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[54] **HF ALKYLATION SYSTEM UTILIZING ALKYLATE STREAM REBOIL**

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[52] **U.S. Cl.** **260/683.48,** 260/683.42

[51] **Int. Cl.** **C07c 3/54**

[58] **Field of Search**..... 260/683.48, 683.43, 683.58, 260/683.59

[56] **References Cited**

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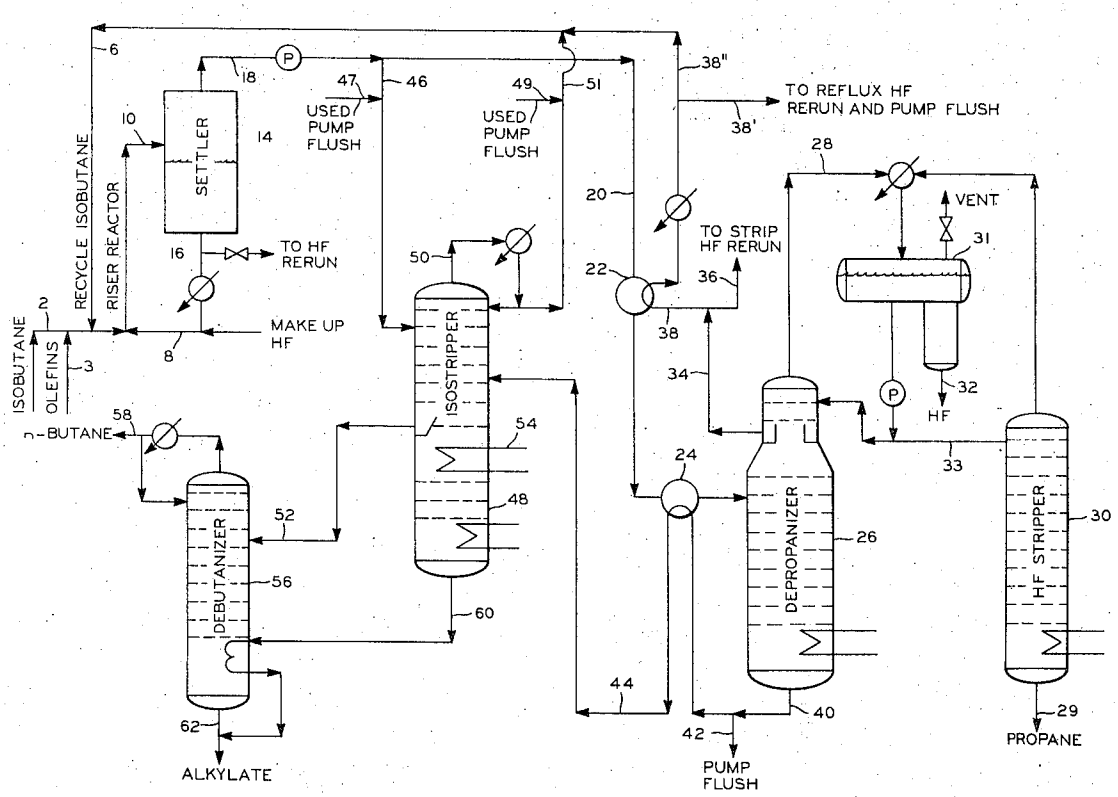
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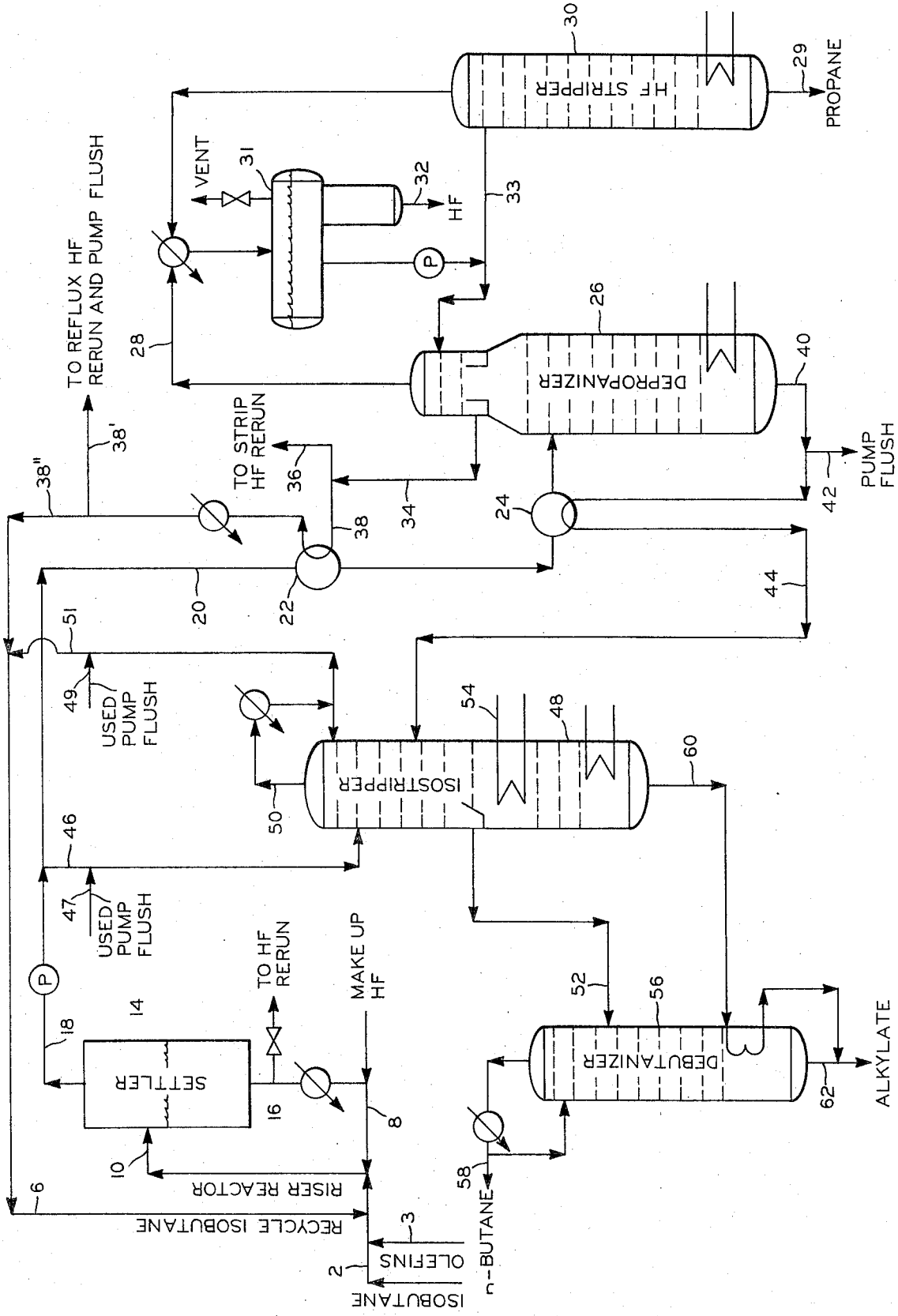
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[57] **ABSTRACT**

