THE TEXAS COMPANY

MONTEBELLO LABORATORY

Review of Operations

Synthesis Runs 17 through 21

July 28, 1947

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Synthesis Runs 17, 19, and 21

It will be recalled that early operations at Montebello were carried out with a dual cyclone system in which the catalyst recovered in the primary cyclone was discharged into a standpipe which was provided with a slide valve and transfer line by means of which catalyst recovered in the primary cyclone could be returned to the base of the synthesis reactor. This arrangement proved very difficult to operate, due principally to difficulties in bridging and plugging of the small lines required in pilot plant operation. In Run 12, the longest run made with this system, it was estimated that the rate of catalyst circulation was on the order of 500 lbs. per hour.

In Run 15 the meter system was seriously upset in the early part of the run and when these difficulties had been straightened out, it was found that there was no circulation in the cyclone-standpipe system, and the rate of carry-over to the secondary cyclone was only on the order of one pound per hour, indicating that the circulation of catalyst was not necessary for good results.

Run 16 was then made, with all catalyst withdrawn from both primary and secondary cyclones. In an attempt to attain higher conversion levels, however, catalyst temperatures were raised from the 620 - 630°F. level of Runs 12 and 15, to about 690°F and catalyst carry-over increased from about one

pound per hour in Run 15 to about 20 pounds per hour in Run 16. Due to this high rate of catalyst loss, the inventory of catalyst in the reactor fell rapidly and it was soon necessary to recharge catalyst fines from the cyclone system in order to continue operation.

In subsequent runs, 17 through 21, repeated attempts have been made to operate without the return of any catalyst from the cyclone system, at temperatures below 650°F. These runs have been quite satisfactory from a mechanical standpoint, extending over periods as long as 319 hours, but have been uniformly low in conversion.

It will be recalled that the Montebello method of operation is similar to that used in other pilot plants and consists in the reduction of a substantial batch of catalyst in the reactor prior to synthesis operations, reduction being obtained by circulating hydrogen through the synthesis system at a pressure on the order of 200 psig. When reduction is complete or the supply of hydrogen is exhausted, the supply of hydrogen is cut off, and pressure maintained on the system by the addition of natural gas until the generator system is in operation. Fresh feed is then introduced over a period of about one hour and no other conditioning is employed. Runs made in this way have invariably shown a time lag or induction period of one or more days duration in which the conversion has increased, this early rise in conversion being followed by a decline extending over the remainder of the run. This behavior is in contrast to the experience of the Beacon Laboratory where

the catalyst is conditioned by treatment with synthesis gas at atmospheric pressure for an extended period, a practice which apparently eliminates the induction period and results in maximum yields at the start of operations. This conditioning step has not been feasable at Montebello since the only source of heat in the synthesis reactor is the recycle gas heater and the recycle gas has insufficient heat capacity to overcome heat loss and bring the reactor up to temperature with the very small weight of gas which can be circulated with a reactor velocity of one or two feet per second at atmospheric pressure.

In the runs which have been made without catalyst circulation at Montebello, no induction period has been observed, and conversion has remained at the low initial level throughout the duration of the run. This behavior has led to the opinion that operations have been such that the most active fraction of the catalyst has been discarded from the cyclone system and that catalyst circulation will be required in order to retain this material in the reactor, and future runs will be made in this way.

There are two other possible explanations for the performance of the last few runs which may be important and which will also be examined. Following Run 16, operations have been carried out on a new batch of pyrites catalyst which was obtained from the same source as previous batches, but which may differ in activity. In the recent runs greater pains have been taken to secure complete reduction of the catalyst and it is possible that this may have had some bearing on the results.

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MONTEBELLO SYNTHESIS UNIT
SUMMARY OF PRELIMINARY DATA

RUN NUMBER	17A	17B	17C	17D	17E	17F	17G	17H	17I
Start	5/7	5/8	5/9	5/10	5/11	5/12	5/13	5/14	5/15
End	5/8	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16
GENERATOR DATA									
Pressure - psig	213	215	215	215	220	225	220	218	218
Gas Rate - SCFH	2405	2370	2480	2470	2490	2480	2425	2450	2440
Oxygen Rate - SCFH	1845	1820	1860	1930	1910	1845	1775	1790	1795
Product Rate - SCFH	7020	7440	7790	7540	7800	7520	7280	7390	7390
Product Composition									
*CEO / **MS	CEO MS	CEO MS	CEO MS	CEO MS	CEO MS	CEO MS	CEO MS	CEO MS	CEO MS
CO / CO	35.0-	34.4-	34.3-	36.0-	34.9-	34.4-	35.5-	35.5-	35.7-
H_2 / H_2	58.2-	61.4-	60.6-	59.8-	59.2-	59.2-	58.5-	59.1-	59.4-
CO_2 / CO_2	2.0-	1.7-	1.8-	1.8-	2.3-	2.3-	2.1-	2.1-	2.0-
N_2 / N_2	0.7-	0.4-	1.2-	0.9-	1.2-	1.2-	1.6-	1.1-	0.9-
CH_4 / CH_4	4.1-	2.1-	2.1-	1.5-	2.9-	2.9-	2.3-	2.2-	2.0-
SYNTHESIS DATA									
Pressure - psig	200	200	200	200	200	200	200	200	200
Recycle Rate - SCFH	10265	9200	10400	10980	11500	11470	11028	11540	11560
Fresh Feed - SCFH	7020	7440	7790	7540	7800	7520	7280	7390	7390
Wet Gas Rate - SCFH	3185	3240	3410	3115	3210	3170	3085	3015	3000
Catalyst Temperature - °F	625	610	610	608	620	618	624	620	620
Catalyst Density - #/cu ft	132	126	131	140	109	104	99.5	89.5	80
Catalyst Fluidized - #	445	402	418.5	418	321	306	302.5	246	227
Cat. Bed Ht. Depth of Catalyst Bed - ft	5.7	5.1	5.2	4.7	4.4	4.6	4.9	4.1	4.4
Fresh Feed - SCFH/#Cat	15.8	18.5	18.6	18.0	24.3	24.6	24.1	30.0	32.6
Inlet Velocity - ft/sec	1.5	1.4	1.6	1.6	1.7	1.6	1.6	1.6	1.6
Recycle Ratio	1.5	1.2	1.3	1.5	1.5	1.5	1.5	1.6	1.6
Contraction - %	55	56.5	56.3	58.8	58.9	57.9	57.6	59.2	59.4
Measured Oil - gph	3.4	4.4	3.9	4.1	3.7	3.9	2.9	3.5	3.5
Measured Water - gph	6.9	6.2	6.0	6.9	6.4	6.3	6.3	6.2	5.6
Steam Pressure - psig	710	700	700	890	900	900	870	860	860
Steam Rate - #/hr	376	225	191	144	147				
% CO_2 in Wet Gas by Orsat	20.6	18.0	18.6	21.8	21.6	21.0	22.1	22.3	21.8
Weight Balance - %	99	102	99	97	92	96	91	93	91
WET GAS COMPOSITION ~~BY~~ ~~~~ ~~MS~~**									
CO	11.69	16.25	16.78	13.06	14.51	15.48	15.78	15.03	15.22
H_2	54.23	48.87	57.03	50.14	52.25	52.28	47.94	45.97	48.55
CO_2	14.59	19.08	15.43	22.97	21.63	17.64	20.68	19.37	13.63
N_2	.63	1.76	1.42	.94	1.08	1.25	3.14	2.84	1.63
CH_4	12.62	4.83	6.22	5.00	4.40	5.91	5.78	5.49	5.96
C_2H_4	1.00	4.77	1.22	2.17	1.39	1.48	1.48	1.78	1.91
C_2H_6	.68	.50	.63	.81	.62	.70	.61	.61	.64
C_3H_6	1.18	1.21	1.33	1.67	1.27	1.85	1.24	1.21	1.16
C_3H_8	.32	.23	.27	.44	.22	.43	.33	.32	.20
C_4H_8	1.23	1.52	1.06	1.31	1.21	1.13	1.28	3.69	2.12
C_4H_{10}	.29	.24	.72	.39	.27	.45	.31	.37	.46
C_5H_{10}	.48	.51	.37	.72	.66	.36	.57	.70	.73
C_5H_{12}				.14	.15				.21
C_6H_{12}	.17	.17	.10	.25	.27	.25	.28	.22	.32

* CEO - CORRECTED EXPLOSION ORSAT
** MS - MASS SPECTROMETER