ANEXOS

Índice

Anexo I: Tablas

Tabla A.1. Datos *P*-ρ-*T* y*P*-η-*T* para la mezcla CO_2+N_2+O_2 con x_{CO2}= 0.968, x_{N2}= 0.020 y x_{O2}= 0.012 a diferentes temperaturas, *T*= 263.15 K, 273.15 K, 293.15 K, 304.21 K, 313.15 K, 333.15 K, 353.15 K y 373.15 K.

***T*= 263.15 K**					
***P*/MPa**	**ρ/kg·m^{-3}**	**η/µPa·s**	***P*/MPa**	**ρ/kg·m^{-3}**	**η/µPa·s**
0.5	10.333	17.180	15.0	1013.10	130.21
1.0	21.548	17.279	16.0	1017.20	131.92
1.5	33.883	17.383	17.0	1021.20	133.59
2.0	47.704	17.492	18.0	1025.10	135.24
2.5	63.637	17.606	19.0	1028.80	136.86
2.7687	73.457	17.657	20.0	1032.40	138.46
4.54	957.71	109.87	21.0	1036.00	140.04
5.0	960.85	110.90	22.0	1039.40	141.60
6.0	967.41	113.11	23.0	1042.70	143.14
7.0	973.55	115.23	24.0	1046.00	144.67
8.0	979.35	117.28	25.0	1049.20	146.18
9.0	984.85	119.26	26.0	1052.30	147.67
10.0	990.08	121.20	27.0	1055.40	149.14
11.0	995.07	123.08	28.0	1058.30	150.61
12.0	999.85	124.92	29.0	1061.20	152.06
13.0	1004.4	126.72	30.0	1064.10	153.49
14.0	1008.9	128.48			

***T*= 273.15 K**					
***P*/MPa**	***ρ*/kg·m^{-3}**	***η*/μPa·s**	***P*/MPa**	***ρ*/kg·m^{-3}**	***η*/μPa·s**
0.5	9.9094	13.865	15.0	969.33	112.88
1.0	20.548	13.933	16.0	974.47	114.62
1.5	32.075	14.024	17.0	979.40	116.33
2.0	44.721	14.147	18.0	984.13	118.01
3.0	74.957	14.533	19.0	988.69	119.65
3.6571	101.13	14.972	20.0	993.08	121.26
5.2555	899.45	92.311	21.0	997.33	122.85
5.5	902.00	92.969	22.0	1001.40	124.41
6.0	906.99	94.274	23.0	1005.40	125.94
7.0	916.19	96.746	24.0	1009.30	127.46
8.0	924.55	99.069	25.0	1013.00	128.95
9.0	932.24	101.27	26.0	1016.70	130.43
10.0	939.38	103.38	27.0	1020.20	131.88
11.0	946.07	105.4	28.0	1023.70	133.33
12.0	952.35	107.36	29.0	1027.10	134.75
13.0	958.3	109.25	30.0	1030.40	136.16
14.0	963.95	111.09			

***T*= 293.15 K**					
***P*/MPa**	***ρ*/kg·m^{-3}**	***η*/μPa·s**	***P*/MPa**	***ρ*/kg·m^{-3}**	***η*/μPa·s**
0.5	9.1675	14.843	15.0	867.21	84.251
1.0	18.849	14.903	16.0	876.09	86.247
1.5	29.123	14.981	17.0	884.32	88.155
2.0	40.09	15.081	18.0	891.99	89.986
3.0	64.675	15.369	19.0	899.19	91.752
4.0	94.36	15.832	20.0	905.99	93.462
5.0	133.11	16.626	21.0	912.42	95.121
6.0	195.09	18.343	22.0	918.53	96.736
6.1061	205.32	18.680	23.0	924.36	98.311
7.1559	729.84	59.834	24.0	929.94	99.850
8.0	761.12	64.508	25.0	935.28	101.36
9.0	786.38	68.615	26.0	940.42	102.83
10.0	805.66	71.974	27.0	945.36	104.28
11.0	821.48	74.891	28.0	950.13	105.71
12.0	835.01	77.510	29.0	954.73	107.11
13.0	846.9	79.911	30.0	959.18	108.49
14.0	857.54	82.147			

