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PROCESS FOR THE PRODUCTION OF GASOLINE
THROUGH THERMAL AND CATALYTIC CRACKING

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2 Sheets-Sheet 2

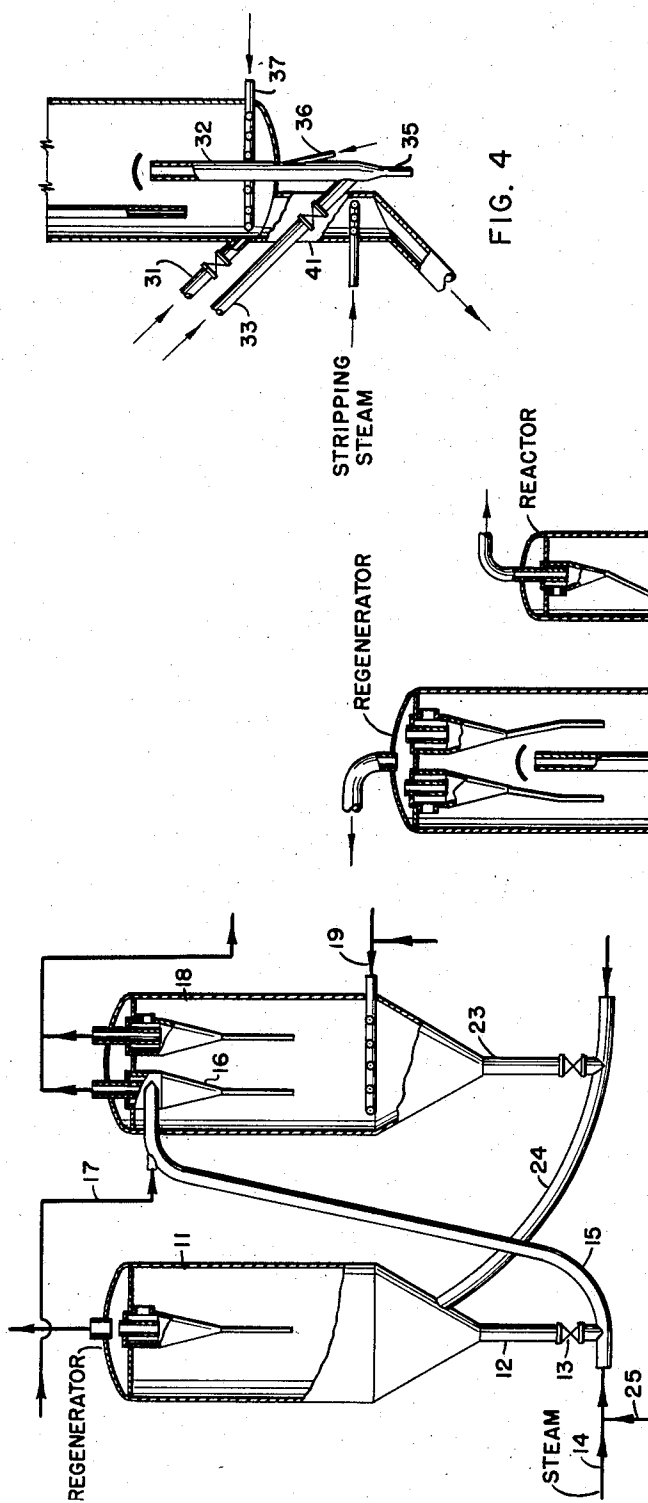


FIG. 2

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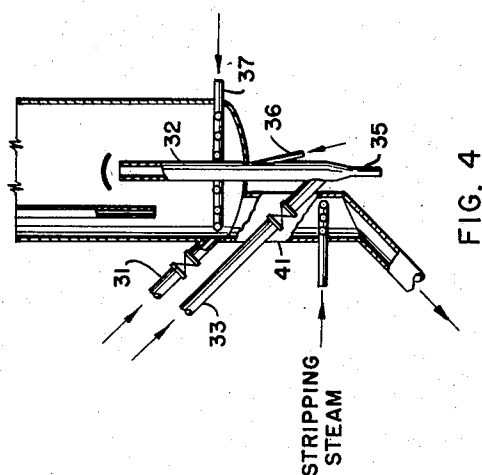


