

**FRACTIONATING AND FURTHER CRACKING A C₆ FRACTION
FROM A NAPHTHA FEED FOR PROPYLENE GENERATION**

FIELD OF THE INVENTION

[0001] The present invention relates to a process for selectively producing C₃ olefins from a catalytically cracked or thermally cracked naphtha stream by fractionating the naphtha feed to obtain at least a C₆ rich fraction and feeding the C₆ rich fraction into a reaction stage at a point wherein the residence time of the C₆ rich fraction is minimized.

BACKGROUND OF THE INVENTION

[0002] The need for low emissions fuels has created an increased demand for light olefins for use in alkylation, oligomerization, MTBE and ETBE synthesis processes. In addition, a low cost supply of light olefins, particularly propylene, continues to be in demand to serve as feedstock for polyolefin, particularly polypropylene production.

[0003] Fixed bed processes for light paraffin dehydrogenation have recently attracted renewed interest for increasing olefin production. However, these types of processes typically require relatively large capital investments as well as high operating costs. It is therefore advantageous to increase olefin yield using processes, which require relatively small capital investment. It is particularly advantageous to increase olefin yield in catalytic cracking processes.

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[0004] European Patent Specifications 490,435-B and 372,632-B and European Patent Application 385,538-A describe processes for converting hydrocarbonaceous feedstocks to olefins and gasoline using fixed or moving beds. The catalysts included ZSM-5 in a matrix, which included a large proportion of alumina.

[0005] U.S. Pat. No. 5,069,776 teaches a process for the conversion of a hydrocarbonaceous feedstock by contacting the feedstock with a moving bed of a zeolite catalyst comprising a zeolite with a medium pore diameter of 0.3 to 0.7 nm, at a temperature above 500°C. and at a residence time less than 10 seconds. Olefins are produced with relatively little saturated gaseous hydrocarbons being formed. Also, U.S. Pat. No. 3,928,172 to Mobil teaches a process for converting hydrocarbonaceous feedstocks wherein olefins are produced by reacting said feedstock in the presence of a ZSM-5 catalyst.

[0006] A problem inherent in producing olefin products using cracking units is that the process depends on a specific catalyst balance to maximize production of light olefins while also achieving high conversion of the 650°F⁺ feed components to fuel products. In addition, even if a specific catalyst balance can be maintained to maximize overall olefin production relative to fuels, olefin selectivity is

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generally low due to undesirable side reactions, such as extensive cracking, isomerization, aromatization and hydrogen transfer reactions. Light saturated gases produced from undesirable side reactions result in increased costs to recover the desirable light olefins. Therefore, it is desirable to maximize olefin production in a process that allows a high degree of control over the selectivity of C₃ olefins while producing minimal by-products.

SUMMARY OF THE INVENTION

[0007] One embodiment of the present invention is a process for producing increased amounts of propylene from naphtha-boiling-range feedstreams comprising:

- (a) fractionating a naphtha-boiling-range feedstream to produce at least a C₆-rich fraction and a C₆-lean fraction;
- (b) injecting at least a portion of said C₆-lean fraction into a reaction stage, said reaction stage containing a cracking catalyst comprising at least one molecular sieve having an average pore diameter of less than 0.7 nm wherein said C₆-lean fraction contacts said cracking catalyst under effective cracking conditions thereby resulting in at least a product stream;
- (c) injecting at least a portion of said C₆-rich fraction into the reaction stage at a place downstream from the C₆-lean fraction;

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- (d) fractionating at least a portion of said product stream of step (b) to produce at least a fraction rich in propylene; and
- (e) collecting at least a portion of the fraction rich in propylene.

[0008] Another embodiment of the present invention provides a process for producing increased amounts of propylene from naphtha-boiling-range feedstreams comprising:

- (a) injecting a naphtha-boiling-range feedstream into a reaction stage, said reaction stage containing a cracking catalyst comprising at least one molecular sieve having an average pore diameter of less than 0.7 nm, wherein said naphtha-boiling-range feedstream contacts said cracking catalyst under effective cracking conditions thereby resulting in at least a product stream;
- (b) fractionating at least a portion of said product stream of step (a) to produce at least a fraction rich in propylene, a C₆-rich fraction, and a C₆-lean fraction; and
- (c) collecting at least a portion of the fraction rich in propylene and the C₆-lean fraction and recycling at least a portion of the C₆-rich fraction to the reaction stage at a place downstream from the C₆-lean fraction.

