United States Patent

Washecheck

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[54] **PROCESS FOR PEAKING THE OXIDATION PRODUCTS OF 1-OLEFINS**

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[58] **Field of Search** .....260/413, 533 R, 604 R

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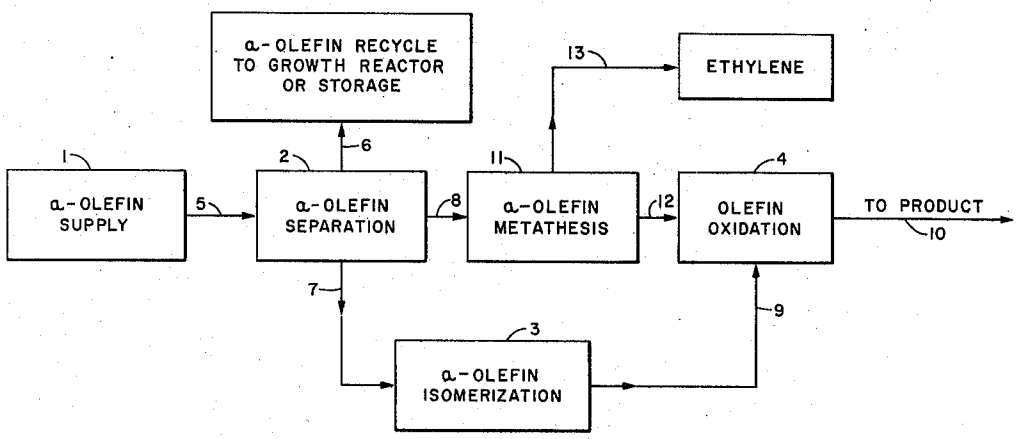
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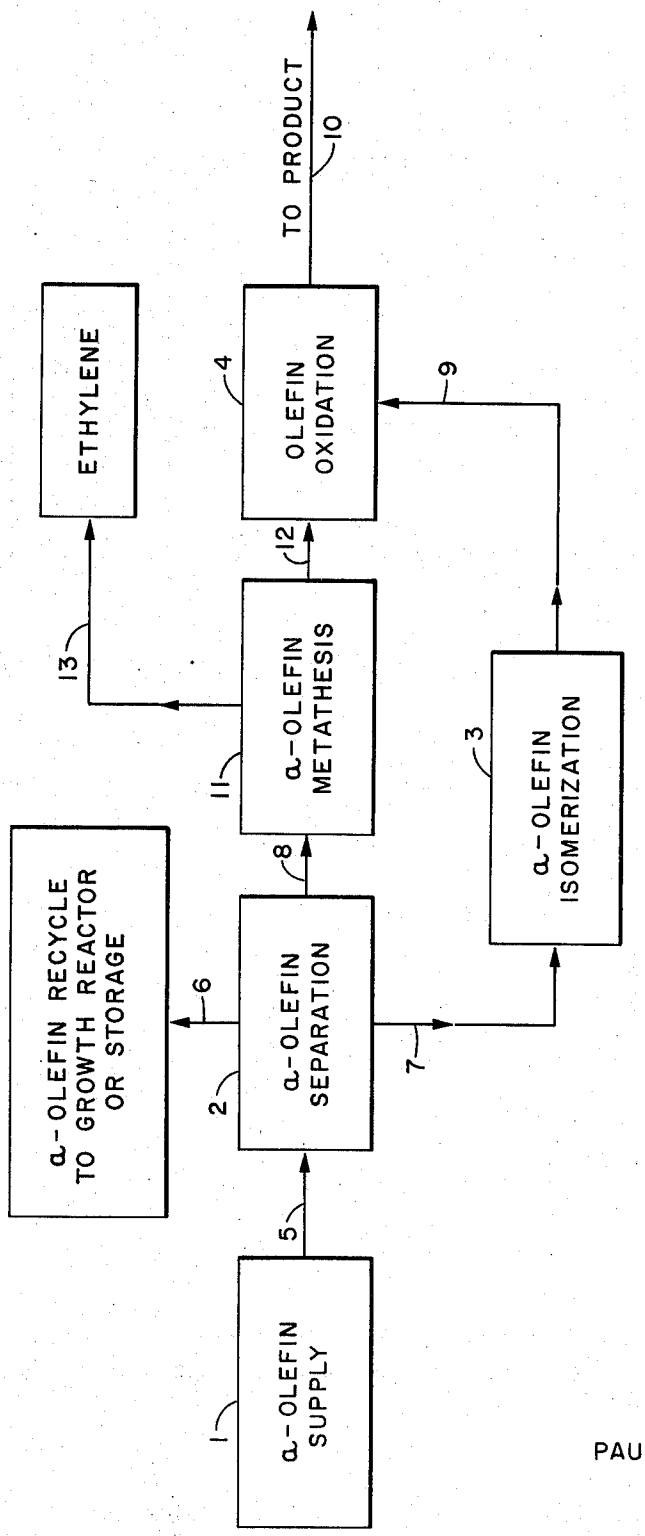
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[57] **ABSTRACT**

A peaking process is disclosed for preparing aldehydes or carboxylic acids from a mixture of alpha olefins. The alpha olefins are separated into at least two fractions consisting of a low molecular weight fraction and a high molecular weight fraction. The high molecular weight fraction is isomerized and the two fractions oxidized. The low molecular weight fraction will oxidize to C_{n-1} product and C_1 product. The high molecular weight fraction will cleave at the double bond giving products containing the number of carbon atoms of the groups on either side of the double bond. The procedure has great versatility by varying the number of fractions and isomerizations. With alpha olefins prepared from metal alkyl growth product, M-values also have an influence on the final product.

