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PROCESS FOR PRODUCING LOW AROMATIC DIESEL FUEL
WITH HIGH CETANE INDEX

The present invention relates to a process for producing low aromatic diesel fuel with a high cetane index.

Recent regulatory developments have led refiners to seek methods for reformulating motor fuels, including gasoline and diesel fuel, to meet increasingly stringent air quality requirements. These techniques include reducing the olefin and aromatic content of the motor fuels while maintaining the desired operational characteristics as predicted by the octane or cetane rating of the fuel.

Alkylation is a reaction in which an alkyl group is added to an organic molecule. Thus an isoparaffin can be reacted with an olefin to provide an isoparaffin of higher molecular weight. Industrially, the concept depends on the reaction of a C_2 to C_5 olefin with isobutane in the presence of an acidic catalyst producing a so-called alkylate.

Industrial alkylation processes have historically used large volumes of liquid Bronsted acid catalysts such as hydrofluoric or sulfuric acid under relatively low temperature conditions. Acid strength is preferably maintained at 88 to 94 weight percent by the continuous addition of fresh acid and the continuous withdrawal of spent acid. Liquid acid catalyzed isoparaffin:olefin alkylation processes share inherent drawbacks including environmental and safety concerns, acid consumption, and sludge disposal. For a general discussion of sulfuric acid alkylation, see the articles by L.F. Albright et al., "Alkylation of Isobutane with C_4 Olefins", 27 Ind. Eng. Chem. Res., 381-397, (1988). For a survey of hydrofluoric acid catalyzed alkylation, see Handbook of Petroleum Refining Processes 23-28 (R.A. Meyers, ed., 1986).

According to the invention, there is provided a process for converting at least one olefin and at least one paraffin to a diesel fuel blending component comprising the

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steps of contacting said olefin and said isoparaffin with a catalyst containing at least one material selected from the group consisting of MCM-22, MCM-36, MCM-49, MCM-56 and MCM-58 to provide a product comprising diesel fuel.

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Feedstocks

The feed olefins can come from among many sources including FCC olefins, the by-products of catalytic dewaxing operations and the olefinic gasoline boiling range fraction from a delayed coker unit. A detailed description of possible olefins sources is outlined in U.S. Patent 5,227,552. Preferably the olefinic feedstock comprises C₂-C₁₀ olefins and most preferably C₃-C₈ olefins.

The isoparaffin can come from FCC, hydrocracking, etc. process or by isolation of field production off-gases. Generally, C₄-C₈ isoparaffins and preferably C₄-C₅ isoparaffins are used in the process of the invention.

Process Conditions

The conditions which can be used in the process of the invention are generally as follows:

	Broad Range	Preferred Range
Temperature	100-500°F	200-400°F
Pressure	0-1500 psig	50-1000 psig
LHSV	0.01-10	0.1-5.0
Olefin:Paraffin Molar Ratio in Feedstock	0.1-100	0.25-50

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The reaction temperature can be varied to obtain a range of aromatics content in the diesel fuel. To produce a diesel range blending stock containing less than about 10 wt% aromatics, the reactor temperature is preferably kept below about 375 °F. To meet the 35 wt% aromatics limit set by the US Environmental Protection Agency (EPA), reactor

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temperature is preferably controlled below about 440 °F. In a preferred embodiment, the process conditions are controlled to produce a distillate product containing less than about 35 weight percent aromatics, and more preferably less than about 10 weight percent aromatics.

5 In general, higher cetane index of the diesel range product is favored by higher olefin WHSV and lower temperatures. However, products produced over a broad range of conversion conditions useful in the present process exceeded a cetane index of 35, and typically met the US EPA minimum of 40 cetane index. Under preferred conversion conditions, the distillate product cetane index was 45 or higher.

15 Conversion is inversely proportional with $\text{WHSV}_{\text{olefin on zeolite}}$ for a given temperature. Between 0.1 and 1.0 WHSV, reactor temperature must be above about 350 °F in order to achieve C₅-olefin conversions above 90%. If temperature is restricted to 375 °F to limit aromatics to 10 wt%, $\text{WHSV}_{\text{olefin on zeolite}}$ must be held below about 0.3 to maintain 90% or greater pentenes conversion.

20 The term "yield" as used herein is defined as the weight of product per weight of converted olefin. Total product yields above unity indicate that isoparaffin has been incorporated into the products. Maximum gasoline yield in isobutane/butene alkylation results from combination of one mole of each reactant to provide a yield slightly above 2.0. Ideally, a diesel range fuel is produced by reacting more than one mole of olefin per isoparaffin. For instance, a mole of isobutane must combine with two or three moles of butene to reach sufficient molecular weight to enter the boiling range of diesel fuel. Likewise, a mole of isopentane would require two moles of pentene to reach diesel range and would give a yield of about 1.5. Therefore, diesel production in the present invention a lower isoparaffin/olefin molar ratio than typically is used for producing gasoline from a similar reactor feed stream.

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Reaction products boiling at a cut point up to about 450°F may be recycled to the contacting step. Preferably, reaction products boiling at a cut point up to about 390°F may be recycled to the contacting step.

5 Catalysts

The catalysts useful in the present invention comprise one or more members of the group consisting of MCM-22, MCM-36, MCM-49, MCM-56 and MCM-58. Preferably, the catalyst is MCM-56.

10 MCM-22 is taught in U.S. Patents 4,992,615; 5,012,033; 5,073,665 and 5,107,047.

MCM-36 is taught in U.S. Patents 4,250,277; 5,258,569 and 5,292,698.

15 MCM-49 is taught in U.S. Patents 5,236,575; 5,254,792 and 5,354,718.

MCM-56 is taught in U.S. Patent 5,362,697.

MCM-58 is taught in International Publication No. WO95/11196.

20 The invention will now be more particularly described with reference to the accompanying examples.

Example 1

The catalyst used in this example was an extrudate of the hydrogen-form of MCM-56 (65%) in an alumina binder (35%). The catalyst was loaded into a stainless steel
25 tubular reactor and bracketed by vycor chips which served as heat exchangers. After placing the reactor in a tube furnace, the catalyst was dried by heating for at least two hours to at least 300 °F in a stream of flowing nitrogen. The reactor temperature was adjusted to 370 °F at 600 psig,
30 and filled with isobutane. A pre-mixed isobutane/butene-2 feed stream (molar ratio = 1) then was introduced at a flow rate of 0.57 gm butene/gm MCM-56/hr. After passing pre-mixed feed through the reactor zone for 49 hrs, product was collected over the following 28 hrs. Product distributions
35 were calculated from gas chromatographic (gc) analyses of the gaseous and liquid products, and an additional simulated distillation ASTM 2887 of the liquid products.