T= 304.21 K					
***P*/MPa**	***ρ*/kg·m^{-3}**	***η*/μPa·s**	***P*/MPa**	***ρ*/kg·m^{-3}**	***η*/μPa·s**
0.5	8.8069	15.382	15.0	797.69	70.746
1.0	18.043	15.442	16.0	810.72	73.048
1.5	27.764	15.518	17.0	822.39	75.191
2.0	38.036	15.613	18.0	832.97	77.208
2.5	48.943	15.731	19.0	842.66	79.120
3.0	60.590	15.875	20.0	851.63	80.945
4.0	86.691	16.27	21.0	859.98	82.695
5.0	118.09	16.874	22.0	867.79	84.382
6.0	158.42	17.858	23.0	875.15	86.012
7.0	217.88	19.732	24.0	882.11	87.594
8.0	358.87	26.225	25.0	888.71	89.132
9.0	612.67	45.941	26.0	895.00	90.630
10.0	680.82	53.674	27.0	901.00	92.094
11.0	718.26	58.54	28.0	906.74	93.525
12.0	744.78	62.305	29.0	912.26	94.927
13.0	765.60	65.469	30.0	917.55	96.324
14.0	782.86	68.241			

***T*= 313.15 K**					
***P*/MPa**	***ρ*/kg·m^{-3}**	***η*/μPa·s**	***P*/MPa**	***ρ*/kg·m^{-3}**	***η*/μPa·s**
0.5	8.5369	15.809	15.0	730.90	60.581
1.0	17.447	15.863	16.0	749.50	63.268
1.5	26.773	15.931	17.0	765.52	65.699
2.0	36.563	16.017	18.0	779.62	67.937
2.5	46.877	16.122	19.0	792.22	70.021
3.0	57.787	16.249	20.0	803.64	71.982
4.0	81.769	16.590	21.0	814.10	73.84
5.0	109.53	17.088	22.0	823.75	75.612
6.0	142.83	17.830	23.0	832.72	77.311
7.0	185.01	18.998	24.0	841.11	78.946
8.0	243.76	21.051	25.0	848.99	80.526
9.0	339.84	25.492	26.0	856.43	82.057
10.0	485.91	34.958	27.0	863.49	83.544
11.0	587.15	43.751	28.0	870.32	84.992
12.0	643.40	49.622	29.0	876.58	86.405
13.0	680.76	53.995	30.0	882.69	87.787
14.0	708.62	57.545			

T= 333.15 K					
***P*/MPa**	***ρ*/kg·m^{-3}**	***η*/μPa·s**	***P*/MPa**	***ρ*/kg·m^{-3}**	***η*/μPa·s**
0.5	7.5167	16.762	15.0	545.02	40.748
1.0	16.263	16.811	16.0	583.06	44.237
1.5	24.835	16.872	17.0	614.37	47.347
2.0	33.733	16.947	18.0	640.61	50.137
2.5	42.987	17.036	19.0	663.05	52.669
3.0	52.63	17.143	20.0	682.58	54.990
4.0	73.241	17.416	21.0	699.83	57.140
5.0	95.947	17.787	22.0	715.26	59.147
6.0	121.26	18.287	23.0	729.20	61.036
7.0	149.87	18.964	24.0	741.93	62.824
8.0	182.75	19.886	25.0	753.63	64.525
9.0	221.18	21.160	26.0	764.45	66.152
10.0	266.7	22.946	27.0	774.53	67.714
11.0	320.43	25.441	28.0	784.14	69.218
12.0	381	28.769	29.0	792.83	70.673
13.0	442.71	32.742	30.0	801.19	72.082
14.0	498.45	36.870			