6 Claims, 1 Drawing Figure





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PROCESS FOR PEAKING THE OXIDATION PRODUCTS OF 1-OLEFINS

BACKGROUND OF THE INVENTION

This invention relates to oxidation of a mixture of alpha olefins so as to obtain oxidation products, such as aldehydes and carboxylic acids, having carbon atoms in a narrower range than did the original mixture.

It is known to produce alpha olefins in the prior art. It is known, for example, that alpha olefins can be prepared from organometal compounds such as aluminum trialkyls by olefin displacement, thermal displacement, or catalytic displacement. See for example U.S. Pat. Nos. 2,971,969, 3,344,202, and 3,280,023. It is also known that long-chain alpha olefins can be prepared by reacting ethylene in presence of catalytic amounts of metal alkyls; see British Pat. Nos. 1,020,563 and 1,037,866 and US Patents Nos. 2,699,457 and 3,322,844. It is also known to produce such alpha olefins by cracking paraffins. The prior art also teaches isomerizing alpha olefins to internal olefins; see U.S. Pat. Nos. 2,956,094, 3,217,061, 3,277,191, and 3,340,322.

It is also known that olefins can be oxidized to aldehydes and/or acids by several means such as ozonolysis, permanganate, chromic acid, osmium tetroxide, and the like.

It is also known in the prior art, see cited patents as examples, that the normal source of olefin production results in a statistical distribution of olefin chain lengths known as a Poisson distribution.

It is also known from the art cited that alpha olefins prepared from metal alkyls, particularly aluminum trialkyls, can be polymerized to various degrees; e.g., M-values, by controlling growth conditions such as temperature, pressure, and time. M-value means the average number of ethylenes added per alkyl substituent.

OBJECTS OF THIS INVENTION

It is an object of this invention to produce oxidized products from alpha olefins having carbon atoms varying over a wide range wherein the product will have carbon atoms varying over a substantially narrower range.

SUMMARY OF THE INVENTION

According to this invention, a mixture of alpha olefins is separated into at least two fractions, one fraction containing olefins having carbon atoms below a predetermined number and one fraction having carbon atoms of said predetermined number and more. At least one high molecular weight fraction, e.g., containing carbon atoms of the predetermined number and more, is isomerized to produce internal olefins preferably predominating in unsaturation near the center of the chain. The nonisomerized lower molecular weight fraction and the isomerized fraction are oxidized to the aldehyde and/or acid thereby producing product having carbon atoms predominately of intermediate chain length.

In this specification and claims, the terms high molecular weight and low molecular weight are relative only and mean that each fraction will consist of compounds containing at least a mixture of two materials of different number of carbon atoms.

BRIEF DESCRIPTION OF THE DRAWING

The drawing is a schematic flow diagram showing a preferred flow scheme for carrying out the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention can best be described by referring to the drawing. An alpha olefin supply **1** is passed to olefin separation zone **2** via conduit **5** wherein the olefins are separated into at least one low molecular weight fraction and at least one high molecular weight fraction. The total number of fractions and choice of separation points will be dependent upon the composition of the original mixture and the desired product. The separation can be any desired process; however, distillation will be generally used. The higher molecular weight fraction is passed via conduit **7** to isomerization zone **3** wherein the alpha olefins are isomerized to internal olefins by process already known. Any olefin fractions not desired to be oxidized are passed via conduit **6** to olefin storage or further processing, such as recycle to the growth reactor, as desired. It should be understood that conduit **6** can represent a plurality of conduits depending upon the number of cuts. The low molecular weight olefins from separation zone **2** pass via conduit **8** to preferably alpha olefin metathesis zone **11** wherein the alpha olefins are converted to internal olefins and ethylene according to the following formula: $2RCH = CH_2 \rightarrow RCH = CHR + CH_2 = CH_2$. The internal olefin is then separated from the ethylene and passed to oxidation zone **4** via conduit **12** while ethylene passes via conduit **13** to recycle or storage. The metathesis step is not a necessary step to the invention but has the advantage of avoiding the formation of formic acid. The isomerized olefins from zone **3** pass via conduit **9** to the oxidation zone **4**. The olefins are oxidized by processes known forming aldehydes or acids depending upon known reaction conditions. The alpha olefins if zone **11** is omitted form C_{n-1} carboxylic acids or aldehydes and formic acid or formaldehyde. The internal olefins form a mixture of products breaking at the double bond.

