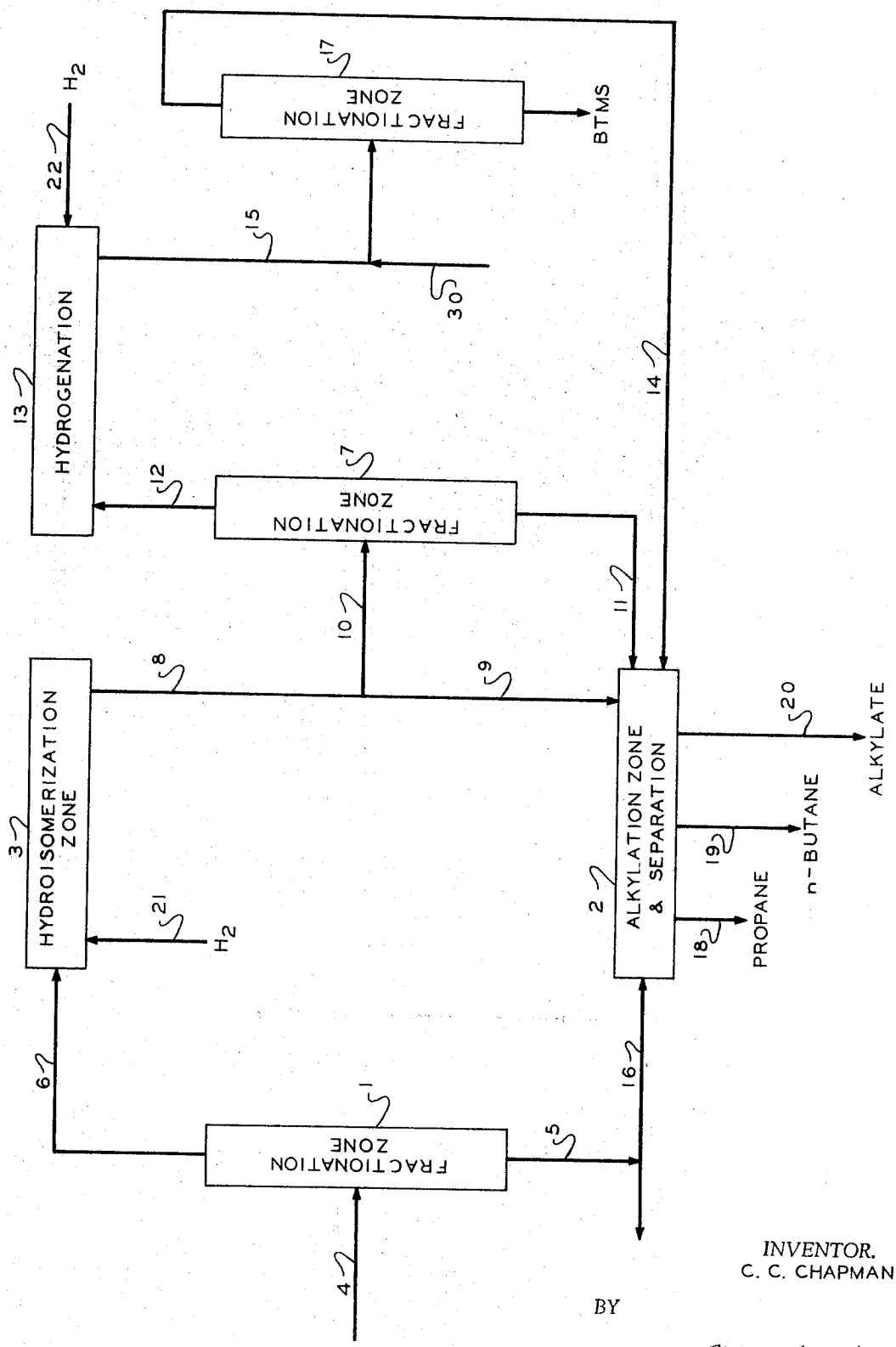
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ALKYLATION WITH CHARGE STOCK FROM ISOMERIZATION AND HYDROGENATION REACTIONS

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ALKYLATION WITH CHARGE STOCK FROM ISOMERIZATION AND HYDROGENATION REACTIONS

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ABSTRACT OF THE DISCLOSURE

An alkylation feedstock comprising butene-1, butene-2, isobutylene and n-butane is fractionated to produce streams which are isomerized to convert the butene-1 to butene-2, or which are hydrogenated to convert the isobutylene to isobutane. A plurality of streams are thus directed to alkylation to provide increased yield of alkylate.