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[0009] Another embodiment of the present invention provides a process for producing increased amounts of propylene from naphtha-boiling-range feedstreams comprising:

- (a) fractionating a naphtha-boiling-range feedstream to produce at least a C₆-rich feed fraction and a C₆-lean feed fraction;
- (b) conducting at least a portion of said C₆-lean feed fraction to a reaction stage, said reaction stage containing a cracking catalyst comprising at least one molecular sieve having an average pore diameter of less than 0.7 nm wherein said C₆-lean feed fraction contacts said cracking catalyst under effective cracking conditions thereby resulting in at least a product stream;
- (c) injecting at least a portion of said C₆-rich feed fraction into the reaction stage at a point downstream from the C₆-lean feed fraction;
- (d) fractionating at least a portion of said product stream of step (b) to produce at least a fraction rich in propylene; a C₆-rich product fraction, and C₆-lean product fraction; and
- (e) collecting at least a portion of the fraction rich in propylene and C₆-lean product fraction and recycling at least a portion of the C₆-rich product fraction to the reaction stage at a point downstream from the C₆-lean feed fraction.

DETAILED DESCRIPTION OF THE INVENTION

[0010] It should be noted that the term "injecting" as used herein is meant to encompass any means known for introducing a stream into a piece of processing equipment. It should also be noted that "C₆-rich fraction" as used herein is meant to refer to that fraction containing at least 50 wt.%, preferably at least 60 wt.%, and more preferably at least 70 wt.% of C₆ compounds.

[0011] The present invention is a process designed to increase propylene yields from a catalytic cracking process unit. Thus, in the practice of the present invention, the reaction stage of the process unit is operated under process conditions effective at maximizing the C₂ to C₄ olefins (particularly propylene) selectivity. Thus, the present invention relates to a process for selectively producing C₃ olefins from naphtha-boiling-range feedstreams. In the practice of the present invention, a naphtha boiling range feedstream is contacted with a cracking catalyst in a reaction stage operated under effective conditions thereby producing at least a product stream. The product stream is then fractionated to produce at least a fraction rich in propylene, a C₆-rich fraction, and a C₆-lean fraction. At least a portion of the fraction rich in propylene and the C₆-lean fraction are recovered while at least a portion of the C₆-rich fraction is recycled to the reaction stage. In another embodiment of the instant invention, the naphtha boiling range feedstream is first fractionated into at least a C₆-rich fraction and a C₆-lean

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fraction. At least a portion of the C₆-lean fraction is injected into the reaction stage wherein it is contacted with a cracking catalyst under effective cracking conditions thereby producing at least a product stream. At least a portion of the C₆-rich fraction is fed into the reaction stage at a place downstream from the C₆-lean fraction, and at least a fraction rich in propylene is subsequently recovered after fractionation. In yet another embodiment of the instant invention, the naphtha boiling range feedstream is first fractionated into a C₆-rich feed fraction and a C₆-lean feed fraction. At least a portion of the C₆-lean feed fraction is injected into the reaction stage wherein it is contacted with a cracking catalyst under effective cracking conditions thereby producing at least a product stream. At least a portion of the C₆-rich feed fraction is fed into the reaction stage at a place downstream from the C₆-lean feed fraction. At least a portion of the product stream is then fractionated to produce at least a fraction rich in propylene, a C₆-rich product fraction, and a C₆-lean product fraction. At least a portion of the C₆-rich product fraction is also injected at a point downstream from the C₆-lean fraction, as described above.

[0012] Feedstreams suitable for use herein are naphtha-boiling-range feedstreams boiling in the range of 65°F to 430°F, preferably from 65°F to 300°F. Non-limiting examples of naphtha-boiling-range feedstreams suitable for use herein include light naphthas or raffinates, containing sufficient amounts of C₄- C₉ olefins

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and/or paraffins, C₄-C₉ fractions from light naphthas or raffinates, catalytic cracked naphtha, coker naphtha, steam cracker pyrolysis gasoline, synthetic chemical streams containing sufficient amounts of C₄-C₉ olefins and/or paraffins or any other hydrocarbons containing sufficient amounts of C₄-C₉ olefins and/or paraffins. Feedstreams containing high levels of dienes, sulfur, nitrogen, and oxygenates may be selectively hydrotreated prior to use in the presently disclosed process. However, appropriate feeds with low levels of dienes, sulfur, nitrogen, metal compounds and oxygenates can be processed directly from FCC units, cokers or steam crackers without any pretreatment.