FIG. 4

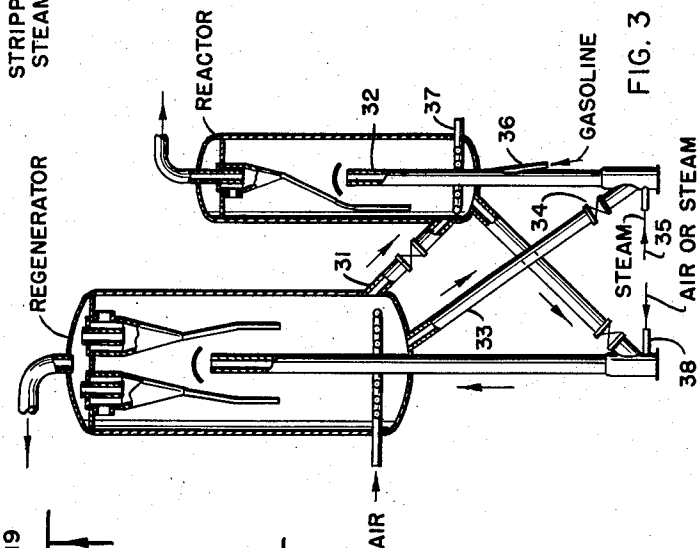


FIG. 3

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PROCESS FOR THE PRODUCTION OF GASOLINE THROUGH THERMAL AND CATALYTIC CRACKING

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6 Claims. (Cl. 208—70)

This invention relates to an improved method for converting hydrocarbon oils boiling above the gasoline boiling range into gasoline of good quality in good yield. A specific aspect of the invention relates to the catalytic treatment of thermally cracked gasoline stocks, including fractions thereof.

It is generally recognized that the process known as catalytic cracking produces gasoline of better quality than thermal cracking and other comparable processes. Consequently it is the desire and practice to catalytically crack as much of the available oil as possible. Certain feed stocks are, however, not amenable to catalytic cracking and it is the practice to convert such stocks, e.g., residues, catalytically cracked gas oils, etc., by thermal cracking methods, e.g., Dubbs cracking, delayed coking, fluid coking, etc. This produces a good olefinic gasoline but the gasoline is distinctly inferior to that produced by catalytic cracking.

It is known that thermally cracked gasolines may be improved in quality by subsequently treating them with cracking catalysts and this operation was carried out during the late war to produce aviation base stock (which contains very little olefins). The process was discontinued, however, as soon as the exceptional demand for aviation base stock ceased to exist, due to the fact that this subsequent treatment involved a considerable loss of gasoline. These losses resulted primarily from cracking of the gasoline to light gases and to some extent by polymerization or condensation reactions producing higher boiling products. Various attempts have been made to curtail the losses due to cracking through the use of mild treating conditions and particularly through the use of partially deactivated catalysts, e.g., catalyst which has been partially spent in a conventional catalytic cracking operation. In spite of these expedients, the loss of gasoline remained sufficiently high that, as far as we are aware, the process finds no commercial application.

We now have found that part of the reason for previous failures to improve the process lies in the fact that previous attempts sought to apply the process in apparatus and process flows which could not provide the special conditions which we now find are required. These conditions briefly stated are (1) the avoidance of contact of the thermally cracked gasoline with so-called dense phase or fluidized cracking catalyst, (2) the use of much lower catalyst-to-oil ratios than normally applied in this and related processes, and (3) a very short contact time between about 0.2 and 0.6 second. In addition to these conditions it is most advantageous to employ freshly regenerated catalyst of full activity (which then allows a minimum contact time) rather than a previously used and partially spent catalyst. Also, in order to allow a minimum contact time, it is most advantageous to employ temperatures of at least 950° F. and preferably temperatures from about 970 to 1070° F.

