

Velocities and Residence Times in Liquid Phase Converters.  
By D. I. Schappert, Ludwigshafen, 13 July 1942Velocities in High Pressure Converters.

Table I shows the most important data required for calculating the velocities in high pressure liquid phase converters. Three operating methods were considered for Wesseling:

- a) - projected full thruput when using cold gas as cooling medium,
- b) - projected full thruput when using cold gas and cold oil as cooling medium,
- c) - present low thruput when using cold oil as cooling medium.

Velocities and Residence Times When Running  
Bituminous Coal in Liquid Phase,  
Ludwigshafen, 8 July 1941

Table II shows velocities and residence times when running bituminous coal for the converters and catchpots at Nordstern, Scholven, 10 Ltr. Converter 411 and Stall 804. The report of 15 May 1939 was used as a basis for the first 3 plants, the experimental data of 29 June 1941 for Stall 804.

Contrary to the former method of calculation, in which a spec. grav. of 1.1 was used for the letdown at converter temperature, these calculations were made with a corrected value of 0.5, which is approximately correct at the high temperatures.

The residence times were calculated:

- 1) - as formerly, with the assumption that the gas and the liquid form a homogeneus mixture in the converter, and
- 2) - with the assumption that a degree of filling of only 40% is obtained, which corresponds to operating conditions in large plants. For this second case, the mean converter velocity was calculated by dividing the total converter length by the residence time.

913 TABLE I

Plant		Leuna	Scholven	Nordstern
Pressure	atm	200	300	700
Number of Converters		4	4	4
Jacket $\phi$ of Converters (I.D.)	mm	1200	1200	1000
Clear I.D.	mm	1044	1044	860
Cross-Section	m <sup>2</sup>	0.65	0.375	0.58
Thruput Inlet gas	$\frac{t}{h}$ m <sup>3</sup> /h	28 28 000	24 28 000	35 35 000
Cold gas to Conv. I	m <sup>3</sup> /h	4 500	4 500	7 000
Cold gas to Conv. II	"	5 000	5 000	8 000
Cold gas to Conv. III	"	3 700	3 700	6 000
Cold gas to Conv. IV	"	5 000	5 000	8 000
Volumes				
Operating Condition	m <sup>3</sup> /h			
Converter I	"	406 / 466	283 / 325	189 / 219
Converter II	"	466 / 533	325 / 371	219 / 253
Converter III	"	533 / 583	371 / 405	253 / 279
Converter IV	"	589 / 649	405 / 451	279 / 314
Velocity in the Converters				
Converter I	m/sec.	0.132 / 0.151	0.091/0.105	0.091/0.105
Converter II	"	0.151 / 0.172	0.105/0.120	0.105/0.122
Converter III	"	0.395 / 0.431	0.120/0.131	0.122/0.134
Converter IV	"	0.431 / 0.480	0.131/0.146	0.134/0.151

x) Cooling Oil

T-358  
(Table I)

Hesseling			Pöhlitz	Welheim	Biechhamme
700			700	700	700
4 1000 860			4 1000 860	4 1000 860	4 1000 860
0.58			0.58	0.58	0.58
45.2 38 000		26 30 000	42 32 000	36 20 000	68 49 000
12 000 13 000 10 000 13 000 a)	12 000 8 000 + 2.3 <sup>x</sup> ) 4.8 <sup>x</sup> ) 6.7 <sup>x</sup> ) b)	7.0 <sup>x</sup> )  c)	7 000 8 000 6 000 8 000	7 000 8 000 6 000 8 000	10 500 12 000 9 000 12 000
213 / 264 264 / 320 320 / 363 363 / 419	213 / 264 264 / 301 301 / 307 307 / 419	157 159 162 165	184 / 214 214 / 249 249 / 274 274 / 309	126 / 156 156 / 191 191 / 216 216 / 251	286 / 331 331 / 382 382 / 421 421 / 472
0.102/0.127 0.127/0.153 0.153/0.174 0.174/0.201	0.102/0.127 0.127/0.145 0.145/0.147 0.147/0.150	0.073 0.074 0.076 0.077	0.085/0.103 0.103/0.120 0.120/0.132 0.132/0.148	0.061/0.075 0.075/0.092 0.092/0.104 0.104/0.121	0.132/0.158 0.153/0.183 0.183/0.202 0.202/0.226