***T*= 353.15 K**					
***P*/MPa**	***ρ*/kg·m^{-3}**	***η*/μPa·s**	***P*/MPa**	***ρ*/kg·m^{-3}**	***η*/μPa·s**
0.5	7.5167	17.702	15.0	394.24	30.51
1.0	15.244	17.746	16.0	432.05	32.947
1.5	23.195	17.801	17.0	467.54	35.444
2.0	31.384	17.868	18.0	500.05	37.918
2.5	39.824	17.946	19.0	529.41	40.314
3.0	48.534	18.038	20.0	555.77	42.604
4.0	66.833	18.266	21.0	579.41	44.777
5.0	86.445	18.565	22.0	600.68	46.835
6.0	107.56	18.948	23.0	619.91	48.783
7.0	130.41	19.434	24.0	637.38	50.632
8.0	155.24	20.047	25.0	653.35	52.391
9.0	182.33	20.816	26.0	668.03	54.069
10.0	211.93	21.777	27.0	681.59	55.675
11.0	244.22	22.970	28.0	694.42	57.215
12.0	279.19	24.431	29.0	705.91	58.698
13.0	316.48	26.186	30.0	716.89	60.128
14.0	355.25	28.228			

T= 373.15 K					
***P*/MPa**	***ρ*/kg·m^{-3}**	***η*/μPa·s**	***P*/MPa**	***ρ*/kg·m^{-3}**	***η*/μPa·s**
0.5	7.0965	18.627	15.0	315.51	27.066
1.0	14.355	18.668	16.0	344.22	28.552
1.5	21.783	18.719	17.0	372.78	30.151
2.0	29.387	18.778	18.0	400.74	31.837
2.5	37.176	18.848	19.0	427.73	33.579
3.0	45.158	18.929	20.0	453.45	35.347
4.0	61.736	19.126	21.0	477.74	37.117
5.0	79.196	19.376	22.0	500.51	38.867
6.0	97.619	19.687	23.0	521.76	40.582
7.0	117.09	20.069	24.0	541.55	42.253
8.0	137.69	20.532	25.0	559.97	43.876
9.0	159.50	21.089	26.0	577.11	45.448
10.0	182.57	21.752	27.0	593.10	46.970
11.0	206.93	22.535	28.0	608.32	48.442
12.0	232.55	23.451	29.0	622.01	49.867
13.0	259.34	24.509	30.0	635.14	51.247
14.0	287.09	25.715			