As a specific example, a mixture of C_2 to C_{30} alpha olefins obtained by displacement of aluminum alkyls is separated in separation zone **2** by distillation into a C_2—C_4 fraction, a C_6—C_{12} fraction, and a C_{14} to C_{30} fraction. The C_2—C_4 fraction is taken overhead via conduit **6** and is returned to the aluminum alkyl preparation for alkylation and further growth. The C_{14}—C_{30} fraction is passed to isomerization zone **3** via conduit **7** wherein it is isomerized. The effluent from zone **3** is passed along with the $C_{6\text{-}12}$ fraction to the oxidation zone **4**. A typical product distribution of such olefins having M-values of 4.00, 5.00, and 6.00 is given in Tables I, II, and III respectively. These results are summarized and shown in Table IV. For calculating olefin distribution for different M-values, see U.S. Pat. No. 3,344,202.

The process obviously can be varied to suit many particular needs. Some such modifications are described below. In all cases, it is assumed that there is a supply of C_2—C_{30} alpha olefins derived by ethylene growth of aluminum trialkyl having a typical statistical distribution.

Case 1: Assume a market for $C_{7\text{-}15}$ carboxylic acids. The alpha olefins will be separated into three fractions;

e.g., C_{2-6}, C_{8-16}, and C_{18-30}. The C_{2-6} fraction is recycled and regrown, the C_{18-30} fraction is isomerized, and the C_{8-16} fraction and the isomerized fraction are oxidized resulting in an increase in the C_{7-15} desired carboxylic acids.

Case 2: Assume that the C_{16}—C_{18} olefins have greater value for some other purpose, e.g., olefin sulfonates, whereas the C_{5-13} acids and C_{19-21} acids have a market. The total olefins then will be separated into five fractions; e.g., C_{2-4} which is recycled and grown, C_{6-14} fraction is oxidized, C_{16-18} separated for sales, C_{20-22} fraction separately oxidized, and the C_{24-30} fraction isomerized and oxidized with the C_{6-14} fraction.

Case 3: Assume normal production of C_5—C_{15} acids; but, due to poor market conditions, the C_{9-11} acids are not moving. In this case, the olefins would be separated into five fractions with the C_{2-4} fraction being recycled to growth, the C_{6-8} fraction oxidized to acids, the C_{10-12} fraction would be recycled for growth or isomerized and oxidized with the C_{6-8} fraction depending upon demand, the C_{18-16} fraction oxidized, and the C_{18-30} fraction isomerized and oxidized with the C_{14-16} fraction.

It can be seen from the above modifications that by utilizing the variables, M-value, recycle and regrowth, and isomerization, the present invention offers a great deal of versatility in preparing oxidized products from a mixture of alpha olefins.

To show the effect of M-value and recycle on distribution, Tables I through V are presented to show carbon atom distribution on C_{6-30} alpha olefins at various M-values and recycle of C_{2-4} olefins. Table VI summarizes this data. Tables VII through XI show similar effect when C_{2-6} is recycled, whereas Table XII summarizes these tables. Table XIII shows a typical case where there is no recycle or isomerization at various M-values.

TABLE I

PEAKING PROCESS

M = 2.00

Recycle = C_{2-4}

No. of C of Acid Product	Base Case No Peaking	1-Olefins of C_{x-2} and Below Not Isomerized 1-Olefins of C_x and Above Isomerized C_{10} and Above	C_{12} and Above	C_{14} and Above	C_{16} and Above	C_{18} and Above
1	35.29	21.53	25.01	26.40	26.86	27.00
2		1.88	0.56	0.15	0.04	0.01
3	13.57	2.30	0.69	0.18	0.04	0.01
4		2.72	0.82	0.22	0.05	0.01
5	18.71	30.73	27.94	27.04	26.78	26.71
6		3.57	1.07	0.29	0.07	0.01
7	15.84	27.33	24.04	22.98	22.68	22.61
8		4.42	1.32	0.35	0.08	0.02
9	9.63	2.19	15.29	14.12	13.79	13.71
10		1.61	1.58	0.42	0.10	0.02
11	4.53	0.74	0.73	6.91	6.55	6.46
12		0.50	0.49	0.49	0.12	0.02
13	1.74	0.22	0.21	0.21	2.59	2.49
14		0.14	0.13	0.13	0.13	0.03
15	0.49	0.06	0.06	0.06	0.05	0.83
16		0.03	0.03	0.03	0.03	0.03
17	0.18	0.01	0.01	0.01	0.01	0.01