[0013] In the practice of the present invention, a naphtha boiling range feedstream as defined above is injected into a reaction stage wherein the naphtha boiling range feedstream contacts a cracking catalyst under effective conditions. The reaction stage can be comprised of one or more fixed bed reactors or reaction zones each of which can comprise one or more catalyst beds of the same or different catalyst. Interstage cooling or heating between reactors, or between catalyst beds in the same reactor, can be employed since cracking reactions are generally exothermic. A portion of the heat generated during cracking can be recovered. Where this heat recovery option is not available, conventional cooling may be performed through cooling utilities. In this manner, optimum reaction temperatures can be more easily maintained.

[0014] Catalysts suitable for use in the practice of the present invention are cracking catalysts that are comprised of at least one molecular sieve having an average pore diameter less than 0.7 nanometers (nm). Molecular sieves suitable for use herein are selected from those materials referred to in the art as zeolites and silicoaluminophosphates (SAPO). It is preferred that the at least one molecular sieve be selected from that class of materials known as zeolites, and more preferred that the zeolite be selected from medium pore zeolites. Medium pore size zeolites that can be used in the practice of the present invention are those described in the "Atlas of Zeolite Structure Types", eds. W. H. Meier and D. H. Olson, Butterworth-Heineman, Third Edition, 1992, which is hereby incorporated by reference. Medium pore size zeolites generally have an average pore diameter less than 0.7 nm, typically from 0.5 nm, to 0.7 nm and include for example, MFI, MFS, MEL, MTW, EUO, MTT, HEU, FER, and TON structure type zeolites (IUPAC Commission of Zeolite Nomenclature). Non-limiting examples of such medium pore size zeolites, include ZSM-5, ZSM-12, ZSM-22, ZSM-23, ZSM-34, ZSM-35, ZSM-38, ZSM-48, ZSM-50, silicalite, and silicalite 2. The most preferred zeolite cracking catalyst used in the presently disclosed process is ZSM-5, which is described in U.S. Pat. Nos. 3,702,886 and 3,770,614. ZSM-11 is described in U.S. Pat. No. 3,709,979; ZSM-12 in U.S. Pat. No. 3,832,449; ZSM-21 and ZSM-38 in U.S. Pat. No. 3,948,758; ZSM-23 in U.S. Pat. No. 4,076,842; and ZSM-35 in U.S.

Pat. No. 4,016,245. All of the above patents are incorporated herein by reference. The pore diameter, sometimes referred to herein as "effective pore diameter", can be measured using standard adsorption techniques and hydrocarbonaceous compounds of known minimum kinetic diameters. See Breck, Zeolite Molecular Sieves, 1974 and Anderson et al., J. Catalysis 58, 114 (1979), both of which are incorporated herein by reference.

[0015] As mentioned above, molecular sieves suitable for use herein also include that class of materials generally known as silicoaluminophosphates (SAPO), such as, for example, SAPO-11, SAPO-34, SAPO-41, and SAPO-42, which are described in U.S. Pat. No. 4,440,871. Other suitable molecular sieves can be selected from chromosilicates; gallium silicates; iron silicates; aluminum phosphates (ALPO), such as ALPO-11 described in U.S. Pat. No. 4,310,440; titanium aluminosilicates (TASO), such as TASO-45 described in EP-A No. 229,295; boron silicates, described in U.S. Pat. No. 4,254,297; titanium aluminophosphates (TAPO), such as TAPO-11 described in U.S. Pat. No. 4,500,651; and iron aluminosilicates.

[0016] The cracking catalyst comprising at least one molecular sieve is also meant to encompass "crystalline admixtures" which are thought to be the result of faults occurring within the crystal or crystalline area during the synthesis of the

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zeolites. Examples of crystalline admixtures of ZSM-5 and ZSM-11 are disclosed in U.S. Pat. No. 4,229,424 which is incorporated herein by reference. The crystalline admixtures are themselves medium pore size zeolites and are not to be confused with physical admixtures of zeolites in which distinct crystals of crystallites of different zeolites are physically present in the same catalyst composite or hydrothermal reaction mixtures.

