ENCLOSURE (B) 8

EFFECT OF REACTION TIME ON THE HYDROGENATION OF COAL

by

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LIST OF TABLES AND ILLUSTRATIONS

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SUMMARY

Studies were made on the effect of varying reaction time on the hydrogenation of Oyama coal, holding reaction conditions constant at 455°C, hydrogen pressure at 100 atmospheres and using Fe_2O_3 as a catalyst. It was found that under these conditions, the optimum reaction time was 1 hour.

I. INTRODUCTION

In the hydrogenation of coal, reaction time is an important factor, particularly from the standpoint of commercial plant design. Although many reports had previously been made on this subject, accurate conclusions could not be drawn, since the experiments had not been made under comparable conditions. This study was limited to the investigation of the effect of reaction time only, holding other variables constant.

Key research personnel working on project were Naval Eng. T. OGAWA and Naval assist. Eng. I. TAKAHASHI.

II. DETAILED DESCRIPTION

The autoclave and test procedures were the same as described in report No. 3 of this series.

Samples were as follows, (same as in report No. 3):

Coal	:	Fushun Oyama coal, sized to under 20 mesh.
Tar	:	30% topped light oil fraction from Shinbara low-temperature tar made in a Davidson type retort.
Catalyst	:	Ferric oxide (commercial grade)
H_2	:	Prepared by electrolysis, purity above 99.5%.

These components were mixed in the following amounts: coal, 100 grams; tar, 40 grams; Fe_2O_3, 5 grams; and H_2, 19 grams.

Runs were made for reaction times of 0 minutes, 30 minutes, 1 hour, 3 hours, and 5 hours and the other reaction conditions were held as constant as possible. Results of the several runs are summarized in Table I(B)8.

III. CONCLUSIONS

From the preceding experiments, it was noted that a part of the coal was hydrogenated during the period of heating to reaction temperature, and the hydrogenation was well underway after 30 minutes. After one hour, the reaction was complete and the yield of liquid products reached a maximum. With increasing reaction time the yield of liquid decreased and the formation of gas increased due to secondary thermal cracking.

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Table I(B)8
EFFECT OF REACTION TIME

		Run Number				
		48	50	76	43	44
Reaction Conditions	React. Time (hr-min)	0-0	0-30	1-0	3-0	5-0
	React. Temp. (^{o}C)	455	455	455	455	455
	Initial Pressure (atm.)	95	100	101	99	98
	Pressure Drop (atm.)	8	21	19	23	23
	Preheating Time (hr-min)	1-30	1-30	1-55	1-25	1-25
Reaction Products (gm)	Gas	29.3	33.5	33.6	33.8	40.5
	Water	13.7	17.8	17.4	17.4	17.5
	Oil	64.0	78.3	85.9	79.2	74.1
	Residue	52.8	29.1	24.9	22.1	25.0
Gas Analyses (gm)	CO_2	2.2	1.3	0.7	0.6	1.6
	C_nH_{2n}	0.5	0.5	0.5	0.3	0.4
	CO	0.8	1.3	1.6	1.3	2.3
	H_2	15.8	13.5	14.3	12.8	23.5
	C_nH_{2n+2}	10.0	16.9	16.5	18.8	12.7
		1.3	1.2	1.3	1.2	1.8
Distillation of Oil (gm)	--180^{o}C	3.7	12.3	10.6	11.2	12.0
	180--230^{o}C		5.8	5.8	6.4	7.2
	230--360^{o}C	60.3	60.2	36.0	34.0	32.7
	Pitch			33.3	27.0	22.1
Analyses of Residue (gm)	Benzene Soluble			0.2		0.1
	Benzene Insoluble	40.1	15.2	12.0	9.5	12.4
	Ash	12.7	13.9	12.9	12.6	12.6