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The total reactor effluent weight was 58.7 g (97.7% mass balance) and showed the following distribution:

	Component	weight %
5	C ₃ -minus	0.00
	Isobutane	43.18
	n-Butane	0.00
	Isopentane	3.57
	n-Pentane	0.00
10	Cyclopentane	0.96
	C ₆ -paraffin	0.44
	Methylcyclopentane	1.44
	C ₄ -olefin	0.00
	Butadiene	0.14
15	C ₅ -olefin	0.00
	Cyclopentene	0.00
	C ₆ -olefin	3.03
	Methylcyclopentane and Benzene	0.02
	C ₇ -plus	47.21
20	Total	100.00

Conversion of total butenes was 97.1%. Calculated yields of C₅-plus components per butenes converted (wt/wt) were:

25	Fraction	Yields
	C ₅	0.08
	C ₆ -300 °F	0.51
	300 - 400 °F	0.21
	400 - 650 °F	0.30
30	above 650 °F	0.04
	Total	1.14

About 25 g of squalane was added to a portion of the liquid product (34.6 g) to serve as a high boiling "chaser" during fractional microdistillation. After distilling the sample to a 300 °F endpoint at ambient atmospheric pressure, the residua were fractionated under vacuum (about 55 torr) to

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obtain a cut (4.3 g) with the intended kerojet boiling range from 300 °F to 400 °F. The actual boiling range for this cut was estimated by simulated distillation analysis ASTM 2887. The boiling range and product properties for this sample were:

Intended cut 300-400 °F	
<u>Boiling Range (°F)</u>	
BP	218
T10	237
T50	353
T90	403
End Point	459
API gravity	54.3
Cetane Index	53
Cetane Number (¹ H nmr)	19

After cooling, the residua were again distilled under vacuum (about 1 -2 torr) to obtain a cut (9.4 g) with the intended diesel fuel boiling range from 400 °F to 650°F. The actual boiling range for this cut was estimated by simulated distillation analysis ASTM 2887. The boiling range and product properties for this sample were:

Intended cut 400-650°F	
<u>Boiling Range (°F)</u>	
IBP	330
T10	386
T50	473
T90	581
EP	655
API gravity	42.6
Cetane Index	55
Cetane Number (¹ H nmr)	19
wt% Aromatics	8.4

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Example 2

The process of Example 1 was repeated with the reactor temperature being adjusted to 302 °F at 600 psig and the pre-mixed isobutane/butene-2 feed stream (molar ratio = 1) being introduced at a flow rate of 1.02 gm butene/gm MCM-56/hr. After passing pre-mixed feed through the reactor zone for 44.5 hrs, product was collected over the following 24 hrs. Product distributions were determined as in Example 1, with the total reactor effluent weighing 92.4 g (99.3% mass balance) and having the following distribution:

Component	weight %
C ₃ -minus	0.00
Isobutane	46.96
n-Butane	0.98
Isopentane	0.34
n-Pentane	0.09
Cyclopentane	0.00
C ₆ -paraffin	0.06
Methylcyclopentane	0.02
C ₄ -olefin	16.64
Butadiene	0.01
C ₅ -olefin	0.03
Cyclopentene	0.00
C ₆ -olefin	0.24
Methylcyclopentane and Benzene	0.01
C ₇ -plus	34.65
Total	100.00

Conversion of total butenes was 66.7%. Calculated yields of C5-plus components per butenes converted (wt/wt) were:

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Fraction	Yields
C ₅	0.01
C ₆ -300 °F	0.74
300 - 400 °F	0.22
400 - 650 °F	0.09
above 650 °F	0.00
Total	1.06

Following the distillation procedures of Example 1, the boiling range and product properties of the intended kerojet boiling range cut were:

Intended cut 300-400°F

Boiling Range (°F)	
BP	219
T10	243
T50	320
T90	391
EP	433
API gravity	54.2
Cetane Index	42
Cetane Number (H ¹ nmr)	11

and the boiling range and product properties for the intended diesel fuel boiling range cut were:

Intended cut 400-650°F

Boiling Range (°F)	
IBP	344
T10	381
T50	456
T90	507
EP	575
API gravity	44.9
Cetane Index	57
Cetane Number (¹ H nmr)	15
wt% Aromatics	1.5

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Example 3

The process of Example 1 was repeated with the reactor temperature being adjusted to 450 °F at 600 psig and the pre-mixed isobutane/butene-2 feed stream (molar ratio = 1) being introduced at a flow rate of 1 gm butene/gm MCM-56/hr. After passing pre-mixed feed through the reactor zone for 41.5 hrs, product was collected over the following 23.3 hrs. Product distributions were calculated from gc analyses of the gaseous and liquid products, and an additional simulated distillation ASTM 2887 of the liquid products. The total reactor effluent weight was 88.1 g (99.4% mass balance) and showed the following distribution:

Component	weight %
C ₃ -minus	0.17
Isobutane	42.48
n-Butane	1.24
Isopentane	7.30
n-Pentane	0.00
Cyclopentane	0.01
C ₆ -paraffin	2.42
Methylcyclopentane	0.55
C ₄ -olefin	0.91
Butadiene	0.00
C ₅ -olefin	0.33
Cyclopentene	0.00
C ₆ -olefin	4.21
Methylcyclopentane and Benzene	0.02
C ₇ -plus	40.35
Total	100.00

Conversion of total butenes was 98.2%. Calculated yields of C₅-plus components per butenes converted (wt/wt) were:

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Fraction	Yields
C ₅	0.16
C ₆ -300 °F	0.58
300 - 400 °F	0.15
400 - 650 °F	0.24
above 650 °F	0.01
Total	1.13

Following the distillation procedures of Example 1,
the boiling range and product properties of the intended
kerojet boiling range cut were:

Intended cut 300-400°F

Boiling Range (°F)	
BP	194
T10	242
T50	343
T90	406
EP	451
API gravity	55.8
Cetane Index	53
Cetane Number (¹ H nmr)	19

and the boiling range and product properties for the
intended diesel fuel boiling range cut were:

Intended cut 400-650°F

Boiling Range (°F)	
IBP	334
T10	398
T50	493
T90	610
EP	684
API gravity	39.5
Cetane Index	52
Cetane Number (¹ H nmr)	25
wt% Aromatics	26.6

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Example 4

The procedure of Example 1 was repeated with the reactor temperature being adjusted to 300 °F at 600 psig and the pre-mixed isobutane/butene-2 feed stream (molar ratio = 1) being introduced at a flow rate of 0.11 gm butene/gm MCM-56/hr. After passing pre-mixed feed through the reactor zone for 313.3 hrs, product was collected over the following 191.5 hrs. Product distributions were calculated from gc analyses of the gaseous and liquid products, and an additional simulated distillation ASTM 2887 of the liquid products. The total reactor effluent weight was 75.6 g (96.2% mass balance) and showed the following distribution:

Component	weight %
C ₃ -minus	0.02
Isobutane	43.72
n-Butane	0.81
Isopentane	0.57
n-Pentane	0.00
Cyclopentane	0.33
C ₆ -paraffin	0.28
Methylcyclopentane	0.00
C ₄ -olefin	1.47
Butadiene	0.01
C ₅ -olefin	0.13
Cyclopentene	0.00
C ₆ -olefin	0.57
Methylcyclopentane and Benzene	0.06
C ₇ -plus	52.04
Total	100.00

Conversion of total butenes was 98.2%. Calculated yields of C₅-plus components per butenes converted (wt/wt) were:

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Fraction	Yields
C ₅	0.02
C ₆ -300 °F	0.58
300 - 400 °F	0.30
400 - 650 °F	0.22
above 650 °F	0.00
Total	1.12

Following the distillation procedures of Example 1,
the boiling range and product properties of the intended
kerojet boiling range cut were:

Intended cut 300-400°F

Boiling Range (°F)	
BP	228
T10	263
T50	380
T90	414
EP	491
API gravity	52.3
Cetane Index	56
Cetane Number (¹ H nmr)	13

and the boiling range and product properties for the
intended diesel fuel boiling range cut were:

Intended cut 400-650°F

Boiling Range (°F)	
IBP	356
T10	398
T50	475
T90	550
EP	628
API gravity	44.2
Cetane Index	58
Cetane Number (¹ H nmr)	18
wt% Aromatics	2.1

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Example 5

The procedure of Example 1 was repeated with the reactor temperature being adjusted to 450 °F at 600 psig and the pre-mixed isobutane/butene-2 feed stream (molar ratio = 1) being introduced at a flow rate of 1 gm butene/gm MCM-56/hr. After passing pre-mixed feed through the reactor zone for 319.5 hrs, product was collected over the following 159 hrs. Product distributions were calculated from gc analyses of the gaseous and liquid products, and an additional simulated distillation ASTM 2887 of the liquid products. The total reactor effluent weight was 62.8 g (96.2% mass balance) and showed the following distribution:

Component	weight %
C ₃ -minus	0.10
Isobutane	27.08
n-Butane	1.63
Isopentane	10.19
n-Pentane	0.04
Cyclopentane	0.00
C ₆ -paraffin	5.65
Methylcyclopentane	0.80
C ₇ -olefin	0.21
Butadiene	0.00
C ₅ -olefin	0.07
Cyclopentene	0.00
C ₆ -olefin	0.53
Methylcyclopentane and Benzene	0.03
C ₇ -plus	53.67
Total	100.00

Conversion of total butenes was 99.6%. Calculated yields of C₅-plus components per butenes converted (wt/wt) were:

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Fraction	Yields
C ₅	0.21
C ₆ -300 °F	0.68
300 - 400 °F	0.19
400 - 650 °F	0.27
above 650 °F	0.08
Total	1.43

Following the distillation procedures of Example 1, the boiling range and product properties of the intended kerojet boiling range cut were:

Intended cut 300-400°F

Boiling Range (°F)	
BP	137
T10	228
T50	282
T90	385
EP	436
API gravity	60.6
Cetane Index	43
Cetane Number (¹ H nmr)	28

and the boiling range and product properties for the intended diesel fuel boiling range cut were:

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Intended cut 400-650°F

Boiling Range (°F)	
IBP	310
T10	386
T50	479
T90	591
EP	655
API gravity	35.8
Cetane Index	44
Cetane Number (¹ H nmr)	27
wt% Aromatics	44.3

Example 6

Example was repeated with the reactor temperature being adjusted to 369 °F at 600 psig and the pre-mixed isobutane/butene-2 feed stream (molar ratio = 1) being introduced at a flow rate of 0.5 gm butene/gm MCM-56/hr. After passing pre-mixed feed through the reactor zone for 74 hrs, product was collected over the following 28.5 hrs. Product distributions were calculated from gc analyses of the gaseous and liquid products, and an additional simulated distillation ASTM 2887 of the liquid products. The total reactor effluent weight was 61.0 g (101.4% mass balance) and showed the following distribution:

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Component	weight %
C ₃ -minus	0.12
Isobutane	29.21
5 n-Butane	1.48
Isopentane	7.89
n-Pentane	0.03
Cyclopentane	0.00
C ₆ -paraffin	4.36
10 Methylcyclopentane	0.61
C ₄ -olefin	0.18
Butadiene	0.00
C ₅ -olefin	0.06
Cyclopentene	0.00
15 C ₆ -olefin	0.41
Methylcyclopentane and Benzene	0.02
C ₇ -plus	55.63
Total	100.00

20 Conversion of total butenes was 99.6%. Calculated yields of C₅-plus components per butenes converted (wt/wt) were:

Fraction	Yields
C5	0.16
25 C ₆ -300 °F	0.66
300 - 400 °F	0.28
400 - 650 °F	0.27
above 650 °F	0.01
Total	1.39

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Following the distillation procedures of Example 1, the boiling range and product properties of the intended kerojet boiling range cut were:

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Intended cut 300-400°F

Boiling Range (°F)	
BP	219
T10	271
T50	372
T90	407
EP	441
API gravity	52.9
Cetane Index	55
Cetane Number (¹ H nmr)	14

and the boiling range and product properties for the intended diesel fuel boiling range cut were:

Intended cut 400-650°F

Boiling Range (°F)	
IBP	344
T10	394
T50	468
T90	555
EP	634
API gravity	43.8
Cetane Index	57
Cetane Number (¹ H nmr)	13
wt% Aromatics	4.2

Example 7

Example 1 was repeated but with the reactor being adjusted to a temperature of 377 °F at 600 psig, and filled with isopentane. A pre-mixed isopentane/pentene-1 feed stream (molar ratio = 4.9) was then introduced into the reactor at a flow rate of 0.56 gm pentenes/gm MCM-56/hr. After passing pre-mixed feed through the reactor zone for 5.8 hrs, product was collected over the following 14.0 hrs. Product distributions were calculated from gc analyses of the gaseous and liquid products, and a simulated distillation ASTM 2887 of the residua after rotory

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evaporation (85 °C, ambient atmospheric pressure) of the total liquid products. The total reactor effluent weight was 343.5 g (99.5% mass balance) and showed the following distribution:

5	Component	weight %
	C ₃ -minus	0.03
	Isobutane	2.98
	n-Butane	0.04
	Isopentane	74.07
10	n-Pentane	0.94
	Cyclopentane	0.00
	C ₆ -paraffin	2.88
	Methylcyclopentane	0.02
	C ₄ -olefin	0.03
15	Butadiene	0.01
	C ₅ -olefin	0.59
	Cyclopentene	0.00
	C ₆ -olefin	0.40
	Methylcyclopentane and Benzene	0.00
20	<u>C₇-plus</u>	18.00
	Total	100.00

Conversion of total C₅-olefins was 96.4%. Calculated yields of isobutane and C₆-plus components per C₅-olefins converted (wt/wt) were:

	Fraction	Yields
	iC ₄	0.19
	C ₆ -300 °F	0.42
30	300 - 400 °F	0.45
	400 - 650 °F	0.37
	<u>above 650 °F</u>	0.08
	Total	1.51

Following the distillation procedures of Example 1, the boiling range and product properties of the intended kerojet boiling range cut were:

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Intended cut 300-400°F

Boiling Range (°F)	
BP	222
T10	286
T50	325
T90	363
EP	427
API gravity	57.7
Cetane Index	52
Cetane Number (¹ H nmr)	25

and the boiling range and product properties for the intended diesel fuel boiling range cut were:

Intended cut 400-650°F

Boiling Range (°F)	
IBP	340
T10	410
T50	482
T90	571
EP	625
API gravity	42.
Cetane Index	8
Cetane Number (¹ H nmr)	57
wt% Aromatics	29
	7.1

Example 8

Example 7 was repeated with the reactor temperature being adjusted to 304 °F at 600 psig and a pre-mixed isopentane/pentene-1 feed stream (molar ratio = 9.8) being introduced at a flow rate of 1.01 gm pentenes/gm MCM-56/hr. After passing pre-mixed feed through the reactor zone for 6.2 hrs, product was collected over the following 4.0 hrs. Product distributions were calculated from gc analyses of the gaseous and liquid products, and a simulated distillation ASTM 2887 of the residua after rotory evaporation (85 °C, ambient atmospheric pressure) of the total liquid products. The total reactor effluent weight

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was 330.7 g (100.6% mass balance) and showed the following distribution:

	Component	weight %
5	C ₃ -minus	0.00
	Isobutane	0.17
	n-Butane	0.01
	Isopentane	88.97
	n-Pentane	0.36
10	Cyclopentane	0.00
	C ₆ -paraffin	0.13
	Methylcyclopentane	0.01
	C ₄ -olefin	0.01
	Butadiene	0.02
15	C ₅ -olefin	7.11
	Cyclopentene	0.00
	C ₆ -olefin	0.02
	Methylcyclopentane and Benzene	0.00
	<u>C₇-plus</u>	3.20
20	Total	100.00

Conversion of total C₅-olefins was 21.5%. Calculated yields of isobutane and C₆-plus components per C₅-olefins converted (wt/wt) were:

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Fraction	Yields
iC4	0.09
C ₆ -300 °F	0.18
300 - 400 °F	1.09
400 - 650 °F	0.47
<u>above 650 °F</u>	0.00
Total	1.83

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Following the distillation procedures of Example 1, the boiling range and product properties of the intended kerojet boiling range cut were:

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Intended cut 300-400°F

Boiling Range (°F)	
BP	193
T10	306
T50	328
T90	341
EP	446
API gravity	55.
Cetane Index	0
Cetane Number (¹ H nmr)	46
	14

and the boiling range and product properties for the intended diesel fuel boiling range cut were:

Intended cut 400-650°F

Boiling Range (°F)	
IBP	302
T10	326
T50	467
T90	519
EP	785
API gravity	44.6
Cetane Index	58
Cetane Number (¹ H nmr)	23
wt% Aromatics	<5

Example 9

Example 7 was repeated with the reactor temperature being adjusted to 449 °F at 600 psig and a pre-mixed isopentane/pentene-1 feed stream (molar ratio = 9.9) being introduced at a flow rate of 0.99 gm pentenes/gm MCM-56/hr. After passing pre-mixed feed through the reactor zone for 19.8 hrs, product was collected over the following 3.5 hrs. Product distributions were calculated from gc analyses of the gaseous and liquid products, and a simulated distillation ASTM 2887 of the residua after rotory evaporation (85 °C, ambient atmospheric pressure) of the total liquid products. The total reactor effluent weight

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was 282.7 g (99.0% mass balance) and showed the following distribution:

Component	weight %
C ₃ -minus	0.03
Isobutane	2.03
n-Butane	0.04
Isopentane	87.25
n-Pentane	0.35
Cyclopentane	0.03
C ₆ -paraffin	2.35
Methylcyclopentane	0.16
C ₄ -olefin	0.10
Butadiene	0.02
C ₅ -olefin	1.18
Cyclopentene	0.00
C ₆ -olefin	0.60
Methylcyclopentane and Benzene	0.05
C ₇ -plus	5.81
Total	100.00

Conversion of total C₅-olefins was 86.9%. Calculated yields of isobutane and C₆-plus components per C₅-olefins converted (wt/wt) were:

Fraction	Yields
iC4	0.26
C ₆ -300 °F	0.57
300 - 400 °F	0.29
400 - 650 °F	0.25
above 650 °F	0.03
Total	1.40

Following the distillation procedures of Example 1, the boiling range and product properties of the intended kerojet boiling range cut were:

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Intended cut 300-400°F

Boiling Range (°F)	
BP	173
T10	267
T50	324
T90	375
EP	444
API gravity	55.0
Cetane Index	45
Cetane Number (¹ H nmr)	17

and the boiling range and product properties for the intended diesel fuel boiling range cut were:

Intended cut 400-650°F

Boiling Range (°F)	
IBP	315
T10	371
T50	471
T90	564
EP	634
API gravity	38.2
Cetane Index	47
Cetane Number (¹ H nmr)	25
wt% Aromatics	46.7

Example 10

Example 7 was repeated with the reactor temperature being adjusted to 444 °F at 600 psig and a pre-mixed isopentane/pentene-1 feed stream (molar ratio = 1.0) being introduced at a flow rate of 0.10 gm pentenes/gm MCM-56/hr. After passing pre-mixed feed through the reactor zone for 87.3 hrs, product was collected over the following 48.2 hrs. Product distributions were calculated from gc analyses of the gaseous and liquid products, and a simulated distillation ASTM 2887 of the residua after rotory evaporation (85 °C, ambient atmospheric pressure) of the total liquid products. The total reactor effluent

-24-

weight was 72.1 g (100.1% mass balance) and showed the following distribution:

	Component	weight %
5	C ₃ -minus	0.19
	Isobutane	10.18
	n-Butane	0.25
	Isopentane	38.87
	n-Pentane	1.29
10	Cyclopentane	0.14
	C ₆ -paraffin	12.99
	Methylcyclopentane	0.24
	C ₄ -olefin	0.05
	Butadiene	0.01
15	C ₅ -olefin	0.41
	Cyclopentene	0.00
	C ₆ -olefin	1.10
	Methylcyclopentane and Benzene	0.08
	<u>C₇-plus</u>	34.21
20	Total	100.00

Conversion of total C₅-olefins was 99.2%. Calculated yields of isobutane and C₆-plus components per C₅-olefins converted (wt/wt) were:

25

Fraction	Yields
iC4	0.21
C ₆ -300 °F	0.42
300 - 400 °F	0.46
400 - 650 °F	0.09
<u>above 650 °F</u>	0.01
Total	1.19

30

Following the distillation procedures of Example 1, the boiling range and product properties of the intended kerojet boiling range cut were:

35

-25-

Intended cut 300-400°F

Boiling Range (°F)	
BP	133
T10	235
T50	322
T90	381
EP	439
API gravity	56.9
Cetane Index	49
Cetane Number (¹ H nmr)	31

and the boiling range and product properties for the intended diesel fuel boiling range cut were:

Intended cut 400-650°F

Boiling Range (°F)	
IBP	311
T10	385
T50	488
T90	592
EP	659
API gravity	33.3
Cetane Index	41
Cetane Number (¹ H nmr)	28
wt% Aromatics	45.9

Example 11

Example 7 was repeated with the reactor temperature being adjusted to 374 °F at 600 psig and a pre-mixed isopentane/pentene-1 feed stream (molar ratio = 4.9) being introduced at a flow rate of 0.56 gm pentenes/gm MCM-56/hr. After passing pre-mixed feed through the reactor zone for 8.0 hrs, product was collected over the following 14.5 hrs. Product distributions were calculated from gc analyses of the gaseous and liquid products, and a simulated distillation ASTM 2887 of the residua after rotory evaporation (85 °C, ambient atmospheric pressure) of the total liquid products. The total reactor effluent weight

-26-

was 358.7 g (100.4% mass balance) and showed the following distribution:

	Component	weight %
5	C ₃ -minus	0.02
	Isobutane	0.70
	n-Butane	0.08
	Isopentane	81.84
	n-Pentane	0.54
10	Cyclopentane	0.06
	C ₆ -paraffin	2.43
	Methylcyclopentane	0.36
	C ₄ -olefin	0.12
	Butadiene	0.02
15	C ₅ -olefin	5.72
	Cyclopentene	0.00
	C ₆ -olefin	1.04
	Methylcyclopentane and Benzene	0.11
	C ₇ -plus	6.97
20	Total	100.00

Conversion of total C₅-olefins was 65.6%. Calculated yields of isobutane and C₆-plus components per C₅-olefins converted (wt/wt) were:

25

Fraction	Yields
iC4	0.06
C ₆ -300 °F	0.53
300 - 400 °F	0.16
400 - 650 °F	0.21
above 650 °F	0.11
Total	1.07

30

Following the distillation procedures of Example 1, the boiling range and product properties of the intended kerojet boiling range cut were:

35

-27-

Intended cut 400-650°F

Boiling Range (°F)	
IBP	311
T10	385
T50	488
T90	592
EP	659
API gravity	33.3
Cetane Index	41
Cetane Number (¹ H nmr)	28
wt% Aromatics	45.9

and the boiling range and product properties for the intended diesel fuel boiling range cut were:

Intended cut 400-650°F

Boiling Range (°F)	
IBP	314
T10	367
T50	466
T90	539
EP	633
API gravity	39.2
Cetane Index	48
Cetane Number (¹ H nmr)	18
wt% Aromatics	9.1

Example 12

Example 7 was repeated with the reactor temperature being adjusted to 297 °F at 600 psig and a pre-mixed isopentane/pentene-1 feed stream (molar ratio = 1.0) being introduced at a flow rate of 0.10 gm pentenes/gm MCM-56/hr. After passing pre-mixed feed through the reactor zone for 77.5 hrs, product was collected over the following 49.0 hrs. Product distributions were calculated from gc analyses of the gaseous and liquid products, and a simulated distillation ASTM 2887 of the residua after rotory evaporation (85 °C, ambient atmospheric pressure) of

-28-

the total liquid products. The total reactor effluent weight was 80.5 g (98.7% mass balance) and showed the following distribution:

5	Component	weight %
	C ₃ -minus	0.00
	Isobutane	0.99
	n-Butane	0.29
	Isopentane	49.40
10	n-Pentane	1.62
	Cyclopentane	0.28
	C ₆ -paraffin	11.51
	Methylcyclopentane	1.27
	C ₄ -olefin	0.01
15	Butadiene	0.01
	C ₅ -olefin	0.62
	Cyclopentene	0.00
	C ₆ -olefin	0.80
	Methylcyclopentane and Benzene	0.20
20	<u>C₇-plus</u>	33.00
	Total	100.00

Conversion of total C₅-olefins was 98.7%. Calculated yields of isobutane and C₆-plus components per C₅-olefins converted (wt/wt) were:

25	Fraction	Yields
	iC4	0.02
	C ₆ -300 °F	0.38
	300 - 400 °F	0.23
30	400 - 650 °F	0.27
	<u>above 650 °F</u>	0.07
	Total	0.98

Following the distillation procedures of Example 1, the boiling range and product properties of the intended kerojet boiling range cut were:

-29-

Intended cut 300-400°F

Boiling Range (°F)	
BP	
T10	132
T50	246
T90	326
EP	378
	453
API gravity	55.7
Cetane Index	48
Cetane Number (¹ H nmr)	17

and the boiling range and product properties for the intended diesel fuel boiling range cut were:

Intended cut 400-650°F

Boiling Range (°F)	
IBP	308
T10	370
T50	487
T90	589
EP	656
API gravity	41.0
Cetane Index	54
Cetane Number (¹ H nmr)	21
wt% Aromatics	7.8

Example 13

Example 7 was repeated with the reactor temperature being adjusted to 296 °F at 600 psig and a pre-mixed isopentane/pentene-1 feed stream (molar ratio = 9.8) being introduced at a flow rate of 0.10 gm pentenes/gm MCM-56/hr. After passing pre-mixed feed through the reactor zone for 43.0 hrs, product was collected over the following 55.0 hrs. Product distributions were calculated from gc analyses of the gaseous and liquid products, and a simulated distillation ASTM 2887 of the residua after rotary evaporation (85 °C, ambient atmospheric pressure) of the total liquid products. The total reactor effluent