It will be appreciated that commercial size apparatus cannot afford these conditions unless specially designed to provide them. For example, the velocity of catalyst

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suspensions in lines must in practice be held below about 75 feet per second (in normal design the velocity is usually limited to about 30 feet per second) because of erosion difficulties. A riser line, which in a commercial unit may be anywhere from 50 to 150 feet long, therefore cannot afford a suitable contact time. Also, for example, to obtain temperatures above 1000° F., it is the custom to preheat the feed vapors and supply the additional heat required with the hot catalyst. The thermal gasoline can be preheated to temperatures of around 1000° F. but this would defeat the purpose since at such temperatures thermal cracking is appreciable and causes the very losses that it is sought to avoid.

These difficulties are avoided in the process of the invention through the use of special arrangements of apparatus and process flows.

The process of the invention will be further described with reference to the accompanying drawings in which suitable apparatus and the main flows are shown semi-diagrammatically and in which:

Figure 1 illustrates one suitable flow diagram;

Figure 2 illustrates in some more detail the main reaction and regeneration apparatus of the flow diagram of Figure 1;

Figure 3 illustrates a different arrangement of the reaction and regeneration apparatus such as may be used, for instance, in the flow diagram of Figure 1;

Figure 4 is a somewhat enlarged detail of part of the reactor of Figure 3 modified to incorporate stripping of the used catalyst.

It will be appreciated that certain parts of the apparatus, e.g., cyclone separators, grids, furnaces, and the like, are illustrated in stylized or symbolic form and that, for the sake of clearness, no attempt has been made to illustrate various conventional minor appurtenances such as control mechanisms, provision for reflux, reboilers, and the like.

In describing the apparatus and flows, the broader and preferred operating conditions are given. The figures shown in parenthesis refer to a specific example of the operation.

The flow shown in Figure 1 includes the thermal cracking step as well as the first step in the product recovery. It will be understood that either of these steps may be carried out somewhat differently. Referring to Figure 1, a hydrocarbon oil boiling essentially above the gasoline boiling range, and preferably a residue or gas oil fraction which is a poor feed for catalytic cracking, is introduced by line 1 and pump 2 to the coils of a cracking furnace 3 wherein it is heated to cracking temperatures in the conventional manner. The material is then passed to a cracking and/or separating chamber 4. Cracked vapors are removed overhead by line 5 to a fractionator 6 whereas residue is removed from the bottom. This residue may be removed from the system or recycled to the cracking furnace in whole or in part as needed. In conventional thermal cracking, fractionating column 6 would be operated to remove as overhead product a thermally cracked gasoline having an end point somewhat lower than the usual gasoline end point. Thus, the end point is normally around 350°–360° F. It is normal to operate in this manner since the material boiling above about 350° F. in thermal gasoline is of particularly poor quality and its inclusion tends to degrade the gasoline. In the present process, the thermal gasoline may be cut to the usual end point. However, it is found that when the present process is employed the end point may be raised considerably, e.g., to 415° F., thereby considerably increasing the yield of gasoline without degradation of its quality. The higher boiling bottom product from fractionating column 6 may be withdrawn from the system or recycled through the thermal cracking step. As will be later explained it may,

however, be advantageously utilized as a coke former in the subsequent operation in which case it is in whole or in part passed to line 7.

The thermal gasoline removed overhead from fractionating column 6 may be passed directly to the heater 8 and thence to the catalytic treatment, but it is preferably topped in topping column 9. Column 9 may be operated merely to remove normally gaseous products, but it is preferably operated to remove products up through C_4 and more preferably up through C_5 . In the latter case, the depentanized bottom product may have an ASTM initial boiling point of, for example, 160°–170° F.

In the specific example the depentanized thermal gasoline has the following properties:

API gravity @ 60° F. _____	55.4
ASTM distillation, ° F.:	
IBP _____	167
10% _____	204
20% _____	216
30% _____	229
40% _____	241
50% _____	254
60% _____	267
70% _____	274
80% _____	296
90% _____	317
95% _____	334
EP _____	358
F-1 octane number _____	174.3

* Debutanized.

It is preferably superheated to the highest temperature possible without any appreciable cracking, but superheating to lower temperatures is possible in some cases as will be clear from the further description of the process. Thus, temperatures of from about 625° F. up to the maximum which can be obtained without appreciable cracking may be used. This latter temperature depends considerably upon the design of the furnace, the character of the thermal gasoline and the amount of cracking which may be tolerated. Regarding the latter, the superheating should be curtailed such that not more than about 0.5% of the gasoline is converted to products boiling outside of the gasoline range.

