

Appendix IV: Experimental Data

TABLE 1

Measured Performance of Catapal B Gamma Alumina Catalyst
Isobutanol Injected into Vaporizer Unit

Run # 11782-	Temp (°C)	Pressure (psig)	Isobutanol Feed (g/kg-hr)	Inlet GHSV (sl/kg-hr)	Isobutanol Conversion %	Isobutene Rate (g/kg-hr)	Linear C4 Rate (g/kg-hr)	Ether Rate (g/kg-hr)	Water Rate (g/kg-hr)	Isobutene Selectivity (wt%)	Carbon Recovery %
78A	250	150	416.0	2580	33.5	81.9	2.9	18.0	30.9	78.5	101
78B	250	500	416.0	2367	20.7	45.7	1.1	15.6	18.2	71.3	101
78C	250	500	1040.0	6372	14.1	76.9	1.9	26.2	30.7	71.1	101
78D	250	150	1040.0	6352	21.2	121.2	3.0	22.5	44.2	80.9	99
78A-2	250	150	416.0	2407	35.7	74.0	2.4	13.9	27.4	80.9	95
78E	330	158	416.0	2453	98.3	300.8	26.9	0.0	105.3	91.5	106
78F	330	501	416.0	2357	98.1	302.8	23.7	0.0	105.1	92.4	106
78G	330	503	1040.0	6158	94.8	751.4	55.7	0.5	259.7	92.7	108
78H	330	149	1040.0	6433	86.4	687.3	57.8	0.0	239.4	92.0	109
78E-2	330	149	416.0	2480	97.8	301.6	26.1	0.0	105.3	91.8	107

5% isobutanol, 95% nitrogen; slurry: 30.07 g catalyst, 120.86 g Drakeol 10 oil
inlet GHSV based on nitrogen and isobutanol
linear C4 = 1-butene, cis-2-butene, and trans-2-butene; ether = diisobutyl ether
water rate was calculated based on rates of butenes, ether, and traces of propene, butane, and isobutane
isobutene selectivity based on water free product distribution

TABLE 2
Measured Performance of Catapal B Gamma Alumina Catalyst
Isobutanol Injected Directly into Reactor

Run # 11782-	Temp (°C)	Pressure (psig)	Isobutanol Feed (g/kg-hr)	Inlet GHSV (sl/kg-hr)	Isobutanol Conversion %	Isobutene Rate (g/kg-hr)	Linear C4 Rate (g/kg-hr)	Ether Rate (g/kg-hr)	Water Rate (g/kg-hr)	Isobutene Selectivity (wt%)	Carbon Recovery %
88A	250	151	410.6	2645	31.9	122.5	3.1	16.0	43.6	86.1	115
88B	250	499	410.6	2614	19.7	66.3	1.3	16.4	25.1	77.8	109
88D	250	500	1026.6	6281	15.6	167.3	3.7	27.9	60.6	83.2	111
88I	290	149	410.6	2550	89.3	317.6	17.5	1.0	107.9	94.2	119
88J	290	500	410.6	2479	70.6	273.3	10.8	7.2	92.9	93.3	124
88K	290	150	1026.6	6278	71.5	647.1	31.0	11.6	220.3	93.4	106
88E	332	152	410.6	2570	99.6	322.6	30.1	0.0	113.3	91.3	114
88N*	332	152	895.0	2717	97.4	635.1	52.0	0.5	221.0	91.9	105
88M**	332	152	1316.2	2844	95.0	1036.9	80.1	0.5	359.4	92.3	118
88H	329	156	1026.6	6198	97.4	727.5	60.2	0.0	253.2	92.0	104
88G	329	500	1026.6	6268	94.8	716.3	52.3	0.5	247.3	92.6	105
88O	329	750	1026.6	6177	92.1	702.8	47.2	1.2	241.6	92.9	105

5% isobutanol, 95% nitrogen; *10% isobutanol, 90% nitrogen; ** 15% isobutanol, 85% nitrogen; slurry: 30.46 g catalyst, 120.68 g Drakeol 10 oil
inlet GHSV based on nitrogen and isobutanol, linear C4 = 1-butene, cis-2-butene, and trans-2-butene; ether = diisobutyl ether
water rate was calculated based on rates of butenes, ether, and traces of propene, butane, and isobutane
isobutene selectivity based on water free product distribution

TABLE 3

Measured Performance of Versal B Eta Alumina Catalyst
Isobutanol Injected Directly into Reactor

Run # 11782-	Temp (°C)	Pressure (psig)	Isobutanol Feed (g/kg-hr)	Inlet GHSV (sl/kg-hr)	Isobutanol Conversion %	Isobutene Rate (g/kg-hr)	Linear C4 Rate (g/kg-hr)	Ether Rate (g/kg-hr)	Water Rate (g/kg-hr)	Isobutene Selectivity (wt%)	Carbon Recovery %
92A	271	154	404.1	2582	48.2	139.9	6.5	14.8	50.1	86.2	106
92B	269	158	1010.3	6275	27.3	262.0	8.4	35.4	94.1	84.9	114
92C	329	156	404.1	2582	98.6	312.4	25.2	0.2	108.6	92.3	112
92D	330	158	1010.3	6076	96.1	758.3	58.3	0.3	262.5	92.5	111
92E	329	157	388.6	2548	98.9	290.8	24.6	0.1	101.4	92.0	109
92F*	331	158	906.7	2705	95.1	660.8	51.1	0.4	229.0	92.3	109
92G*	329	501	906.7	2639	81.5	582.1	37.6	5.2	200.4	92.4	110
92H*	329	99	906.7	2781	93.1	647.2	48.0	0.8	223.6	92.6	109
92I	329	150	388.6	2552	97.7	295.7	24.8	0.0	103.0	91.9	112
92J	270	150	388.6	2552	44.5	135.7	5.2	10.5	47.4	89.2	108

5% isobutanol, 95% nitrogen; * 10% isobutanol, 90% nitrogen; slurry: 30.95 g catalyst, 122.05 g Drakeol 10 oil
inlet GHSV based on nitrogen and isobutanol
linear C4 = 1-butene, cis-2-butene, and trans-2-butene; ether = diisobutyl ether
water rate was calculated based on rates of butenes, ether, and traces of propene, butane, and isobutane
isobutene selectivity based on water free product distribution
runs A-D performed using Isco 314 syringe pump, runs E-J performed using Isco LC-5000 syringe pump

TABLE 4

Measured Performance of Catapal B Gamma Alumina Catalyst
Doped with 0.2 wt.% Potassium

Run # 11782-	Temp (°C)	Pressure (psig)	Isobutanol Feed (g/kg-hr)	Inlet GHSV (sl/kg-hr)	Isobutanol Conversion %	Isobutene Rate (g/kg-hr)	Linear C4 Rate (g/kg-hr)	Ether Rate (g/kg-hr)	Water Rate (g/kg-hr)	Isobutene Selectivity (wt%)	Carbon Recovery %
98A	269	154	400.8	2526	19.6	59.5	1.6	17.7	23.2	75.0	108
98B*	267	500	400.8	2478	42.8	35.5	0.3	11.9	13.9	73.3	74
98C	273	151	1068.7	6474	12.7	127.3	2.7	34.6	2.7	76.2	109
98D	328	151	400.8	2605	94.1	297.6	18.6	0.6	101.7	93.6	111
98E	329	501	400.8	2510	89.3	283.4	15.9	1.2	5.4	93.9	110
98F	330	148	1068.7	6378	84.3	712.4	40.0	4.7	242.7	93.7	110

5% isobutanol, 95% nitrogen; slurry: 30.01 g catalyst, 120.01 g Drakeol 10 oil
inlet GHSV based on nitrogen and isobutanol
linear C4 = 1-butene, cis-2-butene, and trans-2-butene; ether = diisobutyl ether
water rate was calculated based on rates of butenes, ether, and traces of propene, butane, and isobutane
isobutene selectivity based on water free product distribution
* low concentration of isobutanol measured in the outlet flow, reason for this is unknown

TABLE 5

Measured Performance of Catapal B Gamma Alumina Catalyst
Doped with 0.5 wt.% Potassium

Run # 11782-	Temp (°C)	Pressure (psig)	Isobutanol Feed (g/kg-hr)	Inlet GHSV (sl/kg-hr)	Isobutanol Conversion %	Isobutene Rate (g/kg-hr)	Linear C4 Rate (g/kg-hr)	Ether Rate (g/kg-hr)	Water Rate (g/kg-hr)	Isobutene Selectivity (wt%)	Carbon Recovery %
01A	269	149	400.9	2553	13.1	37.4	0.7	15.0	15.3	69.4	106
01B	269	151	1069.1	6310	11.1	48.8	0.6	21.3	1.1	67.7	99
01C	328	149	400.9	2568	84.9	266.6	11.4	2.0	89.7	94.8	108
01D	329	152	1069.1	6279	67.6	551.9	23.2	18.3	188.5	92.5	107
01E	331	147	280.6	1672	89.5	195.5	9.3	0.7	66.0	94.7	108

5% isobutanol, 95% nitrogen; slurry: 30.00 g catalyst, 120.00 g Drakeol 10 oil
inlet GHSV based on nitrogen and isobutanol
linear C4 = 1-butene, cis-2-butene, and trans-2-butene; ether = diisobutyl ether
water rate was calculated based on rates of butenes, ether, and traces of propene, butane, and isobutane
isobutene selectivity based on water free product distribution

TABLE 6

Measured Performance of Catapal B Gamma Alumina Catalyst
Doped with 0.8 wt. % Potassium

Run #	Temp (°C)	Pressure (psig)	Isobutanol Feed (g/kg-hr)	Inlet GHSV (sl/kg-hr)	Isobutanol Conversion %	Isobutene Rate (g/kg-hr)	Linear C4 Rate (g/kg-hr)	Ether Rate (g/kg-hr)	Water Rate (g/kg-hr)	Isobutene Selectivity (wt %)	Carbon Recovery %
13033-1A*	270	151	400.8	2527	-5.9	17.5	0.2	14.1	5.7	53.5	116
1B	270	161	1068.7	6399	3.4	21.3	0.2	17.7	9.3	53.3	101
1C	329	156	400.8	2572	67.7	212.3	8.2	12.5	72.5	90.5	109
1D	330	159	1068.7	6338	45.6	369.3	13.4	53.6	130.3	83.5	108
1E	331	150	179.0	1184	84.5	115.1	4.8	1.5	38.7	94.2	105
1F**	329	153	1258.4	982	70.1	299.7	9.0	53.1	106.5	81.1	68

5% isobutanol, 95% nitrogen; slurry: 30.01 g catalyst, 120.11 g Drakeol 10 oil

inlet GHSV based on nitrogen and isobutanol

linear C4 = 1-butene, cis-2-butene, and trans-2-butene; ether = diisobutyl ether

water rate was calculated based on rates of butenes, ether, and traces of propene, butane, and isobutane

isobutene selectivity based on water free product distribution

* high concentration of isobutanol measured in the outlet flow, reason for this is unknown

** 39% isobutanol, 61% nitrogen; low carbon recovery due to condensation of isobutanol in the line between the reactor and GC

TABLE 7

Measured Performance of Catapal B Gamma Alumina Catalyst
Doped with 0.5 wt. % Potassium, Dried at 120 C before Calcination

Run # 13033-	Temp (°C)	Pressure (psig)	Isobutanol Feed (g/kg-hr)	Inlet GHSV (sl/kg-hr)	Isobutanol Conversion %	Isobutene Rate (g/kg-hr)	Linear C4 Rate (g/kg-hr)	Ether Rate (g/kg-hr)	Water Rate (g/kg-hr)	Isobutene Selectivity (wt%)	Carbon Recovery %
7A	271	149	400.9	2513	17.3	33.8	0.7	21.1	13.9	59.0	101
7B	329	154	1069.1	6239	69.9	529.3	22.3	30.5	181.8	90.3	102
7C	330	145	400.9	2582	86.2	254.1	12.0	3.1	86.4	93.8	103
7D	329	33	280.6	1669	92.2	186.1	9.7	0.5	62.9	94.3	101
7E*	331	33	230.3	1689	92.1	151.5	7.5	0.3	61.1	78.9	103

5% isobutanol, 95% nitrogen; slurry: 30.00 g catalyst, 120.10 g Drakeol 10 oil
inlet GHSV based on nitrogen and isobutanol
linear C4 = 1-butene, cis-2-butene, and trans-2-butene; ether = diisobutyl ether
water rate was calculated based on rates of butenes, ether, and traces of propene, butane, and isobutane
isobutene selectivity based on water free product distribution, theoretical isobutene selectivity = 86.2%
*feed consisted of 2 moles isobutanol / 1 mole methanol, GHSV measured based on total feed

TABLE 8

Measured Performance of Versal B Eta Alumina Catalyst
Doped with 0.2 wt.% Potassium

Run # 13033-	Temp (°C)	Pressure (psig)	Isobutanol Feed (g/kg-hr)	Inlet GHSV (sl/kg-hr)	Isobutanol Conversion %	Isobutene Rate (g/kg-hr)	Linear C4 Rate (g/kg-hr)	Ether Rate (g/kg-hr)	Water Rate (g/kg-hr)	Isobutene Selectivity (wt%)	Carbon Recovery %
9A	249	155	400.5	2473	16.6	41.6	0.7	19.3	16.2	66.9	103
9B	269	154	400.5	2473	50.9	127.5	3.5	24.5	45.5	81.3	100
9C	290	156	400.5	2484	78.2	225.1	8.4	8.6	76.2	92.8	101
9D	310	155	400.5	2484	93.1	273.5	12.5	1.0	92.1	94.9	102
9E	329	157	400.5	2508	98.0	278.8	17.7	0.0	95.3	93.9	100
9F	330	156	1068.0	6078	93.7	713.9	43.4	1.4	243.5	93.7	101

5% isobutanol, 95% nitrogen; slurry: 30.03 g catalyst, 120.88 g Drakeol 10 oil
inlet GHSV based on nitrogen and isobutanol
linear C4 = 1-butene, cis-2-butene, and trans-2-butene; ether = diisobutyl ether
water rate was calculated based on rates of butenes, ether, and traces of propene, butane, and isobutane
isobutene selectivity based on water free product distribution

TABLE 9
Measured Performance of Versal GH Gamma Alumina Catalyst
Isobutanol Injected Directly into Reactor

Run # 13033-	Temp (°C)	Pressure (psig)	Isobutanol Feed (g/kg-hr)	Inlet GHSV (sl/kg-hr)	Isobutanol Conversion %	Isobutene Rate (g/kg-hr)	Linear C4 Rate (g/kg-hr)	Ether Rate (g/kg-hr)	Water Rate (g/kg-hr)	Isobutene Selectivity (wt%)	Carbon Recovery %
12A	290	161	396.4	2380	80.5	240.0	13.3	4.5	82.0	92.9	105
12B	290	157	1057.1	6118	58.3	455.8	20.6	32.8	157.6	89.2	105
12C	290	150	185.0	1169	90.9	125.5	7.5	0.5	42.8	93.8	105
12D	310	156	396.4	2489	95.1	278.1	20.4	0.2	96.0	92.8	105
12E	310	150	1057.1	6144	85.0	662.4	40.3	5.8	226.7	93.0	104
12F	310	150	185.0	1070	97.8	131.1	10.1	0.0	45.4	92.7	103
12G	330	154	396.4	2430	98.7	284.5	25.1	0.0	99.5	91.6	105
12H	330	159	1057.1	6120	95.6	733.2	60.9	0.4	255.3	91.9	104
12I*	330	150	185.0	1187	99.1	149.3	13.5	0.0	52.3	91.5	117

5% isobutanol, 95% nitrogen; slurry: 30.34 g catalyst, 120.08 g Drakeol 10 oil
inlet GHSV based on nitrogen and isobutanol
linear C4 = 1-butene, cis-2-butene, and trans-2-butene; ether = diisobutyl ether
water rate was calculated based on rates of butenes, ether, and traces of propene, butane, and isobutane
isobutene selectivity based on water free product distribution

* three separate runs were performed with each having a carbon recovery of 117-118%, believed to be a pump malfunction when set to this pump rate

TABLE 10
Measured Performance of Engelhard Gamma Alumina Catalyst
Isobutanol Injected Directly into Reactor

Run # 13033-	Temp (°C)	Pressure (psig)	Isobutanol Feed (g/kg-hr)	Inlet GHSV (sl/kg-hr)	Isobutanol Conversion %	Isobutene Rate (g/kg-hr)	Linear C4 Rate (g/kg-hr)	Ether Rate (g/kg-hr)	Water Rate (g/kg-hr)	Isobutene Selectivity (wt%)	Carbon Recovery %
14A	290	151	397.3	2336	93.6	270.9	20.0	0.0	93.6	92.9	103
14B	290	151	1059.5	6093	79.9	633.6	40.4	9.9	218.1	92.1	106
14C	291	150	185.4	1101	97.1	132.3	10.1	0.3	45.8	92.3	105
14D	310	152	397.3	2425	98.7	285.1	25.9	0.0	100.0	91.4	105
14E	310	154	1059.5	6017	95.5	735.2	62.8	0.4	256.6	91.9	104
14F	310	152	185.4	1134	99.4	132.3	12.5	0.0	46.5	91.1	104
14G	330	147	397.3	2445	99.7	285.6	28.1	0.0	100.9	90.8	105
14H	330	147	1059.5	6190	99.3	750.0	77.8	0.0	266.1	90.4	104
14I	330	142	185.4	1136	99.9	132.0	14.4	0.0	47.0	90.0	105
14J	290	505	397.3	2396	80.7	235.2	13.9	5.0	80.9	91.9	104
14K	287	509	1059.5	5934	59.2	451.9	21.1	39.4	157.6	87.0	105
14L	290	499	185.4	1134	89.6	119.4	6.9	1.9	40.9	92.3	102
14A-2	291	135	397.3	2523	91.9	275.5	18.7	0.7	94.7	92.9	107
14M	308	498	397.3	2376	93.8	275.0	20.2	0.5	95.1	92.5	105
14N	310	500	1059.5	5910	84.5	652.2	57.8	7.3	225.2	91.9	104
14O	312	492	185.4	1069	97.1	128.8	9.8	0.1	44.6	92.2	102

5% isobutanol, 95% nitrogen; slurry: 30.27 g catalyst, 119.95 g Drakeol 10 oil
inlet GHSV based on nitrogen and isobutanol, isobutene selectivity based on water free product distribution
linear C4 = 1-butene, cis-2-butene, and trans-2-butene; ether = diisobutyl ether
water rate was calculated based on rates of butenes, ether, and traces of propene, butane, and isobutane

TABLE 11

Measured Performance of Engelhard Gamma Alumina Catalyst
Effect of Stirrer Speed on Mass Transfer

Run # 13033-	Temp (°C)	Pressure (psig)	Stirrer Speed (RPM)	Inlet GHSV (sl/kg-hr)	Isobutanol Conversion %	Isobutene Rate (g/kg-hr)	Linear C4 Rate (g/kg-hr)	Ether Rate (g/kg-hr)	Water Rate (g/kg-hr)	Isobutene Selectivity (wt%)	Carbon Recovery %
14S	310	505	1200	11428	74.3	1166.5	74.6	32.3	403.6	90.8	105
14T	310	510	600	11495	67.2	1035.7	59.7	45.5	358.7	89.9	104
14U	310	509	2000	11495	73.3	1153.5	72.2	35.0	399.5	90.4	106
14V	310	507	800	11495	70.6	1116.7	67.1	40.1	386.3	90.2	106
14W	310	493	300	11517	58.6	977.9	55.5	75.0	342.8	87.5	110

5% isobutanol, 95% nitrogen; isobutanol feed: 2119.1 g/kg-hr
slurry: 30.27 g catalyst, 119.95 g Drakeol 10 oil
inlet GHSV based on nitrogen and isobutanol
linear C4 = 1-butene, cis-2-butene, and trans-2-butene; ether = diisobutyl ether
water rate was calculated based on rates of butenes, ether, and traces of propene, butane, and isobutane
isobutene selectivity based on water free product distribution

TABLE 12

Measured Performance of Engelhard Gamma Alumina Catalyst
Effect of Water Cofeed on Dehydration Rate, 3 moles isobutanol/ 1 mole water at 310°C

Run # 13033-	Temp (°C)	Pressure (psig)	Isobutanol Feed (g/kg-hr)	Inlet GHSV (sl/kg-hr)	Isobutanol Conversion %	Isobutene Rate (g/kg-hr)	Linear C4 Rate (g/kg-hr)	Ether Rate (g/kg-hr)	Water Rate (g/kg-hr)	Isobutene Selectivity (wt%)	Carbon Recovery %
18A	310	165	373.1	2347	94.1	268.9	21.7	1.3	127.9	91.8	109
18B	310	182	995.0	6209	86.3	643.9	46.5	3.1	307.5	92.5	106
18C	311	158	174.1	1192	97.9	123.2	10.4	0.0	58.1	91.9	104
18D	310	354	373.1	2495	93.3	243.4	19.4	0.4	114.1	91.9	100
18E	309	359	995.0	6268	80.8	594.5	41.4	7.3	301.7	91.8	105
18F	310	344	174.1	1164	96.8	116.7	9.6	1.3	52.8	91.0	100
18G	309	499	373.1	2436	89.4	241.1	17.2	1.1	113.7	92.5	103
18H	310	509	995.0	6086	75.4	546.2	33.9	12.5	271.3	91.4	104
18I	309	496	174.1	1154	95.3	113.0	8.4	92.4	53.1	92.4	98

liquid injection: 3 moles isobutanol/ 1 mole water
4.5% isobutanol, 1.5 % water, 94% nitrogen; slurry: 30.27 g catalyst, 119.95 g Drakeol 10 oil
inlet GHSV based on nitrogen and isobutanol
linear C4 = 1-butene, cis-2-butene, and trans-2-butene; ether = diisobutyl ether
isobutene selectivity based on water free product distribution
*water rate was determined by GC

TABLE 13

Measured Performance of Engelhard Gamma Alumina Catalyst
Effect of Water Cofeed on Dehydration Rate, 3 moles isobutanol/ 1 mole water at 290°C

Run # 13033-	Temp (°C)	Pressure (psig)	Isobutanol Feed (g/kg-hr)	Inlet GHSV (sl/kg-hr)	Isobutanol Conversion %	Isobutene Rate (g/kg-hr)	Linear C4 Rate (g/kg-hr)	Ether Rate (g/kg-hr)	Water Rate (g/kg-hr)	Isobutene Selectivity (wt%)	Carbon Recovery %
20A	290	148	375.6	2472	87.9	242.5	16.3	1.2	114.3	92.9	104
20B	291	159	1001.5	6450	72.1	524.7	31.2	10.8	264.0	92.2	103
20C	290	137	175.3	1210	95.1	119.7	8.8	0.2	55.9	92.8	102
20D	289	502	375.6	2406	68.7	172.6	8.1	8.1	89.1	90.9	98
20E	290	510	1001.5	6110	50.5	332.6	15.0	37.2	198.3	85.8	100
20F	290	505	175.3	1170	85.8	101.9	5.6	1.2	48.5	93.3	96

liquid injection: 3 moles isobutanol/ 1 mole water
5% isobutanol, 95% nitrogen; slurry: 30.07 g catalyst, 120.15 g Drakeol 10 oil
inlet GHSV based on nitrogen and isobutanol
linear C4 = 1-butene, cis-2-butene, and trans-2-butene; ether = diisobutyl ether
isobutene selectivity based on water free product distribution
water rate was determined by GC

TABLE 14

Measured Performance of Engelhard Gamma Alumina Catalyst
Effect of Water Cofeed on Dehydration Rate, 3 moles isobutanol/ 2 moles water at 290°C

Run #	Temp (°C)	Pressure (psig)	Isobutanol Feed (g/kg-hr)	Inlet GHSV (sl/kg-hr)	Isobutanol Conversion %	Isobutene Rate (g/kg-hr)	Linear C4 Rate (g/kg-hr)	Ether Rate (g/kg-hr)	Water Rate (g/kg-hr)	Isobutene Selectivity (wt%)	Carbon Recovery %
13033-20H	288	158	424.8	2507	73.5	235.4	13.3	4.6	153.7	92.5	105
20I	290	166	1085.5	6335	55.1	424.5	22.1	24.0	326.7	89.5	102
20J	290	148	188.8	1237	89.6	123.6	8.4	0.4	74.1	92.9	103
20K	288	510	424.8	2513	58.8	154.5	6.9	14.7	119.2	87.3	96
20L	293	520	943.9	6228	42.0	254.4	10.9	31.5	241.3	84.8	99
20M	290	510	188.8	1101	65.1	92.7	4.6	4.5	64.4	90.5	106
20N	286	543	2171.0	11867	51.2	255.9	7.3	47.0	586.4	81.9	67.4

Liquid injection: 3 moles isobutanol/ 2 moles water
5% isobutanol, 95% nitrogen; slurry: 30.07 g catalyst, 120.15 g Drakeol 10 oil
inlet GHSV based on nitrogen and isobutanol
linear C4 = 1-butene, cis-2-butene, and trans-2-butene; ether = diisobutyl ether
isobutene selectivity based on water free product distribution
water rate was determined by GC

TABLE 15

Measured Performance of Engelhard Gamma Alumina Catalyst
Effect of Water Cofeed on Dehydration Rate, 3 moles isobutanol/ 2 moles water at 310°C

Run # 13033-	Temp (°C)	Pressure (psig)	Isobutanol Feed (g/kg-hr)	Inlet GHSV (sl/kg-hr)	Isobutanol Conversion %	Isobutene Rate (g/kg-hr)	Linear C4 Rate (g/kg-hr)	Ether Rate (g/kg-hr)	Water Rate (g/kg-hr)	Isobutene Selectivity (wt%)	Carbon Recovery %
20O	310	158	424.8	2525	89.2	285.7	22.0	0.9	172.8	92.2	107
20P	310	160	1085.5	6202	77.7	621.0	41.9	6.9	395.5	92.1	104
20Q	310	130	188.8	1193	96.2	134.8	11.1	0.2	79.3	91.9	106
20R	309	519	424.8	2485	74.6	241.9	15.2	4.9	156.3	91.7	107
20S	310	527	1085.5	6236	60.1	481.7	27.2	23.2	350.3	89.6	105
20T	310	513	188.8	1071	88.0	126.4	8.2	0.8	76.1	92.7	107
20U	309	506	2171.0	11875	47.7	723.7	40.4	56.1	611.9	87.6	102

liquid injection: 3 moles isobutanol/ 2 moles water
5% isobutanol, 95% nitrogen; slurry: 30.07 g catalyst, 120.15 g Drakeol 10 oil
inlet GHSV based on nitrogen and isobutanol
linear C4 = 1-butene, cis-2-butene, and trans-2-butene; ether = diisobutyl ether
isobutene selectivity based on water free product distribution
water rate was determined by GC