TABLE II

PEAKING PROCESS

M = 3.00

Recycle = C_{2-4}

No. of C of Acid Product	Base Case No Peaking	1-Olefins of C_{x-2} and Below Not Isomerized 1-Olefins of C_x and Above Isomerized C_{10} and Above	C_{12} and Above	C_{14} and Above	C_{16} and Above	C_{18} and Above
1	27.42	14.98	19.59	22.29	23.64	24.21
2		2.99	1.29	0.50	0.17	0.05
3	6.26	3.67	1.58	0.61	0.21	0.07
4		4.34	1.87	0.72	0.25	0.08
5	12.98	20.71	17.43	15.87	15.22	14.98
6		5.70	2.46	0.95	0.33	0.10
7	16.55	26.28	22.12	20.15	19.32	19.02
8		7.05	3.04	1.18	0.41	0.13
9	15.08	4.33	20.94	18.64	17.68	17.32
10		3.72	3.62	1.40	0.49	0.15
11	10.68	2.11	2.05	13.74	12.67	12.28
12		1.70	1.65	1.63	0.57	0.18
13	6.08	0.90	0.87	0.86	7.58	7.15
14		0.68	0.66	0.65	0.64	0.20
15	3.03	0.34	0.33	0.32	0.32	3.58
16		0.24	0.23	0.23	0.23	0.23
17	1.23	0.11	0.11	0.11	0.11	0.11
18		0.08	0.07	0.07	0.07	0.07
19	0.51	0.03	0.03	0.03	0.03	0.03
20		0.02	0.02	0.02	0.02	0.02
21	0.19	0.01	0.01	0.01	0.01	0.01

TABLE III

PEAKING PROCESS

M = 4.00

Recycle = C_{2-4}

No. of C of Acid Product	Base Case No Peaking	1-Olefins of C_{x-2} and Below Not Isomerized 1-Olefins of C_x and Above Isomerized C_{10} and Above	C_{12} and Above	C_{14} and Above	C_{16} and Above	C_{18} and Above
1	22.94	9.50	13.97	17.44	19.72	21.01
2		3.60	1.99	0.99	0.45	0.18
3	2.65	4.42	2.44	1.21	0.55	0.23
4		5.23	2.89	1.44	0.65	0.27
5	7.36	14.31	11.39	9.57	8.57	8.08
6		6.86	3.79	1.89	0.85	0.35
7	12.44	21.65	17.87	15.49	14.18	13.54
8		8.48	4.69	2.33	1.05	0.43
9	15.12	6.12	21.66	18.77	17.19	16.41
10		5.73	5.59	2.78	1.25	0.52
11	14.24	3.80	3.71	18.25	16.42	15.53
12		3.37	3.29	3.23	1.46	0.60
13	10.92	2.08	2.03	1.99	13.10	12.11
14		1.75	1.71	1.68	1.66	0.68
15	7.13	1.02	0.99	0.97	0.96	8.13
16		0.81	0.79	0.78	0.77	0.76
17	3.98	0.45	0.43	0.43	0.42	0.42
18		0.34	0.33	0.33	0.32	0.32
19	1.90	0.18	0.17	0.17	0.17	0.17
20		0.13	0.13	0.12	0.12	0.12
21	0.81	0.06	0.06	0.06	0.06	0.06
22		0.05	0.04	0.04	0.04	0.04
23	0.35	0.02	0.02	0.02	0.02	0.02
24		0.01	0.01	0.01	0.01	0.01
25	0.19	0.01	0.01	0.01	0.01	0.01

TABLE IV

PEAKING PROCESS

M = 5.00

Recycle = C_{2-4}

No. of C of Acid Product	Base Case No Peaking	1-Olefins of C_{x-2} and Below Not Isomerized 1-Olefins of C_x and Above Isomerized C_{10} and Above	C_{12} and Above	C_{14} and Above	C_{16} and Above	C_{18} and Above
1	19.99	5.64	9.17	12.62	15.43	17.42
2		3.69	2.44	1.46	0.80	0.40
3	1.08	4.52	2.99	1.79	0.98	0.49
4		5.36	3.54	2.12	1.16	0.58
5	3.72	10.26	8.08	6.38	5.21	4.50
6		7.02	4.64	2.79	1.52	0.76
7	7.89	16.47	13.64	11.41	9.88	8.96
8		8.69	5.75	3.45	1.89	0.94
9	11.99	7.08	19.09	16.34	14.46	13.31
10		6.99	6.85	4.11	2.25	1.13
11	14.12	5.25	5.15	19.20	16.99	15.64
12		4.95	4.86	4.77	2.61	1.31
13	13.55	3.46	3.39	3.33	16.73	15.21
14		3.13	3.07	3.01	2.97	1.49
15	10.92	2.05	2.01	1.97	1.95	12.72
16		1.77	1.74	1.71	1.69	1.67
17	7.61	1.10	1.08	1.06	1.04	1.03
18		0.91	0.89	0.88	0.87	0.86
19	4.65	0.54	0.52	0.52	0.51	0.50
20		0.43	0.42	0.41	0.41	0.40
21	2.55	0.24	0.24	0.23	0.23	0.23
22		0.18	0.18	0.18	0.18	0.17
23	1.23	0.10	0.10	0.10	0.09	0.09
24		0.07	0.07	0.07	0.07	0.07
25	0.50	0.04	0.04	0.04	0.04	0.04
26		0.03	0.03	0.03	0.03	0.03
27	0.18	0.01	0.01	0.01	0.01	0.01

