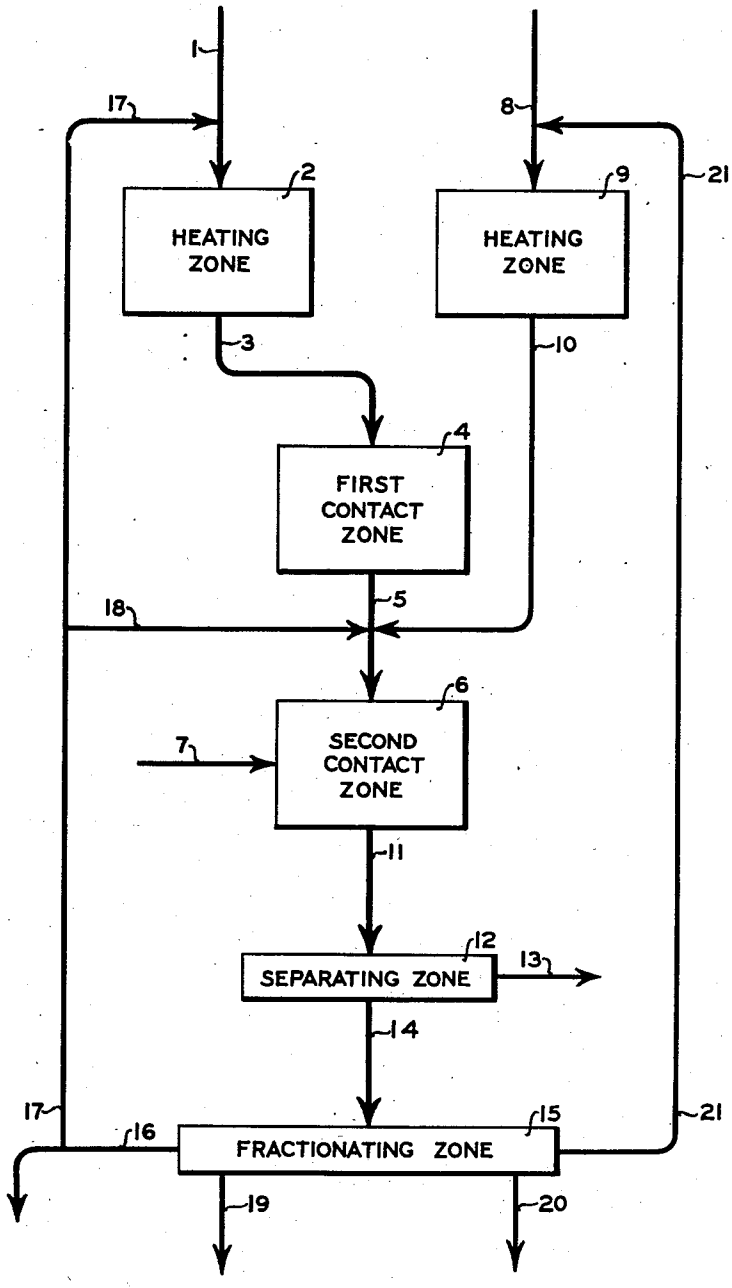
Aug. 1, 1944. J. D. DANFORTH 2,354,851

PROCESS FOR EFFECTING HYDROCARBON CONVERSION REACTIONS

Filed Oct. 27, 1941



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Patented Aug. 1, 1944 2,354,851

UNITED STATES PATENT OFFICE

2,354,851

PROCESS FOR EFFECTING HYDROCARBON CONVERSION REACTIONS

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Application October 27, 1941, Serial No. 416,673

29 Claims. (Cl. 260—683.4)

This application is a continuation-in-part of my copending application Serial No. 373,960, filed January 10, 1941.

This invention relates to a process for effecting hydrocarbon conversion reactions in the presence of a catalyst of the Friedel-Crafts type to produce branched chain saturated hydrocarbons. The reactions to which the invention refers more particularly may involve the isomerization of straight chain or moderately branched chain saturated hydrocarbons into branched chain or more highly branched chain saturated hydrocarbons, or the alkylation of branched chain saturated hydrocarbons by olefins into branched chain saturated hydrocarbons of higher molecular weight, or both the isomerization and alkylation of saturated hydrocarbons simultaneously or successively.

Isomerization reactions of the aforesaid character in the presence of a catalyst of the Friedel-Crafts type are known to be applicable not only to a number of individual paraffinic hydrocarbons of substantially straight chain structure and to certain cyclo-paraffinic or naphthenic hydrocarbons, but also to hydrocarbon mixtures containing these compounds in substantial percentages. Thus the isomerization may, for example, be applied to normal butane, to individual isomerizable saturated hydrocarbons having a boiling point within or near the gasoline boiling range, and to mixtures of these hydrocarbons. Isomerization treatment may, moreover, be applied to substantially olefin-free gasoline fractions and gasolines which contain substantial amounts of straight chain paraffin hydrocarbons in addition to certain amounts of naphthenic and branched chain paraffin hydrocarbons. Isomerization of normal butane and of normally liquid paraffinic hydrocarbons, such as normal pentane, normal hexane and so forth, is frequently desirable since the isomeric branched chain paraffinic hydrocarbons obtained therefrom are more reactive chemically. In the case of gasoline or gasoline fractions, isomerization effects a marked increase in the anti-knock value.

The known proposals for isomerization with the aid of catalysts of the Friedel-Crafts type include methods using generally one or more halides of aluminum, zirconium, zinc, iron and the like and particularly aluminum chloride or aluminum bromide without or with the presence of hydrogen halides, particularly hydrogen chloride. The known proposals, moreover, include methods using a metal halide of Friedel-Crafts type on a solid carrier, and some of the known methods also comprise the performance of the isomerization reaction in the presence of an inert gas or hydrogen.

Alkylation reactions of the aforesaid character are known to be applicable to a number of branched chain paraffin hydrocarbons including isobutane and normally liquid isoparaffins having boiling points within or near the gasoline boiling range, and also to certain naphthenic hydrocarbons, the reaction of these saturated hydrocarbons with certain olefins, such as, for example, butenes, being effected in the presence of a Friedel-Crafts catalyst and of hydrogen halides such as hydrogen chloride or hydrogen bromide. Alkylation reactions permit the synthesis of relatively less commonly available branched chain hydrocarbons from lower molecular weight hydrocarbons of more common occurrence. Alkylation reactions in one particular aspect permit the production of selected highly branched paraffin hydrocarbons boiling within gasoline boiling range and distinguished by particularly high anti-knock values and therefore desirable for use as or in aviation motor fuels.

The present invention aims at an improvement in the performance of reactions of the character described above with the view to obtaining a more continuous and substantially more economical process than has hitherto been possible. The invention particularly provides for a more satisfactory utilization of the catalyst, and for reduction in catalyst loss or requirement of catalyst recovery experienced to an appreciable extent in the various known processes.