	Walden	Schölvon	Converter 411 (with Upper Silesian Bituminous Coal)	Stall 804
<b>Units of Calculation &amp; Interrelated Values</b>				
Specifying Press. atm	700	800	600	710
Throughput: a) Coal (shkts/hr)	11000	9000	7	577
b) Coal Paste	23500	23500	27.3	1940
Gas Throughput: a) Paste Gas	25000	30000	21	2500
b) Cold Gas	25000	12000	"	2020
Converter Gas (Outlet)	11250	15000	26	4150
Intake Gas	110	190	0.11	75
Product Gas	400	390	0.4	41
Product	14000	14000	7.8	852
Intake	9000	7000	8.1	1340
Mean Converter Temp.	480°	475°	493°	468°
Prod. as Vapor at 1 atm, 15°C (Mol. Wt. = 250)	1340	1340	0.75	82
Total Gas Vol/h, 15°C	14300	16860	27.26	4350
Total Gas Vol/h @ Operat. Conditions	191.7	210	0.14	15.7
Volume of Liquid (Spec. Grav. = 0.8)	16	14	0.0162	2.63
Total Throughput/h	207.5	424.4	0.1562	18.38
<b>Size:</b>				
Conv.: No. per Stall	3	3	1	2
I.D.	810 mm	1040 mm	(70 mm)	330 mm
Length betw. Inlet & Outlet	47.7 m	48 m	2250 mm	18.4 m
Free Cross-Section	5500 cm <sup>2</sup>	8500 cm <sup>2</sup>	35 cm <sup>2</sup>	850 cm <sup>2</sup>
Total Conv. Vol.	26.46 m <sup>3</sup>	40.95 m <sup>3</sup>	7.85 l	1.6 m <sup>3</sup>
Catchpot: I.D.	850 mm	944 mm	(70 mm)	350 mm
Length	12 m (10 m)	9 m	1.7 m	7 m
Free Cross-Section	5400 cm <sup>2</sup> (5630 cm <sup>2</sup> )	7000 cm <sup>2</sup>	35 cm <sup>2</sup>	960 cm <sup>2</sup>
Total Volume of which for Intake	1.4 m <sup>3</sup> (3.3 m <sup>3</sup> ) 1.6 m <sup>3</sup> (1.0 m <sup>3</sup> )	4.3 m <sup>3</sup> 1.5 m <sup>3</sup>	5.95 l 1.75 l	0.54 m <sup>3</sup> 0.176 m <sup>3</sup>
<b>Mean Velocities in:</b>				
<b>I) Converter</b>				
1) Gas plus Liquid Calculated Homogeneous Mixture	10.4 cm/sec	13.9 cm/sec	1.24 cm/sec	6 cm/sec
2) @ 40% Full				
a) for Product Gas	16.1 cm/sec	22.3 cm/sec	1.86 cm/sec	8.35 cm/sec
b) for Liquid	2.0 "	1.14 "	0.29 "	2.14 "
<b>II) Catchpot</b>				
a) in Prod.-Gas Section	9.4 "	16.3 "	1.18 "	4.53 "
b) in Liquid Section (calculated for width of catchpot)	0.78 "	5.56 "	0.13 "	0.77 "
<b>Retention Times in:</b>				
<b>I) Converter</b>				
1) Gas plus Liquid Calculated as Homogeneous Mixture	458 sec.	348 sec.	181 sec.	314 sec.
2) @ 40% Full				
a) for Product-Gas	296 "	216 "	121 "	220 "
b) for Liquid	2380 "	4220 "	776 "	861 "
<b>II) Catchpot</b>				
a) in Prod.-Gas Section	52.7 " (40.8")	24.6 "	108 "	83.5 "
b) Liquid Section	360 " (245 ")	396 "	350 "	238 "

1) Cylindrical Space.