-30-

weight was 503.7 g (100.3% mass balance) and showed the following distribution:

5	Component	weight %
	C ₃ -minus	0.03
	Isobutane	0.17
	n-Butane	0.01
	Isopentane	88.55
	n-Pentane	0.41
10	Cyclopentane	0.00
	C ₆ -paraffin	0.10
	Methylcyclopentane	0.02
	C ₄ -olefin	0.04
	Butadiene	0.00
15	C ₅ -olefin	6.01
	Cyclopentene	0.00
	C ₆ -olefin	0.23
	Methylcyclopentane and Benzene	0.00
	C ₇ -plus	4.42
20	Total	100.00

Conversion of total C₅-olefins was 33.2%. Calculated yields of isobutane and C₆-plus components per C₅-olefins converted (wt/wt) were:

25	Fraction	Yields
	iC4	0.06
	C ₆ -300 °F	0.24
	300 - 400 °F	1.06
	400 - 650 °F	0.30
30	above 650 °F	0.00
	Total	1.66

Following the distillation procedures of Example 1, the boiling range and product properties of the intended kerojet boiling range cut were:

-31-

Intended cut 300-400°F

Boiling Range (°F)	
BP	208
T10	302
T50	327
T90	343
EP	454
API gravity	55.8
Cetane Index	48
Cetane Number (¹ H nmr)	16

and the boiling range and product properties for the intended diesel fuel boiling range cut were:

Intended cut 400-650°F

Boiling Range (°F)	
IBP	300
T10	324
T50	461
T90	507
EP	597
API gravity	46.3
Cetane Index	60
Cetane Number (¹ H nmr)	20
wt% Aromatics	<5

Example 14

Example 7 was repeated with the reactor temperature being adjusted to 377 °F at 600 psig and a pre-mixed isopentane/pentene-1 feed stream (molar ratio = 5.0) being introduced at a flow rate of 0.54 gm pentenes/gm MCM-56/hr. After passing pre-mixed feed through the reactor zone for 18.0 hrs, product was collected over the following 6.0 hrs. Product distributions were calculated from gc analyses of the gaseous and liquid products, and a simulated distillation ASTM 2887 of the residua after rotory evaporation (85 °C, ambient atmospheric pressure) of the total liquid products. The total reactor effluent weight was 165.4 g (101.0% mass balance) and showed the following

-32-

distribution:

	Component	weight %
	C ₃ -minus	0.34
5	Isobutane	2.18
	n-Butane	0.81
	Isopentane	74.98
	n-Pentane	0.63
	Cyclopentane	0.00
10	C ₆ -paraffin	2.03
	Methylcyclopentane	0.00
	C ₄ -olefin	0.02
	Butadiene	0.01
	C ₅ -olefin	0.90
15	Cyclopentene	0.00
	C ₆ -olefin	0.39
	Methylcyclopentane and Benzene	0.00
	C ₇ -plus	17.70
20	Total	100.00

Conversion of total C₅-olefins was 94.5%. Calculated yields of isobutane and C₆-plus components per C₅-olefins converted (wt/wt) were:

25

30

Fraction	Yields
iC ₄	0.14
C ₆ -300 °F	0.38
300 - 400 °F	0.50
400 - 650 °F	0.37
above 650 °F	0.04
Total	1.44

35

Following the distillation procedures of Example 1, the boiling range and product properties of the intended kerojet boiling range cut were:

-33-

Intended cut 300-400°F

Boiling Range (°F)	
BP	164
T10	269
T50	316
T90	351
EP	428
API gravity	57.7
Cetane Index	49
Cetane Number (¹ H nmr)	26

and the boiling range and product properties for the intended diesel fuel boiling range cut were:

Intended cut 400-650°F

Boiling Range (°F)	
IBP	302
T10	372
T50	471
T90	575
EP	636
API gravity	43.3
Cetane Index	56
Cetane Number (¹ H nmr)	27
wt% Aromatics	7.1

Example 15

Example 7 was repeated with the reactor temperature being adjusted to 302 °F at 600 psig and a pre-mixed isopentane/pentene-1 feed stream (molar ratio = 1.0) being introduced at a flow rate of 1.00 gm pentenes/gm MCM-56/hr. After passing pre-mixed feed through the reactor zone for 18.0 hrs, product was collected over the following 6.0 hrs. Product distributions were calculated from gc analyses of the gaseous and liquid products, and a simulated distillation ASTM 2887 of the residua after rotory evaporation (85 °C, ambient atmospheric pressure) of the total liquid products. The total reactor effluent weight

-34-

was 102.2 g (103.1% mass balance) and showed the following distribution:

	Component	weight %
5	C ₃ -minus	0.09
	Isobutane	0.99
	n-Butane	0.00
	Isopentane	50.81
	n-Pentane	0.73
10	Cyclopentane	0.00
	C ₆ -paraffin	0.00
	Methylcyclopentane	0.00
	C ₄ -olefin	0.00
	Butadiene	0.00
15	C ₅ -olefin	38.20
	Cyclopentene	0.00
	C ₆ -olefin	0.00
	Methylcyclopentane and Benzene	0.00
	C ₇ -plus	9.19
20	Total	100.00

Conversion of total C₅-olefins was 23.9%. Calculated yields of isobutane and C₆-plus components per C₅-olefins converted (wt/wt) were:

25

Fraction	Yields
iC ₄	0.08
C ₆ -300 °F	0.02
300 - 400 °F	0.63
400 - 650 °F	0.12
above 650 °F	0.00
Total	0.85

30

Following the distillation procedures of Example 1, the boiling range and product properties of the intended kerojet boiling range cut were:

35

-35-

Intended cut 300-400°F

Boiling Range (°F)	
BP	213
T10	318
T50	332
T90	346
EP	418
API gravity	54.6
Cetane Index	47
Cetane Number (¹ H nmr)	16

and the boiling range and product properties for the intended diesel fuel boiling range cut were:

Intended cut 400-650°F

Boiling Range (°F)	
IBP	309
T10	325
T50	474
T90	498
EP	589
API gravity	45.3
Cetane Index	61
Cetane Number (¹ H nmr)	22
wt% Aromatics	5.1

Example 16

Example 7 was repeated with the reactor temperature being adjusted to 458 °F at 600 psig and a pre-mixed isopentane/pentene-1 feed stream (molar ratio = 1.0) being introduced at a flow rate of 1.01 gm pentenes/gm MCM-56/hr. After passing pre-mixed feed through the reactor zone for 17.5 hrs, product was collected over the following 7.0 hrs. Product distributions were calculated from gc analyses of the gaseous and liquid products, and a simulated distillation ASTM 2887 of the residua after rotory evaporation (85 °C, ambient atmospheric pressure) of the total liquid products. The total reactor effluent weight was 115.7 g (99.9% mass balance) and showed the following