Principally, the present invention comprises passing a stream of fluid through a first contact zone containing a Friedel-Crafts type catalyst, causing said stream of fluid to remove a portion of the catalyst from the first zone, maintaining a higher catalyst concentration in the first zone than in the effluent therefrom, permitting substantially the whole of the resultant effluent materials from the first zone to flow into a second contact zone wherein hydrocarbon material to be converted is reacted in the presence of Friedel-Crafts type catalyst, and maintaining the flow of said effluent from the first to the second zone at a substantially continuous and sufficient rate to maintain the reaction.

In a general way the present process is carried out by maintaining a satisfactory concentration of an active catalyst in the second contact zone and continuously supplying thereto small increments of active catalyst from the first contact zone. The transfer of the catalyst from

the first to the second zone is effected by means of a fluid in liquid or gaseous state which may comprise the whole or a portion of the total hydrocarbons charged to the process, or a relatively low boiling fraction of said hydrocarbons, or a normally gaseous paraffin hydrocarbon from an external source, or a substantially inert gas or a mixture of two or more of these materials. Frequently it is desirable to have hydrogen and/or a hydrogen halide present during the reactions, and in such event hydrogen and/or hydrogen halide may also be utilized as suitable carrying fluids. The carrying fluid is contacted in the first contact zone with the catalyst contained therein under conditions of temperature and pressure necessary to introduce into the carrier fluid a desired portion of the catalyst. Having, for example, aluminum chloride, which is preferred for practising the process of the present invention, present in the first contact zone, the carrying fluid during its passage through this zone under proper conditions of temperature and pressure picks up the desired portion of the aluminum chloride and the resultant effluent from the first contact zone supplies the picked-up portion of the catalyst to the second contact zone, wherein the reactions of the process are effected or completed. The selection of any particular fluid for carrying catalyst from the first zone to the second zone will depend primarily on the nature of the catalyst used and the remaining conditions under which the desired branched chain saturated hydrocarbons are to be produced from a given initial hydrocarbon material. Various modes in which this selection may be effected are hereafter described more fully.

It is essential for obtaining optimum results in the process of the present invention that the second contact zone be filled with granular particles or shaped bodies of solid material (hereafter for the sake of brevity referred to as granular packing material) which of itself may or may not have isomerizing and/or alkylating activity but which results in the efficient utilization within the second contact zone of the active catalyst contained in the effluent from the first contact zone. During the normal operation of the process only a small portion of the catalyst is removed by the stream of fluid at any one time from the total quantity of catalyst contained in the first contact zone and a higher catalyst concentration will prevail in the second contact zone containing granular packing material than is maintained in the effluent flowing from the first to the second zone.

Another feature of the invention resides in the manner of substantially continuously providing freshly exposed catalyst in the reaction zone or zones of a substantially stationary or fixed reaction apparatus, containing solid or liquid Friedel-Crafts catalyst, thus obviating the necessity of mechanical agitation and like disadvantageous devices.

In both isomerization and alkylation reactions in the presence of a catalyst of the Friedel-Crafts type in vaporous state it is necessary for a substantial concentration of the catalyst to be present in the reaction zone. In conventional operations the vaporous catalyst will be carried out of the reaction zone by the reaction products, and in order to secure a substantially continuous operation it would be necessary to recycle relatively large amounts of the catalyst (frequently in the form of a sludge-like material) particularly when the reactions are carried out with the hydrocarbons in gaseous phase. The present process makes it possible to avoid such a requirement of separating large quantities of catalyst from the reaction products and recirculating the separated catalytic material in a cyclic passage way. A similar requirement of recirculation also exists when the reactions are carried out in liquid phase or in mixed phase, that is, where both gases and liquids may be simultaneously present in the reaction zone. In either case of vapor phase, liquid phase and mixed phase operations when practising the present invention, catalytic material is present in substantial quantities in the first contact zone and only a portion and, more commonly, a rather small portion of the catalyst is carried from the first contact zone to the second contact zone, which latter zone serves either to largely retain active catalyst on the packing material or to maintain a high concentration of active catalyst in the latter zone at all times during the normal progress of the process. In this manner it is rendered possible to use either the second contact zone as principal reaction zone or to use both the first and the second contact zones simultaneously as reaction zones while at the same time preventing the continuous discharge of large quantities of catalytic material from the second contact zone.

In the normal operation of the process the materials issuing from the first contact zone will be supplied in their totality to the second contact zone and no portion thereof is withdrawn from the system at any point between the first and second contact zones. When employing the second contact zone as principal reaction zone, active catalyst such as active aluminum chloride is charged to the reaction zone substantially continuously and simultaneously with the hydrocarbon reactants so that as the catalyst retained upon the packing material decreases in activity during use, a further quantity of fresh aluminum chloride is introduced to the second zone containing the granular packing material. The granular packing material so employed may consist of porcelain, pumice, firebrick, quartz, activated charcoal, other activated carbons, diatomaceous earth, kaolin, raw and acid-treated clays, bauxite, alumina, silica gel, zirconia, titania, composites of silica with alumina and/or zirconia and so forth. Any of these packing materials may also be used in some instances in the first contact zone. The alternative filling materials are not necessarily equivalent and the particular filling or packing material employed is dependent primarily upon the hydrocarbons being treated, the temperature and pressure used and the nature and amount of the catalyst charged.

When a relatively large packed contact zone is employed, it may also be desirable to introduce the mixture of carrying fluid and catalyst to said zone at various points between the inlet and outlet thereof so that the catalyst is present in exactly the optimum concentration at all points throughout the bed of granular filling material within the packed contact zone and also so that substantially no excess of the catalyst is present at the point of its introduction with a resulting catalyst deficiency at other points throughout the entire bed or beds of packing material.

In one specific mode of practising isomerization in the presence of aluminum chloride in accordance with the present invention, the aluminum chloride may be picked up in the first contact zone by at least a portion of the normal paraffinic hydrocarbon charge and carried thereby to the

second or packed contact zone. A normally gaseous halide such as hydrogen chloride may be introduced to the second contact zone simultaneously with the effluent from the first contact zone, so as to effect substantial isomerization to more-branched chain paraffinic hydrocarbons in the second contact zone. Hydrogen halide may be introduced together with the normal paraffin to the first contact zone containing the aluminum chloride, when it is desired to effect substantial isomerization to more-branched chain paraffinic hydrocarbons in said first contact zone. In the latter case the resulting mixture of normal and branched chain hydrocarbons containing aluminum chloride may then be contacted in the second contacting zone with an olefin so that alkylation reactions will predominate in the second contact zone although some isomerization may also occur therein. It is also within the concepts of the invention to use the first contact zone essentially only as catalyst pick-up zone and to carry out simultaneously both isomerization and alkylation of paraffins in successive sections of the second contact zone containing packing material in the presence of aluminum chloride carried into said zone by a fluid such as, for example, a straight-chain paraffinic reactant. In the last mentioned mode of operation substantial proportions of the paraffinic hydrocarbons undergo isomerization into branched and more-highly branched chain hydrocarbons in the first section of the second contact zone and these branched chain hydrocarbons are readily alkylated with olefins introduced to the second contact zone at one or more intermediate points.