[0017] The cracking catalysts used in the present invention are typically held together with an inorganic oxide matrix component. The inorganic oxide matrix can be made from an inorganic oxide sol or gel which is dried to "glue" the catalyst components together. Preferably, the inorganic oxide matrix is not catalytically active and will be comprised of oxides of silicon and aluminum. It is also preferred that separate alumina phases be incorporated into the inorganic oxide matrix. Species of aluminum oxyhydroxides-g-alumina, boehmite, diaspore, and transitional aluminas such as a-alumina, b-alumina, g-alumina, d-alumina, c-alumina, k-alumina, and r-alumina can be employed. Preferably, the alumina species is an aluminum trihydroxide such as gibbsite, bayerite, nordstrandite, or doyleite. The matrix material may also contain phosphorous or aluminum phosphate.

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[0018] As mentioned above, the naphtha boiling range feedstream contacts the above-defined cracking catalyst under effective cracking conditions. Effective cracking conditions as used herein will be considered those conditions selected to achieve the desired boiling point conversion of the feed and include temperatures from 500°C to 700°C, preferably from 525°C to 650°C.

[0019] The contacting of the naphtha boiling range feedstream with the cracking catalyst produces at least a product stream. At least a portion of this product stream, preferably substantially all, of the product stream from the reaction stage is sent to a fractionation stage where various products are recovered, particularly a C₃-rich, i.e. propylene rich, fraction, a C₆-rich fraction, a C₆-lean fraction, and optionally a C₄-rich fraction. The C₃ fraction and the C₄ fraction will typically be rich in olefins, and at least a portion, preferably substantially all, of the C₃ (propylene)-rich fraction can then be collected. In the practice of the present invention, at least a portion, preferably substantially all, of the C₆-rich fraction is recycled and injected into the reaction stage at a point downstream from the injection of the naphtha boiling range feedstream to increase the yield of propylene. It is preferred that the C₆-rich fraction be injected into the reaction stage at a point downstream from the naphtha boiling range feedstream at a point selected in the reaction stage wherein the liquid hourly space velocity of the C₆-rich fraction is

greater than 10 hr^{-1} , preferably greater than 20 hr^{-1} , more preferably greater than 40 hr^{-1} , and most preferably greater than 60 hr^{-1} .

[0020] As stated above, in one embodiment of the instant invention, a naphtha boiling range feedstream is fractionated into at least a C_6 -rich fraction and a C_6 -lean fraction. At least a portion, preferably substantially all, of the C_6 -lean fraction is introduced or injected into the reaction stage wherein it contacts a cracking catalyst as defined above under conditions as defined above thereby producing at least a product stream. At least a portion, preferably substantially all, of the C_6 -rich fraction is injected into the reaction stage at a point downstream from the C_6 -lean fraction. The injection of the C_6 -rich fraction is selected using the above criteria. At least a portion, preferably substantially all, of the product stream is fractionated to produce at least a fraction rich in propylene. At least a portion, preferably substantially all of the fraction rich in propylene is collected.

[0021] In yet another embodiment of the present invention, a naphtha boiling range feedstream is fractionated into at least a C_6 -rich feed fraction and a C_6 -lean feed fraction. At least a portion, preferably substantially all, of the C_6 -lean feed fraction is introduced or injected into the reaction stage wherein it contacts a cracking catalyst as defined above under conditions as defined above thereby producing at least a product stream. At least a portion, preferably substantially all,

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of the C₆-rich feed fraction is injected into the reaction stage at a point downstream from the C₆-lean feed fraction. The injection of the C₆-rich feed fraction is selected using the above criteria. At least a portion, preferably substantially all, of the product stream is fractionated to produce at least a fraction rich in propylene, a C₆-rich product fraction, a C₆-lean product fraction. At least a portion, preferably substantially all of the fraction rich in propylene is collected, and at least a portion, preferably substantially all, the C₆-rich product fraction is recycled and injected into the reaction stage at a point downstream from the C₆-lean feed fraction. The injection of the C₆-rich product fraction is selected using the above-described criteria. It should be noted that it is contemplated that in this embodiment, the C₆-rich feed fraction and the C₆-rich product fraction can be injected into the reaction stage at the same or different points or places.

[0022] The following examples will illustrate the improved effectiveness of the present invention, but is not meant to limit the present invention in any fashion.

EXAMPLES

Example 1

[0023] A light cat naphtha was distilled into five different fractions to study feedstock effects in naphtha cracking. The distillation was performed according to the ASTM specification for distillation of naphtha, ASTM D-86. The results of the

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feedstock component properties of the distilled light cat naphtha are given in Table

1.