-36-

distribution:

	Component	weight %
	C ₃ -minus	0.09
5	Isobutane	6.31
	n-Butane	0.05
	Isopentane	39.79
	n-Pentane	1.17
	Cyclopentane	0.00
10	C ₆ -paraffin	6.93
	Methylcyclopentane	0.42
	C ₄ -olefin	0.06
	Butadiene	0.00
	C ₅ -olefin	0.72
15	Cyclopentene	0.00
	C ₆ -olefin	0.62
	Methylcyclopentane and Benzene	0.02
	<u>C₇-plus</u>	43.81
20	Total	100.00

Conversion of total C₅-olefins was 98.6%. Calculated yields of isobutane and C₆-plus components per C₅-olefins converted (wt/wt) were:

25

30

35

Fraction	Yields
iC ₄	0.13
C ₆ -300 °F	0.36
300 - 400 °F	0.27
400 - 650 °F	0.30
<u>above 650 °F</u>	0.12
Total	1.17

Following the distillation procedures of Example 1, the boiling range and product properties of the intended kerojet boiling range cut were:

-37-

Intended cut 300-400°F

Boiling Range (°F)	
BP	185
T10	276
T50	330
T90	382
EP	445
API gravity	56.7
Cetane Index	51
Cetane Number (¹ H nmr)	32

and the boiling range and product properties for the intended diesel fuel boiling range cut were:

Intended cut 400-650°F

Boiling Range (°F)	
IBP	315
T10	395
T50	495
T90	596
EP	652
API gravity	38.3
Cetane Index	51
Cetane Number (¹ H nmr)	31
wt% Aromatics	28.8

Example 17

Example 7 was repeated with reactor temperature being adjusted to 450 °F at 600 psig and a pre-mixed isopentane/pentene-1 feed stream (molar ratio = 9.8) being introduced at a flow rate of 0.10 gm pentenes/gm MCM-56/hr. After passing pre-mixed feed through the reactor zone for 21.0 hrs, product was collected over the following 41.5 hrs. Product distributions were calculated from gc analyses of the gaseous and liquid products, and a simulated distillation ASTM 2887 of the residua after rotory evaporation (85 °C, ambient atmospheric pressure) of the total liquid products. The total reactor effluent weight was 384.0 g (99.3% mass balance) and showed the

-38-

following distribution:

Component	weight %
C ₃ -minus	0.01
Isobutane	4.91
n-Butane	0.00
Isopentane	82.16
n-Pentane	0.43
Cyclopentane	0.00
C ₆ -paraffin	1.96
Methylcyclopentane	0.00
C ₄ -olefin	0.01
Butadiene	0.00
C ₅ -olefin	0.27
Cyclopentene	0.00
C ₆ -olefin	1.78
Methylcyclopentane and Benzene	0.00
C ₇ -plus	8.46
Total	100.00

Conversion of total C₅-olefins was 97.0%. Calculated yields of isobutane and C₆-plus components per C₅-olefins converted (wt/wt) were:

Fraction	Yields
iC4	0.56
C ₆ -300 °F	0.70
300 - 400 °F	0.36
400 - 650 °F	0.28
above 650 °F	0.05
Total	1.96

Following the distillation procedures of Example 1, the boiling range and product properties of the intended kerojet boiling range cut were:

-39-

Intended cut 300-400°F

Boiling Range (°F)	
BP	166
T10	269
T50	327
T90	379
EP	454
API gravity	57.2
Cetane Index	51
Cetane Number (¹ H nmr)	33

and the boiling range and product properties for the intended diesel fuel boiling range cut were:

Intended cut 400-650°F

Boiling Range (°F)	
IBP	302
T10	360
T50	472
T90	577
EP	646
API gravity	38.0
Cetane Index	47
Cetane Number (¹ H nmr)	32
wt% Aromatics	37.5

Example 18

Example 7 was repeated with the reactor temperature being adjusted to 374 °F at 600 psig and pre-mixed isopentane/pentene-1 feed stream (molar ratio = 4.8) being introduced at a flow rate of 0.56 gm pentenes/gm MCM-56/hr. After passing pre-mixed feed through the reactor zone for 50.5 hrs, product was collected over the following 6.5 hrs. Product distributions were calculated from gc analyses of the gaseous and liquid products, and a simulated distillation ASTM 2887 of the residua after rotory evaporation (85 °C, ambient atmospheric pressure) of the total liquid products. The total reactor effluent weight was 181.3 g (101.0% mass balance) and showed the following

-40-

distribution:

Component	weight %
C ₃ -minus	0.01
Isobutane	0.82
n-Butane	0.00
Isopentane	80.76
n-Pentane	0.51
Cyclopentane	0.03
C ₆ -paraffin	0.06
Methylcyclopentane	0.00
C ₄ -olefin	0.05
Butadiene	0.00
C ₅ -olefin	9.62
Cyclopentene	0.00
C ₆ -olefin	0.37
Methylcyclopentane and Benzene	0.00
C ₇ -plus	7.77
Total	100.00

Conversion of total C₅-olefins was 42.6%. Calculated yields of isobutane and C₆-plus components per C₅-olefins converted (wt/wt) were:

25

30

Fraction	Yields
iC ₄	0.12
C ₆ -300 °F	0.19
300 - 400 °F	0.83
400 - 650 °F	0.12
above 650 °F	0.00
Total	1.26

Following the distillation procedures of Example 1, the boiling range and product properties of the intended kerojet boiling range cut were:

-41-

Intended cut 300-400°F

Boiling Range (°F)	
BP	158
T10	298
T50	330
T90	351
EP	468
API gravity	54.9
Cetane Index	47
Cetane Number (¹ H nmr)	13

and the boiling range and product properties for the intended diesel fuel boiling range cut were:

Intended cut 400-650°F

Boiling Range (°F)	
IBP	293
T10	323
T50	455
T90	496
EP	587
API gravity	46.2
Cetane Index	59
Cetane Number (¹ H nmr)	21
wt% Aromatics	16.1

Example 19

The catalyst used in this example was an extrudate of the proton-form of MCM-58 (65%) in an alumina binder (35%). The catalyst (15.65 g) was loaded into a stainless steel tubular reactor and bracketed by vycor chips which served as heat exchangers. After placing the reactor in a tube furnace, the catalyst was dried by heating for at least two hours to at least 300 °F in a stream of flowing nitrogen. The reactor temperature was adjusted to 297 °F at 600 psig, and filled with isopentane. A pre-mixed isopentane/pentene-1 feed stream (molar ratio = 9.7) then was introduced at a flow rate of 0.1 gm pentenes/gm MCM-58/hr. After passing pre-mixed feed through the reactor