When aluminum chloride is the catalyst employed in the process, the first contact zone, in which aluminum chloride is picked up by one or more of the fluids used in the process is preferably maintained at a temperature between about 65° and 180° C. under a pressure of from substantially atmospheric to approximately 35 atmospheres or more. The resulting mixture of carrying fluid and aluminum chloride is then introduced to a second contact zone which generally will be maintained at a temperature between about minus 20° C. and plus 180° C. The temperature on the second contact zone is preferably maintained at a temperature between 35° and 150° C. when isomerization is the primary objective, while relatively low temperatures of the aforesaid range of −20° to +180° and particularly temperatures from about −20° to about +120° C. are preferred for effecting alkylation. Hydrogen chloride may also be added to the paraffinic hydrocarbon fraction charged. The hydrogen chloride may be employed in any of the modes of operation to the extent of up to about 20% of the weight of the paraffinic hydrocarbon fraction. Hydrogen may be added, if so desired, to the reaction mixture generally in a quantity of not more than about 10 mole per cent of the hydrocarbons present. When effecting alklation it is desirable that the amounts of olefinic hydrocarbons added are such that the total mixture subjected to alkylation contains between about 1 and about 25 mole per cent of olefins based upon the alklatable hydrocarbons present.

In a specific mode of effecting primarily alkylation with the aid of aluminum chloride in accordance with the invention, branched chain paraffin hydrocarbons may be employed for carrying aluminum chloride from the first contact zone and the alkylation is then effected in the second contact zone, to which olefinic hydrocarbon material is supplied at one or more points from an outside source.

The hydrogen and/or hydrogen chloride used to assist in the isomerizing and alklating treatments may also be employed for carrying aluminum chloride to the second or packed contact zone as it is generally desirable to carry the catalyst by means of a fluid having relatively low activity therewith. Saturated hydrocarbons charged or recycled in the process may also be employed for carrying the catalyst, but when used for this purpose it is desirable that the catalyst carrying fluid be substantially free from olefins and aromatic hydrocarbons since these materials tend to react with the catalyst to form sludge-like materials which interfere with proper operation of the first contact zone and thus prevent long continuous operation of the process.

While a normally gaseous paraffin or an added substantially inert gas is frequently used as the fluid to carry the catalyst to the second contact zone, or to a plurality of such zones, a liquid, or vapors of a normally liquid material, may be employed similarly. When the catalyst carrying medium is a liquid such as a relatively low-boiling normally liquid paraffinic fraction and is maintained in substantially liquid state under the conditions prevailing in the first contact zone, the aluminum chloride catalyst is dissolved and/or dispersed in the carrying fluid thus employed and the resulting solution and/or dispersion is thereafter introduced to the second contact zone containing granular packing material. In this way it is possible to maintain a relatively high concentration of catalytic material in a contactor to which more catalyst is introduced substantially continuously with a liquid charge to replenish the loss of catalyst which normally occurs and is carried away by the reaction mixture passing therethrough.

In such modes of operation of the present process in which catalyst is removed from the first contact zone by a stream of fluid comprising hydrocarbon material to be reacted in the second contact zone, it is frequently advantageous to divide said hydrocarbon material into two portions, to pass the first portion of the hydrocarbon material through the primary contacting zone and to bring an unheated or less heated second portion of the hydrocarbon material into contact with the hotter effluent from the first contact zone by introducing the said second portion to the second contact zone at any desired point or plurality of points thereof so that a reaction mixture of desired temperature is obtained. Alternatively it may be desirable to pass a relatively cool portion of the saturated hydrocarbon material through the first contact zone and thereafter introduce the resultant effluent together with a more highly heated portion of the hydrocarbon material to the second contact zone, when it is desired to effect the reaction in the latter zone at a higher temperature than that required in the first contact zone.

The alternative means which may be utilized for introducing a catalyst of the Friedel-Crafts type, and particularly aluminum chloride, to the second (packed) zone or to a plurality of packed contact zones by a fluid carrying medium are not necessarily equivalent and the particular means employed in any specific case depends primarily upon the properties of the hydrocarbons undergoing treatment, the nature of the catalyst and the operating conditions employed.

The features and advantages of the present in-

vention will be further evident from a consideration of the following description of a characteristic operation of the process illustrated by the flow diagram of the attached drawing.

Referring to the drawing, a hydrocarbon fraction containing normal and/or mildly-branched chain paraffinic hydrocarbons or another catalyst carrying fluid is passed through line 1, heating zone 2, and line 3 to the first contact zone 4 containing aluminum chloride or another Friedel-Crafts catalyst as hereinabove set forth. When aluminum chloride is used as catalyst, this material may be present in first contact zone 4 as a solid, a liquid, as a mixture with other metal halides, or as an adsorbed layer on a carrier. From contact zone 4 the hydrocarbon fraction or other fluid charged thereto carries a minor proportion of the catalyst therefrom through line 5 to the second contact zone 6 containing a granular packing material of the kind already mentioned.

When a hydrogen halide as hydrogen chloride is introduced through line 1 simultaneously with normal or mildly branched chain paraffinic hydrocarbons, a substantial amount of isomerization occurs in the presence of aluminum chloride in the first contact zone 4. Gases containing hydrogen and/or hydrogen chloride recovered in the process may be recycled through lines 17 and 18 to assist the formation of branched chain paraffins in the first contact zone 4 and in second contact zone 6. Branched chain paraffinic hydrocarbons charged to or formed in the first contact zone 4 and directed through line 5 to the second contact zone 6 are therein contacted with olefinic hydrocarbons admitted through line 7. When only a portion of the freshly charged normal and/or mildly-branched chain paraffinic hydrocarbon fraction is directed through line 1 to pick up aluminum chloride in contact zone 4, the remainder of the charged hydrocarbon fraction is introduced through line 8 to heating zone 9 and from thence is conducted through line 10 to line 5, through which normal and branched chain paraffinic hydrocarbons are directed to the second contact zone 6. The excess of normal and mildly-branched chain hydrocarbons recovered by fractionating the products of the process are recycled through lines 21 and 8, heater 9 and line 10 to line 5, and thence to contact zone 6 in which alkylatable hydrocarbons are reacted with olefinic hydrocarbons to produce higher boiling branched chain paraffinic hydrocarbons of higher boiling range and high anti-knock value.

Olefinic hydrocarbons introduced to the second contact zone 6 as described may be admitted thereto at a plurality of points throughout this reaction zone in order to substantially avoid polymerization and to assist in dissipating the exothermic heat of the alkylation reaction. Freshly charged paraffinic hydrocarbons, recycled gases, or gases added by means not shown in the attached drawing, may be used singly or in any combination to carry aluminum chloride from the first contact zone 4 through line 5 to the second contact zone 6.

When the operation just described is modified so that no olefin is introduced through line 7, further isomerization to more-highly branched chain hydrocarbons may take place in contact zone 6 in the presence of aluminum chloride therein deposited upon the packing material, both the zone 4 and the zone 6 functioning therefore as isomerizing reaction zones.