Referring to Figures 1 and 2 wherein like parts are indicated by the same reference numbers, the catalytic section comprises a catalyst regenerator 11 which may be of any suitable design and which operates to burn carbonaceous deposits from the spent catalyst with air or other oxidizing gas at a temperature between about 1090° F. and 1200° F. (1125° F.). Hot regenerated catalyst is withdrawn from the regenerator by standpipe 12 at a rate controlled by valve 13.

The preferred catalyst is the synthetic silica-alumina cracking catalyst commercially used in the fluidized catalyst catalytic cracking process but any other finely divided solid cracking catalyst such, for instance, as certain treated clays (so-called natural catalyst), HF treated alumina, alumina-boria, aluminum fluoride-aluminum phosphate, silica-magnesia, silica-magnesia-alumina, silica-zirconia, and the like, may be used. This class of catalyst is designated clay-type cracking catalyst. The clay-type cracking catalysts are characterized by having a highly microporous structure affording a large available surface, by having highly acid centers which promote the cracking of hydrocarbons, by the absence of any appreciable amounts of active forms of heavy metal compounds of the hydrogenation-dehydrogenation type (e.g., Fe, Cr, Ni, Co, Mn, Mo, Cu, V) which cause excessive coke formation, and by their ability to withstand temperatures of at least about 1100° F. without appreciable sintering. The catalyst may be ground to pass a U.S. standard 100 mesh sieve or may be produced in the form of microspheroidal particles. In the specific example, the

catalyst is an equilibrium synthetic silica-alumina cracking catalyst having the following inspection data:

Surface area _____	m. ² /g. _____	102
Pore volume _____	cc./g. _____	0.260
Average pore radius _____	Å _____	54
Al ₂ O ₃ _____	percent _____	Ca. 14
Fe _____	do _____	0.11
V _____	do _____	0.0034
Cu _____	do _____	0.0007
Cr _____	do _____	0.0019
Ni _____	do _____	0.0018
<50 microns _____		10.0
>120 microns _____		15.0

As pointed out above, it is found that one of the requirements for efficient conversion without appreciable cracking is the use of a catalyst-to-oil ratio which is considerably below those normally used in related processes. The catalyst-to-oil ratio is the ratio of the weight of catalyst to the weight of thermally cracked gasoline continuously introduced into the treating zone. The catalyst-to-oil ratio should be at least about 2 but should not exceed about 8. The flow of hot regenerated catalyst is therefore controlled by valve 13 to produce a low catalyst-to-oil ratio within this range. In the specific example, the catalyst-to-oil ratio is 3.3. Other applied ratios were 2.7, 4.6 and 7.5. This controlled amount of freshly regenerated catalyst is dispersed in superheated steam introduced by line 14 and the resulting dispersion is passed up through line 15. Line 15 in the specific example is 65 feet in length and debouches into cyclone separator 16 (Figure 2) wherein the solid catalyst is quickly separated from the vapors.

The superheated vapors of the thermally cracked gasoline (810° F.) are introduced into line 15 by line 17. As previously pointed out, it is essential in the present process that the vapors of the thermally cracked gasoline be contacted with the dispersed catalyst, but not with so-called dense catalyst phase. This requires that the velocity of the suspension be maintained at all times sufficiently high to maintain the catalyst particles in free suspension in the vapors and prevent them from settling into a so-called fluidized (pseudo-liquid) phase such as is the case in the regenerator. The minimum velocity depends upon the size distribution and range of the catalyst particles and the carrying power of the vapor mixture but is around 30 feet per second in lines of this type. On the other hand, the velocity cannot, for practical reasons, exceed about 75 feet per second if the line contains a bend, or about 100 feet per second if the line contains no bend. In the particular example, the velocity at the exit of the line is 55 feet per second. Then in order to insure the necessary short contact time, the superheated vapors of the thermally cracked gasoline are introduced into the steam-catalyst suspension in the line at an intermediate point. In the particular example, the point of introduction is about 12 feet from the end, thus giving a contact time of a little over 0.2 second. Under these conditions and when operating with a temperature of 1005° F. at the exit of line 15, the thermal gasoline is upgraded; whereas the production of C_4 hydrocarbons (which remain in the gasoline) is less than 2% and the loss to lower boiling products is only about 1% or less. On the other hand, the loss to coke is only about 0.2 to 0.4%. The percentage of coke based on the catalyst is about 0.05%.