A side draw stream from an isostripper to a debutanizer is removed from the isostripper as a liquid stream of normal butane and higher hydrocarbons. The alkylate-containing bottoms from the isostripper are used to indirectly heat or reboil the bottom of the debutanizer. Alkylate is recovered from the reboiler line as well as from the debutanizer.

2 Claims, 1 Drawing Figure




HF STRIPPER
30
29
PROPANE
VENT
31
32
HF
33
TO REFLUX HF
RERUN AND PUMP FLUSH
38'
28
DEPROPANIZER
26
40
TO STRIP
HF RERUN
36
38
34
38"
24
PUMP
FLUSH
42
20
22
44
51
49
USED
PUMP
FLUSH
54
48
ISOSTRIPPER
60
50
46
47
USED
PUMP
FLUSH
TO HF
RERUN
MAKE UP
HF
52
56
DEBUTANIZER
62
ALKYLATE
14
18
SETTLER
16
8
10
RISER REACTOR
58
n-BUTANE
6
RECYCLE ISOBUTANE
3
OLEFINS
2
ISOBUTANE

HF ALKYLATION SYSTEM UTILIZING ALKYLATE STREAM REBOIL

In HF alkylation, it is desirable to fractionate a product resulting from reaction of isobutane, olefins, and hydrofluoric acid catalysts while maintaining the energy requirements for said fractionation at a low level. This is particularly important where energy is valuable and the products for generating the energy are in relatively short supply.

This invention, therefore, resides in an improved HF alkylation system wherein a side draw stream passing from a first fractionation zone into a second fractionation zone is removed from the first fractionation zone at a location at which said side draw stream comprises substantially liquid normal butane and heavier hydrocarbons.

