

Ruhrchemie.

In the Ruhrchemie medium pressure plant freshly charged reactors are started in Stage III where they are put under gas pressure and heated to 125°C. in stationary gas. A gas rate of 500 cu.m./h. is then set up and the temperature increased by 5°/h. till 160°C. is reached, and then by 1°/h. till the contraction is 45%. The gas rate is then increased to 1,000 cu.m./h. and the temperature raised at 1°/h. till the contraction again reaches 45%. The gas rate is then put up to its normal value of 1,500 cu.m./h. and the temperature increased till the contraction is 40%. These figures refer to the normal synthesis gas for Stage III and are varied if necessary to correspond to the composition, and in particular, to the inert content of this gas. Further details are shown in Figure 5.

For synthesis, the same general principle was used as at atmospheric pressure, namely, to aim at the same output/reactor/day for each stage. Details are given in Table 21.

Table 20

Method of Working. Hoesch-Denzin

	Water-gas	Washed Converted Water-gas	Synthesis Gas, Stage I	Residual Gas, Stage I	Synthesis Gas, Stage II	Residual Gas, Stage II	Synthesis Gas, Stage III	Residual Gas, Stage III
CO <sub>2</sub>	7.86	6.71	7.81	17.50	15.38	26.94	22.56	33.45
O <sub>2</sub>	0.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CnHm	0.0	0.00	0.00	0.08	0.80	1.18	1.10	1.40
CO	37.74	13.36	33.66	30.99	27.94	23.21	21.00	14.60
H <sub>2</sub>	48.39	73.18	52.47	31.35	39.41	17.80	29.60	11.30
CH <sub>4</sub>	0.30	0.40	0.40	6.79	5.75	12.51	10.26	16.94
N <sub>2</sub>	4.97	6.35	5.66	12.39	10.72	18.36	15.48	22.31

A volume of 37,000 cu.m./h. of synthesis gas-I enters Stage I, which is run to a contraction of 51.6%. The residual gas is mixed with 4,200 cu.m./h. washed converted water-gas to give a volume of 22,000 cu.m./h. synthesis gas-II. Stage II is run to a contraction of 46.5% and the residual gas mixed with 2,000 cu.m./h. washed converted water-gas to give 13,500 cu.m./h. synthesis gas-III. Stage III is run to a contraction of 29.2%. Further details are given in the production data of Table 23, and the gas compositions at the various stages in the plant are given in Table 22.

Table 22.

Gas Analyses for the Ruhrchemie Medium Pressure Plant

	Synth- esis Gas- I	Resi- dual Gas- I	Synth- esis Gas- II	Resi- dual Gas- II	Synth- esis Gas- III	Resi- dual Gas- III
CO <sub>2</sub>	7.0	15.1	14.8	28.3	25.1	36.5
Un.Hn	0.0	0.8	0.8	1.2	1.1	1.3
CO	34.6	34.5	28.4	23.6	20.1	14.1
H <sub>2</sub>	52.7	33.6	42.0	17.7	28.5	10.8
CH <sub>4</sub>	0.4	5.2	4.4	11.6	9.7	16.0
N <sub>2</sub>	5.3	10.8	9.6	17.6	15.5	21.3

Schaffgotsch-Benzin.

Since there is so little first-hand information about this plant, which is in Eastern Germany, the production data given for it in Table 23 are of interest.

Table 23.

Performance Data for the Medium Pressure Plants

	Stage	Ruhr- chemie,	Hoesch- Benzin,	Schaff- gotsch Benzin.
		Oct. 1943 - Mar. 1944.	Jan. - June, 1944.	Jan - June, 1944.
1. Synthesis Gas, N. cu. m./month x $10^6$	I	30.460	32.342	24.518
2. (CO + H <sub>2</sub> ), N. cu. m./month x $10^6$	I	26.254	27,562	20,475
3. Ratio H <sub>2</sub> /CO	I	1.846	1.82	1.89
4. Average number of reactors in use for synthesis	I	33.4	39.4	36.0
	II	19.5	16.2	17.7
	III	8.1		6.0
	I-III	60.8	54.3	59.8
5. Number of freshly charged reactors brought into use, per month	I-III	10	10	8
6. Number of reactors emptied, per month	I-III	12	7	8

Table 23 continued

	Stage	Ruhr- chemie	Hoesch- Benzin	Schaff- gotsch- Benzin
7. Mean life of catalyst, hours	I	2557	3095	3637
	II	2130	2021	1394
	III	361	332	304
	I-III	2110	2446	2714
8. Mean temperature, °C.	I	198.8	198.3	189.4
	II	196.9	195.5	185.6
	III	197.4	199.0	178.7
	I-III	197.6	197.9	187.1
9. Mean gas rate, N. cu. m./reactor/h.	I	1108	957	932
	II	1121	1318	961
	III	1675	2031	1023
	I-III	713	706	562

Table 23 continued

		Stage	Ruhr- chemie	Hoesch- Benzin	Schaff- gotsch- Benzin
10. Contraction, % (from special analysis for N <sub>2</sub> )		I	51.6	53.5	56.6
		II	46.5	43.2	31.7
		III	29.2	34.4	9.9
		I-III	75.4	77.0	72.4
11. Yield of Primary Products, g./N. cu. m. (CO + H <sub>2</sub> )	Without Gasol	I-III	137.4	142.4	143.3
	With Gasol (Produced)	I-III	154.7	157.9	-
	(Recovered)	I-III	147.6	157.6	156.5
12. Liquid Primary Products, t./month		I-III	3615	3928	2933
13. Liquid Primary Products + Gasol, t./month		I-III	3882	4347	3203
14. Production, t./reactor/day		I-III	2.01	2.04	1.61

Table 23 (Continued).

		Stage	Ruhr- chemie	Hoesch- Benzin	Schaft- Gotsch- Benzin.
16. Mean cobalt content of a reactor, t.		I-III	0.884	0.803	0.922
17. Conversion of (CO + H <sub>2</sub> ), %	Total	I	62.9	66.3	68.0
		II	69.5	65.8	-
		III	54.2	69.3	-
		I-III	53.7	93.6	91.8
18.	to liquid products	I-III	66.6	69.3	67.9
19.	to gas and gasol	I-III	26.3	25.5	25.1
20. % CO in	Synthesis Gas	I	34.5	33.2	28.8
	Residual Gas	I	31.5	30.2	22.4
	Synthesis Gas	II	28.6	27.2	22.3
	Residual Gas	II	25.6	22.4	17.4
	Synthesis Gas	III	20.1	20.7	16.8
	Residual Gas	III	14.2	13.8	16.5

Table 23 (Continued)

		Stage	Ruhr- chemie	Hoesch- Benzin	Schnaff- gotsch- Benzin
21. % H <sub>2</sub> in	Synthesis Gas	I	52.7	52.0	54.7
	Residual Gas	I	33.6	31.2	32.4
	Synthesis Gas	II	42.0	38.9	31.5
	Residual Gas	II	17.7	17.5	13.9
	Synthesis Gas	III	28.5	28.6	13.4
	Residual Gas	III	10.8	9.4	9.3
22. % CH <sub>4</sub> in	Synthesis Gas	I	0.4	0.4	2.5
	Residual Gas	III	13.6	13.2	20.0
23. % CO <sub>2</sub> in	Synthesis Gas	I	7.9	8.7	7.0
	Residual Gas	III	36.5	37.0	26.7
24. Sulphur in Synthe- sis gas, g./100 N. cu.m.	Inorganic	I	0.05	0.04	0.03
	Organic	I	0.05	0.23	0.11
	Total	I	0.1	0.27	0.14