Catalyst containing only 0.05% coke cannot supply sufficient heat in the regeneration to make the process self-supporting in this respect. The catalyst separated by the separator 16 is still very hot and highly active. This catalyst is collected as a fluidized bed in the bottom of vessel 18. A hydrocarbon oil which boils essentially above the gasoline boiling range is injected into this bed by line 19 and the distributor connected thereto. This oil is cracked and further carbonizes the catalyst. Suf-

efficient oil is thus injected to afford the mentioned regeneration temperature. While any high boiling hydrocarbon oil may be used for this purpose, it is advantageous to employ oil from the bottom of the topping column 6 introduced by line 7 as previously described. Also there is generally a small carry-over of so-called catalyst fines with the vapor product in spite of the use of efficient cyclone separators. This catalyst collects in the bottom product of the production fractionator 20. This resulting slurry may advantageously be used in place of, or in addition to, other oils. If a secondary product fractionator 21 is used instead of side strippers for intermediate products attached to column 20, the bottom product of the secondary fractionator may also be so used. Part of the slurry oil may also advantageously be recycled to the thermal cracking via line 22.

The carbonized catalyst from vessel 18 is withdrawn continuously via standpipe 23 and passed with air via line 24 back to the regenerator.

The hot regenerated catalyst continuously withdrawn from the regenerator via standpipe 12, being in a fluidized state, contains appreciable amounts of gas and the gas normally contains a small amount, e.g., 0.5% of oxygen. In a plant of commercial size, the oxygen so introduced into line 15 may be sufficient to burn many barrels of the thermally cracked gasoline per day. In order to avoid loss of this valuable material, a small amount of oil of low value may be introduced with the steam via line 25. The amount of oil so added in the process illustrated should be held to the minimum required to scavenge the oxygen, but in some other cases, as will be explained, large amounts can be employed.

While in the process just described with reference to Figure 1, a small amount of oil may be added to scavenge the oxygen and some small amount of oil is cracked to increase the concentration of the coke on the catalyst, it is to be understood that the process is not a catalytic cracking process as this term is generally understood in the industry. The amount of catalyst supplied via line 12 is only sufficient to provide the prescribed low catalyst-to-oil ratio with respect to the thermal gasoline and this amount would be totally insufficient to supply the requirements of a catalytic cracking process.

On the other hand, it is frequently desirable to integrate the process with catalytic cracking and this can be done by utilizing the principles set forth above while affording means for supplying the required amount of catalyst for the cracking step. Thus, the regenerator and reactor system illustrated in Figure 3 may be substituted. Referring to Figure 3, it can be seen that by raising the regenerator and supplying a suitable inclined standpipe 31 a major portion of freshly regenerated catalyst may be fed to the reactor by gravity. This then allows a reactor with a dished bottom (as distinguished from the usual conical bottom) to be employed and this in turn allows a straight riser 32 of sufficiently short length to be applied for the treatment of thermally cracked gasoline. In this case, the relatively small amount of hot freshly regenerated catalyst required for treating the thermally cracked gasoline is introduced into the riser line 32 via inclined standpipe 33 and valve 34. As previously pointed out, with a straight vertical line such as 32 high linear velocities may be safely employed. Due to this fact and the fact that a relatively short tube may be employed in this arrangement, the catalyst introduced via line 33 and valve 34 may be dispersed directly with the superheated vapors of the thermally cracked gasoline introduced via line 35 instead of using steam for this purpose. It is, however, generally preferable to disperse the catalyst in steam or steam containing a scavenging amount of less valuable hydrocarbon material, e.g., natural gas, and introduce the superheating vapors of the thermally cracked gasoline at an intermediate point via line 36. When using an apparatus such as illustrated in Figure 3, a catalytic cracking operation may be simul-

taneously carried out by introducing the oil to be cracked via line 37.