TABLE V

PEAKING PROCESS

M = 6.00

Recycle = C_{2-4}

No. of C of Acid Product	Base Case No Peaking	1-Olefins of C_{x-2} and Below Not Isomerized 1-Olefins of C_x and Above Isomerized C_{10} and Above	C_{12} and Above	C_{14} and Above	$C_{16}C_{18}$ andand AboveAbove	
1	17.73	3.22	5.65	8.51	11.32	13.69
2		3.43	2.59	1.79	1.14	0.67
3	0.43	4.21	3.17	2.20	1.39	0.82
4		4.98	3.76	2.60	1.65	0.97
5	1.77	7.66	6.22	4.85	3.73	2.92
6		6.53	4.93	3.41	2.17	1.27
7	4.55	12.14	10.28	8.51	7.05	6.00
8		8.08	6.10	4.22	2.68	1.57
9	8.15	7.21	15.34	13.16	11.36	10.05
10		7.36	7.27	5.03	3.19	1.87
11	11.53	6.10	6.02	17.47	15.32	13.76
12		6.00	5.92	5.83	3.71	2.17
13	13.26	4.64	4.58	4.51	17.61	15.81
14		4.40	4.34	4.28	4.22	2.47
15	12.86	3.19	3.15	3.10	3.06	15.69
16		2.92	2.88	2.84	2.80	2.77
17	10.71	2.00	1.97	1.94	1.92	1.90
18		1.77	1.74	1.72	1.69	1.68
19	7.92	1.15	1.13	1.11	1.10	1.09
20		0.98	0.97	0.95	0.94	0.93
21	5.15	0.61	0.60	0.59	0.58	0.57
22		0.50	0.49	0.49	0.48	0.47
23	3.13	0.30	0.29	0.29	0.28	0.28
24		0.24	0.23	0.23	0.23	0.22
25	1.62	0.13	0.13	0.13	0.13	0.13
26		0.10	0.10	0.10	0.10	0.10
27	0.79	0.06	0.06	0.06	0.05	0.05
28		0.04	0.04	0.04	0.04	0.04
29	0.34	0.02	0.02	0.02	0.02	0.02
30		0.02	0.02	0.02	0.02	0.02
31	0.18	0.01	0.01	0.01	0.01	0.01

TABLE VI

SUMMARY OF PEAKING PROCESS

M = 2–6

Recycle = C_{2-4}

No. of C of Acid Product	Base Case No Peaking	1-Olefins of C_{x-2} and Below Not Isomerized 1-Olefins of C_x and Above Isomerized C_{10} and Above	C_{12} and Above	C_{14} and Above	C_{16} and Above	C_{18} and Above
M=2.00						
1	35.29	21.53	25.01	26.40	26.86	27.00
2–4	13.57	6.90	2.07	0.55	0.13	0.03
5–9	44.18	68.24	69.66	64.78	63.40	63.06
10–15	6.76	3.27	3.20	8.22	9.54	9.85
16–19	0.18	0.04	0.04	0.04	0.04	0.04
20–30	0.00	0.00	0.00	0.00	0.00	0.00
M=3.00						
1	27.42	14.98	19.59	22.29	23.64	24.21
2–4	6.26	11.00	4.74	1.83	0.63	0.20
5–9	44.61	64.07	65.99	56.79	52.96	51.55
10–15	19.79	9.45	9.18	18.60	22.27	23.54
16–19	1.74	0.46	0.44	0.44	0.44	0.44
20–30	0.19	0.03	0.03	0.03	0.03	0.03
M=4.00						
1	22.94	9.50	13.97	17.44	19.72	21.01
2–4	2.65	13.25	7.32	3.64	1.65	0.68
5–9	34.92	57.42	**59.40**	48.05	41.84	38.81
10–15	32.29	17.75	17.32	28.90	34.85	37.57
16–19	5.88	1.78	1.72	1.71	1.68	1.67
20–30	1.35	0.28	0.27	0.26	0.26	0.26
M=5.00						
1	19.99	5.64	9.17	12.62	15.43	17.42
2–4	1.09	13.57	8.97	5.37	2.94	1.47
5–9	23.60	49.52	51.20	40.37	32.96	28.47
10–15	38.59	25.83	25.33	36.39	43.50	47.50
16–19	12.26	4.32	**4.23**	4.17	4.11	4.06
20–30	4.46	1.10	1.09	1.07	1.06	1.04
M=6.00						
1	17.73	3.22	5.65	8.51	11.32	13.69
2–4	0.43	12.62	9.52	6.59	4.18	2.46
5–9	14.37	41.62	42.87	34.15	26.99	21.81
10–15	37.65	31.69	31.28	40.22	47.11	51.77
16–19	18.63	7.84	7.72	7.61	7.51	7.44
20–30	11.21	3.01	2.96	2.93	2.88	2.84

TABLE VII

PEAKING PROCESS

M = 2.00

Recycle = C_{2-6}

No. of C of Acid Product	Base Case No Peaking	1-Olefins of C_{x-2} and Below Not Isomerized 1-Olefins of C_x and Above Isomerized C_{10} and Above	C_{12} and Above	C_{14} and Above	C_{16} and Above	C_{18} and Above
1	35.29	14.74	20.73	23.07	23.84	24.06
2		3.14	0.93	0.25	0.06	0.01
3	13.57	3.85	1.14	0.30	0.07	0.02
4		4.56	1.35	0.36	0.08	0.02
5	18.71	5.27	1.56	0.41	0.10	0.02
6		5.98	1.77	0.47	0.11	0.02
7	15.84	45.80	39.70	37.77	37.22	37.08
8		7.40	2.19	0.58	0.14	0.03
9	9.63	3.67	25.26	23.21	22.63	22.49
10		2.70	2.61	0.69	0.16	0.04
11	4.53	1.25	1.20	11.35	10.74	10.59
12		0.84	0.81	0.80	0.19	0.04
13	1.74	0.37	0.35	0.35	4.25	4.09
14		0.23	0.22	0.22	0.22	0.05
15	0.49	0.09	0.09	0.09	0.09	1.35
16		0.05	0.05	0.05	0.05	0.05
17	0.18	0.02	0.02	0.02	0.02	0.02