Alternately a substantially inert fluid may be charged through line 1, heater 2, and line 3 to the first contact zone 4 to pick up and carry a desired amount of catalyst to the second contact zone 6 to which the hydrocarbon fraction is introduced by way of line 8, heater 9, and lines 10 to 5 so as to use only the zone 6 as isomerizing reaction zone. Light gases including hydrogen and hydrogen chloride recovered from the process are admitted to zone 6 by way of lines 18 and 5. With this modification of the process it is generally desirable that all of the recycled hydrogen and hydrogen chloride be directed from line 17 through lines 18 and 5 to the second contact zone 6, and that none of this may be recycled from line 17 to line 1.

In each modification of the process as hereinabove described with reference to the drawing, the reaction product is directed from the second or packed contact zone 6 through line 11 to separating zone 12 in which a relatively heavy residue or sludge-like material containing partially spent aluminum chloride is separated and withdrawn through line 13 to storage or to other use. Separating zone 12 may comprise a cooling and separating chamber or other suitable devices for removing aluminum chloride from the hydrocarbon stream which is directed from zone 12 through line 14 to fractionating zone 15. Such separation in zone 12 may for example be effected in a tower containing an adsorptive material through which the hydrocarbons pass and upon which the aluminum chloride is deposited and retained.

In case isomerization and alkylation have both been carried out as described in first contact zone 4 and second contact zone 6, the reaction product removed from zone 6 through separating zone 12 is fractionated in fractionating zone 15 to separate said product into a fraction of light gases including hydrogen and hydrogen chloride, an isoparaffinic product, a residue, and a recycle stock. The fraction of light gases including hydrogen and hydrogen chloride is directed from fractionating zone 15 through line 16 and in part conducted to storage or other use while at least a portion of said fraction is directed through lines 17 and 18 to lines 1 and 5, respectively, as hereinabove set forth. An isoparaffinic product, which is the desired product of the process, is withdrawn from fractionator 15 through line 19 to cooling and storage. Relatively heavy reaction products generally boiling outside of the boiling range of gasoline, are withdrawn from fractionating zone 15 through line 20 while a recycle stock comprising unconverted and incompletely converted paraffinic hydrocarbons is recycled from fractionating zone 15 through lines 21 and 8 to heating zone 9 and thence through line 5 to the second contact zone 6 where said recycle stock is subjected to further isomerization and/or alkylation treatment.

In case the process as described is applied to the isomerization of a paraffinic hydrocarbon such as, for example, normal butane, and no olefin is admitted through line 7, the reaction products separated in fractionating zone 15 comprise: light gases including hydrogen, hydrogen chloride, and small amounts of propane; isobutane; a relatively heavy residue containing pentane and higher hydrocarbons; and a fraction comprising essentially normal butane. The light gases are withdrawn through line 16 and recycled in part through line 17, the isobutane and residue are separately withdrawn to storage

through lines 19 and 20, respectively, while the unconverted normal butane may be recycled through line 21 to further isomerization treatment in contact with the aluminum chloride contained upon the packing material in the second contact zone 6, or the normal butane, if so desired, may be recycled, by means not shown, to contact with the aluminum chloride in the first contact zone 4.

In case the process is operated for the production of isoparaffinic hydrocarbons boiling within the gasoline boiling range by alkylation of a lower boiling isoparaffinic hydrocarbon by an olefin, the initial isoparaffinic hydrocarbon may be directed, if so desired, together with additions of hydrogen chloride and/or hydrogen, through line 1, heater 2, line 3, and first contact zone 4 containing aluminum chloride; the resulting effluent material containing aluminum chloride is commingled with recycled isoparaffin in line 5 and thence directed to the second (packed) contact zone 6 to which an olefinic hydrocarbon is admitted through line 7 to at least one point intermediate the inlet and outlet of said second contact zone. The reaction products from contact zone 6 are directed through line 11 to separating zone 12 from which aluminum chloride sludge is discharged through line 13 while the other constituents of the total reaction product are directed through line 14 to fractionating zone 15 in which separation is effected into light gases, an alkylate boiling substantially within gasoline boiling range, a higher boiling fraction, and a recycle stock comprising essentially the unconverted isoparaffin charged to the process. The light gases which contain hydrogen chloride and hydrogen, in case these materials are employed simultaneously, are removed from the fractionating zone 15 through line 16 and in part may be recycled therefrom through line 17 to line 1 and/or to line 18. The alkylate of gasoline boiling range and higher boiling residue are directed to storage through lines 19 and 20, respectively, while the recycle stock, comprising essentially unconverted isoparaffinic hydrocarbon, is directed through lines 21 and 8 to heater 9 and thence through lines 10 and 5 to further treatment in the second contact zone 6.

The following examples are introduced as characteristic of the results obtained in the present process, although these data are presented with no intention of thereby limiting the generally broad scope of the invention. The expression "hourly liquid space velocity" as used in the examples signifies the passage of a given volume of hydrocarbon material, measured in liquid or liquefied state at normal temperature, per hour through a unit volume of reaction space. The c. c. measurements of hydrocarbon charges and products given in the examples refer to measurements of the hydrocarbon material in liquid or liquefied state.

EXAMPLE I

A mixture of 99.8 mole per cent normal butane and 0.2 mole per cent pentane was passed upwardly through a vertically elongated first contact zone containing 206 grams of granular anhydrous aluminum chloride and the effluent therefrom was commingled with hydrogen chloride and then directed downwardly through a vertically elongated second contact zone containing 550 cc. of formed porcelain packing material commonly known as Berl saddles. The hydrogen chloride was added at the entrance end of the second (packed) contact zone at a rate of 2 grams per hour while the normal butane was introduced to the process at the rate of 70 cc. per hour. Table I shows the amount of normal butane isomerized into isobutane in a number of runs in which the first contact zone and second (packed) contact zone were maintained at different temperatures between 60° and 99° C. In each run the two contact zones were maintained under substantially equalized pressure.

TABLE I

Isomerization of n-butane in the second contact zone

	Run No.					
	1	2	3	5	8	10
Duration, hours	24	24	24	24	24	24
Process conditions:						
n-Butane feed, cc./hr.	[1] 70	------	------	------	------	------
Hourly liquid space velocity	[1] 0.1	------	------	------	------	------
Hydrogen chloride gms./hr.	[1] 2.0	------	------	------	------	------
Mole percent HCl	[1] 7.1	------	------	------	------	------
Temperature, °C.:						
First contact zone	60	71	82	82	88	93
Second contact zone	88	88	88	99	99	99
Pressure, atmospheres	18	18	18	19	19	19
Charge analysis, mole percent:						
n-Butane	[1] 99.8	------	------	------	------	------
Pentanes	[1] 0.2	------	------	------	------	------
Products analysis, mole percent:						
Propane	------	------	------	1.2	2.8	3.2
n-Butane	97.5	87.3	66.2	51.9	47.3	44.0
Isobutane	1.6	11.7	32.8	43.5	46.4	49.1
Pentanes	0.9	1.0	1.0	3.4	3.5	3.7

[1] Constant for all runs.