When effecting conventional catalytic cracking in addition to the treatment of thermally cracked gasoline, it is generally desirable to include additional facilities for stripping the spent catalyst before it is regenerated. In the apparatus illustrated in Figure 3, the catalyst is stripped sufficiently to decrease the regeneration load by the steam introduced via line 38 and used to transport the catalyst spent into the regenerator. However, the stripped material is lost with the flue gas. In the modification of the reactor illustrated in Figure 4, additional stripping with recovery of the main stripped material is effected in the depending stripping zone 41. This zone, it will be observed, is offset in such a manner as to allow riser line 32 to be retained short, thereby affording the required short holding time without requiring an excessive linear velocity.

In conventional catalytic cracking, the vaporous product is passed to a first fractionating column wherein it is de-superheated and fractionated to separate as an overhead product all of the gasoline and lighter boiling products. This fraction is then cooled to condense the gasoline and passed to a separator to separate the condensed liquid from the uncondensed vapors. The vapors are compressed, e.g., to 300 p.s.i.g., and the compressed vapors and the liquid are passed to a rectified absorber tower to separate so-called dry gas. The liquid is then passed to a debutanizer column to separate mainly C₃-C₄ hydrocarbons and produce so-called debutanized gasoline which is then given such further treatment as necessary, e.g., extraction of mercaptans, and blended to produce the finished gasoline. The compression of the cracked gases required for efficient separation and recovery by this or related process schemes is a major operating cost in catalytic cracking and many catalytic cracking plants are limited by the compression capacity at this point. When the treatment of thermally cracked gasoline is integrated with a catalytic cracking operation, the treated thermally cracked gasoline may be combined with the catalytically cracked gasoline and the mixture passed to a single recovery system such as described. However, when using the treating method of the invention, the increased load on the product recovery system can be avoided since, when properly applied, there is practically no gas produced, e.g., 0.1%, and the treated thermally cracked gasoline does not contain sufficient C₄ hydrocarbons to require stabilization.

This has distinct advantages over and above the decreased load on the product recovery system. Thus, the treated thermally cracked gasoline, if withdrawn separately from the catalytically cracked product, may bypass the usual product fractionation system. The thermally cracked product may therefore be withdrawn from the treater at a lower pressure than that of the catalytically cracked vapors. This then allows catalyst to be transferred from the regenerator to the gasoline treating tube with a much lower head of catalyst, i.e., a much shorter standpipe. This, in turn, allows a much shorter reaction tube to be used. As previously pointed out, this is advantageous as it allows the desirable short contact times to be obtained in commercial operation without excessive linear velocities of the dilute catalyst suspension.

One of the features of the present process (in which the thermally cracked gasoline is contacted with dispersed catalyst but contact with so-called dense phase catalyst is avoided) is that the process affects a rapid shift of the double bond in alpha olefins to internal positions thereby increasing the octane number while, at the same time, depreciation of the octane number through saturation of olefins and destruction to gas and coke are minimized. These latter two reactions take place to significant extents in the conventional treating process and in all such cases where the thermal gasoline is contacted with fluidized catalyst (pseudo liquid). While a small

amount of cracking of the thermally cracked gasoline takes place in the present process, the cracked products are largely propylene and butylenes along with some isobutane and a minimum of light gas.

Inspection of the properties of the products obtained by the process show a 20 to 35% reduction in sulfur and a 40-50% reduction of the conjugated diolefins present in the charge. The only change in the boiling range was a small increase in the end point of the product. For example, when treating a depentanized charge having a 95% ASTM point of 334° F. and final boiling point of 358° F., the 95% point is increased to about 342° F. and the final boiling point to about 410° F. The relative performance of the untreated and treated thermal gasoline in a refinery pool gasoline was also investigated. Calculation of the blending octane numbers of the depentanized charge and product shows that the described process affords an F-1 octane increase of from 2.5 to 6.0 units unleaded and from 3.0 to 6 units at the 2.0 cc. TEL level, depending upon the operating conditions. In this regard the temperature of the treatment is important as the higher temperature treatments recommended afford the greatest improvement in the F-1 rating of the product. Unblended F-1 octane numbers increased from 1.7 to 4.3 units unleaded and from 2.6 to 4.0 units at 2.0 cc. of TEL upon increase of the temperature by 122° F.