-42-

zone for 22.5 hrs, product was collected over the following 28 hrs. Product distributions were calculated from gc analyses of the gaseous and liquid products, and an additional simulated distillation ASTM 2887 of the liquid products. The total reactor effluent weight was 307.2 g (99.6% mass balance) and showed the following distribution:

Component	weight %
C ₃ -minus	0.01
Isobutane	0.11
n-Butane	0.02
Isopentane	89.66
n-Pentane	0.44
Cyclopentane	0.07
C ₆ -paraffin	0.20
Methylcyclopentane	0.01
C ₄ -olefin	0.02
Butadiene	0.00
C ₅ -olefin	3.31
Cyclopentene	0.00
C ₆ -olefin	0.56
Methylcyclopentane and Benzene	0.00
C ₇ -plus	5.59
Total	100.00

Conversion of total pentenes was 55.7%. Calculated yields of isobutane and C₆-plus components per pentenes converted (wt/wt) were:

Fraction	Yields
iC ₄	0.13
C ₆ -300 °F	0.17
300 - 400 °F	0.44
400 - 650 °F	0.42
above 650 °F	0.03
Total	1.19

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About 25 g of squalane was added to a portion of the liquid product (39 g) to serve as a high boiling "chaser" during fractional microdistillation. After distilling the sample to a 300 °F endpoint at ambient atmospheric pressure, the
5 residua were fractionated under vacuum (about 55 torr) to obtain a cut (12.3 g) with the intended kerojet boiling range from 300 °F to 400 °F. The actual boiling range for this cut was estimated by simulated distillation analysis ASTM 2887. The boiling range and product properties for
10 this sample were:

Intended cut 300-400 °F	
Boiling Range (°F)	
IBP	202
15 T10	299
T50	328
T90	358
EP	460
API gravity	55.6
20 Cetane Index	48
Cetane Number (H ¹ nmr)	20

After cooling, the residua were again distilled under vacuum (about 1 -2 torr) to obtain a cut (13.9 g) with the
25 intended diesel fuel boiling range from 400 °F to 650°F. The actual boiling range for this cut was estimated by simulated distillation analysis ASTM 2887. The boiling range and product properties for this sample were:

-44-

Intended cut 400-650°F

Boiling Range (°F)	
IBP	308
T10	375
T50	475
T90	578
EP	630
API gravity	45.7
Cetane Index	62
Cetane Number (H ¹ nmr)	29
wt.% Aromatics	1.7

Example 20

Example 19 was repeated with the reactor temperature being adjusted to 350 °F at 600 psig. After passing the isopentane/pentene-1 pre-mixed feed through the reactor zone for 48.3 hrs, product was collected over the following 25.8 hrs. Product distributions were calculated from gc analyses of the gaseous and liquid products, and an additional simulated distillation ASTM 2887 of the liquid products. The total reactor effluent weight was 288.1 g (99.7% mass balance) and showed the following distribution:

-45-

	Component	weight %
	C ₃ -minus	0.00
	Isobutane	0.33
	n-Butane	0.01
5	Isopentane	87.89
	n-Pentane	0.51
	Cyclopentane	0.00
	C ₆ -paraffin	0.80
	Methylcyclopentane	0.04
10	C ₄ -olefin	0.00
	Butadiene	0.00
	C ₅ -olefin	0.49
	Cyclopentene	0.00
	C ₆ -olefin	0.12
15	Methylcyclopentane and Benzene	0.00
	<u>C₇-plus</u>	9.82
	Total	100.00

Conversion of total pentenes was 94.7%. Calculated yields
 20 isobutane and C₆-plus components per pentenes converted
 (wt/wt) were:

	Fraction	Yields
25	C ₅	0.04
	C ₆ -300 °F	0.28
	300 - 400 °F	0.38
	400 - 650 °F	0.54
	<u>above 650 °F</u>	0.04
30	Total	1.28

Following the distillation procedures of Example 1,
 the boiling range and product properties of the intended
 35 kerojet boiling range cut were:

-46-

Intended cut 300-400°F

5	Boiling Range (°F)	
	BP	143
	T10	270
	T50	320
	T90	348
10	EP	440
	API gravity	59.5
	Cetane Index	55
	Cetane Number (H ¹ nmr)	31

and the boiling range and product properties for the intended diesel fuel boiling range cut were:

Intended cut 400-650°F

20	Boiling Range (°F)	
	IBP	309
	T10	380
	T50	490
	T90	600
25	EP	672
	API gravity	46.5
	Cetane Index	65
	Cetane Number (H ₁ nmr)	33
	wt% Aromatics	0.8

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What is claimed is:

1. A process for converting at least one olefin and at least one paraffin to a diesel fuel blending component comprising the steps of contacting said olefin and said isoparaffin with a catalyst containing at least one material selected from MCM-22, MCM-36, MCM-49 MCM-56 and MCM-58 to provide a product comprising diesel fuel.

2. The process of claim 1, wherein said catalyst comprises MCM-56.

3. The process of claim 1, wherein said catalyst comprises MCM-58.

4. The process of claim 1, wherein said conversion conditions include a temperature in the range of from about 100-500°F; a pressure in the range of from about 0 to about 1500 psig; an olefin WHSV (on zeolite basis) in the range of from about 0.01 to 10; and an isoparaffin:olefin molar ratio in the feedstock in the range of from about 0.1-100.

5. The process of claim 1, wherein said conversion conditions include a temperature in the range of from about 200-400°F; a pressure in the range of from about 50 to about 100 psig; an olefin WHSV (on zeolite basis) in the range of from about 0.1 to 5; and an isoparaffin:olefin molar ratio in the feedstock in the range of from about 0.25 to about 50.

6. The process of claim 1, wherein said at least one olefin is selected from C₃-C₁₀ olefins.

7. The process of claim 6, wherein said at least one olefin is selected from C₄-C₈ olefins.



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8. The process of claim 1, wherein said at least one isoparaffin is selected from C₄-C₉ isoparaffins.

5 9. The process of claim 8 wherein said at least one isoparaffin is selected from C₄-C₅ isoparaffins.



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(54) Title: PROCESS FOR PRODUCING LOW AROMATIC DIESEL FUEL WITH HIGH CETANE INDEX		
(57) Abstract A process for converting at least one olefin and at least one paraffin to a diesel fuel blending component comprises the steps of contacting said olefin and said isoparaffin with a catalyst selected from the group consisting of MCM-22, MCM-36, MCM-49, MCM-56 and MCM-58 to provide a product containing a diesel fuel.		