This invention pertains to the alkylation of hydrocarbons.

In one of its more specific aspects, this invention pertains to the preparation of feedstocks for alkylation.

Both hydrocarbon hydrogenation and hydroisomerization processes are well known and have been employed for some time in producing high octane blending stocks for motor fuels. There has now been developed a process in which the two processes have been integrated to produce optimum feedstocks for alkylation.

According to the method of this invention there is provided a process for preparing a charge stock to an alkylation unit from a feedstream comprising butene-1, butene-2, isobutylene, isobutane and n-butane in which a separation, or fractionation, is made to produce stream *a* containing isobutylene, butene-1, and isobutane and stream *b* containing butene-2 and n-butane; stream *a* is hydroisomerized to convert butene-1 to butene-2 as products contained in stream *c*; stream *c* is separated or fractionated to produce stream *d* containing the isobutylene and isobutane and stream *e* containing butene-2; stream *d* is hydroisomerized to produce stream *f*, a stream containing isobutene, and streams *b*, *e* and *f* are charged to an alkylation unit.

Accordingly, it is an object of the present invention to produce optimum alkylation feedstocks.

The method of this invention will be more easily understood if explained in conjunction with the attached figure which shows a simplified flow diagram of the process.

The principal conversion processes involved in the method of this invention are hydroisomerization and hydrogenation. Both of these procedures, together with the intermediate separation, preferably fractionation, steps are well known and any of the variety of such processes may be employed to effect the process changes referred to. Hence, the details of the specific conditions under which any of these processes are carried out need not be recited.

Referring now to the attached drawing there is shown, introduced into fractionation zone **1** through conduit **4**, a charge stock material. From fractionation zone **1**, two streams are recovered, one through overhead conduit **6** and one through bottoms conduit **5**, assuming the fractionation to be conducted at about 95 p.s.i.a., at a bottom tower temperature of about 150° F. and a top tower temperature of about 127° F. (All streams discussed herein are designated with the same number as that conduit through which they are passed. All stream quantities are given in metric tons per day.) Stream quantities around fractionation zone **1** are as follows:

	Stream No.			
	4	5	16	6
Identification	Charge stock	Bottoms from fractionation Zone 1	Portion of Stream 5 to alkylation unit	Overhead from fractionation Zone 1
Propylene	2.23			2.23
Propane	18.53			18.53
Butadiene	9.98			9.98
Isobutylene	188.03	11.21	0.52	176.82
Butene-1	208.69	16.30	0.76	192.39
Butene-2	391.50	386.80	18.05	4.70
Isobutane	148.53	0.63	0.03	147.90
n-Butane	653.29	612.16	28.56	41.13
Amylenes	4.81	4.81	0.22	
Isopentanes	13.25	13.25	0.64	
n-Pentane	3.16	3.16	0.14	

About 49 metric tons per day of stream **5** is passed into the alkylation unit **2** through conduit **16**, the balance of stream **5** being otherwise disposed of. Stream **6** passes into the hydroisomerization unit **3** into which 0.51 metric ton per day of hydrogen are introduced through conduit **21**. The product issuing from the hydroisomerization unit through conduit **8** is passed into fractionation zone **7** through conduit **10**. Depending upon the availability of isobutane, as provided in the after-discussed stream **30**, it may be advantageous to split stream **8** into streams **9** and **10**, stream **9** being introduced directly into the alkylation unit. While the invention is not meant to be so limited, it will be assumed herein that this procedure is followed. In this instance, compositions of these streams are as follows when employing conventional hydroisomerization catalysts and space velocities at a pressure of about 100 p.s.i.a. and a catalyst bed temperature of about 350° F.

	Stream No.		
	8	9	10
Identification	Hydroisomerization product	To alkylation Zone 2	To fractionation Zone 7
Propylene	2.21	0.62	1.59
Propane	18.55	5.19	13.36
Isobutylene	175.06	49.02	126.04
Butene-1	22.27	6.23	16.04
Butene-2	183.09	51.26	131.83
Isobutane	149.73	41.92	107.81
n-Butane	43.28	12.12	31.16

Stream **10**, passing into fractionation zone **7**, is fractionated at a pressure of about 95 p.s.i.a. at a top tower temperature of about 125° F. and a bottom tower temperature of about 146° F., to produce a bottoms product through conduit **11** and an overhead stream through conduit **12**. Analysis of these two streams into which stream **10** is separated is as follows:

	Stream No.	
	12	11
Identification	Overhead from fractionation Zone 7	Bottoms from fractionation Zone 7
Propylene	1.59	
Propane	13.36	
Isobutylene	94.55	31.49
Butene-1	11.63	4.41
Butene-2	5.57	126.26
Isobutane	106.08	1.73
n-Butane	3.65	27.51

Stream **11** is introduced into the alkylation unit whereas stream **12**, and 4.09 metric tons per day of hydrogen added through conduit **22**, are introduced into hydrogenation unit **13**. This hydrogenation unit will be operated under any of the conventional operating conditions with any of the commercially available catalysts to hydrogenate, primarily, the unsaturated butenes to butane. The

product from the hydrogenation unit is conducted through conduit **15** into fractionation zone **17**. Additional isobutane can be introduced into fractionation zone **17** through conduit **30** to be fractionated so as to produce an overhead stream high in isobutane content through conduit **14**.

When fractionation zone **17** is operated at about 135 p.s.i.a. at a top tower temperature of about 150° F. and a bottom tower temperature of about 172° F., an analysis of its feed and overhead streams is as follows:

	Stream No.		
	15	30	14
Identification	Product from hydrogenation Zone 13	Added isobutane	Overhead from fractionation Zone 17
Propylene		3.26	
Propane	15.25		18.26
Isobutylene			
Butene-1			
Butene-2			
Isobutane	204.15	63.84	260.00
n-Butane	21.12	163.57	13.55
Isopentane		2.10	
n-Pentane		0.23	

As a result, there are introduced into alkylation zone **2**, and into which is equipped with recovery facilities for the separation of the alkylate product, a plurality of streams which are directed to maximizing the yield of alkylate from the original charge stock.

The alkylation process is conventional within the art, for example, being operated at a pressure of about 100 p.s.i.a. and at a temperature of 100° F., employing hydrofluoric acid in an amount about 1 volume of acid per volume of hydrocarbon, the isobutane olefin mole ratio being about 10 to 1. Under these conditions, the propane stream, n-butane stream and alkylate product recovered through conduits **18**, **19**, and **20**, respectively, have the analyses as shown below, in metric tons per day.

	Stream No.		
	18	19	20
Identification	Propane cut from alkylation unit	Butane cut from alkylation unit	Alkylate product
Propane	23.45		
Isobutane	0.22	3.52	
n-Butane		77.85	3.89
Isopentane		0.62	
n-Pentane		0.14	
Alkylate		0.89	587.17

It will be seen from the above data that a considerable alkylate yield is realized by the method of this invention with only a minimal loss of olefins.

In fact, the method of this invention provides an increase in alkylate octane of about 4 to 5 units (RON clear) over that produced when the original charge stock material is introduced directly into the alkylation unit. Also, there is some increase in volume of alkylate produced by the invention.

It will be evident from the foregoing that various modifications can be made to the method of this invention. Such, however, are considered as being within the scope of the invention.

What is claimed is:

1. A method of preparing a charge stock to an alkylation from a feed-stream comprising butene-1, butene-2, isobutylene, isobutane and n-butane which comprises

(a) separating said feedstream into a first and a second stream, a principal portion of said isobutylene, butene-1 and isobutane being contained in said first stream and a principal portion of said butene-2 and said n-butane being contained in said second stream;

(b) converting a principal portion of the butene-1 of said first stream to butene-2 to produce a third stream containing principally isobutylene, butene-2 and isobutane;

(c) separating said third stream into a fourth and a fifth stream, a principal portion of said isobutylene and isobutane being contained in said fourth stream and a principal portion of said butene-2 being contained in said fifth stream;

(d) converting a principal portion of the isobutylene to said fourth stream to isobutane and to produce a sixth stream containing principally isobutane; and,

(e) introducing said second, fifth and sixth streams into an alkylation unit.

2. The method of claim **1** in which a portion of said third stream and a stream comprising principally isobutane are introduced into said alkylation unit.

3. The method of claim **2** in which the separating of said feedstream into a first and second stream and separating of said third stream into a fourth and fifth stream are done by fractionation.

4. The method of claim **2** in which a principal portion of the butene-1 of said first stream is converted to butene-2 by isomerization.

5. The method of claim **2** in which a principal portion of the isobutylene of said fourth stream is converted to isobutane by hydrogenation.

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