TABLE 1: FEED COMPONENT PROPERTIES

Feed % of Feed	IBP-130 33.1	130-150 14.3	150-170 11.9	170-190 7.3	190+ 33.4	***** LCN *****	
						Wt. Avg.	Actual
Olefins, Wt. %							
C5	62.4	9.2	0.3	0.0	0.0	22.0	26.2
C6	4.4	49.0	48.4	20.8	0.6	16.0	15.8
C7	0.1	5.2	14.3	30.5	22.0	12.1	10.6
C8	0.0	0.0	0.0	0.0	5.4	1.8	1.3
C9	0.0	0.0	0.0	0.0	1.2	0.4	0.1
C10	0.0	0.0	0.0	0.0	0.1	0.0	0.0
C11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total, %	66.9	63.5	63.0	51.3	29.4	52.3	54.0

LCN distilled into five cuts to study feedstock effects in naphtha cracking

- IBP-130°F cut olefins mostly pentenes
- 130-150/150-170°F cut olefins mostly hexenes
- 190°F+ mostly heptenes

Example 2

[0024] A series of tests in a small bench reactor were conducted on the various boiling fractions of the light cat naphtha. All tests were conducted at 575°C, 72 hr¹ WHSV over a fixed bed of 0.3 g of ZSM-5 medium-pore zeolite catalyst. Prior to the cracking tests, the ZSM-5 catalyst was aged by steaming it with 100% steam at 816°C and 1 atmosphere for 16 hours.

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[0025] The yields of key products from these series of tests are given in Table 2.

The effluent stream of the reactor was analyzed by on-line gas chromatography ("GC"). A column having a length of 60 m packed with fused silica was used for the analysis. The GC used was a dual FID Hewlett-Packard Model 5880.

TABLE 2: OLEFINSMAX IN LCN CRACKING

Feed	***** LCN *****						Actual
	IBP-130	130-150	150-170	170-190	190+	Wt. Avg.	
C4-Conv., Wt%	22.4	41.4	45.0	39.9	32.3	32.3	32.8
Key Yields, Wt%							
Ethylene	3.3	3.0	3.5	2.2	2.6	3.0	2.7
Propylene	10.8	27.5	27.8	21.0	15.4	17.4	16.9
Butylene	7.6	10.0	12.4	15.5	12.2	10.6	11.6
Lt Sats	0.8	0.9	1.4	1.1	2.1	1.3	1.7
- Propane	0.1	0.4	0.5	0.4	0.4	0.3	0.4
C3=/C4-Sel	48.2	66.4	61.8	52.6	47.7	53.9	51.5

- C6 cuts (130-150°F and 150-170°F) show the highest propylene yield with OlefinsMax cracking catalyst

Example 3

[0026] In addition to ZSM-5, the various boiling fractions of the light cat naphtha were also tested with a SAPO-11 catalyst. In the case of SAPO-11, the zeolite was tested fresh. Otherwise, the procedure used in the experiments with

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SAPO-11 was nominally identical to the experiments with ZSM-5. The results are given in Table 3.

TABLE 3: SAPO-11 IN LCN CRACKING

Feed	***** LCN *****						Actual
	IBP-130	130-150	150-170	170-190	190+	Wt. Avg.	
C4-Conv., Wt%	17.3	41.4	33.0	30.2	24.6	26.0	26.5
Key Yields, Wt%							
Ethylene	3.7	1.5	1.1	0.9	0.9	1.9	1.9
Propylene	10.5	35.8	26.5	17.0	10.4	16.4	15.2
Butylene	2.6	3.3	4.4	11.0	11.8	6.6	7.4
Lt Sats	0.5	0.9	1.0	1.2	1.5	1.0	2.1
- Propane	0.1	0.3	0.2	0.3	0.4	0.2	0.3
C3=/C4-Sel	60.7	86.5	80.3	56.3	42.3	63.1	57.4

- C6 cuts (130-150°F and 150-170°F) also show the highest propylene yield with SAPO-11

CLAIMS:

1. A process for producing increased amounts of propylene from naphtha-boiling-range feedstreams comprising:
 - (a) fractionating a naphtha-boiling-range feedstream to produce at least a C₆-rich fraction and a C₆-lean fraction;
 - (b) injecting at least a portion of said C₆-lean fraction into a reaction stage, said reaction stage containing a cracking catalyst comprising at least one molecular sieve having an average pore diameter of less than 0.7 nm wherein said C₆-lean fraction contacts said cracking catalyst under effective cracking conditions thereby resulting in at least a product stream;
 - (c) injecting at least a portion of said C₆-rich fraction into the reaction stage at a place downstream from the C₆-lean fraction;
 - (d) fractionating at least a portion of said product stream of step (b) to produce at least a fraction rich in propylene; and
 - (e) collecting at least a portion of the fraction rich in propylene.
2. A process for producing increased amounts of propylene from naphtha-boiling-range feedstreams comprising:
 - (a) injecting a naphtha-boiling-range feedstream into a reaction stage, said reaction stage containing a cracking catalyst comprising at least one

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molecular sieve having an average pore diameter of less than 0.7 nm, wherein said C₆-lean fraction contacts said cracking catalyst under effective cracking conditions thereby resulting in at least a product stream;

(b) fractionating at least a portion of said product stream of step (a) to produce at least a fraction rich in propylene, a C₆-rich fraction, and a C₆-lean fraction; and

(c) collecting at least a portion of the fraction rich in propylene and the C₆-lean fraction and recycling at least a portion of the C₆-rich fraction to the reaction stage at a place downstream from the C₆-lean fraction.

3. A process for producing increased amounts of propylene from naphtha-boiling-range feedstreams comprising:

(a) fractionating a naphtha-boiling-range feedstream to produce at least a C₆-rich feed fraction and a C₆-lean feed fraction;

(b) conducting at least a portion of said C₆-lean feed fraction to a reaction stage, said reaction stage containing a cracking catalyst comprising at least one molecular sieve having an average pore diameter of less than 0.7 nm wherein said C₆-lean feed fraction contacts said

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cracking catalyst under effective cracking conditions thereby resulting in at least a product stream;

(c) injecting at least a portion of said C₆-rich feed fraction into the reaction stage at a point downstream from the C₆-lean feed fraction;

(d) fractionating at least a portion of said product stream of step (b) to produce at least a fraction rich in propylene; a C₆-rich product fraction, and C₆-lean product fraction; and

(e) collecting at least a portion of the fraction rich in propylene and C₆-lean product fraction and recycling at least a portion of the C₆-rich product fraction to the reaction stage at a point downstream from the C₆-lean feed fraction.

4. The process of any of the preceding claims wherein the at least one molecular sieve is selected from zeolites and silicoaluminophosphates.
5. The process of any of the preceding claims wherein the at least one molecular sieve is a medium-pore zeolite.
6. The process of claim 5 wherein the medium-pore zeolite is selected from the group consisting of ZSM-5, ZSM-11, ZSM-12, ZSM-22, ZSM-23, ZSM-48, and ZSM-50.

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7. The process of claim 4 wherein the silicoaluminophosphates is selected from the group consisting of SAPO-11, SAPO-34, SAPO-41, and SAPO-42.
8. The process of any of the preceding claims wherein the propylene rich fraction has a propylene concentration greater than 60 wt.%.
9. The process of any of the preceding claims wherein said effective cracking conditions include temperatures from 500°C to 700°C.
10. The process of any of the preceding claims wherein the C₆ rich fraction contains at least 50 wt.% of C₆ compounds.
11. The process of any of the preceding claims wherein said molecular sieve is selected from chromosilicates, gallium silicates, iron silicates, aluminum phosphates (ALPO), titanium aluminosilicates (TASO), boron silicates, titanium aluminophosphates (TAPO), and iron aluminosilicates.
12. The process of any of the preceding claims wherein said cracking catalyst further comprises an inorganic oxide matrix component.

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13. The process of claim 10 wherein said inorganic oxide matrix component is not catalytically active and is selected from oxides of silicon and aluminum.
14. The process of claim 1 wherein the at least a portion of said C₆-rich fraction is injected into the reaction stage at a place downstream from the C₆-lean fraction wherein the liquid hourly space velocity of the C₆-rich fraction is greater than 10 hr⁻¹.
15. The process of claim 1 wherein said reaction stage is comprised of one or more fixed bed reactors or reaction zones each of which comprises one or more catalyst beds of the same or different cracking catalyst.
16. The process of claim 13 wherein interstage cooling or heating between reactors, or between catalyst beds in the same reactor, is employed in order to maintain optimum reaction temperatures.