrogenated bottoms fraction similar to that produced in Example 2 and having the following inspections: A. P. I. gravity, 42.7; aniline point, 112; on an ASTM–D–86 distillation, a 10% point of 323° F.; a 50% point of 350° F.; a 90% point of 399° F.; and an F–1 clear octane number of 52.2, was dehydrogenated over a platinum catalyst. The operating conditions were as follows: pressure, 500 p. s. i. g.; liquid hourly space velocity, 3.0; average catalyst temperature, 867° F.; and 6000 cubic feet of hydrogen per barrel of feed. The dehydrogenated product had the following inspections: A. P. I. gravity, 37.8; aniline point, 38; on an ASTM–D–86 distillation, a 10% point of 286° F.; a 50% point of 348° F.; a 90% point of 436° F.; and an F–1 clear octane number of 89.4. The dehydrogenated product containing 5 or more carbon atoms per molecule amounted to 90.8 volume percent of the feed.

Blends of cracked naphtha with straight-run naphtha are advantageously treated in the manner above described, for example, blends containing at least 25 volume percent of cracked naphtha, and especially blends containing 50 volume percent or more of cracked naphtha.

The advantages of operation pursuant to the process of the invention may be summarized as follows: It permits production of premium and regular grades of gasoline without over-treating the regular grade. It permits the use of lower operating severity in both stages than could be used if the whole naphtha were reformed and then fractionated to give a premium grade gasoline of required quality. It gives higher total yields of gasoline. It makes possible production of much higher quality premium grade gasoline by exclusion of the relatively low octane components produced by hydrocracking of the higher boiling hydrocarbons, i. e., materials which boil in the premium grade boiling range, and cannot be separated from the higher quality low boiling components by fractional distillation.

We claim:

1. A process for upgrading cracked naphtha which comprises fractionally distilling the naphtha to separate an overhead fraction having an ASTM–D–86 90% point in the range from 275 to 350° F. and a bottoms fraction, separately contacting the overhead fraction and hydrogen and the bottoms fraction and hydrogen with a cobalt-molybdenum catalyst in a hydrogenation zone under conditions of temperature and space velocity sufficiently severe in each case to reduce the sulfur content and the nitrogen content of the liquid product below about 0.2% by weight and 5 parts per million, respectively, said conditions being substantially less severe in the case of the overhead fraction, separately contacting the hydrogenated overhead fraction and hydrogen and the hydrogenated bottoms fraction and hydrogen with a platinum catalyst under dehydrogenating conditions sufficiently severe in each case to produce a liquid product having an F–1 clear octane rating above 80, said conditions being substantially less severe in the case of the hydrogenated bottoms fraction.

2. A process for upgrading cracked naphtha which comprises contacting the naphtha and hydrogen with a cobalt-molybdenum catalyst in a hydrogenation zone under conditions of temperature and space velocity sufficiently severe to reduce the sulfur content and the nitrogen content of the liquid product below about 0.2% by weight and 5 parts per million, respectively, fractionally dis-

tilling the hydrogenation reaction product to separate an overhead fraction having an ASTM–D–86 90% point in the range from 275 to 350° F. and a bottoms fraction, separately contacting the hydrogenated overhead fraction and hydrogen and the hydrogenated bottoms fraction and hydrogen with a platinum catalyst in a dehydrogenation zone under dehydrogenating conditions sufficiently severe in each case to produce a liquid product having an F–1 clear octane rating above 80, said conditions being substantially less severe in the case of the bottoms fraction, separating a liquid product and a gaseous product rich in hydrogen from the effluents from the dehydrogenating zone and passing the hydrogen-rich gas into the hydrogenation zone together with further quantities of cracked naphtha.

3. A process for upgrading cracked naphtha which comprises maintaining a plurality of serially connected masses of cobalt-molybdenum catalyst constituting a hydrogenation zone, introducing from 25 to 50% by weight of the naphtha feed and hydrogen into contact with the first of said serially connected masses, introducing the remainder of the naphtha feed into the hydrogenation zone downstream from said first serially connected mass, maintaining conditions of temperature and space velocity in the hydrogenation zone sufficiently severe to reduce the sulfur content and the nitrogen content of the liquid product below about 0.2% by weight and 5 parts per million, respectively, fractionally distilling the hydrogenation reaction product to separate an overhead fraction having an ASTM–D–86 90% point in the range from 275 to 350° F. and a bottoms fraction, separately contacting the hydrogenated overhead fraction and hydrogen and the hydrogenated bottoms fraction and hydrogen with a platinum catalyst in a dehydrogenation zone under dehydrogenating conditions sufficiently severe in each case to produce a liquid product having an F–1 clear octane rating above 80, said conditions being substantially less severe in the case of the bottoms fraction, separating a liquid product and a gaseous product rich in hydrogen from the effluents from the dehydrogenating zone and passing the hydrogen-rich gas into the hydrogenation zone together with further quantities of cracked naphtha.

4. A process for improving the antiknock rating of a 390–440° F. end point naphtha containing sulfur compounds and nitrogen compounds which comprises fractionally distilling the naphtha to separate an overhead fraction having a 90% point below about 350° F. and a higher boiling bottoms fraction, contacting the overhead fraction and hydrogen with a cobalt-molydenum catalyst in a hydrogenation zone under conditions of temperature and space velocity in the ranges from 500 to 850° F. and from 1 to 5 v./v./hr., respectively, and sufficiently severe to reduce the sulfur content and nitrogen content of the liquid product to values below about 0.2% by weight and 5 parts per million, respectively, passing the liquid product and hydrogen into contact with a platinum catalyst in a dehydrogenation zone under conditions of temperature and space velocity in the ranges from 880 to 980° F. and from 1 to 3 v./v./hr., respectively, and sufficiently severe to produce a liquid product having an F–1 clear octane rating above 80, contacting the bottoms fraction and hydrogen with a cobalt-molybdenum catalyst in a hydrogenation zone under conditions of temperature and space velocity in the ranges from 600 to 850° F. and from 1 to 5 v./v./hr., respectively, and sufficiently severe to reduce the sulfur and nitrogen contents of the liquid product to values below 0.2% by weight and 5 parts per million, respectively, and contacting the last-mentioned liquid product and hydrogen with a platinum catalyst in a dehydrogenation zone under conditions of temperature and space velocity in the ranges from 850 to 950° F. and from 1 to 3 v./v./hr., respectively, and sufficiently severe to produce a liquid product having an F–1 clear octane rating above 80.

5. A process for improving the antiknock rating of a 390–440° F. end point naphtha containing sulfur compounds and nitrogen compounds which comprises contacting the naphtha and hydrogen with a cobalt-molybdenum catalyst in a hydrogenation zone under conditions of temperature and space velocity in the range from 600 to 850° F. and from 1 to 5 v./v./hr., respectively, and sufficiently severe to reduce the sulfur content and nitrogen content of the liquid product to values below about 0.2% by weight and 5 parts per million, respectively, fractionally distilling the hydrogenated liquid product to separate an overhead fraction having a 90% point below about 350° F. and a higher boiling bottoms fraction, passing the overhead fraction and hydrogen into contact with a platinum catalyst in a dehydrogenation zone under conditions of temperature and space velocity in the ranges from 880 to 980° F. and from 1 to 3 v./v./hr., respectively, and sufficiently severe to produce a liquid product having an F–1 clear octane rating above 80, passing the bottoms fraction and hydrogen into contact with a platinum catalyst in a dehydrogenation zone under conditions of temperature and space velocity in the ranges from 850 to 950° F. and from 1 to 3 v./v./hr., respectively, and sufficiently severe to produce a liquid product having an F–1 clear octane rating above 80, and separating a gas rich in hydrogen from the effluent from the dehydrogenation zone and passing it into the hydrogenation zone together with further quantities of naphtha.

6. A process for upgrading cracked naphtha which comprises fractionally distilling the naphtha to separate an overhead fraction having an ASTM–D–86 90% point in the range from 275° to 350° F. and a bottoms fraction, maintaining a plurality of serially connected masses of cobalt-molybdenum catalyst constituting a hydrogenation zone, passing the bottoms fraction and hydrogen into the first of said serially connected masses and through the hydrogenation zone while maintaining conditions of temperature and space velocity in the hydrogenation zone sufficiently severe to produce a hydrogenated bottoms fraction having a sulfur content below about 0.2% by weight and a nitrogen content below about 5 parts per million, separately contacting the overhead fraction and hydrogen with the catalyst in the hydrogenation zone while maintaining conditions of temperature and space velocity sufficiently severe to produce a hydrogenated overhead fraction having a sulfur content below 0.2% by weight and a nitrogen content below about 5 parts per million, separately contacting the hydrogenated overhead fraction and hydrogen and the hydrogenated bottoms fraction and hydrogen with a platinum catalyst in a dehydrogenation zone under dehydrogenating conditions sufficiently severe in each case to produce a liquid product having an F–1 clear octane rating above 80, said conditions being substantially less severe in the case of the bottoms fraction, separating a liquid product and a gaseous product rich in hydrogen from the effluents from the dehydrogenating zone and passing the hydrogen-rich gas into the hydrogenation zone together with further quantities of cracked naphtha.

7. The method as defined in claim 6, wherein one of the plurality of catalytic masses constituting the hydrogenation zone is periodically withdrawn from service during the hydrogenation of the overhead fraction, regenerated by burning carbonaceous deposits from the surface of the catalyst with a free oxygen-containing gas and returning the regenerated catalyst mass to service in the hydrogenation zone prior to hydrogenating the bottoms fraction.

8. A process for producing a relatively low boiling gasoline having a 90% point below about 325° F. and an F–1 clear octane rating above 85 and a relatively high boiling gasoline having a 90% point above about 350° F. and an F–1 clear octane rating of 3 to 10 numbers below that of the relatively low boiling gasoline from a naphtha having an end point in the range from 400 to 450° F., which comprises fractionally distilling the naphtha to

separate an overhead fraction having a 90% point below 325° F. and a higher boiling bottoms fraction, contacting the overhead fraction and hydrogen with platinum catalyst under reforming conditions of temperature, pressure and space velocity sufficiently severe to produce a normally liquid product having an F–1 clear octane rating above 85, and contacting the bottoms fraction and hydrogen with a platinum catalyst under relatively mild reforming conditions of temperature, pressure and space velocity to produce a liquid product having an F–1 clear octane number 3 to 10 numbers lower than that obtained by reforming the overhead fraction.

9. A process for upgrading cracked naphtha which comprises contacting the naphtha and hydrogen with a cobalt molybdenum catalyst in a hydrogenation zone under conditions of temperature and space velocity sufficiently severe to reduce the sulfur content and the nitrogen content of the liquid product below about 0.2% by weight and 20 parts per million, respectively, and to substantially completely saturate the olefins contained in said naphtha, fractionally distilling the hydrogenation reaction product to separate an overhead fraction having an ASTM–D–86 90% point in the range from 275 to 350° F. and a higher boiling fraction, separately contacting the hydrogenated overhead fraction and hydrogen and the hydrogenated higher boiling fraction and hydrogen with a platinum catalyst in a dehydrogenation zone under dehydrogenating conditions sufficiently severe in each case to produce a liquid product having an F–1 clear octane rating above 80, said conditions being substantially less severe in the case of the higher boiling fraction.

10. The method as defined in claim 9, wherein the effluent from the dehydrogenating zone during dehydrogenation of the hydrogenated higher boiling fraction is fractionally distilled to separate a relatively low octane overhead fraction boiling below about 300° F. and a relatively high octane bottoms fraction.

11. The method as defined in claim 10, wherein a substantial proportion of the relatively high octane bottoms fraction is blended with a substantial proportion of the effluent from the dehydrogenation zone during treatment of the hydrogenated overhead fraction having an ASTM–D–86 90% point in the range from 275 to 350° F.

12. A process as defined in claim 4, wherein the last-mentioned liquid product is fractionally distilled to separate a relatively low octane overhead fraction boiling below about 300° F. and a relatively high octane bottoms fraction and blending said bottoms fraction with the effluent produced in the dehydrogenation zone during contact of the hydrogenated first-mentioned overhead fraction with the platinum catalyst.

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