TABLE VIII

PEAKING PROCESS

M = 3.00

Recycle = C_{2-6}

No. of C of Acid Product	Base Case No Peaking	1-Olefins of C_{x-2} and Below Not Isomerized 1-Olefins of C_x and above Isomerized C_{10} and Above	C_{12} and Above	C_{14} and Above	C_{16} and Above	C_{18} and Above
1	27.42	10.04	16.15	19.68	21.42	22.16
2		3.88	1.66	0.64	0.22	0.07
3	6.26	4.76	2.04	0.78	0.27	0.09
4		5.64	2.41	0.93	0.32	0.10
5	12.98	6.51	**2.79**	1.07	0.37	0.12
6		7.39	3.16	1.22	0.42	0.13
7	16.55	34.10	28.47	25.82	24.72	24.31
8		9.14	3.91	1.51	0.52	0.16
9	15.08	5.62	26.95	23.89	22.61	22.14
10		4.83	4.66	1.79	0.62	0.20
11	10.68	2.74	2.64	17.62	16.21	15.70
12		2.20	2.12	2.08	0.72	0.23
13	6.08	1.16	1.12	1.10	9.70	9.14
14		0.88	0.85	0.83	0.82	0.26
15	3.03	0.44	0.42	0.42	0.41	4.58
16		0.31	0.30	0.29	0.29	0.29
17	1.23	0.15	0.14	0.14	0.14	0.14
18		0.10	0.10	0.09	0.09	0.09
19	0.51	0.05	0.04	0.04	0.04	0.04
20		0.03	0.03	0.03	0.03	0.03
21	0.19	0.01	0.01	0.01	0.01	0.01

TABLE IX

PEAKING PROCESS

M = 4.00

Recycle = C_{2-6}

No. of C of Acid Product	Base Case No Peaking	1-Olefins of C_{x-2} and Below Not Isomerized 1-olefins of C_x and above Isomerized C_{10} and Above	C_{12} and Above	C_{14} and Above	C_{16} and Above	C_{18} and Above
1	22.94	6.47	11.62	15.60	18.19	19.65
2		4.10	2.26	1.12	0.50	0.21
3	2.65	5.02	2.77	1.37	0.62	0.25
4		5.95	3.27	1.63	0.73	0.30
5	7.36	6.87	**3.78**	1.88	0.85	0.35
6		7.80	4.29	2.13	0.96	0.39
7	12.44	24.63	20.25	17.51	16.01	15.27
8		9.65	5.31	2.64	1.19	0.49
9	15.12	6.96	24.54	21.22	19.40	18.51
10		6.52	6.33	3.14	1.42	0.58
11	14.24	4.33	4.20	20.63	18.54	17.52
12		3.84	3.73	3.65	1.64	0.68
13	10.92	2.37	2.30	2.25	14.79	13.66
14		1.99	**1.94**	1.90	1.87	0.77
15	7.13	1.15	1.12	1.10	1.08	9.17
16		0.92	0.90	0.88	0.87	0.86
17	3.98	0.51	0.49	0.48	0.48	0.47
18		0.39	0.38	0.37	0.36	0.36
19	1.90	0.20	0.20	0.19	0.19	0.19
20		0.15	0.14	0.14	0.14	0.14
21	0.81	0.07	0.07	0.07	0.07	0.07
22		0.05	0.05	0.05	0.05	0.05
23	0.35	0.02	0.02	0.02	0.02	0.02
24		0.02	0.02	0.02	0.02	0.02
25	0.19	0.01	0.01	0.01	0.01	0.01