Lead susceptibilities were determined for the unblended and pool blended motor ratings. The lead susceptibilities for the treated product are in general equal to or slightly better than the untreated charge. This is a decided advantage over the conventional treatments of thermal gasoline. When thermal gasoline is treated with a fluidized bed of catalyst, the lead susceptibility of the product is lower than that of the charge. This is also the case when operating with a fixed bed of catalyst as indicated by the trend toward lower octane number improvement as the concentration of TEL in the product is increased.

The thermal gasoline treated by the described process is a product which differs markedly from that obtained by conventional treatment of thermal gasoline. Thus, whereas the olefin disappearance in conventional treatment may be typically 48%, the olefin disappearance in the present process is normally of the order of 4 to 10%. On the other hand, the saturates in the feed are reduced somewhat by the present process whereas they are normally increased in the conventional treating methods. The decrease in saturates content can be accounted for primarily by increase in the aromatic content.

Infra red olefin type analyses of the olefin concentrates separated chromatographically from the product treated according to the invention show a marked change from alpha-type double bonds in the charge to product olefins with internal double bonds. Approximately 60 to 80% of the alpha olefins are converted to beta-type olefins, and part to types not detectable by the infra red method, e.g., cyclic olefins, aromatics with alkene side chains, etc. The low catalyst-to-oil ratios specified in the present process are particularly conducive to the largest production of desirable type olefins with minimum disappearance of olefins due to saturation. Thus, both the catalyst-to-oil ratio, the short contact time, the high temperature, and the avoidance of contacting the gasoline vapors with a dense catalyst bed all play important roles in determining the direction of the reaction of the alpha olefins. There is some evidence, although it is not conclusive, that some skeletal isomerization may also occur in the process. However, such skeletal isomerization does not appear to play any significant role. On the other hand, in the conventional operation with a fluidized catalyst bed, it has been determined that considerable skeletal isomerization is essential to counteract the loss in octane number which would otherwise result from the saturation of the normal olefins.

We claim as our invention:

1. Process for the production of high octane olefinic gasoline which comprises thermally cracking a hydrocarbon oil, separating from the cracked product an olefinic thermal gasoline, vaporizing and superheating said olefinic thermal gasoline, producing a dispersion of finely divided freshly regenerated cracking catalyst in superheated steam and passing said dispersion as a rapidly moving free suspension through a narrow confined vertical path to a separating zone, injecting said vaporized and superheated olefinic gasoline vapors into said confined path near the top thereof at a point sufficiently close to said separating zone that the residence time of the said gasoline vapors in said path is between 0.2 and 0.6 second, maintaining the temperature of the said vapors in said path between 950° F. and 1100° F. and regulating the quantity of said catalyst dispersed in said steam such that the weight ratio of catalyst to olefinic gasoline is between about 2 and 8.

2. Process for the production of high octane olefinic gasoline which comprises thermally cracking a hydrocarbon oil, separating from the cracked product an olefinic thermal gasoline, vaporizing and superheating said olefinic thermal gasoline, producing a dispersion of finely divided freshly regenerated cracking catalyst in superheated steam and passing said dispersion as a rapidly moving free suspension through a narrow confined path to a separating zone, injecting said vaporized and superheated olefinic gasoline vapors into said confined path near the top thereof at a point sufficiently close to said separating zone that the residence time of the said gasoline vapors in said path is between 0.2 and 0.6 second, maintaining the temperature of the said vapors in said path between 950° F. and 1100° F., regulating the quantity of said catalyst dispersed in said steam such that the weight ratio of catalyst to olefinic gasoline is between about 2 and 8, separating the catalyst from the mixture of steam and gasoline vapors in said separating zone, collecting the separated catalyst as a dense fluidized bed, injecting a hydrocarbon oil in said fluidized bed to crack the same and deposit carbonaceous deposits on said catalyst, and then regenerating the carbonized catalyst by burning the carbonaceous deposits therefrom in a separate regeneration zone thereby to produce the aforementioned hot freshly regenerated catalyst.