The variation in amount of isomerization was apparently due to the variation in the quantity of aluminum chloride carried under the different temperature and pressure conditions from the first contact zone into the second contact zone. The utilization of aluminum chloride in the second contact zone at 99° C. was more efficient than at 38° C., particularly with small amounts of catalyst.

EXAMPLE II

110 grams (200 cc.) of a hydrocarbon fraction containing 3.8 mole per cent propane, 74.7% isobutane, and 21.5% normal butane was passed per hour upwardly through a vertically elongated steel vessel constituting the first contact zone and containing 200 grams (173 cc.) of aluminum chloride particles (having average diameters of from 0.33 to 4.7 mm.) at 96° C. under a pressure of 13 atmospheres. The resulting mixture of hydrocarbons and aluminum chloride was directed from the top of the first steel vessel to a similar second vessel constituting the second contact and reaction zone and containing 100 cc. of porcelain packing material (Berl saddles of about 7 mm. maximum diameter) maintained at a temperature between about 66° and about 82° C. as indicated in Table II.

At the beginning of a run the isobutane-containing fraction was charged for from about 4 to 8 hours in order to carry aluminum chloride into the second contact zone, and then ethylene and hydrogen chloride were added simultaneously to the second contact zone to effect alkylation of the isobutane with ethylene in the presence of aluminum chloride introduced to the second zone continuously during the reaction by the isobutane passing through the first contact zone to the second zone. Table II indicates the composi-

tion of the total charging stocks, as if each stock were one mixture (although the materials are actually supplied as separate streams), in order to permit ready comparison of the molal proportions of the components present.

TABLE II

Alkylation of isobutane by ethylene in the presence of aluminum chloride introduced by the isobutane to the second contact zone

	Period No.				
	2	3	4	6	8
Duration.....hours	27	24	24	25	18
Temp. of second contact zone.....°C	66	66	66	77	82
Total charging stock composition, mole percent:					
Ethylene	11.8	13.7	18.0	19.5	17.7
Butanes (mainly iso-)	83.1	81.9	77.1	76.3	78.1
Hydrogen chloride	1.3	1.2	1.2	1.2	1.1
Hydrogen	0.6	0.7	0.7	0.0	0.0
Propane	3.2	3.0	3.0	3.0	3.1
Weight balance, grams charged:					
Butanes	3,245	3,250	2,810	2,650	2,190
Ethylene	211	226	281	316	231
Liquid product:					
Total grams	499	500	551	481	279
Weight percent based on ethylene charged	237	221	204	152	121
Weight percent based on ethylene reacted	237	221	196	168	215
Distillation, vol., percent:					
21–41° C	19	10	0	12	7
41–66° C	62	66	74	56	63
Above 66° C	19	24	26	32	30
Olefins in exit gas, mole percent, 4 hours after start of period	0	0	3	3.8	13

The above table shows that the completeness of the alkylation reaction was affected by the proportion of ethylene present in the reaction mixture charged together with aluminum chloride and hydrogen chloride to the second contact zone containing packing material. After a short time on test, an exit gas containing substantially no ethylene was obtained in period 1 and the ethylene removal continued to be complete until period 4 when the ethylene concentration in the charge was increased to 18%. When the total charge contained more than 18% of ethylene, small quantities of this olefin appeared in the exit gas.

The chief difference in the nature of the liquid hydrocarbon product obtained as the concentration of ethylene in the charge was increased, consisted in an increase in the precentages of alkylation products boiling higher than hexanes at the expense of the pentane production, while the yield of hexanes remained fairly constant. The alkylation products boiling higher than hexanes contained a substantial proportion of octanes probably formed by the alkylation of hexanes with ethylene. The hexane fractions obtained in the different periods of this run had zero bromine number and contained between about 0.02 and 0.05 per cent by weight of chlorine.

EXAMPLE III

Several runs were made on the alkylation of isobutane with isobutene in the presence of aluminum chloride in the form of a constantly renewed amount of aluminum chloride freshly carried from a first contact zone and continuously deposited upon formed particles of a ceramic packing material of about 7 mm. maximum diameter contained in a second contact and reaction zone. In each run the pressure in the two zones was substantially equalized. Good results were obtained when 330 cc. per hour of a liquefied fraction containing 2.2 mole per cent of propane, 79.3% isobutane, and 18.5% normal butane was pumped upwardly through the first contact zone which comprised a tubular chamber containing 200 grams (172 cc.) of aluminum chloride particles of from about 0.83 to about 4.87 mm. average diameter maintained at 82° C. and under a pressure of 18 atmospheres. The resulting mixture containing isobutane, normal butane, propane, and aluminum chloride was thereafter introduced to a second contact zone to which isobutene and hydrogen chloride were also admitted. In the different runs the second contact zone was maintained at temperatures of from −10° to +38° C. while the molal ratio of paraffin to isobutene was varied from 8.7 to 17.6. The results given in Table III show how the yield and quality of the alkylation product was affected by varying the temperature of the second contact zone and the paraffin to olefin ratio.

TABLE III

Alkylation of isobutane with isobutene in the second contact zone

	Run No.				
	1	2	3	4	5
Temp. of second contact zone.....°C	27	15	2	2	−10
Molal ratio of paraffin to olefin	14.8	15.3	8.7	17.6	16.5
Liquid product:					
Yield, percent of butane charged	162	168	142	184	191
Bromine number of C_8 fraction	5	2.9	2.4	0.7	0.1
Per cent by volume boiling below 150° C	85	77	71	82	85

The results given in the above table show that a decrease in the temperature of the second contact zone within the range indicated in the table improved the yield and quality of the hydrocarbon product as indicated by its bromine number. The per cent by volume of the hydrocarbon product boiling below 150° C. was practically the same in the five runs shown above. As shown in the table, the highest yields of hydrocarbons boiling below 150° C. were obtained at the higher molal ratios of paraffin to olefin when using relatively low temperatures in the second contact zone.

Good alkylation was obtained when the hydrogen chloride concentration was as low as 0.7 mole per cent in the charging stock or, expressed differently, with as much as 6 moles of olefin per mole of hydrogen chloride.

The octane number of the total alkylate obtained in runs 2 to 5 inclusive, measured by the C. F. R. "Motor method" was approximately 87.3, and the octane number of this total alkylate increased to 95.4 by addition of 1 cc. tetraethyl lead per 3.79 liters of alkylate.

EXAMPLES IV

A mixture comprising 95.5 mole per cent normal butane, 0.4% isobutane, 0.2% pentanes, and 3.9% hydrogen chloride was passed upwardly through a vertically elongated first contact zone consisting of a steel reactor containing 627 grams (600 cc.) of granular anhydrous aluminum chloride maintained at a temperature of 82° C. and under a pressure of 18 atmospheres. The effluent mixture from said first contact zone consisted of a paraffinic hydrocarbon fraction, hydrogen chloride, and aluminum chloride. In the

first period of the run referred to in Table IV the paraffinic hydrocarbon fraction of the effluent mixture issuing from the first contact zone contained 60.3% isobutane, 30% normal butane, 5.5% propane, and 4% pentane. About 5.2 molecular proportions of said paraffinic hydrocarbon fraction and admixed hydrogen chloride and aluminum chloride was commingled with 1 molecular proportion of ethylene and the resultant commingled materials were passed into a second contact zone containing shaped particles of porcelain packing material, said second zone being maintained at a temperature which varied from 52° C. at the top to 41° C. at the bottom. In the second contact zone, ethylene reacted with isobutane formed in the first contact zone and admitted to the second contact zone, thus forming a product substantially consisting of branched-chain paraffinic hydrocarbons. The yield and composition of the product of the process changes as the run progressed as indicated in Table IV.

TABLE IV

Production of normally liquid branched-chain hydrocarbons from normal butane and ethylene by isomerization in the first contact zone and alkylation in a second contact zone

	Period No.		
	1	2	3
Duration.....hours..	48	72	35
Temperature, °C.:			
Of first contact zone	82	82	82
Of second contact zone, top	52	52	52
Of second contact zone, bottom	41	41	41
Paraffinic product, weight percent based on ethylene charged	149	196	207
Distillation, volume percent:			
20–40° C. fraction	32	33	19
40–65° C. fraction	48	47	48
Fraction boiling above 65° C	20	20	33
Total product boiling below 150° C	98	99	93
Bromine number of 40–65° C. fraction	1	1.5	2
Fraction boiling above 65° C	0	0	2
Chlorine, weight percent of 40–65° C. fraction	0.01	0.006	0.026

The novelty and utility of the present invention can be seen from the preceding specification and examples, although neither section is intented to unduly limit its generally broad scope.

I claim as my invention:

1. A process for effecting hydrocarbon conversion reactions to produce branched chain saturated hydrocarbons in the presence of a catalyst which comprises passing a stream of a substantially saturated hydrocarbon through a first contact zone containing a Friedel-Crafts type catalyst to form a substantial yield of alkylatable saturated hydrocarbons, causing the resultant hydrocarbon mixture comprising alkylatable saturated hydrocarbons to remove a portion of said catalyst from said first zone, maintaining a higher catalyst concentration in said first zone than in the effluent therefrom, permitting substantially the whole of the resultant effluent from said first zone to flow into a second contact zone containing a solid packing material in the form of granular particles, and introducing to at least one point intermediate the inlet and the outlet of said second zone from an outside source an olefin-containing hydrocarbon fraction to effect formation of branched chain saturated hydrocarbons by reaction of said alkylatable saturated hydrocarbons with olefins in the presence of the Friedel-Crafts catalyst and packing material in said second zone.

2. A process for effecting hydrocarbon conversion reactions to produce branched chain saturated hydrocarbons in the presence of a catalyst which comprises passing a stream of a substantially saturated hydrocarbon through a first contact zone containing aluminum chloride catalyst to form a substantial yield of alkylatable saturated hydrocarbons, causing the resultant hydrocarbon mixture comprising alkylatable saturated hydrocarbons to remove a portion of said catalyst from said first zone, maintaining a higher catalyst concentration in said first zone than in the effluent therefrom, permitting substantially the whole of the resultant effluent from said first zone to flow into a second contact zone containing a solid packing material in the form of particles, and introducing to at least one point intermediate the inlet and outlet of said second zone from an outside source an olefin-containing hydrocarbon fraction to effect formation of branched chain saturated hydrocarbons of gasoline boiling range by reaction of said alkylatable saturated hydrocarbons with olefins in the presence of the aluminum chloride catalyst and packing material in said second zone.

3. A process for effecting hydrocarbon conversion reactions to produce branched chain saturated hydrocarbons in the presence of a catalyst which comprises passing a stream of a substantially saturated hydrocarbon and hydrogen chloride through a first contact zone containing aluminum chloride catalyst to form a reaction mixture containing a substantial proportion of alkylatable saturated hydrocarbons, causing said reaction mixture to remove a portion of said catalyst from said first zone, maintaining a higher catalyst concentration in said first zone than in the effluent therefrom, permitting substantially the whole of the resultant effluent from said first zone to flow into a second contact zone containing a solid packing material in the form of particles, and introducing to at least one point intermediate the inlet and outlet of said second zone from an outside source an olefin-containing hydrocarbon fraction to effect formation of branched chain saturated hydrocarbons of gasoline boiling range by reaction of said alkylatable saturated hydrocarbons with olefins in the presence of the aluminum chloride catalyst and packing material in said second zone.

4. A process for effecting hydrocarbon conversion reactions to produce branched chain paraffin hydrocarbons in the presence of a catalyst which comprises passing a stream of a paraffin hydrocarbon and hydrogen chloride through a first contact zone containing aluminum chloride catalyst to form a reaction mixture containing a substantial proportion of isoparaffin hydrocarbons, causing said reaction mixture to remove a portion of said catalyst from said first zone, maintaining a higher catalyst concentration in said first zone than in the effluent therefrom, permitting substantially the whole of the resultant effluent from said first zone to flow into a second contact zone containing a solid packing material in the form of particles, and introducing to at least one point intermediate the inlet and outlet of said second zone from an outside source an olefin-containing hydrocarbon fraction to effect formation of branched chain paraffin hydrocarbons of gasoline boiling range by reaction of said isoparaffin hydrocarbons with olefins in the presence of aluminum chloride catalyst and packing material in said second zone.

5. A process for effecting hydrocarbon conver-

sion reactions to produce branched chain paraffin hydrocarbons in the presence of a catalyst which comprises passing a stream of a normal paraffin hydrocarbon and hydrogen chloride through a first contact zone containing aluminum chloride catalyst to form a reaction mixture containing a substantial proportion of isoparaffin hydrocarbons, causing said reaction mixture to remove a portion of said catalyst from said first zone, maintaining a higher catalyst concentration in said first zone than in the effluent therefrom, permitting substantially the whole of the resultant effluent from said first zone to flow into a second contact zone containing a solid packing material in the form of particles, and introducing to at least one point intermediate the inlet and outlet of said second zone from an outside source an olefin-containing hydrocarbon fraction to effect formation of branched chain paraffin hydrocarbons of gasoline boiling range by reaction of said isoparaffin hydrocarbons with olefins in the presence of the aluminum chloride catalyst and packing material in said second zone.

6. A process for effecting hydrocarbon conversion reactions to produce more-branched chain paraffin hydrocarbons of gasoline boiling range in the presence of a catalyst which comprises passing a stream of a mildly-branched chain paraffin hydrocarbon and hydrogen chloride through a first contact zone containing aluminum chloride catalyst to form a reaction mixture containing a substantial proportion of more-branched chain paraffin hydrocarbons, causing said reaction mixture to remove a portion of said catalyst from said first zone, maintaining a higher catalyst concentration in said first zone than in the effluent therefrom, permitting substantially the whole of the resultant effluent from said first zone to flow into a second contact zone containing a solid packing material in the form of particles, and introducing to at least one point intermediate the inlet and outlet of said second zone from an outside source an olefin-containing hydrocarbon fraction to effect formation of paraffin hydrocarbons of gasoline boiling range by reaction of said branched and more-branched chain paraffin hydrocarbons with olefins in the presence of the aluminum chloride catalyst and packing material in said second zone.

7. A process for effecting hydrocarbon conversion reactions to produce branched chain paraffin hydrocarbons in the presence of a catalyst which comprises passing a stream of a paraffin hydrocarbon and hydrogen chloride through a first contact zone containing aluminum chloride catalyst to form a reaction mixture containing a substantial proportion of isoparaffin hydrocarbons, causing said reaction mixture to remove a portion of said catalyst from said first zone, maintaining a higher catalyst concentration in said first zone than in the effluent therefrom, directing substantially the whole of the resultant effluent from the first zone to at least one point in a second contact zone containing a solid packing material, introducing to at least one point intermediate the inlet and outlet of said second zone from an outside source an olefin-containing hydrocarbon fraction to effect alkylation of said isoparaffin hydrocarbons by olefins in the presence of the aluminum chloride catalyst and packing material in said second zone, recovering from the alkylation products the branched chain paraffin hydrocarbons of gasoline boiling range, and recycling unconverted paraffin and isoparaffin hydrocarbons to further conversion in the presence of aluminum chloride in said first and second contact zones.

8. A process for effecting hydrocarbon conversion reactions to produce branched chain paraffin hydrocarbons in the presence of a catalyst which comprises passing a stream of a normal paraffin hydrocarbon and hydrogen chloride through a first contact zone containing aluminum chloride catalyst to form a reaction mixture containing a substantial proportion of isoparaffin hydrocarbons, causing said reaction mixture to remove a portion of said catalyst from said first zone, maintaining a higher catalyst concentration in said first zone than in the effluent therefrom, directing substantially the whole of the resultant effluent from the first zone to at least one point in a second contact zone containing a solid packing material, introducing to at least one point intermediate the inlet and outlet of said second zone from an outside source an olefin-containing hydrocarbon fraction to effect alkylation of said isoparaffin hydrocarbons by olefins in the presence of the aluminum chloride catalyst and packing material in said second zone, recovering from the alkylation products the branched chain paraffins of gasoline boiling range, and recycling unconverted normal paraffin and isoparaffin hydrocarbons to further conversion in the presence of aluminum chloride in said first and second contact zones.

9. A process for effecting hydrocarbon conversion reactions to produce more-branched chain paraffin hydrocarbons in the presence of a catalyst which comprises passing a stream of a mildly-branched chain paraffin hydrocarbon and hydrogen chloride through a first contact zone containing aluminum chloride catalyst to form a reaction mixture comprising essentially mildly-branched and more-highly branched chain paraffin hydrocarbons, causing said reaction mixture to remove a portion of said catalyst from said first zone, maintaining a higher catalyst concentration in said first zone than in the effluent therefrom, directing substantially the whole of the resultant effluent from the first zone to at least one point in a second contact zone containing a solid packing material, and introducing to at least one point intermediate the inlet and outlet of said second zone from an outside source an olefin-containing hydrocarbon fraction to effect alkylation of said mildly-branched and more-highly branched chain paraffin hydrocarbons by olefins in the presence of the aluminum chloride catalyst and packing material in said second zone, recovering from the alkylation products the more-branched chain paraffins of gasoline boiling range, and recycling unconverted mildly-branched and more-highly branched chain paraffin hydrocarbons to further conversion in the presence of aluminum chloride in said first and second contact zones.

10. A process for effecting hydrocarbon conversion reactions to produce branched chain paraffin hydrocarbons in the presence of a catalyst which comprises passing a stream of a paraffin hydrocarbon and hydrogen chloride through a first contact zone containing aluminum chloride catalyst to form a reaction mixture containing a substantial proportion of isoparaffin hydrocarbons, causing said reaction mixture to remove a portion of said catalyst from said first zone, maintaining a higher catalyst concentration in said first zone than in the effluent therefrom, directing substantially the whole of the resultant effluent from said first zone to a plurality of points

in a second contact zone containing a granular solid packing material, and introducing to at least one point intermediate the inlet and outlet of said second zone from an outside source an olefin-containing hydrocarbon fraction to effect alkylation of isoparaffin hydrocarbons by olefins in the presence of the aluminum chloride catalyst and packing material in said second zone.

11. A process for effecting hydrocarbon conversion reactions to produce branched chain paraffin hydrocarbons in the presence of a catalyst which comprises passing a stream of a paraffin hydrocarbon boiling between about 0° and about 200° C. and hydrogen chloride through a first contact zone containing aluminum chloride catalyst to form a reaction mixture containing a substantial proportion of branched chain paraffin hydrocarbons, causing said reaction mixture to remove a portion of said catalyst from said first zone, maintaining a higher catalyst concentration in said first zone than in the effluent therefrom, permitting substantially the whole of the resultant effluent from said first zone to flow into a second contact zone containing a granular solid packing material, and introducing an olefin from an outside source to at least one point intermediate the inlet and outlet of said second zone to effect alkylation of branched chain paraffin hydrocarbons by olefins.

12. A process for effecting hydrocarbon conversion reactions to produce branched chain paraffin hydrocarbons in the presence of a catalyst which comprises passing a stream of a paraffin hydrocarbon and hydrogen chloride through a first contact zone containing aluminum chloride catalyst at a temperature of from about 65° to about 180° C. under a superatmospheric pressure to form a reaction mixture containing a substantial proportion of isoparaffin hydrocarbons, causing said reaction mixture to remove a portion of said catalyst from said first zone, maintaining a higher catalyst concentration in said first zone than in the effluent therefrom, directing substantially the whole of the resultant effluent from the first zone to at least one point in a second contact zone containing a solid packing material maintained at a temperature of from about —20° to about 120° C. under a superatmospheric pressure, introducing to at least one point intermediate the inlet and outlet of said second zone from an outside source an olefin-containing hydrocarbon fraction to form branched chain paraffin hydrocarbons of gasoline boiling range by alkylation of said isoparaffin hydrocarbons by olefins in the presence of the aluminum chloride catalyst and packing material in said second zone, recovering from the alkylation products the branched chain paraffin hydrocarbons of gasoline boiling range, and recycling unconverted paraffin and isoparaffin hydrocarbons to further conversion in the presence of aluminum chloride in said first and second contact zones.

13. A process for effecting hydrocarbon conversion reactions to produce branched chain paraffin hydrocarbons in the presence of a catalyst which comprises passing a stream of a paraffin hydrocarbon and hydrogen chloride through a first contact zone containing aluminum chloride catalyst at a temperature of from about 65° to about 180° C. under a super-atmospheric pressure to form a reaction mixture containing a substantial proportion of isoparaffin hydrocarbons, causing said reaction mixture to remove a portion of said catalyst from said first zone, maintaining a higher catalyst concentration in said first zone than in the effluent therefrom, directing substantially the whole of the resultant effluent from said first zone to a plurality of points in a second contact zone containing a granular solid packing material maintained at a temperature of from about —20° to about 120° C. under a superatmospheric pressure, and introducing to at least one point intermediate the inlet and outlet of said second zone from an outside source an olefin-containing hydrocarbon fraction to effect alkylation of isoparaffin hydrocarbons by olefins in the presence of the aluminum chloride catalyst and packing material in said second zone.

14. A process for effecting hydrocarbon conversion reactions to produce branched chain paraffin hydrocarbons in the presence of a catalyst which comprises passing a stream of normal butane and hydrogen chloride through a first contact zone containing aluminum chloride at a temperature of from about 65° to about 180° C. under a superatmospheric pressure to form a reaction mixture containing a substantial proportion of isobutane, causing said reaction mixture to remove a portion of said catalyst from said first zone, maintaining a higher catalyst concentration in said first zone than in the effluent therefrom, directing substantially the whole of the resultant effluent from the first zone to at least one point in a second contact zone containing a solid packing material maintained at a temperature of from about —20° to about 120° C. under a superatmospheric pressure, introducing to at least one point intermediate the inlet and outlet of said second zone from an outside source an olefin-containing hydrocarbon fraction to form branched chain paraffin hydrocarbons of gasoline boiling range by alkylation of isobutane by olefins in the presence of the aluminum chloride catalyst and packing material in said second zone, recovering from the alkylation products the branched chain paraffin hydrocarbons of gasoline boiling range, and recycling unconverted normal butane and isobutane to further conversion in the presence of aluminum chloride in said first and second contact zones.

15. A process for effecting hydrocarbon conversion reactions to produce branched chain paraffin hydrocarbons in the presence of a catalyst which comprises passing a stream of normal butane and hydrogen chloride through a first contact zone containing aluminum chloride at a temperature of from about 65° to about 180° C. under a superatmospheric pressure to form a reaction mixture containing a substantial proportion of isobutane, causing said reaction mixture to remove a portion of said catalyst from said first zone, maintaining a higher catalyst concentration in said first zone than in the effluent therefrom, directing substantially the whole of the resultant effluent from the first zone to at least one point in a second contact zone containing a solid packing material maintained at a temperature of from about —20° to about 120° C. under a superatmospheric pressure, introducing to at least one point intermediate the inlet and outlet of said second zone from an outside source a normally gaseous olefin to form branched chain paraffin hydrocarbons of gasoline boiling range by alkylation of said isobutane in the presence of the aluminum chloride catalyst and packing material in said second zone, recovering from the alkylation products the branched chain paraffin hydrocarbons of gasoline boiling range, and recycling unconverted normal butane and isobutane to further conversion in the presence of

aluminum chloride in said first and second contact zones.

16. A process for effecting hydrocarbon conversion reactions to produce branched chain paraffin hydrocarbons in the presence of a catalyst which comprises passing a stream of normal butane and hydrogen chloride through a first contact zone containing aluminum chloride catalyst at a temperature of from about 65° to about 180° C. under a superatmospheric pressure to form a reaction mixture containing a substantial proportion of isobutane, causing said reaction mixture to remove a portion of said catalyst from said first zone, maintaining a higher catalyst concentration in said first zone than in the effluent therefrom, directing substantially the whole of the resultant effluent from said first zone to a plurality of points in a second contact zone containing a granular solid packing material maintained at a temperature of from about —20° to about 120° C. under a superatmospheric pressure, and introducing to at least one point intermediate the inlet and outlet of said second zone from an outside source an olefin-containing hydrocarbon fraction to effect alkylation of isobutane by olefins in the presence of the aluminum chloride catalyst and packing material in said second zone.

17. A process for effecting hydrocarbon conversion reactions to produce branched chain paraffin hydrocarbons in the presence of a catalyst which comprises passing a stream of normal butane and hydrogen chloride through a first contact zone containing aluminum chloride catalyst at a temperature of from about 65° to about 180° C. under a superatmospheric pressure to form a reaction mixture containing a substantial proportion of isobutane, causing said reaction mixture to remove a portion of said catalyst from said first zone, maintaining a higher catalyst concentration in said first zone than in the effluent therefrom, directing substantially the whole of the resultant effluent from said first zone to a plurality of points in a second contact zone containing a solid packing material maintained at a temperature of from about —20° to about 120° C. under a superatmospheric pressure, and introducing to at least one point intermediate the inlet and outlet of said second zone from an outside source a normally gaseous olefin to effect alkylation of said isobutane in the presence of the aluminum chloride catalyst and packing material in said second zone to form branched chain paraffin hydrocarbons of gasoline boiling range.

18. A process for producing more valuable products from normal and mildly branched chain paraffins which comprises passing a stream of said paraffins at isomerizing conditions through a first contact zone containing a Friedel-Crafts type catalyst and therein isomerizing a substantial portion of said paraffins, removing a portion of the catalyst with the effluent from said first zone, introducing said effluent to a second zone containing a solid contact mass and collecting a substantial portion of the catalyst in said effluent on said contact mass, simultaneously introducing olefin hydrocarbons to said second zone, reacting olefins with isoparaffins in said second zone and removing resultant reaction products from the outlet end thereof.

19. The process of claim 18 further characterized in that said Friedel-Crafts type catalyst comprises aluminum chloride.

20. The process of claim 18 further characterized in that the paraffin comprises normal butane and the olefin comprises butenes.

21. A process for the conversion of hydrocarbons which comprises passing a stream of paraffinic fluid through and in relative movement with a bulk supply of metal halide catalyst of the Friedel-Crafts type in a first zone under conditions such that only a portion of said catalyst is picked up by and carried in said stream, said fluid and conditions being such that no appreciable chemical reaction is effected between the fluid and said catalyst in the first zone, introducing the catalyst-containing effluent from said first zone and an olefinic reactant to a second zone maintained under alkylating conditions, and reacting a substantial portion of said paraffinic fluid with said olefinic reactant in said second zone in the presence of catalyst supplied thereto from the first zone.

22. The process of claim 21 further characterized in that said second zone contains a body of solid packing material upon which is deposited catalyst supplied to said second zone in the effluent from said first zone.

23. The process as defined in claim 21 further characterized in that said fluid is passed through said bulk supply in vaporous form.

24. A hydrocarbon conversion process which comprises passing a stream of normal paraffins through and in relative movement with a bulk supply of metal halide catalyst of the Friedel-Crafts type in a first zone, isomerizing a substantial portion of the paraffins in said zone to form isoparaffins, removing a portion of said catalyst with the hydrocarbon stream discharging from said zone, introducing the resultant catalyst-containing stream to a second zone maintained under alkylating conditions, and reacting at least a portion of said isoparaffins with olefins in said second zone in the presence of catalyst supplied thereto from the first zone.

25. The process of claim 18 further characterized in that the olefin hydrocarbon comprises ethylene.

26. The process of claim 21 further characterized in that the reaction in said second zone is accomplished in the presence of a hydrogen halide.

27. The process of claim 24 further characterized in that said metal halide comprises aluminum chloride and hydrogen chloride is supplied to said first zone.

28. The process of claim 1 further characterized in that said saturated hydrocarbon comprises a naphthenic hydrocarbon.

29. The process of claim 1 further characterized in that said saturated hydrocarbon comprises a mixture of naphthenic and paraffinic hydrocarbons.

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