TABLE X

PEAKING PROCESS

M = 5.00

Recycle = C_{2-6}

No. of C of Acid Product	Base Case No Peaking	1Olefins of C_{x-2} and Below Not Isomerized 1Olefins of C_x and Above Isomerized C_{10} and Above	C_{12} and Above	C_{14} and Above	C_{16} and Above	C_{18} and Above
1	19.99	3.99	7.78	11.47	14.47	16.58
2		3.92	2.59	1.55	0.85	0.42
3	1.09	4.81	3.18	1.90	1.04	0.52
4		5.70	3.76	2.25	1.23	0.62
5	3.72	6.58	4.35	2.60	1.42	0.71
6		7.47	4.93	2.96	1.61	0.81
7	7.89	17.51	14.48	12.10	10.48	9.49
8		9.24	6.10	3.66	2.00	1.00
9	11.99	7.52	20.27	17.34	15.33	14.10
10		7.43	7.27	4.36	2.38	1.19
11	14.12	5.58	5.46	20.37	18.01	16.57
12		5.27	5.16	5.06	2.76	1.38
13	13.55	3.68	3.60	3.54	17.73	16.11
14		3.33	3.26	3.19	3.15	1.58
15	10.92	2.18	2.13	2.09	2.06	13.48
16		1.89	1.85	1.81	1.79	1.77
17	7.61	1.17	1.14	1.12	1.10	1.09
18		0.97	0.95	0.93	0.92	0.91
19	4.65	0.57	0.56	0.55	0.54	0.53
20		0.46	0.45	0.44	0.43	0.43
21	2.55	0.26	0.25	0.25	0.24	0.24
22		0.20	0.19	0.19	0.19	0.18
23	1.23	0.11	0.10	0.10	0.10	0.10
24		0.08	0.08	0.08	0.07	0.07
25	0.50	0.04	0.04	0.04	0.04	0.04
26		0.03	0.03	0.03	0.03	0.03
27	0.18	0.01	0.01	0.01	0.01	0.01

TABLE XI

PEAKING PROCESS

M = 6.00

Recycle = C_{2-6}

No. of C of Acid	Base Case No	1-Olefins of C_{x-2} and Below Not Isomerized 1-Olefins of C_x and Above Isomerized C_{and} Above				and Above
1	17.73	2.41	4.91	7.87	10.76	13.20
2		3.53	2.66	1.84	1.17	0.68
3	0.43	4.33	3.26	2.26	1.43	0.84
4		5.12	3.86	2.67	1.70	0.99
5	1.77	5.92	4.47	3.09	1.96	1.15
6		6.72	5.07	3.50	2.22	1.30
7	4.45	12.48	10.57	8.74	7.25	6.16
8		8.31	6.27	4.33	2.75	1.61
9	8.15	7.42	15.78	13.52	11.67	10.32
10		7.58	7.47	5.17	3.28	1.92
11	11.53	6.28	6.19	17.65	15.74	14.14
12		6.17	6.09	6.00	3.81	2.23
13	13.26	4.77	4.71	4.64	18.09	16.24
14		4.52	4.46	4.40	4.34	2.54
15	12.86	3.28	3.24	3.19	3.15	16.11
16		3.00	2.96	2.92	2.88	2.85
17	10.71	2.06	2.03	2.00	1.97	1.95
18		1.82	1.79	1.76	1.74	1.72
19	7.92	1.18	1.16	1.15	1.13	1.12
20		1.01	0.99	0.98	0.96	0.95
21	5.15	0.62	0.61	0.60	0.60	0.59
22		0.51	0.51	0.50	0.49	0.49
23	3.13	0.30	0.30	0.30	0.29	0.29
24		0.24	0.24	0.24	0.23	0.23
25	1.62	0.14	0.14	0.13	0.13	0.13
26		0.11	0.11	0.10	0.10	0.10
27	0.79	0.06	0.06	0.06	0.06	0.06
28		0.04	0.04	0.04	0.04	0.04
29	0.34	0.02	0.02	0.02	0.02	0.02
30		0.02	0.02	0.02	0.02	0.02
31	0.18	0.01	0.01	0.01	0.01	0.01

TABLE XII

SUMMARY OF PEAKING PROCESS

M = 2-6

Recycle = C_{2-6}

1-Olefins of C_{x-2}

No. of C of Acid Product	Base Case No Peaking	and Below Not Isomerized 1-Olefins of C_x and Above Isomerized C_{10} and Above	C_{12} and Above	C_{14} and Above	C_{16} and Above	C_{18} and Above
M=2.00						
1	35.29	14.74	20.73	23.07	23.84	24.06
2–5	32.28	16.82	4.98	1.32	0.31	0.07
6–10	25.47	65.55	71.53	62.72	60.26	59.66
11–15	6.76	2.78	2.67	12.81	15.49	16.12
16–20	0.18	0.07	0.07	0.07	0.07	0.07
21–30	0.00	0.00	0.00	0.00	0.00	0.00
M=3.00						
1	27.42	10.04	16.15	19.68	21.42	22.16
2–5	19.24	20.79	8.90	3.42	1.18	0.38
6–10	31.63	61.08	67.15	54.23	48.89	46.94
11–15	19.79	7.42	7.15	22.05	27.86	29.91
16–20	1.74	0.64	0.61	0.59	0.59	0.59
21–30	0.19	0.01	0.01	0.01	0.01	0.01
M=4.00						
1	22.94	6.47	11.62	15.60	18.19	19.65
2–5	10.01	21.94	12.08	6.00	2.70	1.11
6–10	27.56	55.56	60.72	46.64	38.98	35.24
11–15	32.29	13.68	13.29	29.53	37.92	41.80
16–20	5.88	2.17	2.11	2.06	2.04	2.02
21–30	1.35	0.17	0.17	0.17	0.17	0.17
M=5.00						
1	19.99	3.99	7.78	11.47	14.47	16.58
2–5	4.81	21.01	13.88	8.30	4.54	2.27
6–10	19.88	49.17	53.05	40.42	31.80	26.59
11–15	38.59	20.04	19.61	34.25	43.71	49.12
16–20	12.26	5.05	4.95	4.85	4.78	4.73
21–30	4.46	0.73	0.70	0.70	0.68	0.67
M=6.00						
1	17.73	2.41	4.91	7.87	10.76	13.20
2–5	2.20	18.90	14.25	9.86	6.26	3.66
6–10	12.60	42.51	45.16	35.26	27.17	21.31
11–15	37.65	25.02	24.69	36.18	45.13	51.26
16–20	18.63	9.07	8.93	8.81	8.68	8.59
21–30	11.21	2.07	2.06	2.02	1.99	1.98