3. Process for the production of high octane olefinic gasoline which comprises thermally cracking a hydrocarbon oil, separating from the cracked product an olefinic thermal gasoline, vaporizing and superheating said olefinic thermal gasoline, producing a dispersion of finely divided hot freshly regenerated catalyst in superheated steam containing a small amount of hydrocarbon oil other than gasoline sufficient to react with the oxygen normally carried with the hot regenerated catalyst, passing said mixture as a rapidly moving free suspension through a narrow confined path to a separating zone, injecting said vaporized and superheated olefinic gasoline vapors into said confined path near the top thereof at a point sufficiently close to said separating zone that the residence time of the said gasoline vapors in said path is between 0.2 and 0.6 second, maintaining the temperature of the said vapors in said path between 950° F. and 1100° F., and regulating the quantity of said catalyst dispersed in said steam such that the weight ratio of catalyst to olefinic gasoline is between about 2 and 8.

4. In a process for the production of gasoline involving the thermal cracking of a hydrocarbon oil boiling essentially above the gasoline range to produce a thermally cracked gasoline and the separate production of catalytically cracked gasoline by the catalytic cracking of the hydrocarbon oil boiling essentially above the gasoline boiling range through the use of a finely divided cracking catalyst which is continuously regenerated in a separate regeneration zone by burning carbonaceous deposits therefrom, the improvement which comprises

continuously withdrawing hot freshly regenerated catalyst from said regeneration zone, suspending the said withdrawn hot freshly regenerated catalyst in superheated steam and transporting the resulting suspension up through an elongated tubular reaction zone at a temperature between 950° F. and 1100° F. to a catalyst disengaging zone at sufficient velocity to prevent separation of a dense catalyst phase, injecting into said suspension in said reaction zone preheated vapors of said thermally cracked gasoline at a point along the length of said tubular reaction zone near the top thereof sufficiently close to said catalyst disengaging zone that the residence time of the gasoline vapors in said reaction zone is between about 0.2 and 0.6 second, and adjusting the rate of said withdrawal of said freshly regenerated catalyst from said regeneration zone such that the weight ratio of catalyst to thermally cracked gasoline in said reaction zone is between 2 and 8.

5. In a process for the production of gasoline involving the thermal cracking of a hydrocarbon oil boiling essentially above the gasoline boiling range to produce an olefinic cracked gasoline and the separate production of catalytically cracked gasoline by the catalytic cracking of a hydrocarbon oil boiling essentially above the gasoline boiling range through the use of a finely divided cracking catalyst which is continuously regenerated by burning carbonaceous deposits therefrom in a separate regeneration zone, the improvement which comprises, continuously withdrawing hot freshly regenerated catalyst from said regeneration zone and passing the same into a fluidized bed of said catalyst in a separate cracking zone, injecting the said hydrocarbon oil to be catalytically cracked into said bed of fluidized catalyst in said cracking zone, maintaining a catalyst disengaging zone above the level of said fluidized bed in said cracking zone, withdrawing vapors of catalytically cracked gasoline substantially free of catalyst from said disengaging zone, separately withdrawing continuously a second

portion of hot freshly regenerated catalyst as a confined stream from said regeneration zone, dispersing said second portion of hot freshly regenerated catalyst in superheated vapors of said thermally cracked gasoline the weight ratio of catalyst to gasoline in said dispersion being between 2 and 8, passing the resulting dispersion as a confined stream up through said fluidized bed and discharging the dispersion into the said disengaging zone above said fluidized bed, maintaining the temperature of said dispersion in said confined stream between 950° F. and 1100° F., maintaining the velocity of said dispersion in said confined stream sufficiently high to prevent settling of the dispersed catalyst and sufficiently high that the residence time in said confined stream is between 0.2 and 0.6 second, withdrawing from said disengaging zone vapors of the thermally cracked gasoline commingled with the said vapors of the catalytically cracked gasoline, withdrawing spent cracking catalyst from said fluidized bed and passing the same into said regeneration zone.

6. The process claimed in claim 5 in which the said second portion of hot freshly regenerated catalyst withdrawn from said regeneration zone is first dispersed in superheated steam and the said superheated vapors of the thermally cracked gasoline are introduced into the resulting dispersion.

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