Other aspects, objects, and advantages of the present invention will become apparent from a study of the disclosure, the appended claims, and the drawing.

The drawing is a diagrammatic view of an example HF alkylation system.

Referring to the drawing, isobutane **2**, olefin **3**, recycle isobutane **6**, liquid feed streams are charged along with liquid hydrofluoric acid catalyst **8** to HF alkylation riser-reaction zone **10**, wherein the isobutane is alkylated with the olefins to produce gasoline alkylate. The emulsion of hydrocarbon and HF catalyst from riser-reactor **10** is passed to a phase separation zone **14** wherefrom settled catalyst **16** is removed, cooled, and recycled to the riser-reaction zone **10**. A portion of the catalyst can be removed and charged to conventional HF rerun facilities, not shown. Rerun HF and make-up HF can be added back to the alkylation system.

The hydrocarbon liquid phase **18** is passed to fractionation. One portion **20**, sufficient to prevent build-up of light hydrocarbons, e.g., propane, is passed via side draw and bottoms indirect heat exchange **22, 24** to a depropanizer **26**. Overhead vapors **28** from the depropanizer **26** are condensed, along with subsequently

recovered vapors from an HF stripper **30**, are passed to accumulator **31** and an HF phase **32** is recovered, as liquid, and recycled to alkylation. The liquid hydrocarbon phase yield **33** is passed to the HF stripper **30** to yield an LPG (liquefied petroleum gas) propane product **29**.

A liquid side draw **34**, comprising isobutane, is removed from the depropanizer **26** and a portion **36** thereof is vaporized and used to strip the HG rerun unit (not shown). The remainder **38** is further cooled, a portion **38'** being used as pump flush and as reflux for the HF rerun unit (not shown), and this remainder **38''** is recycled to the alkylation zone as a portion of the recycled isobutane **6**. Bottoms **40** from the depropanizer **26**, in part are used as other pump flush **42**, and the remainder major portion **44** is charged to a first fractionation zone or isostripper **48** as the "lower" feed thereto. The remainder **46** of the alkylation reactor effluent **18** along with recovered pump flush **47** is charged as "top" feed to the isostripper **48**.

Overhead vapors **50**, mainly isobutane, are removed from the isostripper **48**, condensed, and, along with recovered pump flush **49**, are returned via **51** as recycle isobutane liquid **6**.

A side draw liquid stream **52** is removed from, for example, above on inter-heater **54** of the isostripper **48** and charged to a second fractionation zone or debutanizer **56**. Bottoms **60** from the isostripper **48** are used to indirectly (reboil) heat the bottom of the debutanizer **56**, and are removed from the system with the bottoms yield **62** from the debutanizer **56** as the alkylate product.

The side draw stream **52** is withdrawn from the isostripper **48** at a location at which said side draw stream **52** is substantially liquid normal butane and heavier hydrocarbons. Normal butane is removed from debutanizer **56** via **58**.

Example operation of the HF alkylation system is as follows:

EXAMPLE (BARRELS PER DAY HYDROCARBON FLOW)

						Feed to DeC_3			DeC_3 Yields				
	Isobutane Feed	Olefin Feed	Recycle Isobutane	Total Feed to Reactor	Reactor Effluent	Reactor Effluent	From Pump Flush	Total	DC_3 Side Draw	Side Draw to Recycle	Bottoms Yield	Accum. HF	To HF Stripper
(HF)	-	-	(167)	(167)	(278)	(111)	-	(111)	-	-	-	(111)	(7)
Ethane	-	4	6	10	10	4	-	4	-	-	-	-	30
Propylene	-	899	-	899	-	-	-	-	-	-	-	-	-
Propane	27	338	1,945	2,310	2,490	996	-	996	475	439	6	15	880
Isobutane	2,603	986	32,954	36,543	33,600	13,440	78	13,518	9,455	8,733	4,055	-	12
Butenes	-	1,127	-	1,127	-	-	-	-	-	-	-	-	-
Normal Butane	110	743	3,409	4,262	4,318	1,727	17	1,744	883	815	861	-	-
Amylenes	-	785	-	785	-	-	-	-	-	-	-	-	-
Pentanes Plus	-	772	583	1,355	6,515	2,606	49	2,655	97	90	2,558	-	-
Total Hydrocarbon	2,740	5,654	38,897	47,291	46,933	18,773	144	18,917	10,910*	10,077	7,480	15	922
Total	2,740	5,654	39,064	47,458	47,211	18,884	144	19,028	10,910	10,077	7,480	126	929
Conduit Number	(4)	(3)	(6)	(7)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)

* (To Recycle iC_4 - 10,077)
(To HF Rerun & Pump Flush 833)
Pump Flush - 288
Rerun Stripping - 454
Rerun Reflux - 91

See drawing for numbers, pressures, temperatures

EXAMPLE (continued)

	Feed to Isostripper				Isostripper Yields					DeC_4		
	Propane Product	Total	Lower from DC_3	Total	Over-head	Pump Flush	Total iC_4 Recycle	Bottoms	Side Draw	Over-head	Bottoms	Alkylate Product
(HF)	-	(167)	-	(167)	(167)	-	(167)	-	-	-	-	
Ethane	4	6	-	6	6	-	6	-	-	-	-	
Propylene	-	-	-	-	-	-	-	-	-	-	-	
Propane	500	1,494	6	1,500	1,500	6	1,506	-	-	-	-	
Isobutane	8	20,238	3,899	24,137	24,096	125	24,221	3	38	38	-	3
Butenes	-	-	-	-	-	-	-	-	-	-	-	
Normal Butane	-	2,608	827	3,435	2,582	12	2,594	121	732	710	22	143
Amylenes	-	-	-	-	-	-	-	-	-	-	-	
Pentanes Plus	-	3,958	2,460	6,418	492	1	493	5,331	595	17	578	5,909
Total Hydrocarbon	512	28,304	7,192	35,496	28,676	144	28,820	5,455	1,365	765	600	6,055
Total	512	28,471	7,192	35,663	28,843	144	28,987	5,455	1,365	765	600	6,055

Operating Conditions:

Preferred alkylation temperature range 40° F.–150° F., more preferably 75° F.–140° F. in reaction zone **10.**

Preferred HF catalyst to hydrocarbon volume ratio range in reaction zone 1:1 to 10:1.

Preferred external isobutane to olefin mol ratio range 2:1 to 30:1.

Preferred pressure is sufficient to maintain liquid phases in the alkylation zone, e.g., 150 psia and above.

Preferred isoparaffin feed...isobutane and/or isopentane.

Preferred olefin feed...propylene and/or butylenes and/or amylenes.

HF catalyst can preferably contain up to about 10 weight percent acid-soluble oils, preferably below 5 weight percent acid-soluble oils, up to 10 weight percent water, preferably less than about 5 weight percent water.

Preferred residence or contact time in the reaction zone is 5 to 500 seconds, more preferably 10 to 240 seconds.

Typical Tower Conditions	
Depropanizer 26:	
Top Temperature, °F.	131
Bottom Temperature, °F.	255
Pressure, psia	300
HF Stripper 30:	
Top Temperature, °F.	128
Bottom Temperature, °F.	145
Pressure, psia	330
Isostripper 48:	
Top Temperature, °F.	148
Bottom Temperature, °F.	343
Side Draw(52)Temperature, °F.	197
Pressure, psia	135
Debutanizer 56:	
Top Temperature, °F.	136
Bottom Temperature, °F.	220
Pressure, psia	100

By the use of this invention wherein liquid, as opposed to vapors, are passed from the first to the second fractionation zone, normal butane of a higher purity is passed to the debutanizing zone, thereby decreasing the amount of isostripper energy requirements for heating and permitting the use of a smaller debutanizing column.

Other modifications and alterations of this invention will become apparent to those skilled in the art from the foregoing discussion and accompanying drawing, and it should be understood that this invention is not to be unduly limited thereto.

What is claimed is:

1. In an HF-alkylation process wherein isoparaffin, olefin and hydrofluoric acid catalysts are reacted in a reaction zone to form an alkylate, wherein the alkylate-containing hydrocarbon is passed into a first fractionation zone to remove unreacted isoparaffin, wherein a side draw stream is separated from said first fractionation zone and wherein said side draw stream is passed into a second fractionation zone,

the improvement which comprises

separating said side draw stream from the first fractionation zone as a liquid stream consisting substantially of normal butane and heavier hydrocarbon,

separating normal butane from said second fractionation zone, and

passing the alkylate-containing bottoms from said first fractionation zone into the bottom portion of said second fractionation zone as reboil for said second fractionation zone.

2. The process of claim **1** wherein a first portion of the alkylate product is recovered from said second fractionation zone and a second portion of said product is recovered from said alkylate-containing bottoms from said first fractionation zone.

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