TABLE XIII

SUMMARY OF PEAKING PROCESS

W/O RECYCLED OR ISOMERIZED

M-Valve	W/O Recycled C_{2-4}	C_{2-6}	W/O isomerized for each case Where C_x and above are isomerized C_{10} and above	C_{12} and Above	C_{14} and Above	C_{16} and Above	C_{18} and Above
2.00	22.56	49.62	26.32	11.28	4.06	1.26	0.34
3.00	8.71	25.52	52.08	31.08	15.95	7.13	2.81
4.00	3.30	12.08	72.28	52.75	33.99	19.40	9.88
5.00	1.24	5.45	85.20	70.57	53.03	35.97	22.04
6.00	0.46	2.37	92.33	82.97	69.20	53.14	37.40

It can be seen from the data presented in these tables that the peaking process proposed has a high degree of versatility. The acids of various carbon number do not have the same value on the commercial market. Thus, the ranges of acids that will be selected fro peaking will be determined by the economics. The versatility offered by this peaking process would have a definite economic advantage. In general, the middle range of acids and/or aldehydes (C_{5-15}) are more valuable than the lower (C_{2-4}) or higher (C_{16-x}) ranges. The proposed peaking process allows the production of this middle range with much lower content of low range (encountered in isomerization of total olefin mixture) or high range (encountered in nonisomerized olefin mixture).

Although these calculations were based on a statistical distribution of the double bond at all possible positions on the carbon chain, this is an idealistic situation. In actual fact, most isomerization procedures produce a higher concentration of internal double bonds than would be expected from a statistical distribution. This is a favorable situation and would actually improve the proposed peaking process. Thus, the data presented here would be a minimum example of the peaking process.

Having thus described the invention, I claim:

1. A peaking process for preparing oxidized products selected from the group consisting of aldehydes and acids from a mixture of alpha olefins, said process comprising separating said alpha olefins into at least two fractions wherein one fraction contains the relatively lower molecular weight olefins from said alpha olefin mixture, and the other the relatively higher molecular weight olefins from said alpha olefin mixture, isomerizing the fraction containing the higher molecular weight olefins to internal olefins, and then oxidizing the two fractions simultaneously in the same action zone.

2. The process of claim 1 wherein the alpha olefins are obtained by displacement of aluminum trialkyls.

3. The process of claim 2 wherein the alpha olefins contain even carbon atom olefins of two to 30 carbon atoms.

4. The process of claim 3 wherein the olefins are fractionated into at least three fractions and the lowest molecular weight fraction is recycled to the aluminum trialkyl zone for regrowing, a low molecular weight fraction but higher than the lowest molecular weight fraction is oxidized and a higher molecular weigh fraction is isomerized and oxidized.

5. The process of claim 4 wherein the lowest molecular weight fraction consists of ethylene and butene-1.

6. The process of claim 5 wherein the low molecular weight fraction to be oxidized consists of C_6 to C_{12} alpha olefins and the higher molecular eight fraction consists of C_{14} to C_{30} alpha olefins.

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PO-1050
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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,696,134 Dated October 3, 1972

Inventor(s) Washecheck

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Page 4, column 3, line 23, "C_{18-16}" should read --C_{14-16}--.

Page 4, column 3, line 53, in the last five columns of TABLE 1, after "and" insert --Above--.

Page 5, column 5, line 16, column two of TABLE IV, "1.08" should read --1.09--.

Page 6, column 8, in the heading of TABLE XI, column 1, after "Acid" insert --Product--.

Page 6, column 8, in the heading of TABLE XI, column 2, after "No" insert --Peaking--.

Page 6, column 8, in the heading of TABLE XI, column 3, after "C" insert --$_{10}$ and--.

Page 6, column 8, in the heading of TABLE XI, column 4, before "Above" insert -- C_{12} and--.

Page 6, column 8, in the heading of TABLE XI, column 5, before "Above" insert --C_{14} and--.

Page 6, column 8, in the heading of TABLE XI, column 6, before "Above" insert -- C_{16} and--.

Page 6, column 8, in the heading of TABLE XI, column 7, before "and" insert --C_{18}--.

Page 7, column 9, line 51, "fro" should read --for--.

Page 7, column 10, line 32, "action" should read --reaction--.

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(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,696,134 Dated October 3, 1972

Inventor(s) Washecheck - 2 -

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Page 7, column 10, line 43, "weigh" should read --weight--.

Page 7, column 10, line 49, "eight" should read --weight--.

Signed and sealed this 20th day of February 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents