

PROCESSING OF FCC NAPHTHA

BACKGROUND OF THE INVENTION

5 Field of the Invention

The present invention relates to a process for the desulfurization of a full boiling range fluid catalytic cracked naphtha. More particularly the present invention employs catalytic distillation steps which reduce sulfur to very low levels, makes more efficient use of hydrogen and causes less olefin hydrogenation for a full boiling range naphtha stream. More particularly the invention relates to a process for controlling the end point of gasoline blended from the treated naphtha by concurrently distilling the naphtha while desulfurizing and then recombining the fractions for the desired endpoint.

Related Information

15 Petroleum distillate streams contain a variety of organic chemical components. Generally the streams are defined by their boiling ranges which determine the composition. The processing of the streams also affects the composition. For instance, products from either catalytic cracking or thermal cracking processes contain high concentrations of olefinic materials as well as saturated (alkanes) materials and polyunsaturated materials (diolefins). Additionally, these components may be any of the various isomers of the compounds.

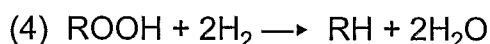
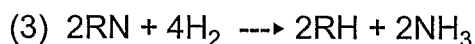
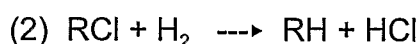
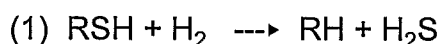
20 The composition of untreated naphtha as it comes from the crude still, or straight run naphtha, is primarily influenced by the crude source. Naphthas from paraffinic crude sources have more saturated straight chain or cyclic compounds. As a general rule most of the "sweet" (low sulfur) crudes and naphthas are paraffinic. The naphthenic crudes contain more unsaturates and cyclic and polycyclic compounds. The higher sulfur content crudes tend to be naphthenic. Treatment of the different straight run naphthas may be slightly different depending upon their composition due to crude source.

30 Reformed naphtha or reformate generally requires no further treatment except perhaps distillation or solvent extraction for valuable aromatic product removal. Reformed naphthas have essentially no sulfur contaminants due to the severity of their pretreatment for the process and the process itself.

Cracked naphtha as it comes from the catalytic cracker has a relatively high octane number as a result of the olefinic and aromatic compounds contained therein. In some cases this fraction may contribute as much as half of the gasoline in the refinery pool together with a significant portion of the octane.

Catalytically cracked naphtha (gasoline boiling range material) currently forms a significant part ($\approx 1/3$) of the gasoline product pool in the United States and it provides the largest portion of the sulfur. The sulfur impurities may require removal, usually by hydrotreating, in order to comply with product specifications or to ensure compliance with environmental regulations. Some users require the sulfur of the final product to be below 50 wppm.

The most common method of removal of the sulfur compounds is by hydrodesulfurization (HDS) in which the petroleum distillate is passed over a solid particulate catalyst comprising a hydrogenation metal supported on an alumina base. Additionally copious quantities of hydrogen are included in the feed. The following equations illustrate the reactions in a typical HDS unit:



Typical operating conditions for the HDS reactions are:

Temperature, °F	600-780
Pressure, psig	600-3000
H ₂ recycle rate, SCF/bbl	1500-3000
Fresh H ₂ makeup, SCF/bbl	700-1000

After the hydrotreating is complete, the product may be fractionated or simply flashed to release the hydrogen sulfide and collect the now desulfurized naphtha. The loss of olefins by incidental hydrogenation is detrimental by the reduction of the octane rating of the naphtha and the reduction in the pool of olefins for other uses.

In addition to supplying high octane blending components the cracked naphthas are often used as sources of olefins in other processes such as etherifications, oligomerizations and alkylations. The conditions of hydrotreating of

the naphtha fraction to remove sulfur will also saturate some of the olefinic compounds in the fraction reducing the octane and causing a loss of source olefins.

Various proposals have been made for removing sulfur while retaining the more desirable olefins. Since the olefins in the cracked naphtha are mainly in the low boiling fraction of these naphthas and the sulfur containing impurities tend to be concentrated in the high boiling fraction the most common solution has been prefractionation prior to hydrotreating. The prefractionation produces a light boiling range naphtha which boils in the range of C₅ to about 250°F and a heavy boiling range naphtha which boils in the range of from about 250-475 °F.

The predominant light or lower boiling sulfur compounds are mercaptans while the heavier or higher boiling compounds are thiophenes and other heterocyclic compounds. The separation by fractionation alone will not remove the mercaptans. However, in the past the mercaptans have been removed by oxidative processes involving caustic washing. A combination oxidative removal of the mercaptans followed by fractionation and hydrotreating of the heavier fraction is disclosed in U.S. patent 5,320,742. In the oxidative removal of the mercaptans the mercaptans are converted to the corresponding disulfides.

Several U.S. patent describe the concurrent distillation and desulfurization of naphtha and these include 5,597,476; 5,779,883; 6,083,378; 6,303,020; 6,416,658; 6,444,118; 6,495,030; 6,678,830 and 6,824,679. In each of these patents the naphtha is split into two or three fractions based upon boiling point. Generally combining the fractions is mentioned only in passing. However, in commercial designs it has become the practice to combine all of the treated naphtha fractions and to send the total to gasoline blending.

In commercial designs which simply reblend all of the HCN and MCN in their production ratio, the endpoint of the FCC gasoline produced is essentially the same as the endpoint of the feed.

It is an advantage of the present invention that a full boiling range naphtha stream is hydrodesulfurized by splitting it into boiling range fractions which are treated to simultaneously hydrodesulfurize and fractionate the fractions. It is a further advantage of the present invention that the sulfur may be removed from the light portion of the stream to a heavier portion of the stream without any substantial

loss of olefins. It is a particular feature of the present invention that substantially all of the sulfur contained in the naphtha is ultimately converted to H_2S which is quickly removed from the catalyst zones and easily distilled away from the hydrocarbons minimizing production of recombinant mercaptans and with reduced hydrogenation of olefins. Finally, another particular feature of the present invention is that the fractions may be selectively combined to adjust the endpoint (ASTM D-86 95% point) as desired for various situations.

SUMMARY OF THE INVENTION

Briefly the invention is a process for the desulfurization of a catalytic cracked naphtha comprising contacting the naphtha and hydrogen in the presence of the hydrodesulfurization catalyst to react a portion of the organic sulfur compounds contained within the naphtha with hydrogen to form H_2S , and separating the naphtha stream into a lighter fraction and a heavier fraction by distillation; withdrawing the lighter fraction from as an overheads; withdrawing the heavier fraction from as a bottoms; and combining a portion of the heavier fraction with the lighter fraction to obtain an ASTM D-86 95% point greater than the end point of the lighter fraction and less than the ASTM D-86 95% point of the heavier fraction and preferably less than the D-86 95% point of the feed naphtha.

In one embodiment a full boiling range naphtha, containing diolefins and organic sulfur compounds, including mercaptan is split into a first heavy fraction and a light fraction. The light fraction is brought into contact with a thioetherification catalyst under conditions of concurrent fractionation and reaction to react diolefins and mercaptans to form organic sulfides and to fractionate the organic sulfides into the first heavy fraction. The light fraction having a reduced sulfur content is recovered as overheads.

The first heavy fraction is recovered and used as the feed for fractionated into an intermediate fraction and a second heavy fraction. Both fractions are individually brought into contact with hydrodesulfurization catalyst and hydrogen under conditions of concurrent fractionation and reaction to react organic sulfur including organic sulfides from the light fraction with the hydrogen to form H_2S and hydrocarbons. The intermediate fraction having a reduced sulfur content from the first heavy feed is recovered and combined with the light fraction. A second heavy

fraction having a reduced sulfur content from the first heavy feed is recovered and a portion thereof comprising less than all of the second heavy fraction is combined with the light and intermediate fractions to produce a selected endpoint. A portion of the second heavy fraction having a reduced sulfur content from that of the first heavy feed is combined the combined intermediate fraction and light fraction to obtain an ASTM D-86 95% point greater than the end point of the combined intermediate fraction and light fraction and less than the ASTM D-86 95% point of the second heavy fraction. The unused heavy fraction is sent to diesel fuel processing.

The present invention provides a new configuration where the amount of heavy cracked naphtha blended into light/intermediate cracked naphtha is controlled and can be varied, thus giving a refiner control over the endpoint of the gasoline produced. Any excess heavy cracked naphtha produced would be suitable to route to a distillate hydrotreater or perhaps directly into the diesel pool. This also gives some flexibility to vary the amount of gasoline and diesel fuel produced at the refinery. Since less than all of the recovered heavy naphtha fraction is blended with intermediate fraction, it is contemplated that, up to 100 % of the desulfurized heavy fraction will be used.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a simplified flow diagram in schematic form of one embodiment of the invention.

FIG. 2 is a simplified flow diagram in schematic form of a second embodiment of the invention.

FIG. 3 is a simplified flow diagram in schematic form of an embodiment of the invention employing one fixed bed, straight pass HDS polishing reactor in combination with a distillation column.

FIG. 4 is a simplified flow diagram in schematic form of an embodiment of the invention employing fixed bed, straight pass HDS reactors.

DETAILED DESCRIPTION

The process for simultaneously desulfurizing and distilling a full boiling range fluid cracked naphtha has been described previously. See for example U.S. Pat. No. 5,597,476 which is incorporated by reference herein in its entirety. The patent discloses a two-step process in which naphtha is fed to a first distillation column

reactor which acts as a depentanizer or dehexanizer with the lighter material containing most of the olefins and mercaptans being boiled up into a first distillation reaction zone where the mercaptans are reacted with diolefins to form sulfides which are removed in the bottoms along with any higher boiling sulfur compounds. The bottoms are subjected to hydrodesulfurization in a second distillation column reactor where the sulfur compounds are converted to H_2S and removed. The second distillation column reactor desulfurizes FCC gasoline in a distillation environment. In the case of the present invention an overhead and a bottom stream are produced. The overhead product contains the midrange cat-cracked naphtha (MCN) and typically covers a boiling range of 150 - 350°F, although there is some flexibility for the exact temperatures. The bottom product contains the heavy cat-cracked naphtha (HCN) and has a typical endpoint near 480°F.

Heretofore the MCN and HCN have been simply recombined and fed into a common product stripper to remove dissolved gases such as H_2S and H_2 . In the present invention it has been found useful in some circumstances to reduce the amount of HCN blended back into the MCN, and therefore reduce the endpoint of the gasoline product. Controlling the amount of HCN blended into the MCN gives the refiner a means to adjust the product endpoint within the range of 350 -450°F. This is a potentially powerful tool to make seasonal adjustments to the gasoline quality and quickly satisfy product specifications for boutique markets.

According to the present invention the hydrodesulfurization reactions and distillation separations may be carried out concurrently in a reaction distillation zone or in a fixed bed, straight pass reaction zone followed by a distillation zone or in combinations of these two modes.

In the present process a full boiling range naphtha stream containing organic sulfur compounds and diolefins may be fractionated in a first distillation column reactor by boiling a portion of the stream containing lower boiling organic sulfur compounds, generally mercaptans and diolefins into contact with a Group VIII metal hydrogenation catalyst under conditions to form sulfides. A lower boiling portion of the stream, having a reduced amount of organic sulfur compounds and diolefins is recovered as light naphtha overheads. The sulfides formed by the reaction of the mercaptans and diolefins are higher boiling and are removed from the column in a

heavier bottoms. The heavier bottoms comprise that portion of the streams not removed as overheads. Although hydrogen is present in this column, it is present in an amount to maintain the catalyst in the hydride form for the sulfide reaction and very little of the olefins present are hydrogenated. Furthermore, the presence of diolefins in this fraction deters olefin hydrogenation, since the diolefins are preferentially hydrogenated.

The heavier bottoms and hydrogen may be fed to a second distillation column reactor, where the heavier bottoms are fractionated into an intermediate naphtha fraction and a heavy naphtha fraction. The organic sulfur compounds in the intermediate naphtha portion are brought into contact with hydrogen in the upper end of the distillation column reactor in the presence of a hydrodesulfization catalyst under conditions to convert the organic sulfur compounds to H_2S which is removed overhead with the intermediate naphtha fraction. Higher boiling organic sulfur compounds originally present in the stream and the sulfides produced in the first column are brought into contact with hydrogen in the lower end of the distillation column reactor in the presence of a hydrodesulfurization catalyst under conditions to convert the heavier sulfur compounds to H_2S which is also removed with the intermediate naphtha in the overheads. The H_2S is separated from the intermediate fraction is condensed and recovered. A reduced sulfur content heavy naphtha is recovered as bottoms. The recovered heavy, intermediate and light naphtha fractions are then selectively blended to obtain the endpoint (ASTM D-86 95% point) of less than the heavy fraction and greater than the combined light and intermediate fractions.

The endpoint being controlled is measured by the ASTM D-86 method which is the standard in the refining industry. ASTM D-86 does not measure a true boiling point because of the equipment used but is still the standard used. Because ASTM D-86 does not measure a true boiling point, the endpoint according to this method may be manipulated by blending a higher boiling stock into a lower boiling stock.

THIOETHERIFICATION AND SELECTIVE HYDROGENATION CATALYSTS

Catalysts which are useful in the mercaptan-diolefin reaction and the selective hydrogenation of dienes include the Group VIII metals. Generally the metals are deposited as the oxides on an alumina support.

A preferred catalyst for the thioetherification reaction in CD mode is 54 wt.% Ni on 8 to 14 mesh Al_2O_3 (alumina) spheres, supplied by Calcat designated as E-475-SR. Typical physical and chemical properties of the catalyst as provided by the manufacturer are as follows:

TABLE

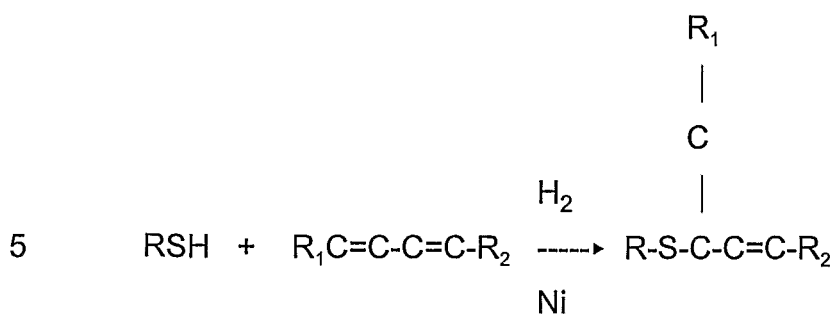
Designation	E-475-SR
Form	Sphere
Nominal size	8x14 mesh
Ni wt. %	54
Support	alumina

Hydrogen must be fed to the reactor at a rate to the reactor must be sufficient to maintain the reaction, but kept below that which would cause flooding of the column which is understood to be the "effectuating amount of hydrogen " as that term is used herein. Generally the mole ratio of hydrogen to diolefins and acetylenes in the feed is at least 1.0 to 1.0 and preferably 2.0 to 1.0.

The thioetherification catalyst also catalyzes the selective hydrogenation of polyolefins, such as the diolefins, contained within the light cracked naphtha and to a lesser degree the isomerization of some of the mono-olefins. Using the preferred Ni catalyst the relative rates of reaction for various compounds are in the order of from faster to slower:

- (1) reaction of diolefins with mercaptans
- (2) hydrogenation of diolefins
- (3) isomerization of the mono-olefins
- (4) hydrogenation of the mono-olefins.

The reaction of interest is the reaction of the mercaptans with diolefins. In the presence of the catalyst the mercaptans will also react with mono-olefins. However, there is an excess of diolefins to mercaptans in the light cracked naphtha feed and the mercaptans preferentially react with them before reacting with the mono-olefins. The equation of interest which describes the reaction is:



where R₁ or R₂ can be either an alkyl group or a hydrogen atom.

This may be compared to the reaction described below which consumes hydrogen. The only hydrogen utilized in the removal of the mercaptans in the thioetherification is that necessary to keep the catalyst in the reduced "hydride" state. In the concurrent hydrogenation of the dienes, hydrogen is consumed.

SELECTIVE HYDROGENATION CATALYST

The catalyst may be used as individual Group VIII metal component or in admixture with each other or modifiers as known in the art, particularly those in Group VIB and IB such as hydrogenation catalysts of the type characterized by platinum, palladium, rhodium or mixtures thereof. Generally the metals are deposited as the oxides on an alumina support. The supports are usually small diameter extrudates or spheres, typically alumina. Catalysts preferred for the selective hydrogenation of diolefins are alumina supported palladium catalysts.

CATALYST STRUCTURES

The catalyst typically is in the form of extrudates having a diameter of 1/8, 1/16 or 1/32 inches and an L/D of 1.5 to 10. The catalyst also may be in the form of spheres having the same diameters. In their regular form they present too compact a mass and are preferably prepared in the form of a catalytic distillation structure. The catalytic distillation structure must be able to function as catalyst and as mass transfer medium.

When the catalysts are used within a distillation column reactor, they are preferably prepared in the form of a catalytic distillation structure. The catalytic distillation structure must be able to function as catalyst and as mass transfer medium. The catalyst is preferably supported and spaced within the column to act as a catalytic distillation structure. A variety of catalyst structures for this use are disclosed in U.S. patents 4,443,559; 4,536,373; 5,057,468; 5,130,102; 5,133,942;

5,189,001; 5,262,012; 5,266,546; 5,348,710; 5,431,890; and 5,730,843 which are incorporated herein by reference.

5 A preferred structure is that shown in U.S. patent 5,730,843 which is incorporated by reference. As disclosed therein the structure comprises a rigid frame made of two substantially vertical duplicate grids spaced apart and held rigid by a plurality of substantially horizontal rigid members and a plurality of substantially horizontal wire mesh tubes mounted to the grids to form a plurality of fluid pathways among the tubes. At least a portion of the wire mesh tubes contain a particulate catalytic material. The catalyst within the tubes provides a reaction zone where
0 catalytic reactions may occur and the wire mesh provides mass transfer surfaces to effect a fractional distillation. The spacing elements provide for a variation of the catalyst density and loading and structural integrity and provides ample vapor and liquid throughput capability.

5 In the various drawings components having the same relationship and general function are give the same indicia to illustrate the congruity of the embodiments of the invention.

Referring now to Fig. 1 a first embodiment of the present invention is shown. The light FC naphtha is fed via flow line 101 to a thioetherification distillation column reactor 10 containing a bed 12 of thioetherification catalyst. Hydrogen is fed in an
0 amount sufficient to keep the catalyst in the hydride state. In the reactor 10 the mercaptans in the naphtha are reacted with diolefins to form sulfides which are higher boiling and are removed with the bottoms via flow line 103. A light naphtha product is taken as overheads via flow line 102 and sent to the final blend.

5 The bottoms in flow line 103 are combined with a heavy FC naphtha stream from flow line 104 and fed via flow line 105 to a hydrodesulfurization distillation column reactor 20 containing two beds 22 and 24 of hydrodesulfurization catalyst. Hydrogen is also fed to the unit. It may be co-fed as shown or as a separate feed below the bed 24. In the distillation column reactor 20 the organic sulfur compounds, including the sulfides produced in the reactor 10, are reacted with hydrogen to form
0 hydrogen sulfide. An intermediate boiling range naphtha (MCN) is taken as overheads via flow line 106 and stripped of hydrogen sulfide in stripper 30 where the hydrogen sulfide is removed as overheads via flow line 107. The product MCN is

taken from the stripper 30 as bottoms via flow line 108. A heavy naphtha stream (HCN) is taken from the reactor 20 as bottoms via flow line 109 and stripped of hydrogen sulfide in stripper 40 where the hydrogen sulfide is taken as overheads via flow line 110. The product HCN is removed from the stripper as bottoms via flow line 111. Once stripped, the HCN is suitable to send to the diesel pool, via flow line 112 or perhaps to a distillate hydrotreater or other type of unit if additional processing is required. Some of the HCN is also routed via flow line 113 into the MCN product. The amount of HCN blended into the MCN depends on the endpoint required in the final product. A higher endpoint temperature will require more of the HCN, and a lower endpoint will require less HCN. The combined stream of MCN and desired HCN is sent to the final blend via flow line 114.

For the situations where there are separate Heavy and Light feed streams provided, there is a possibility for the refiner to send some of the heavy feed directly to the diesel pool or other process unit without treatment in distillation column reactor 20. To permit this option, a recycle of the HCN product back into the feed to the hydrodesulfurization distillation column reactor is incorporated. These connections are shown as dashed lines 109A and 111A in Figs.1 and 2. Only a small makeup of heavy feed is required to continue to run the distillation column reactor 20. Also, a small purge of HCN product would be sent to the diesel, or the gasoline pool, whichever is desired

If the refiner determines that the HCN requires additional processing before being sent to the diesel pool, there may be an opportunity to eliminate the stripper 40 and save capital. This layout is provided in Fig 2. As determined by endpoint considerations, the required proportion of the HCN would be routed to the stripper 30 via flow line 115 where it would mix with the MCN and be stripped of dissolved gases. The remainder of the HCN would be routed directly to a distillate hydrotreater. The dissolved hydrogen and hydrogen sulphide in the HCN do not pose a problem in a typical distillate hydrotreater. The dissolved gases could pose a problem if there is a need to store the material prior to further processing, so this process scheme must be considered carefully.

In some cases, for example when the sulphur specifications are extremely low or when mercaptan specifications are very tight, additional processing of the

MCN/HCN blend may be required. This could take the form of a variety of options such as an adsorption bed, a caustic treating unit (with or without extraction), a mercaptan sweetening unit, a secondary hydrotreating unit, etc. Such units are well known in the art and are not shown.

5 Although the invention is, in general, described in terms of the preferred embodiments where catalytic distillation reactors are employed for the hydrodesulfurizations, any or all of the hydrodesulfurizations may be carried out in fixed bed, single pass reactors as illustrated in Figs. 3 and 4.

0 Further reduction in total sulfur can be obtained by routing the heavy naphtha stream (HCN) in bottoms 109 via flow line 115 from the reactor 20 to stripper 30 where it would mix with the MCN, stripped of dissolved gases and total product from reactor 20 sent to a polishing reactor 50 via line 108 where it is subjected to further hydrodesulfurization in fixed catalyst bed 52 with hydrogen added through line 108 A and the product passed via line 118 to splitter 60 where H₂S and H₂ are removed
5 as overheads via line 116 and the polished product split to send the LCN to the Final Blend via sidedraw line 114. Some or all of the HCN may also go to the Final Blend or Diesel via line 120 by adjustment of the operating conditions of splitter 60. The unconverted sulfur will either recycle to extension in the heavy recycle loop (109A, 105) or be easily converted in the diesel hydrotreater (not shown).

0 Although the invention is generally described in terms of the preferred embodiments, using catalytic distillation reactors for the hydrodesulfurization, any or all of the hydrodesulfurizations may be carried out in fixed bed, straight pass reactors as illustrated in Figs. 3 and 4.

5 Fig. 4 illustrates the present process where each of the hydrodesulfurization is carried out in fixed bed, straight pass reactors 310 and 340 with appropriate adjustments. Nonetheless, the product streams 102 and 114 to the Final Blend and Diesel are substantially equivalent to those produced by the catalytic distillation HDS.

0 The feed 101 is hydrodesulfurized in fixed bed, straight pass reactor 310 with the product the product passing to stripper 320 where the H₂S is removed via line 312. The liquid from stripper 320 with reduced sulfur content is sent via line 314 to splitter 330 where the LCN overheads 102 are recovered and sent Final Blend.

The bottoms 103 are sent to fixed bed, straight pass reactor 340 where it contacts hydrodesulfurization catalyst 24. The bottoms is passed to stripper 30 and H₂S is removed vial line 107. The liquid bottoms having reduced sulfur content pass via line 318 to splitter 350 and a MCH is taken overheads 108 to Final Blend vial line 114 while bottoms 111 are handled as described above.

EXAMPLE

A pilot plant test conducted to verify the production of low endpoint gasoline from a wide boiling range stock. A full range fluid catalytic cracked naphtha was treated to recover the C₅'s and most C₆'s in the overhead of a thioetherification distillation column reactor that removed the mercaptans from the distillate product. The bottoms from this thioetherification reactor had the properties set out in TABLE I below.

TABLE I

Total Sulfur (wppm)	1356
Total RSH (wppm)	n/a
Total N (wppm)	65.5
Bromine No. (g/100g)	51.7
Density (g/cc)	0.798
ASTM D3710 distillation	°F
IBP	150
5%	187
10%	202
20%	218
30%	244
40%	263
50%	290
60%	308
70%	345
80%	377
90%	416
95%	454
EP	497

The hydrodesulfurization distillation column reactor was set up in a 3" diameter column x 50 ft. tall. A Co/Mo catalyst (DC-130 from Criterion Catalyst Company) was loaded into the column in structure as described in U.S. patent 5,730,843. Operating conditions and results are presented in TABLE II below.

TABLE II

5	Feed rate, lbs/hr	60.1
	Feed Sulfur (wppm)	1356
	Reboiler Hydrogen (scfh)	59.9
	Feed Pt. Hydrogen (scfh)	20.1
	Pressure (pig)	265
10	Throughput (bpd/ft ³ catalyst packing)	2.8
	Upper bed temp. °F	487
	Lower bed temp. °F	537
	Reflux ratio	2.45
15	OH sulfur in feed (wppm)	593.9
	OH Br.# in feed	71.3
	OH Product sulfur (wppm)	46.7
	OH Product RSH (wppm)	31.0
	OH Br #	42.9
20	OH sulfur conversion (%)	92.1
	OH Br # conversion (%)	39.8
	Bottoms Product Sulfur (wppm)	277.0
	Bottoms RSH (wppm)	2.7
	Combined OH& Btms Sulfur (wppm)	156.1
25	Combined OH & Btms RSH	17.8
	Combined OH & Btms Br #	28.3
	OH Recovery % of feed	56.9
	ASTM D-86	°F
30	IBP	184.8
	5%	195.1
	50%	218.3
	95%	268.2
	EP	291.1
35		
	Research Octane of OH product	85.0
	Motor Octane of OH Product	77.3

Portions of the overheads and bottoms were blended and a D-86 distillation ran on the blend. TABLE III below shows the D-86 distillation data for various blends.

TABLE III

Amount of Btms,%		0.00	2.00	5.00	10.00	20.00	30.00	100.00
5	IBP	184.1	183.5	183.9	183.2	185.0	187.2	313.0
	10%	202.6	203.1	203.3	204.2	207.1	211.2	328.8
	20%	206.7	205.9	207.8	208.6	211.2	218.0	334.3
	30%	210.9	211.5	212.6	213.7	218.2	225.6	339.4
	40%	216.1	217.2	218.2	219.8	225.9	236.1	347.4
10	50%	222.4	223.9	225.6	227.0	235.8	249.3	356.7
	60%	230.0	231.6	234.5	236.2	248.4	266.8	366.4
	70%	238.8	241.2	244.8	248.6	266.5	291.2	382.2
	80%	249.8	253.1	258.5	266.0	292.9	326.0	403.5
	90%	264.4	270.5	277.3	298.0	352.2	382.1	431.4
	EP	283.0	318.0	375.1	417.6	442.5	456.0	497.8

The invention claimed is:

1. A process for the desulfurization of a catalytic cracked naphtha comprising contacting the catalytic cracked naphtha and hydrogen in the presence of the hydrodesulfurization catalyst to react a portion of the organic sulfur compounds contained within the naphtha with hydrogen to form H_2S ; separating the naphtha stream by distillation into a lighter fraction and a heavier fraction; withdrawing the lighter fraction as an overheads; withdrawing the heavier fraction as a bottoms; and combining a portion of the heavier fraction with the lighter fraction to obtain an ASTM D-86 95% point greater than the end point of the lighter fraction and less than the ASTM D-86 95% point of the heavier fraction.

2. The process according to claim 1 wherein said contacting and separating are carried out concurrently in a reaction distillation zone.

3. The process according to claim 2 comprising contacting said heavier fraction with hydrogen in the presence of the hydrodesulfurization catalyst to react a portion of the organic sulfur compounds contained therein with hydrogen to form H_2S ; separating the heavier fraction by distillation into a second lighter fraction and a second heavier fraction; withdrawing the second lighter fraction as an overheads; withdrawing the second heavier fraction as a bottoms.

4. The process according to claim 3 wherein said contacting and separating of the heavier fraction are carried out concurrently in a reaction distillation zone.

5. The process according to claim 1 wherein said contacting and separating are carried out consecutively in a fixed bed, straight pass reaction zone followed by a distillation zone.

6. The process according to claim 5 comprising contacting said heavier fraction with hydrogen in the presence of the hydrodesulfurization catalyst to react

a portion of the organic sulfur compounds contained therein with hydrogen to form H_2S ; separating the heavier fraction by distillation into a second lighter fraction and a second heavier fraction; withdrawing the second lighter fraction as an overheads; withdrawing the second heavier fraction as a bottoms.

7. The process according to claim 3 wherein said contacting and separating of the heavier fraction are carried out consecutively in a fixed bed, straight pass reaction zone followed by a distillation zone.

8. The process according to claim 1 comprising the steps of:

(a) feeding hydrogen and a naphtha stream containing organic sulfur compounds to a distillation column reactor containing a bed of hydrosulfurization catalyst;

(b) concurrently in said distillation column reactor

(i) contacting the naphtha and hydrogen in the presence of the hydrosulfurization catalyst to react a portion of the organic sulfur compounds contained within the naphtha with hydrogen to form H_2S , and

(ii) separating the naphtha stream into a lighter fraction and a heavier fraction;

(c) withdrawing the lighter fraction from the distillation column reactor as an overheads;

(d) withdrawing the heavier fraction from the distillation column reactor as a bottoms; and

(e) combining a portion of the heavier fraction with the lighter fraction to obtain an ASTM D-86 95% point greater than the end point of the lighter fraction and less than the ASTM D-86 95% point of the heavier fraction.

9. The process according to claim 8 wherein said lighter fraction is stripped of hydrogen sulfide prior to combining with a portion of said heavier fraction.

10. The process according to claim 9 wherein said heavier fraction is stripped of hydrogen sulfide prior to combining a portion of said heavier fraction with said lighter fraction.

11. The process according to claim 8 wherein said blend is stripped of hydrogen sulfide.

12. The process according to claim 8 wherein said naphtha stream is a full boiling range fluid cracked naphtha containing olefins, mercaptans and other organic sulfur compounds and said full boiling range fluid cracked naphtha is treated to removed mercaptans and C₆ and lighter material prior to feeding to said distillation column reactor.

13. The process according to claim 12 wherein the treatment is by thioetherification in a distillation column reactor containing a thioetherification catalyst.

14. A process for the treatment of a full boiling range fluid cracked naphtha comprising the steps of:

(a) feeding hydrogen and a full boiling range fluid cracked naphtha containing olefins, diolefins, mercaptans and other organic sulfur compounds to a first distillation column reactor containing a thioetherification catalyst;

(b) concurrently in said first distillation column reactor,

(i) reacting diolefins with mercaptans to form sulfides, and

(ii) separating by fractional distillation the C₆ and lighter materials from the C₇ and heavier materials including said sulfides;

(c) removing C₆ and lighter materials from said first distillation column reactor as a first overheads;

(d) removing said C₇ and heavier materials from said first distillation column as a first bottoms;

(e) feeding hydrogen and said first bottoms to a second distillation column reactor containing a bed of hydrodesulfurization catalyst;

- (f) concurrently in said distillation column reactor
 - (i) contacting the C₇ and heavier materials and hydrogen in the presence of the hydrodesulfurization catalyst to react a portion of the sulfides and other organic sulfur compounds with hydrogen to form hydrogen sulfide, and
 - (ii) separating the C₇ and heavier materials into a first fraction having an ASTM D-86 endpoint below a second fraction;
- (g) withdrawing the first fraction from the distillation column reactor as a second overheads;
- (h) withdrawing the second fraction from the distillation column reactor as a second bottoms;
- (i) stripping said second overheads to remove hydrogen sulfide;
- (j) stripping said second bottoms to remove hydrogen sulfide; and
- (k) combining a portion of the second fraction with the first fraction to obtain an ASTM D-86 95% point greater than the end point of the first fraction and less than the ASTM D-86 95% point of the second fraction.

15. A process for the desulfurization of a catalytic cracked naphtha comprising:

fractionating a full boiling range naphtha, containing diolefins and organic sulfur compounds, including mercaptan into a first heavy fraction and a light fraction;

contacting the light fraction with a thioetherification catalyst under conditions of concurrent fractionation and reaction to react diolefins and mercaptans to form organic sulfides and to fractionate the organic sulfides into the first heavy fraction;

recovering the light fraction having a reduced sulfur content as overheads;

recovering and fractionating the first heavy fraction into an intermediate fraction and a second heavy fraction;

individually contacting said first heavy fraction and said intermediate fraction with a hydrodesulfurization catalyst and hydrogen under conditions of concurrent fractionation and reaction to react organic sulfur including organic sulfides from the light fraction with the hydrogen to form H₂S and hydrocarbons;

recovering the intermediate fraction having a reduced sulfur content from the first heavy feed and combining said intermediate fraction with the light fraction; and

recovering a second heavy fraction having a reduced sulfur content from that of the first heavy feed and combining a portion of the second heavy fraction with the combined intermediate fraction and light fraction to obtain an ASTM D-86 95% point greater than the end point of the combined intermediate fraction and light fraction and less than the ASTM D-86 95% point of the second heavy fraction.

16. The process according to claim 1 wherein said combined portions of the heavier fraction with the lighter fraction has an ASTM D-86 95% point less than the D-86 95% point of the catalytic cracked naphtha.