Anexo II: Figuras

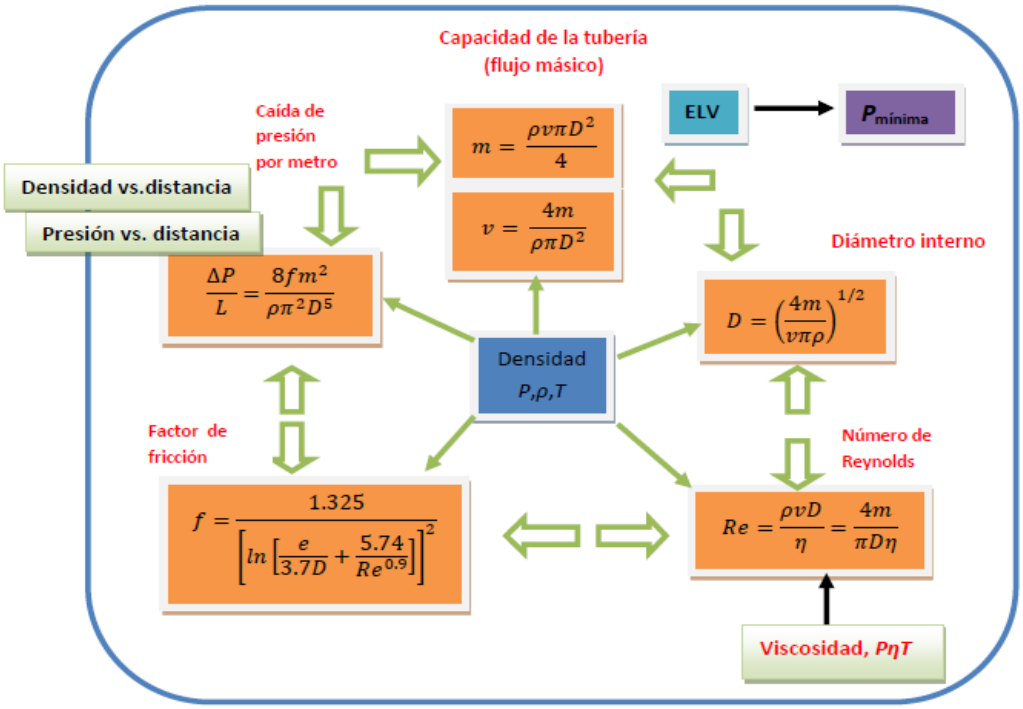


Figura A.1. Esquema del cálculo de parámetros relativos al diseño y operación de la etapa de transporte.

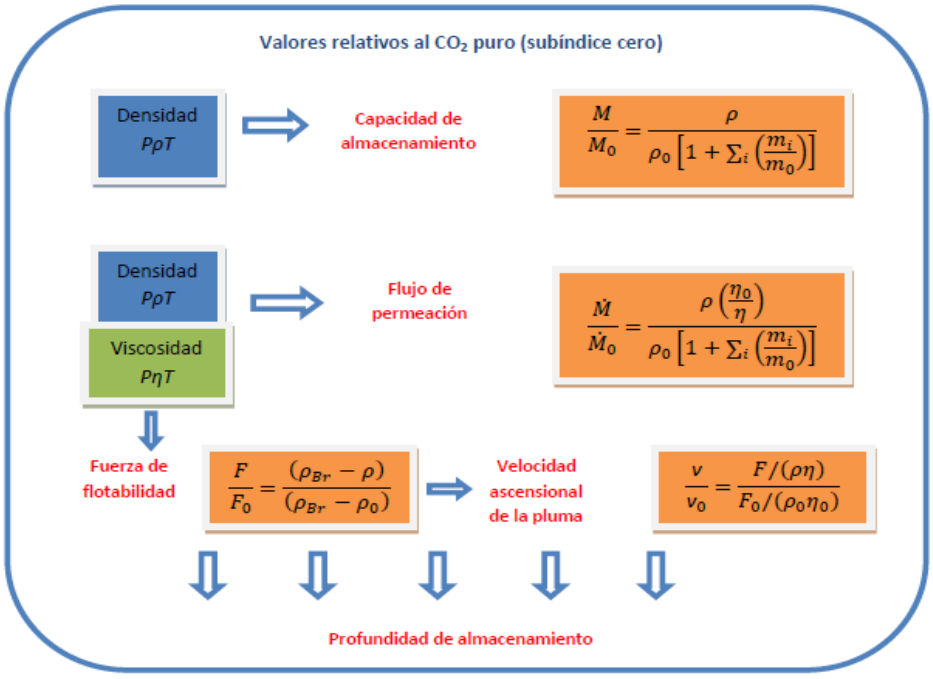


Figura A.2. Esquema de cálculo de parámetros relativos a las etapas de inyección y almacenamiento.

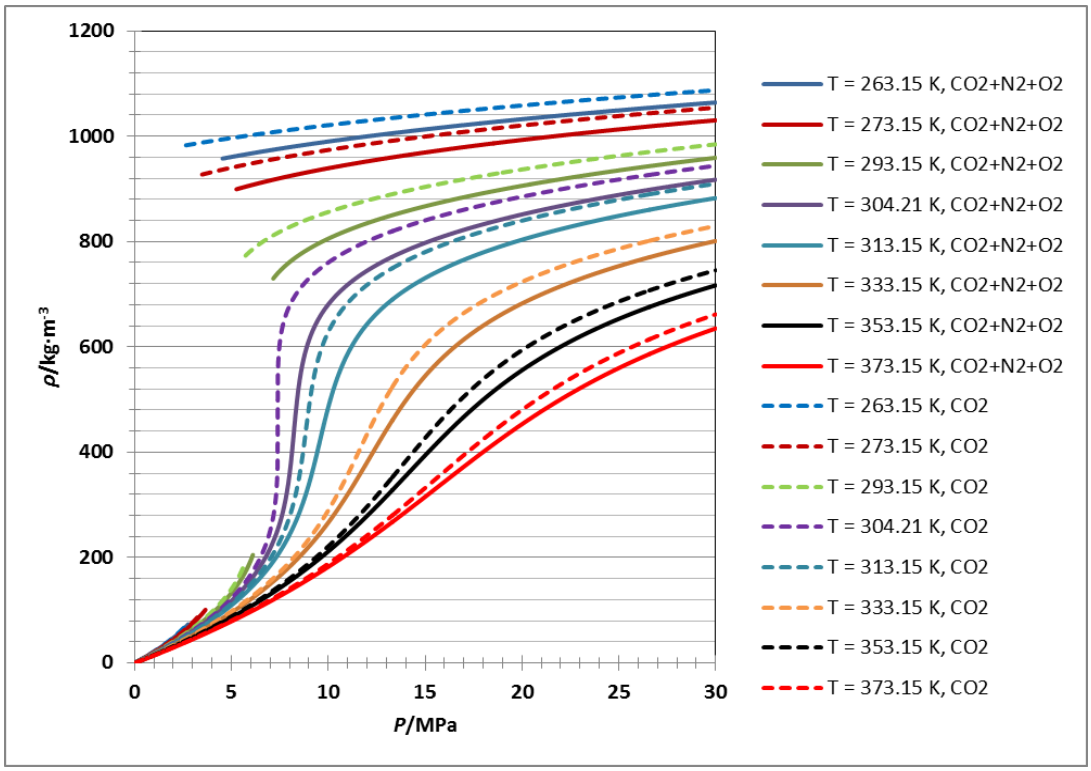


Figura A.3. Densidades para la mezcla CO_2+N_2+O_2 con x_{CO2}= 0.968, x_{N2}= 0.020 y x_{O2}= 0.012 y para el CO_2 puro a varias presiones, *P*, y temperaturas, *T*.

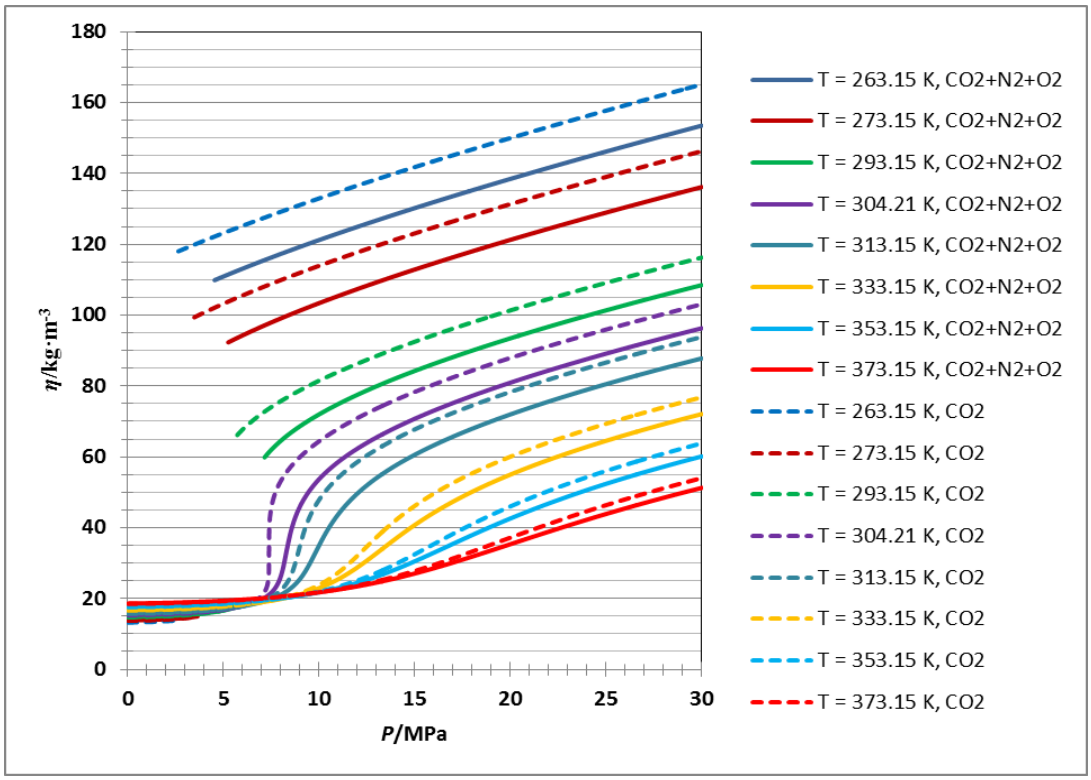
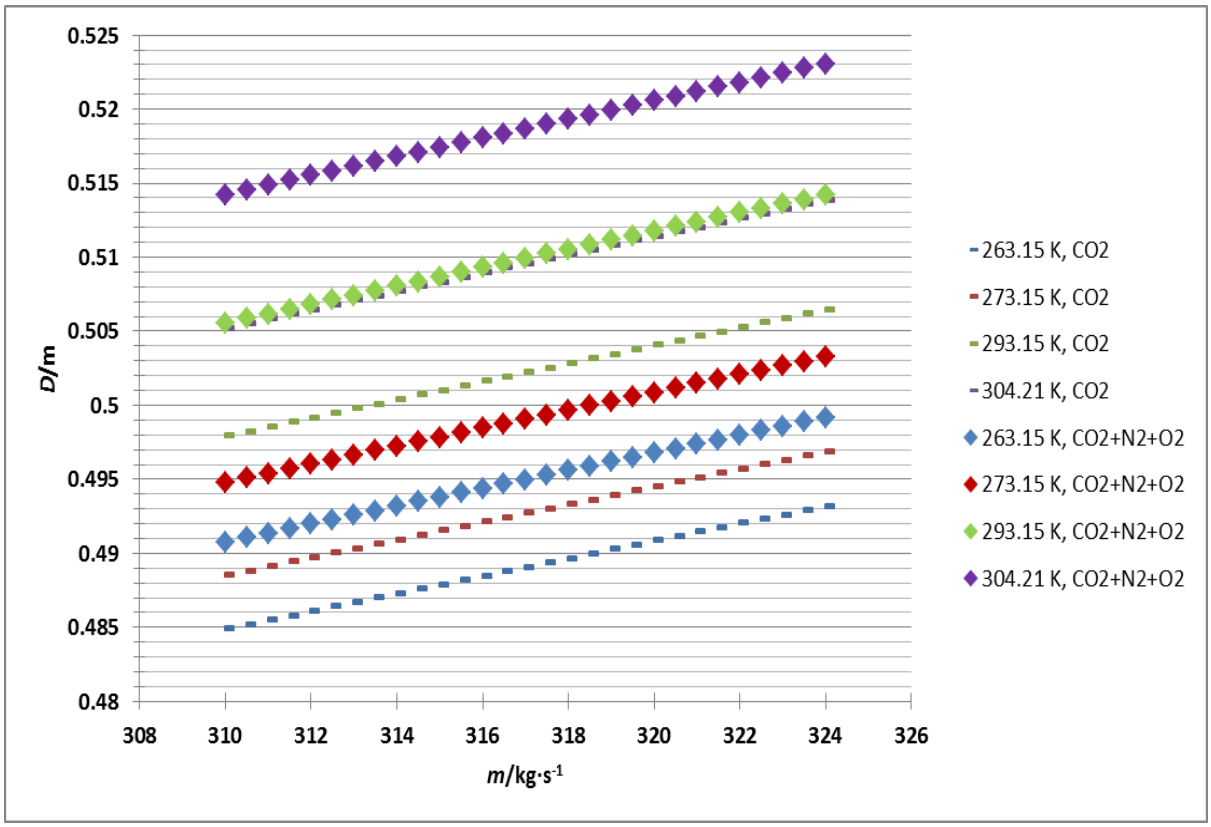


Figura A.4. Densidades para la mezcla CO_2+N_2+O_2 con x_{CO2}= 0.968, x_{N2}= 0.020 y x_{O2}= 0.012 y para el CO_2 puro a varias presiones, *P*, y temperaturas, *T*.

a)



b)

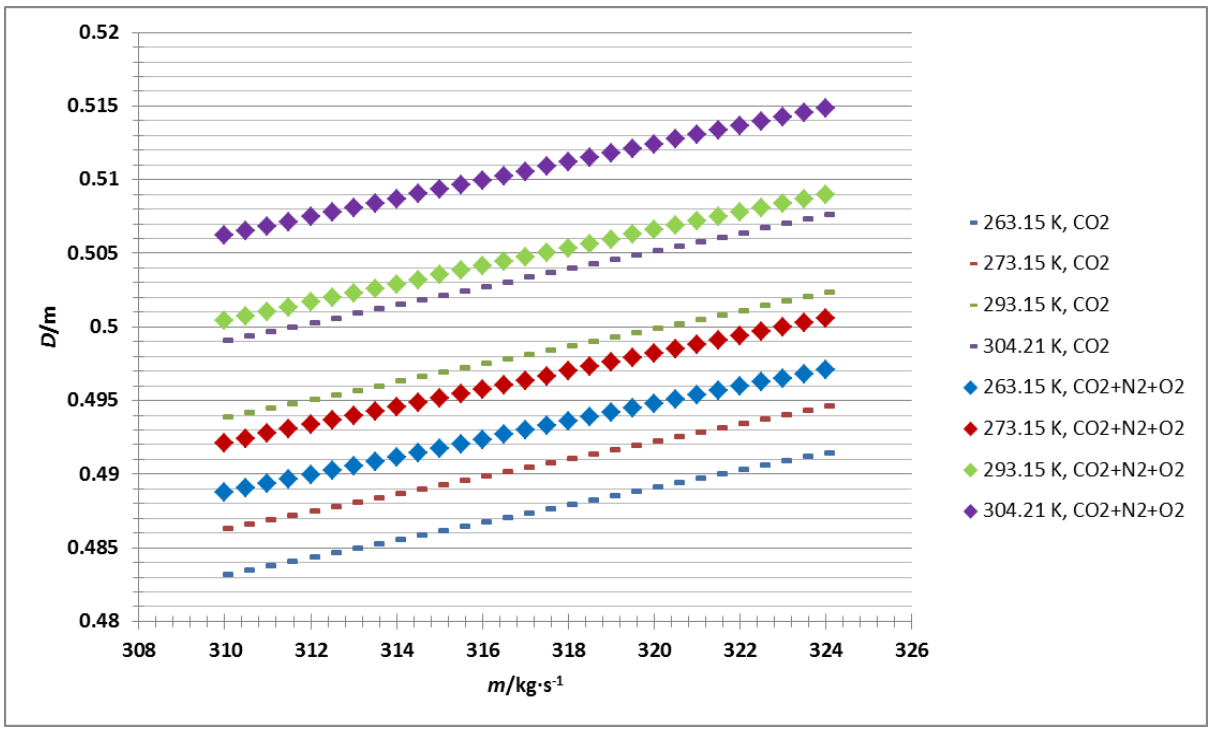


Figura A.5. Diámetro interno de la tubería, *D*, frente al flujo de masa, *m*, para la mezcla CO_2+N_2+O_2 con x_{CO2}=0.968, x_{N2}= 0.020 y x_{O2}=0.012 y para CO_2 puro a: a) *P*= 14 MPa y b) *P*= 20 MPa, a las temperaturas de transporte, *T*.