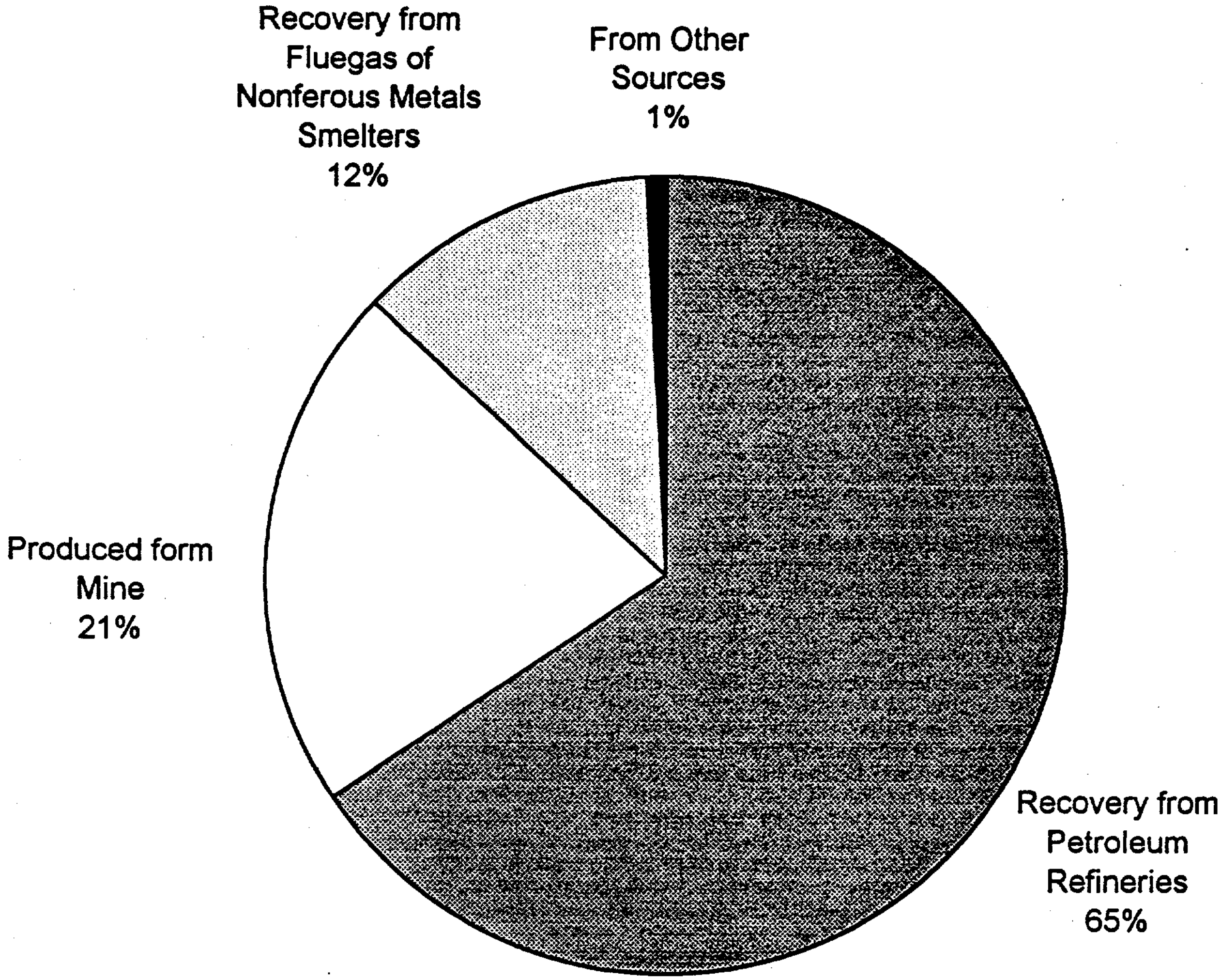


Figure 1. Elemental Sulfur Production with respect to the Sources

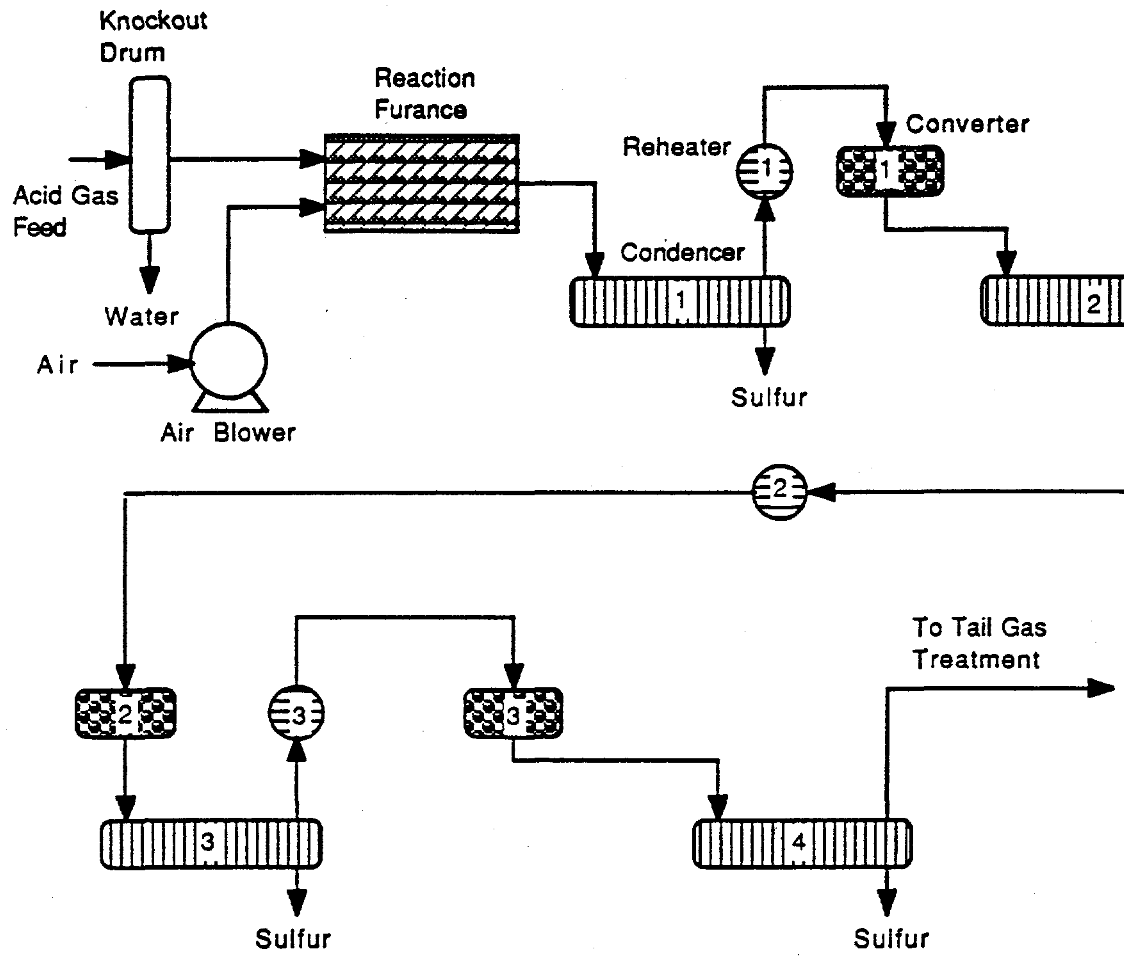


Figure 2. Schematic Structure of Conventional Claus Process Unit

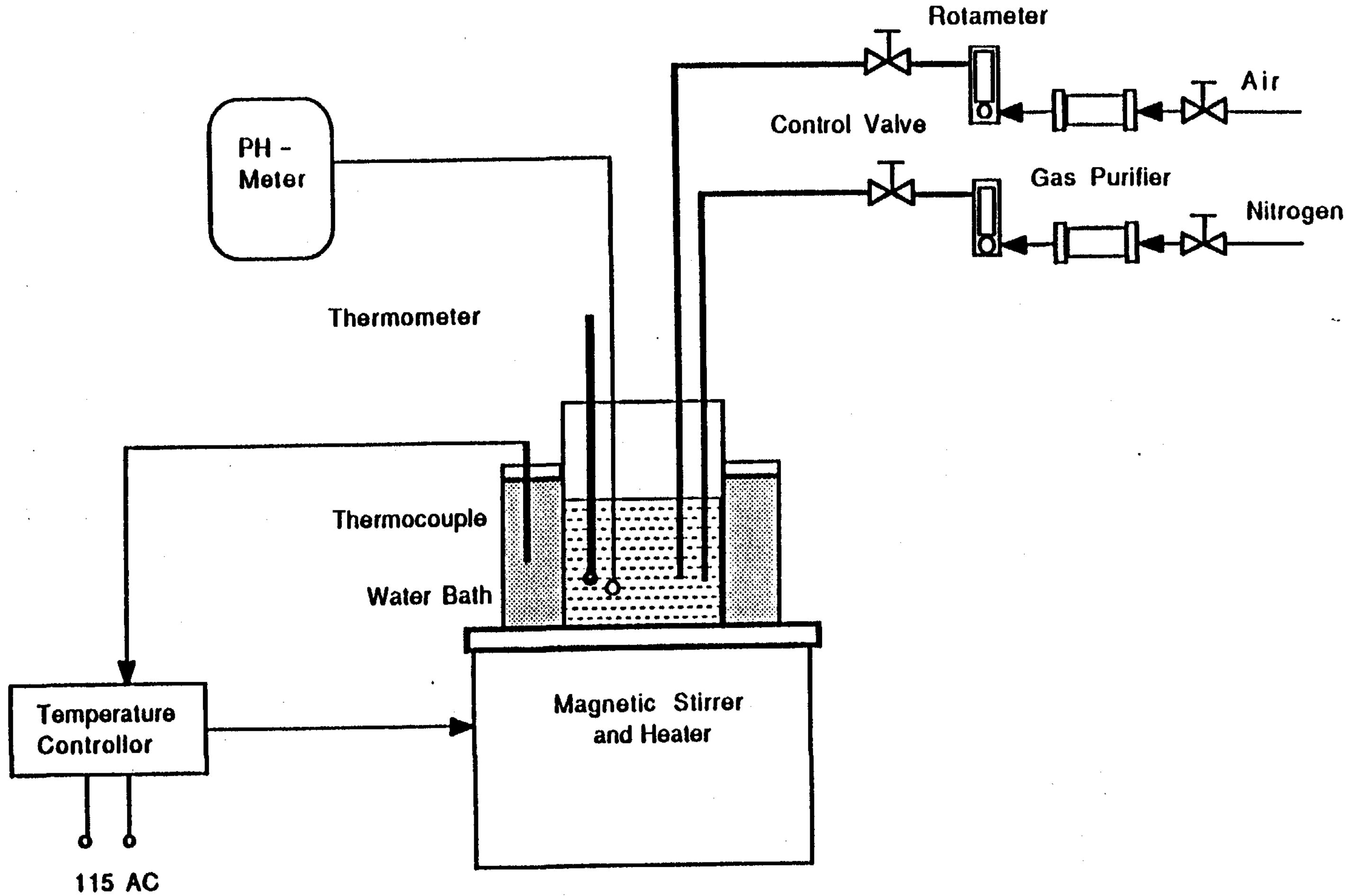


Figure 3. Schematic Diagram of Catalyst Preparation System

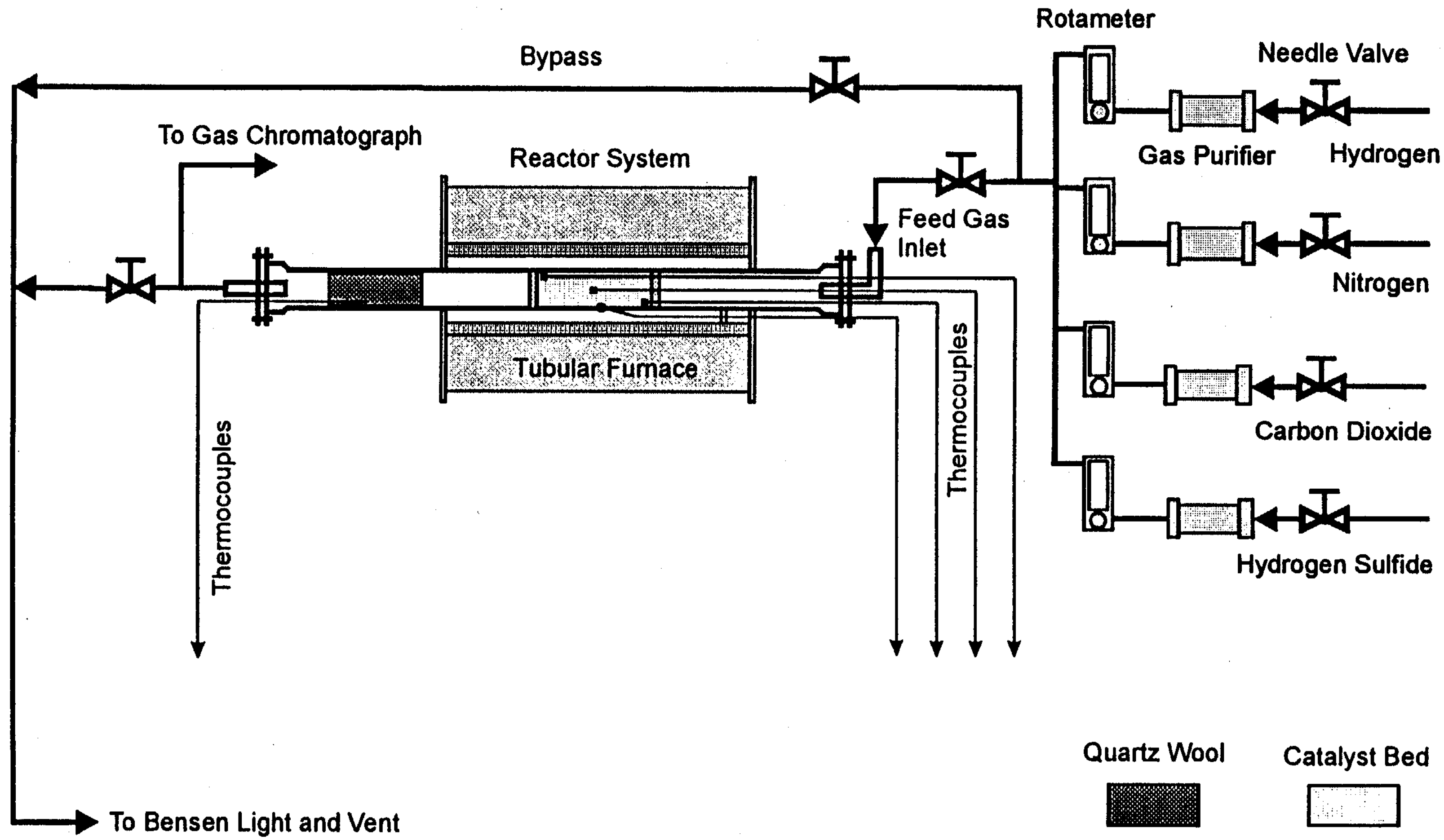


Figure 4. Experimental Apparatus for Catalyst Screening Study

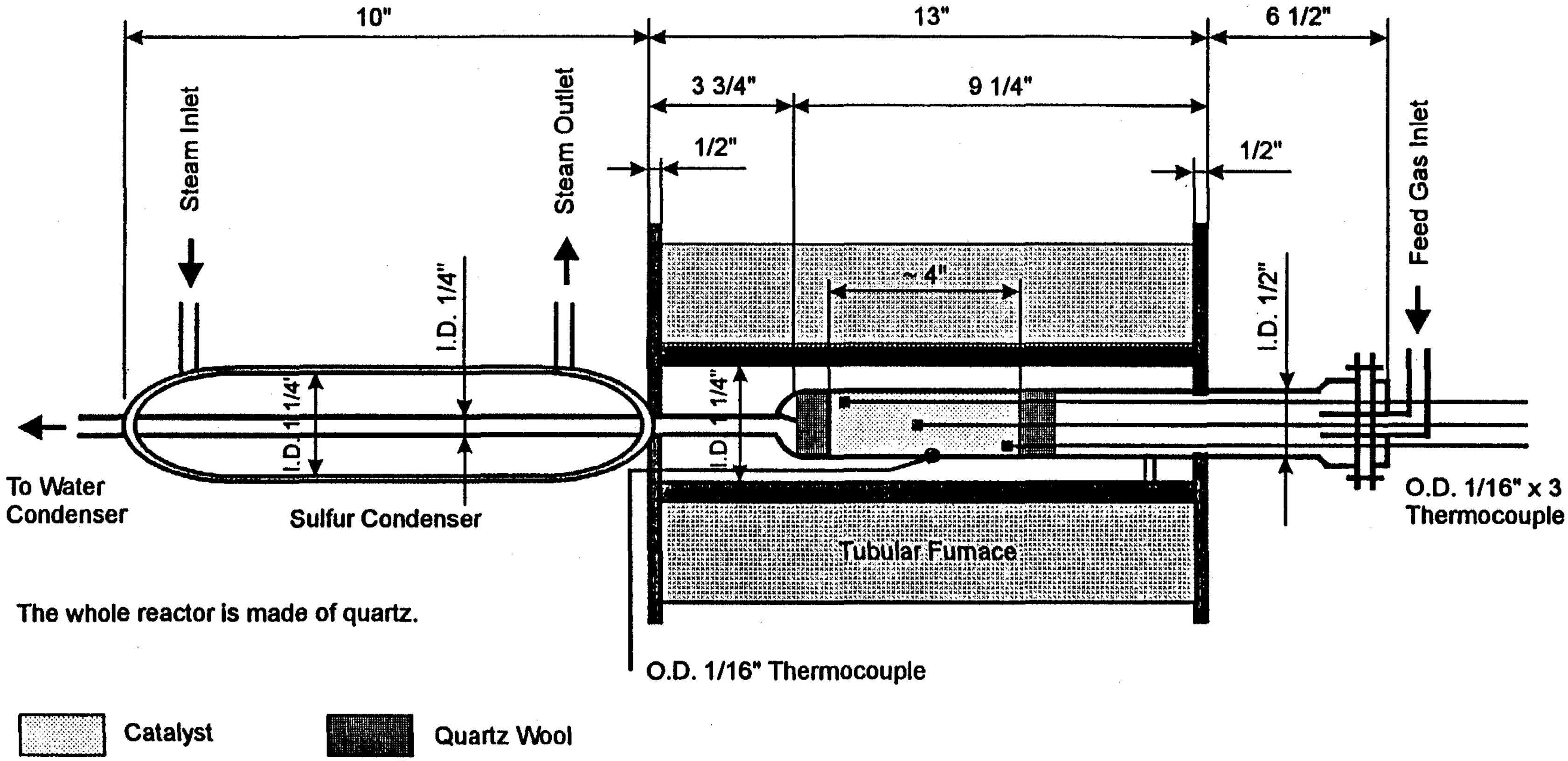


Figure 5. Reactor Structure and Dimension

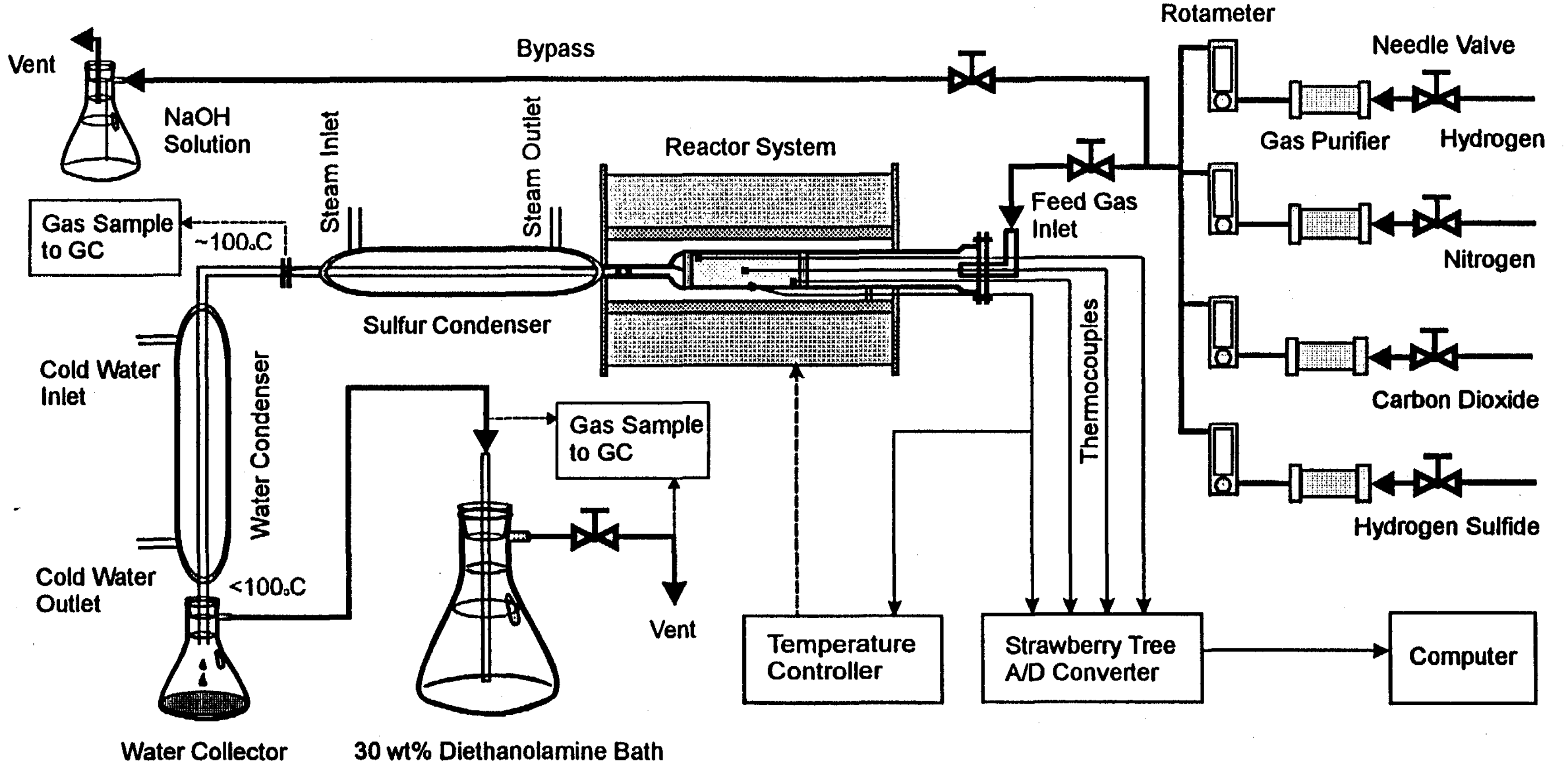


Figure 6. Schematic Diagram of Experimental Apparatus System

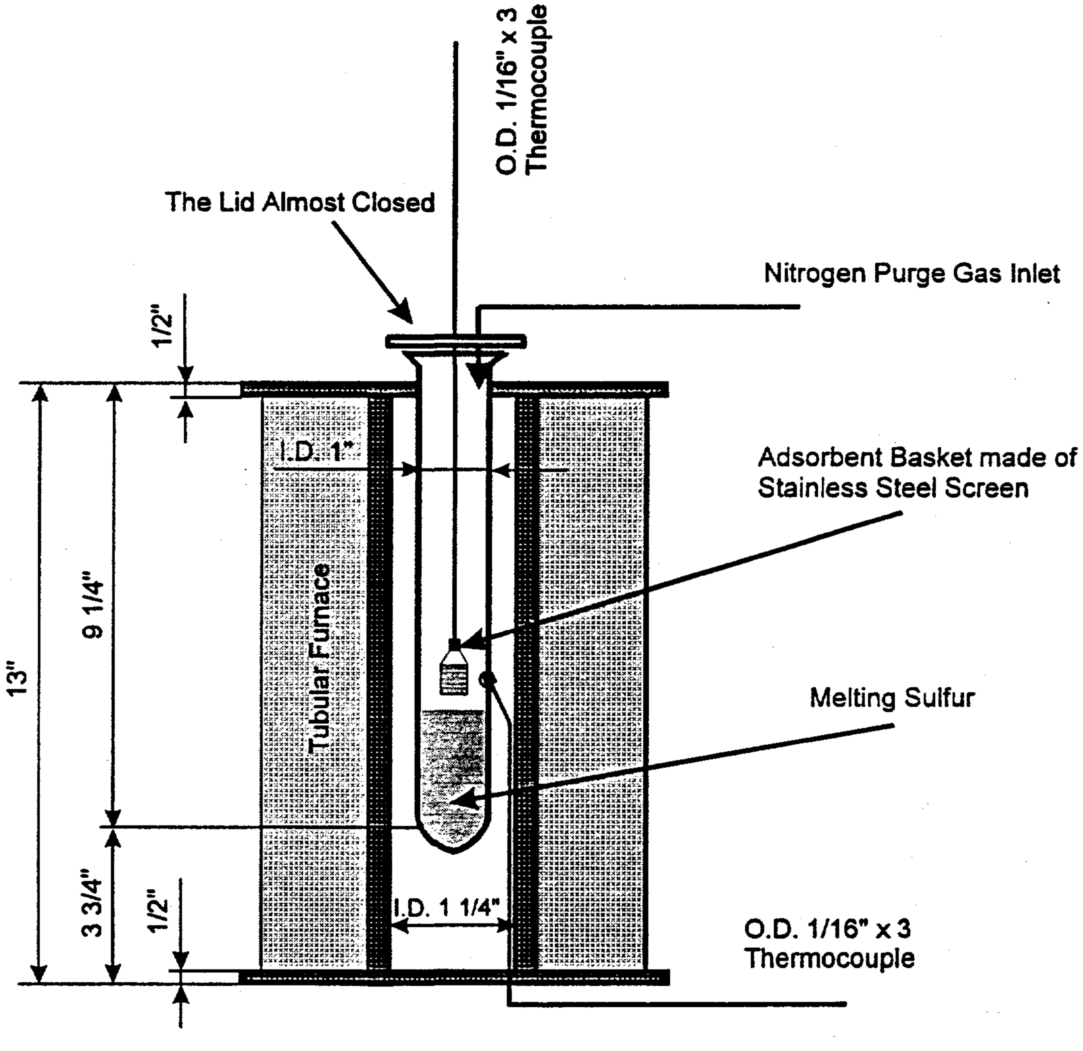


Figure 7. Experimental Apparatus for Adsorption of Sulfur

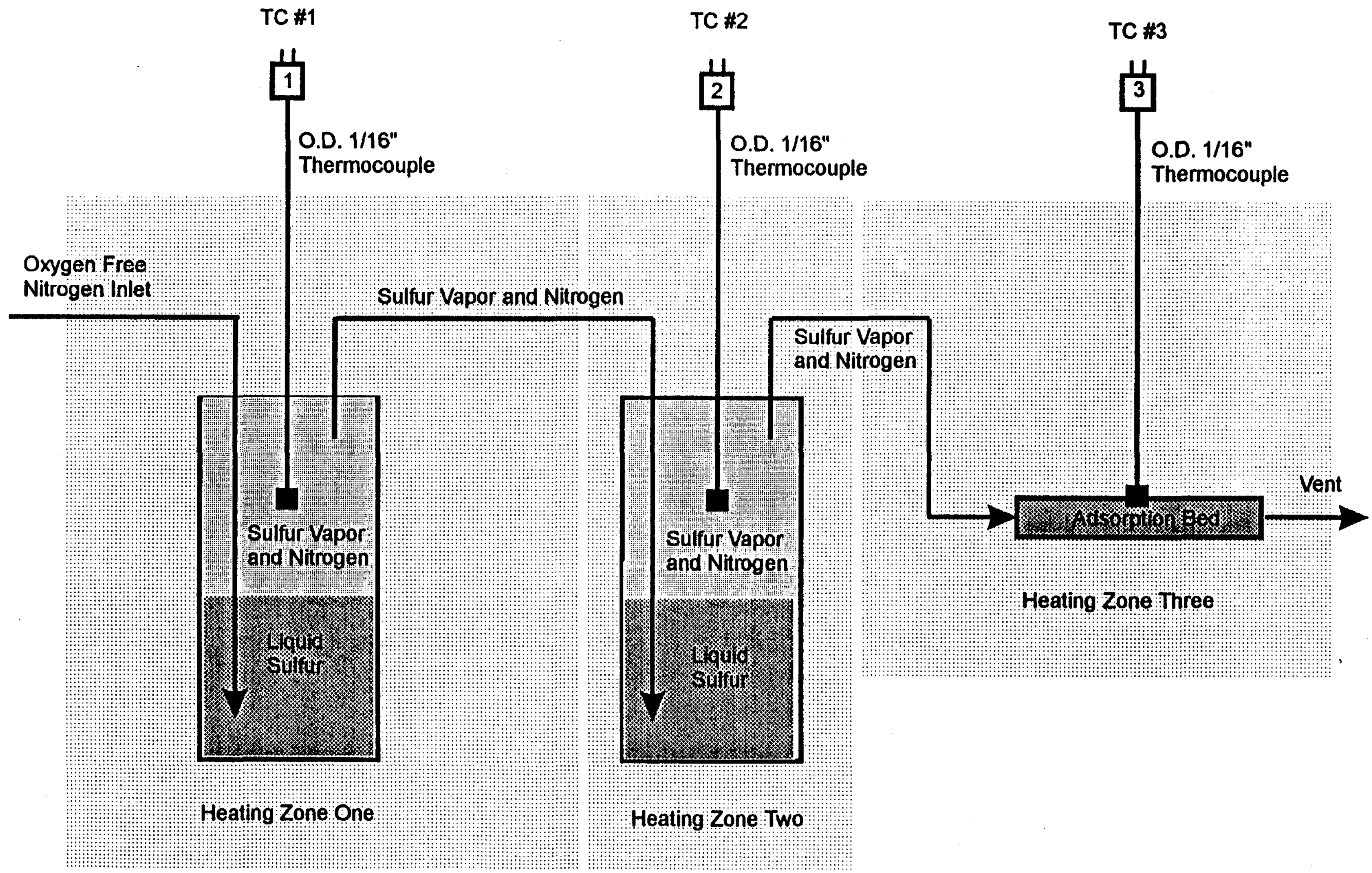


Figure 8. New Experimental Apparatus for Adsorption of Sulfur

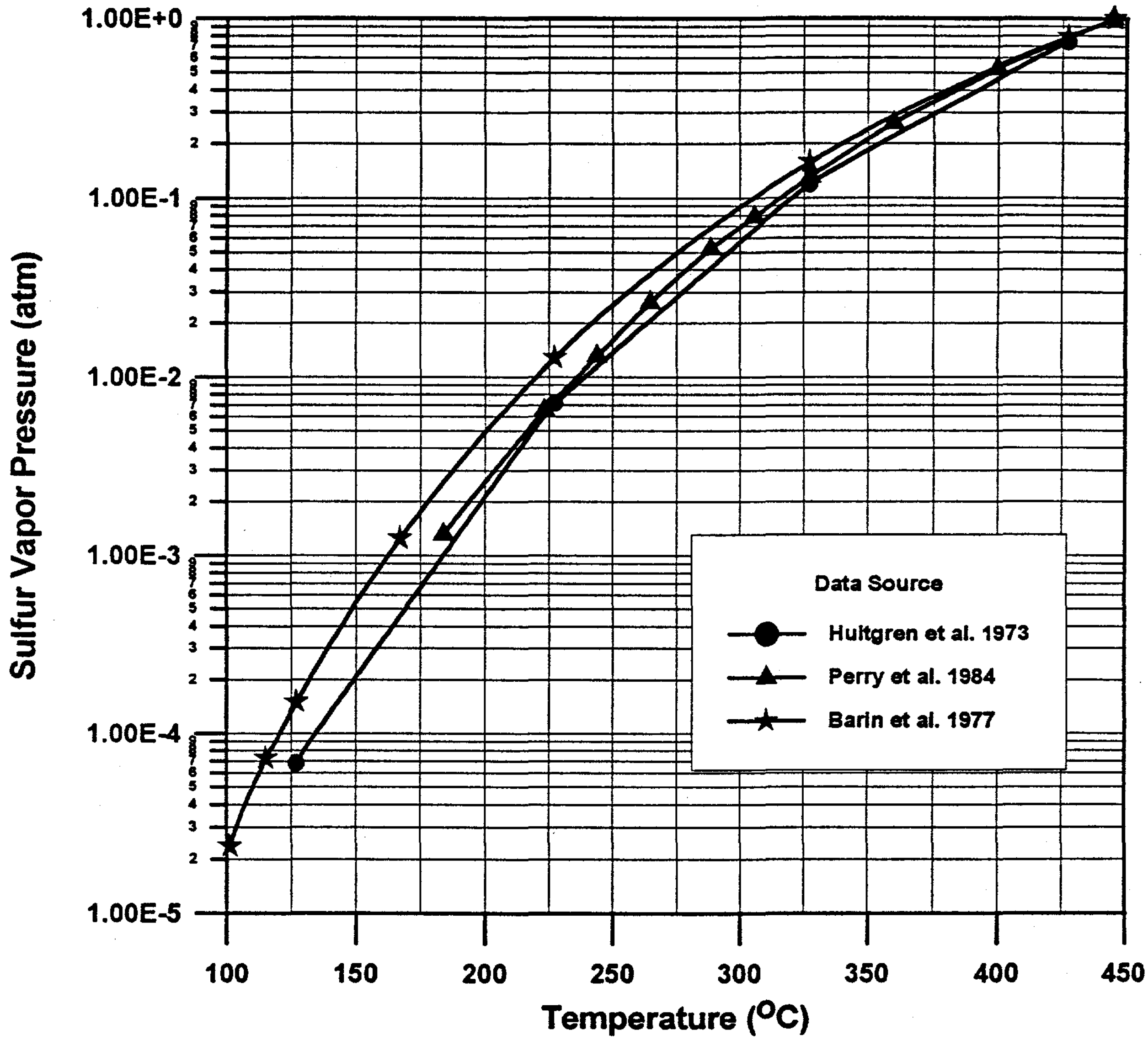


Figure 9. Sulfur Vapor Pressure (atm) v.s. Temperature (^{O}C)

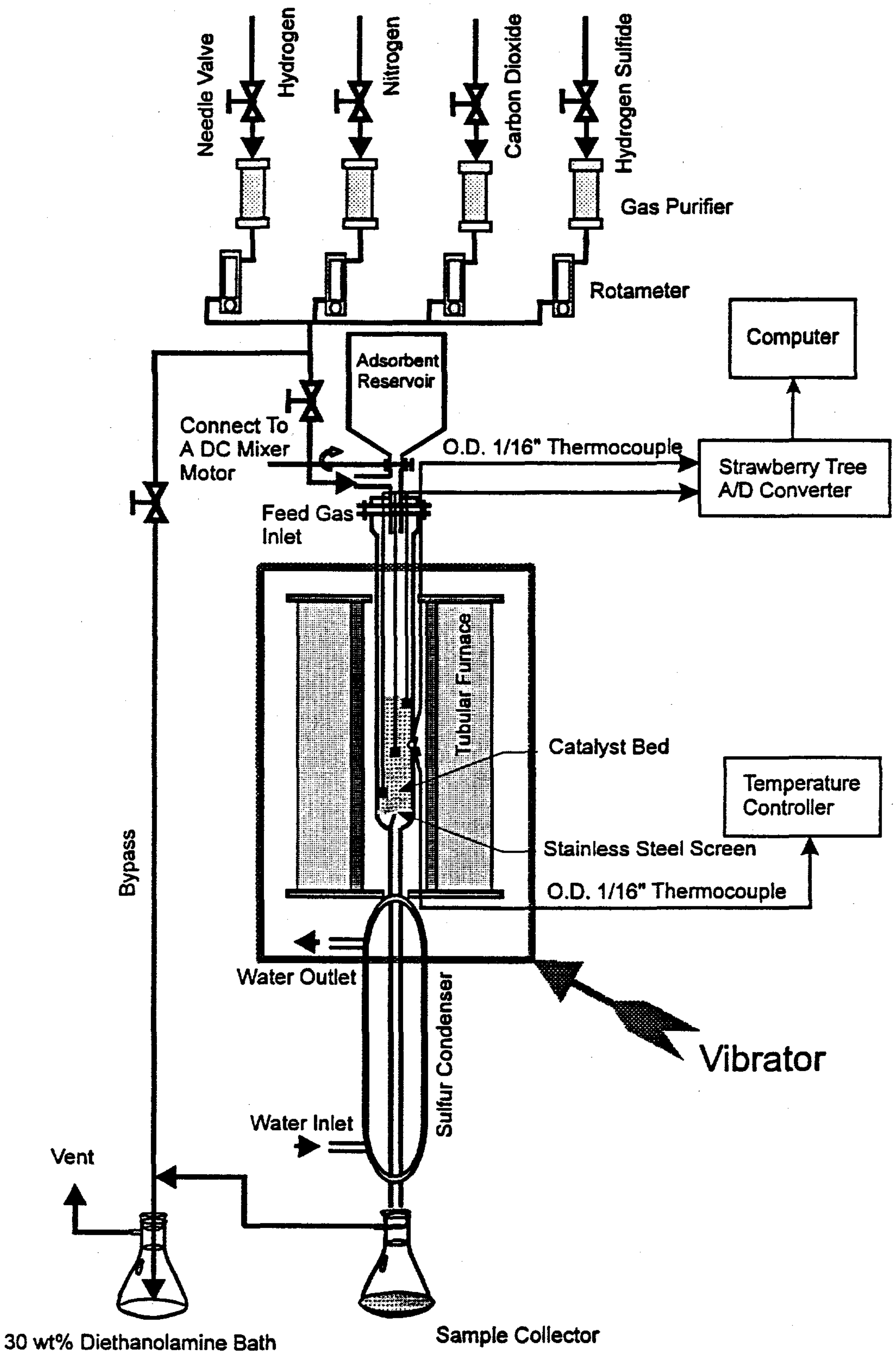


Figure 10. Experimental System for Adsorption Test

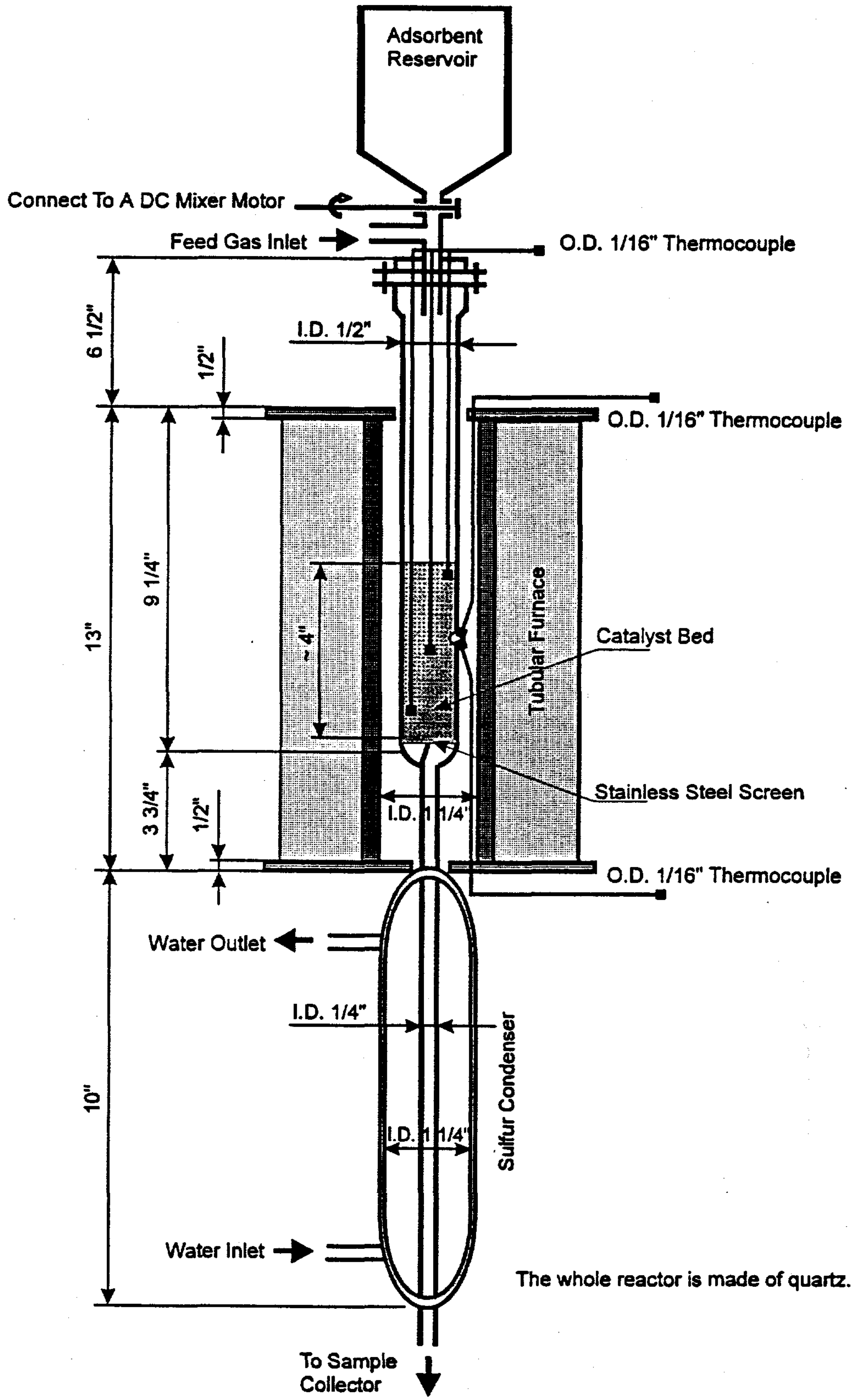
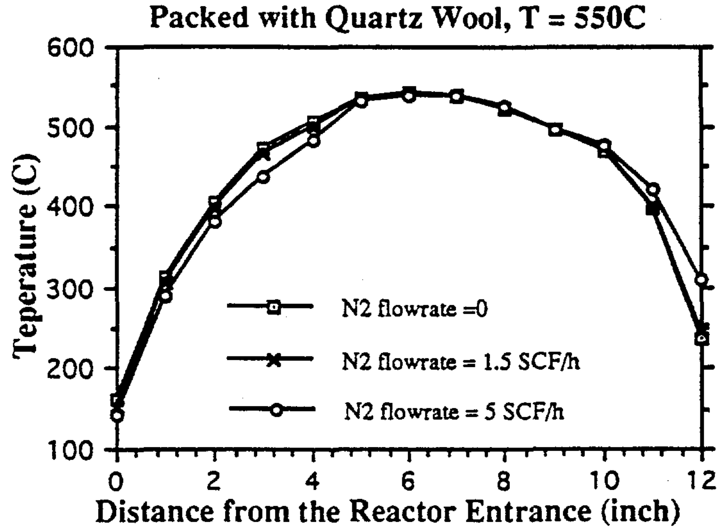


Figure 11. Structure of Adsorption Reactor



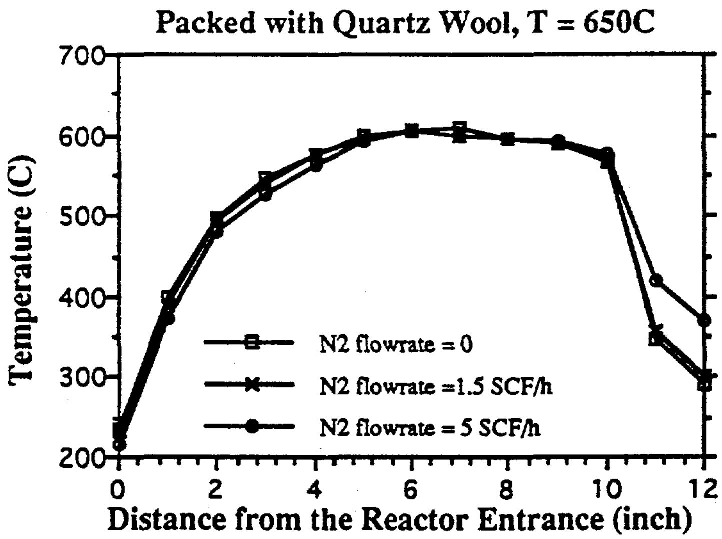


Figure 12. Temperature Profile in the Original Reactor

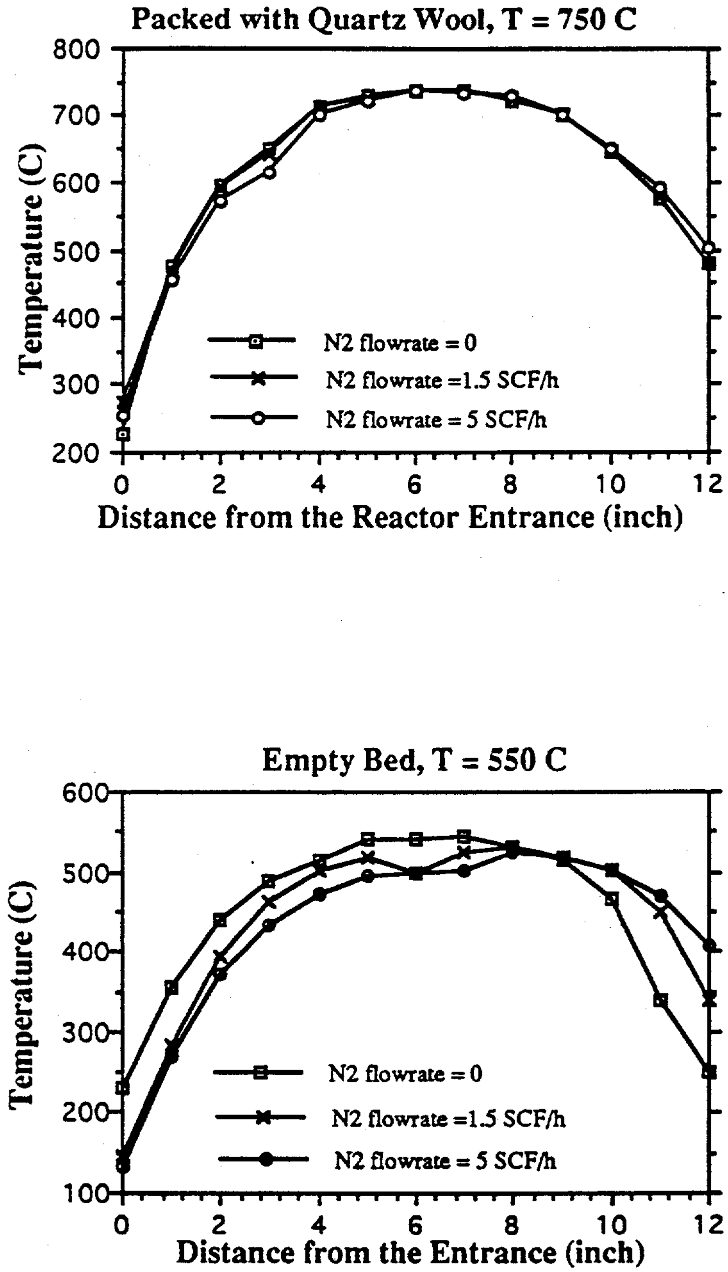
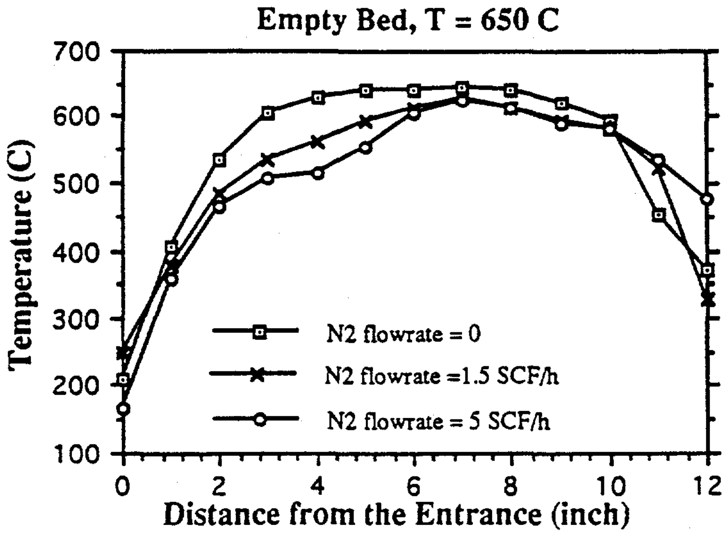


Figure 13. Temperature Profile in the Original Reactor



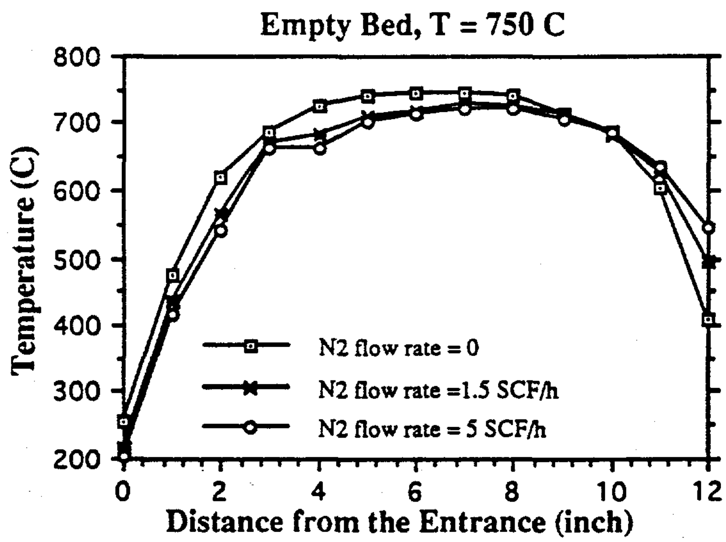


Figure 14. Temperature Profile in the Original Reactor

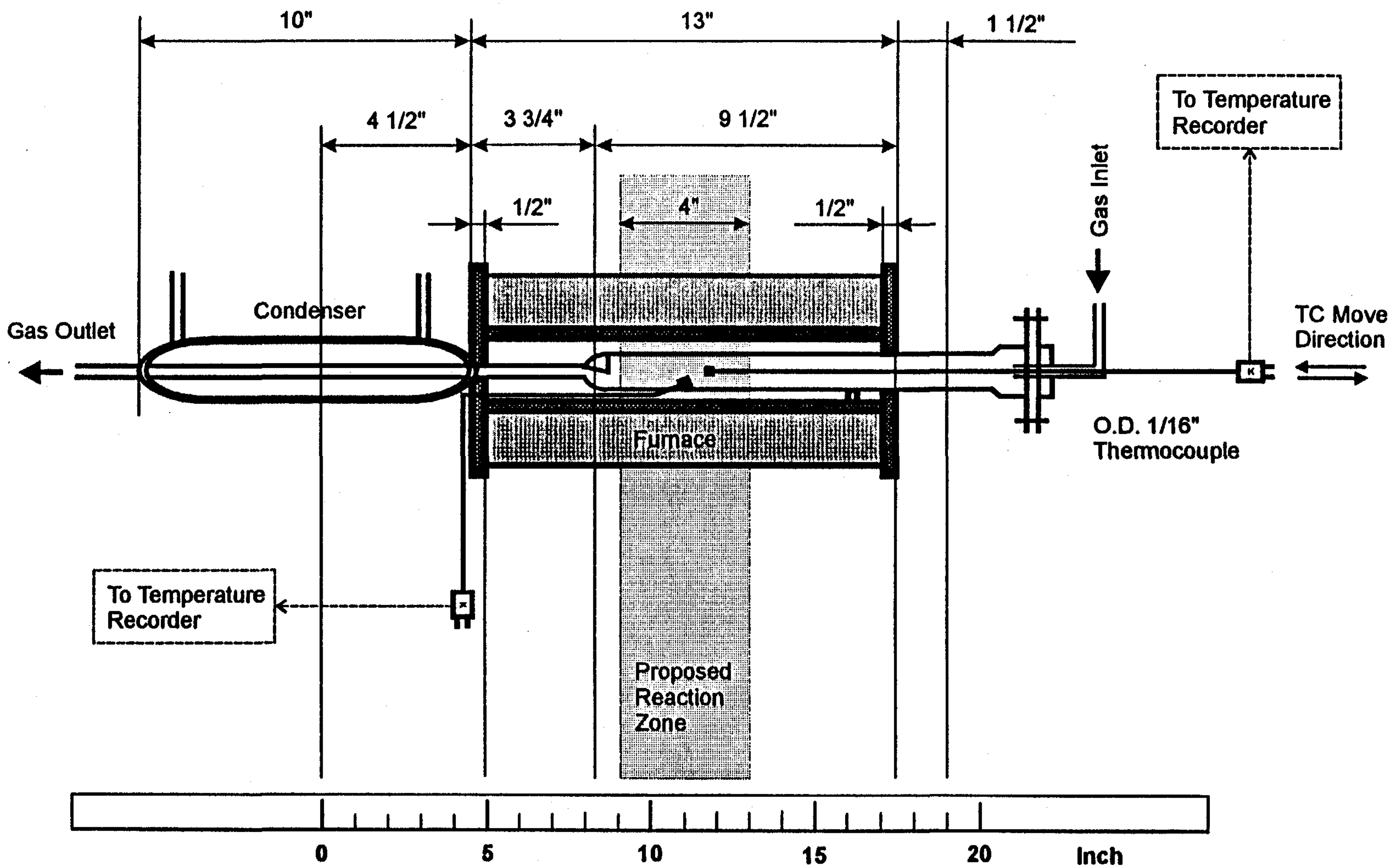


Figure 15. Position Chart of Corresponding Temperature Profile

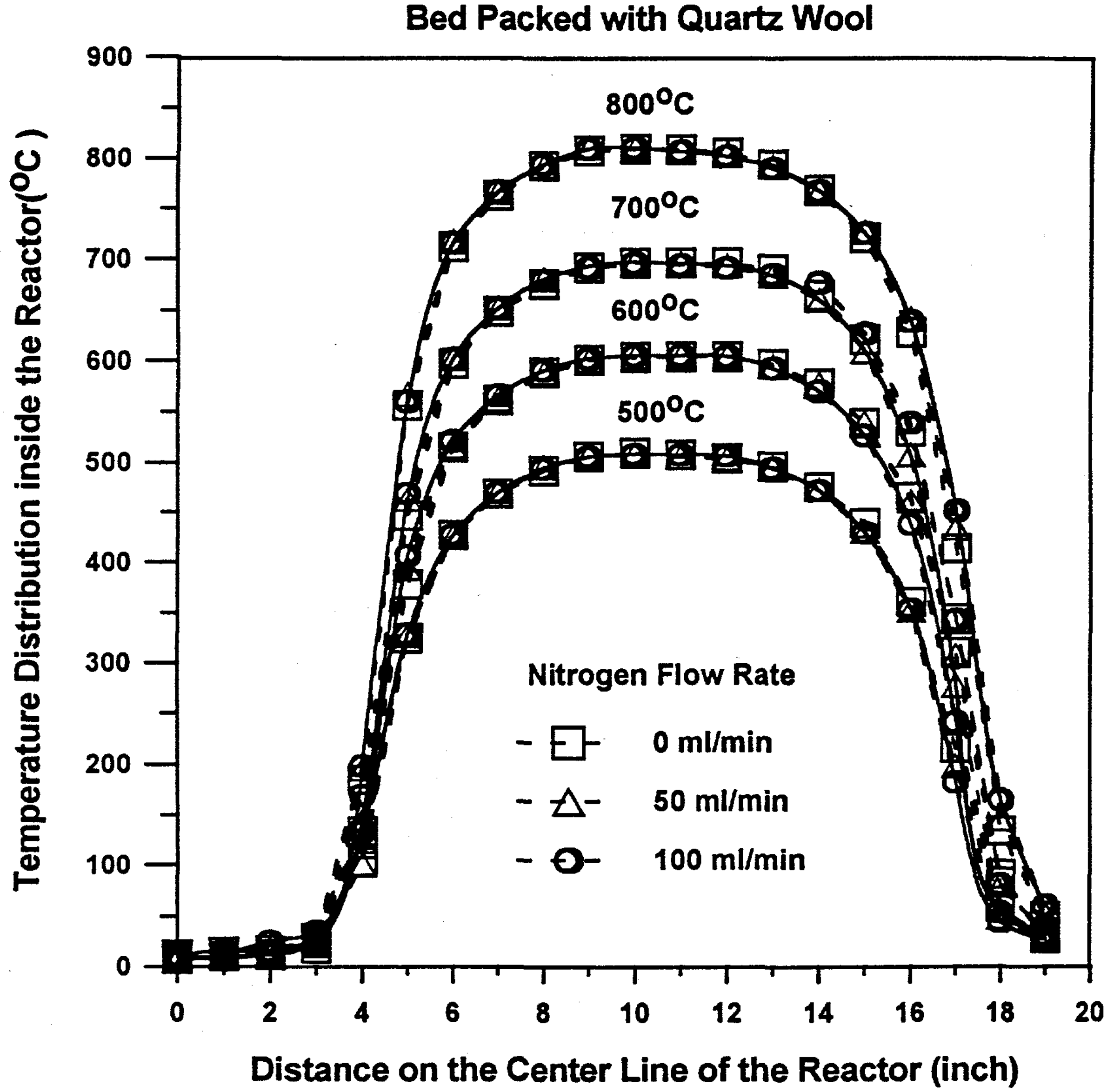


Figure 16. Temperature Profile inside the Modified Reactor

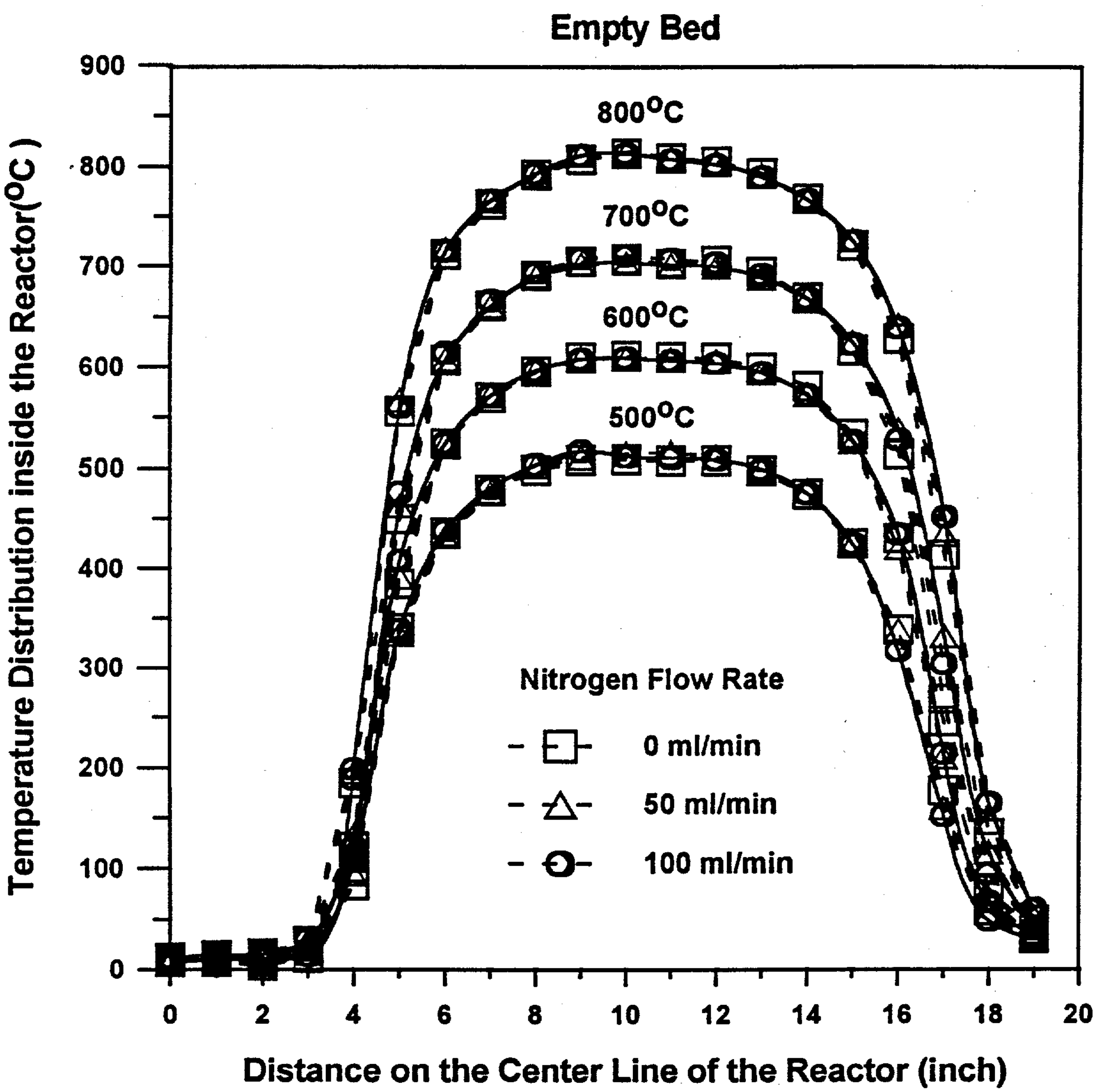


Figure 17. Temperature Profile inside the Modified Reactor

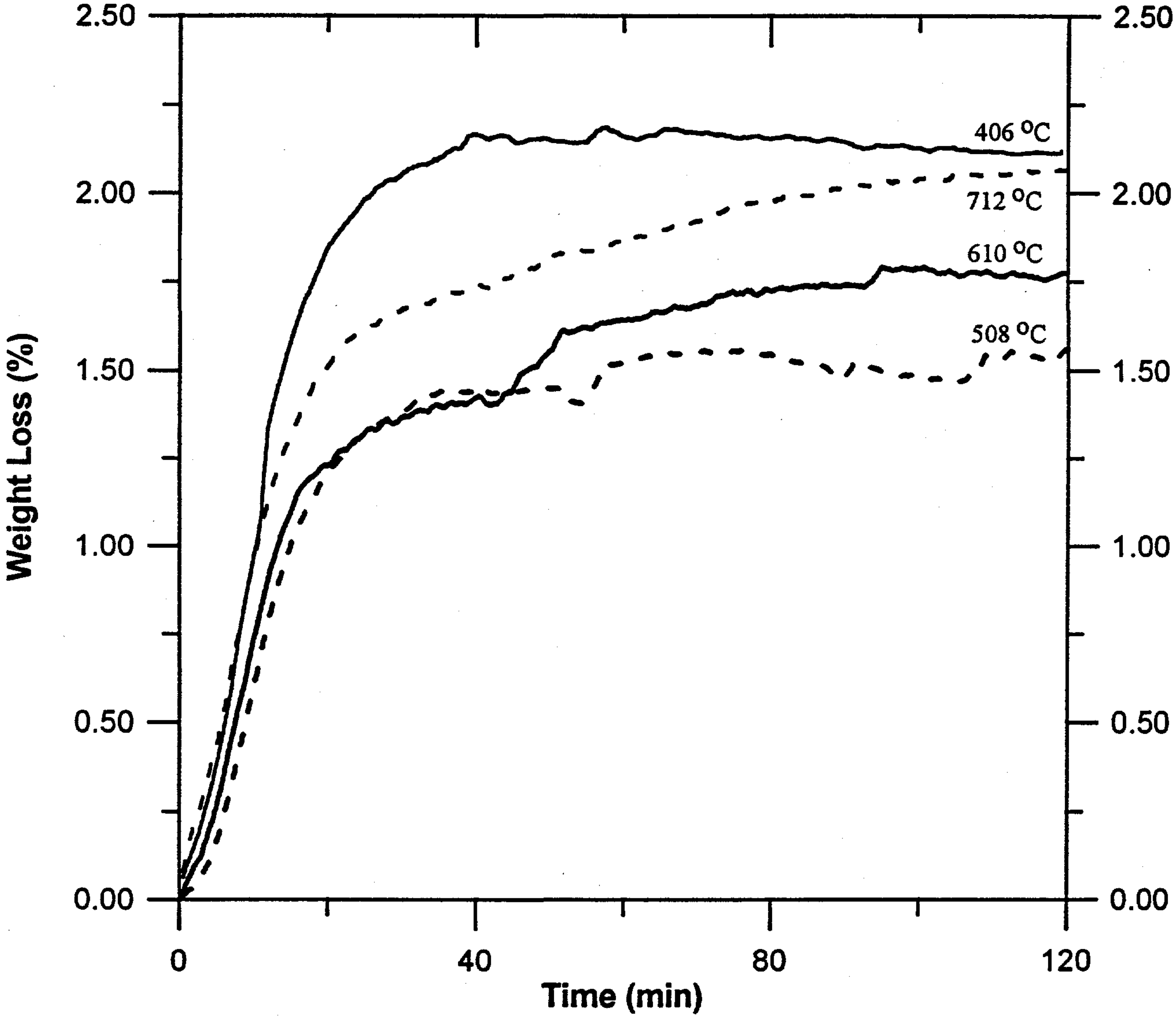


Figure 18. Weight Loss v.s. Time Heated with Air for 2 Hours in TGA

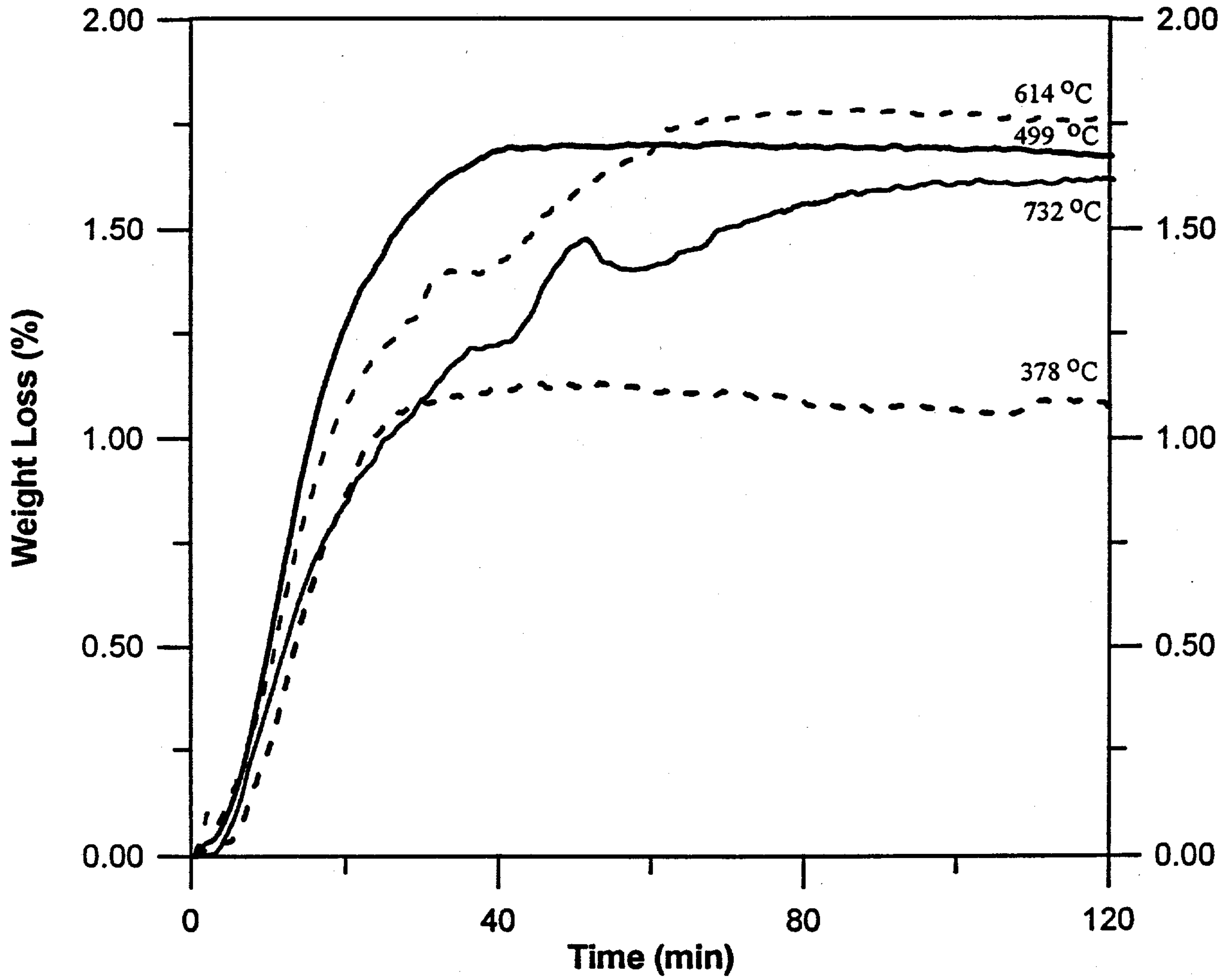
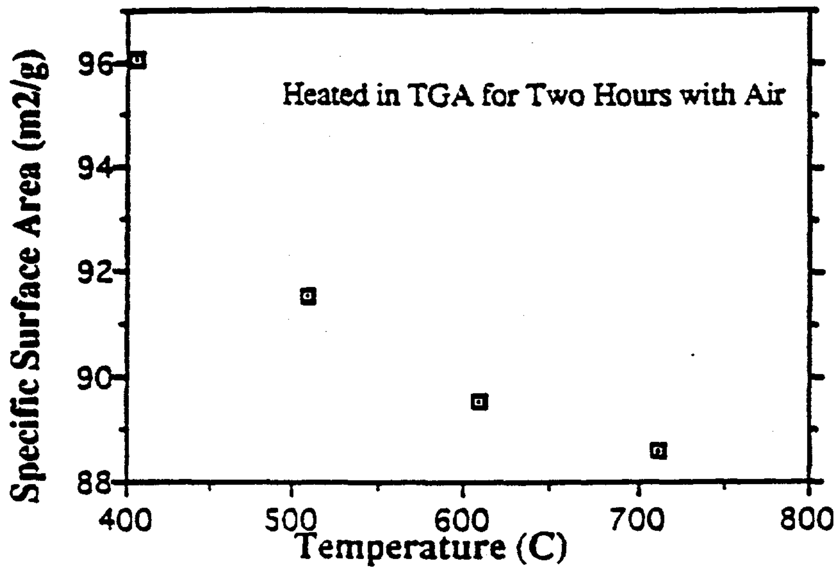


Figure 19. Weight Loss v.s. Time Heated with Nitrogen for 2 Hours in TGA



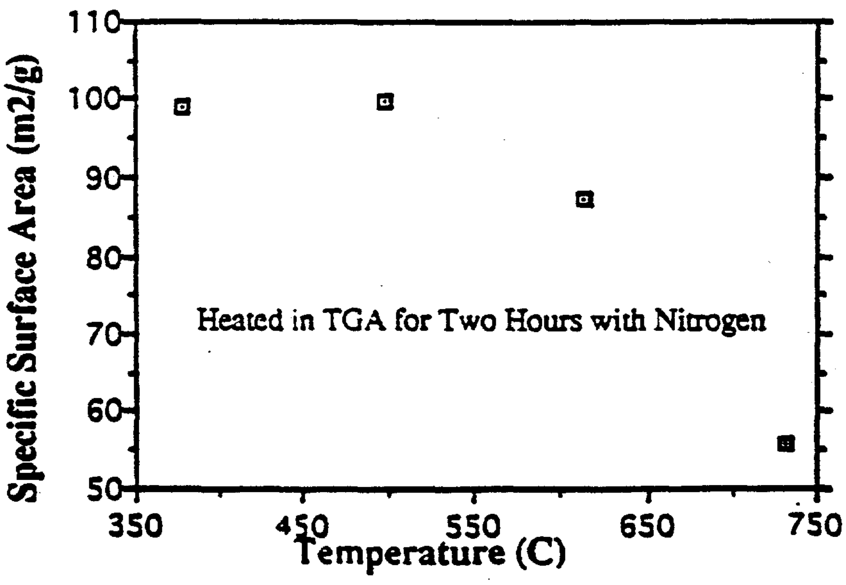


Figure 20. Change of Specific Surface Area v.s. Temperature

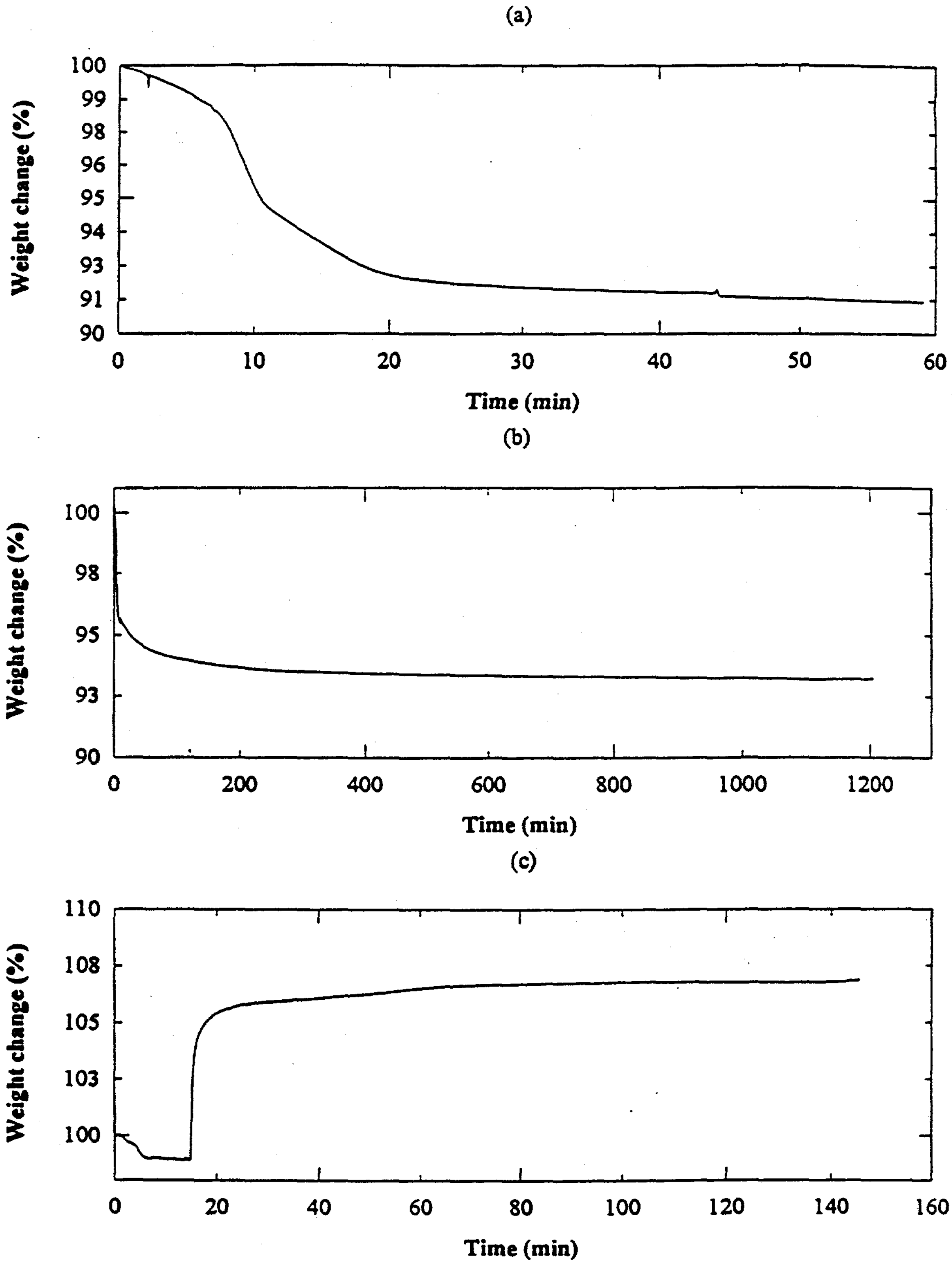


Figure 21. TGA Record History (a) Co-Mo Oxide Purge under N_2, (b) Co-Mo Oxide Reduction under H_2, and (c) Reduced Co-Mo Oxide Sulfidation under H_2S

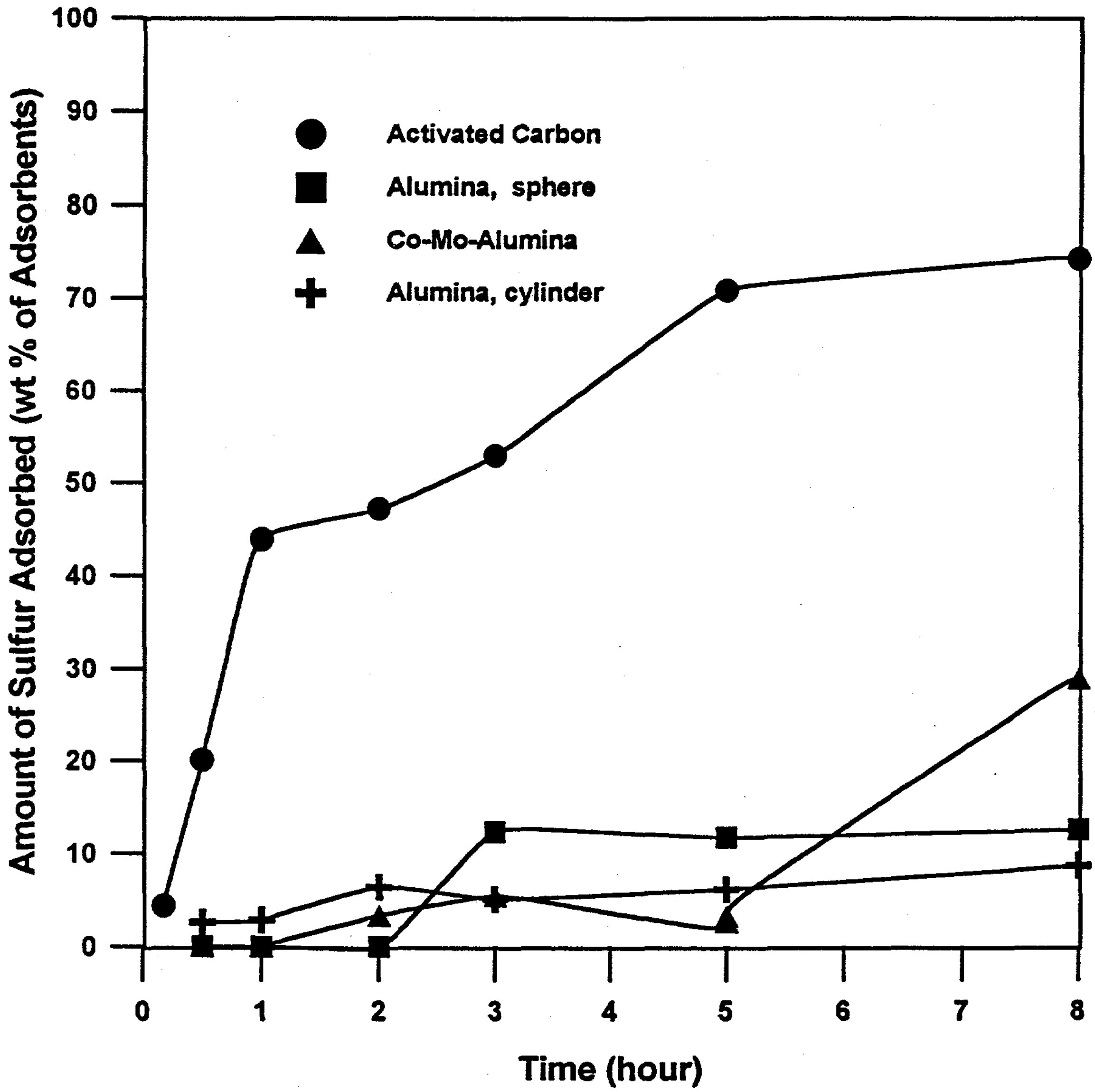
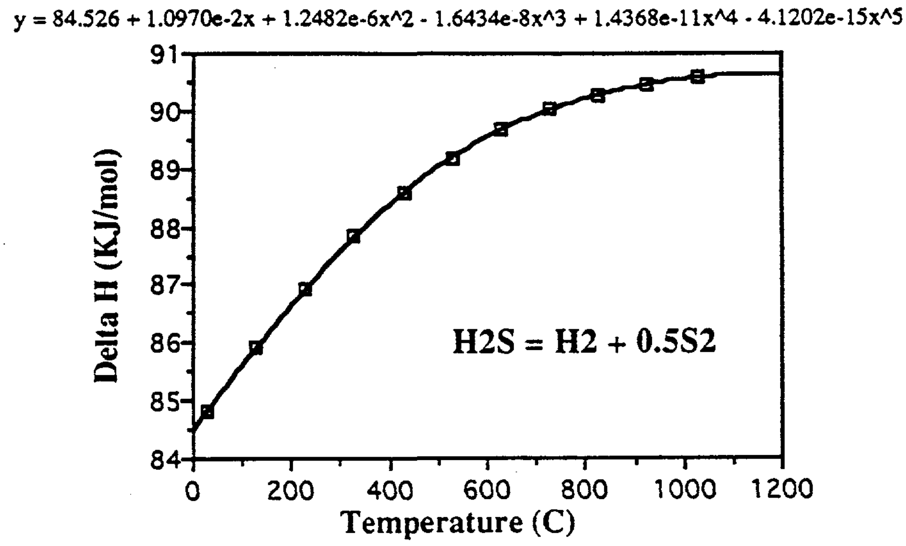


Figure 22. The Amount of Sulfur Adsorbed on Various Kind of Adsorbents at 290°C



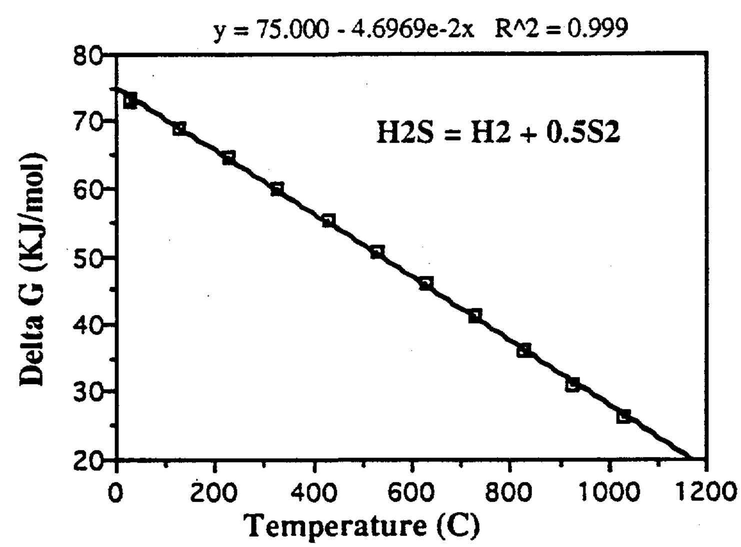
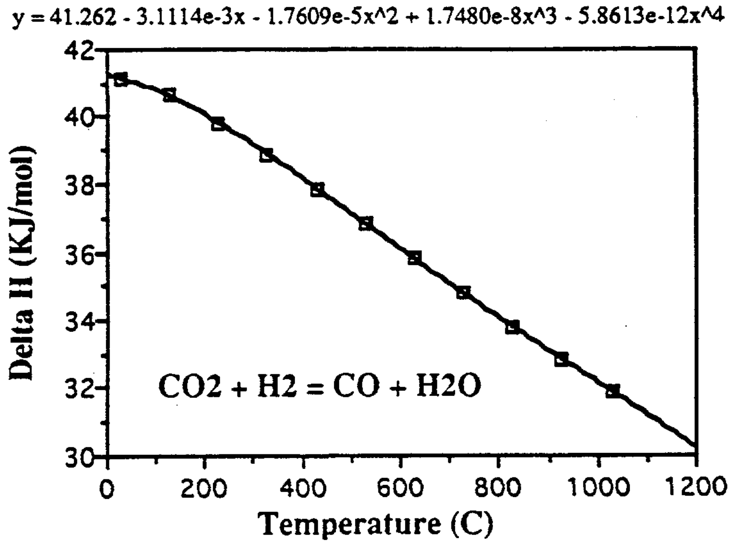


Figure 23. Change of Enthalpy and Gibbs Free Energy v.s. Temperature



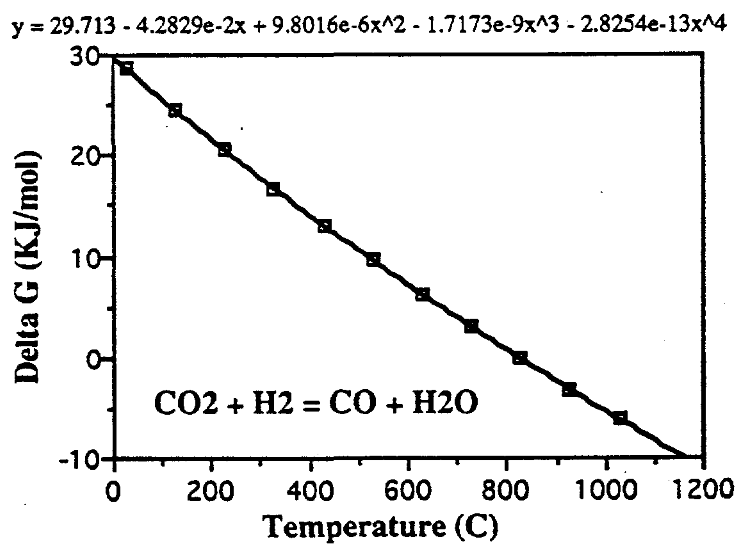
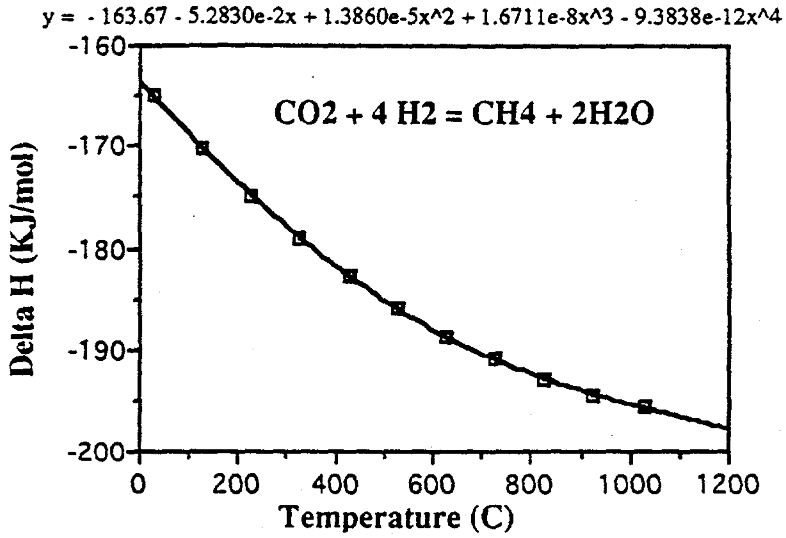


Figure 24. Change of Enthalpy and Gibbs Free Energy v.s. Temperature



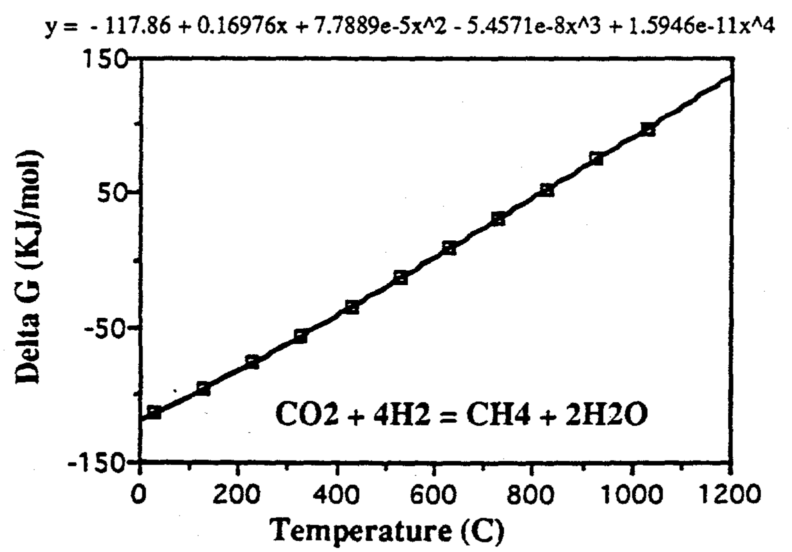
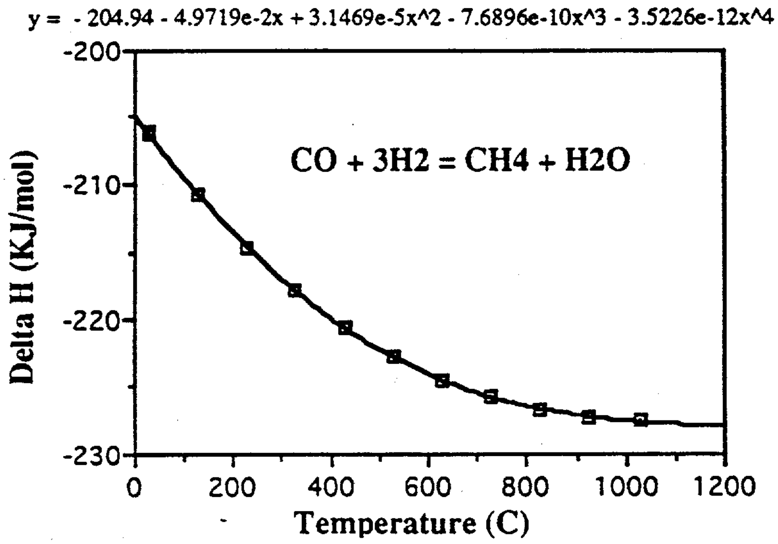


Figure 25. Change of Enthalpy and Gibbs Free Energy v.s. Temperature



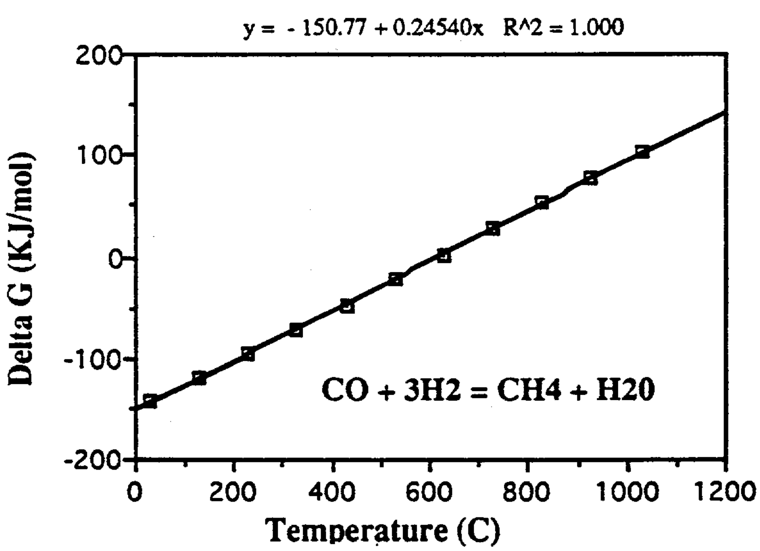


Figure 26. Change of Enthalpy and Gibbs Free Energy v.s. Temperature

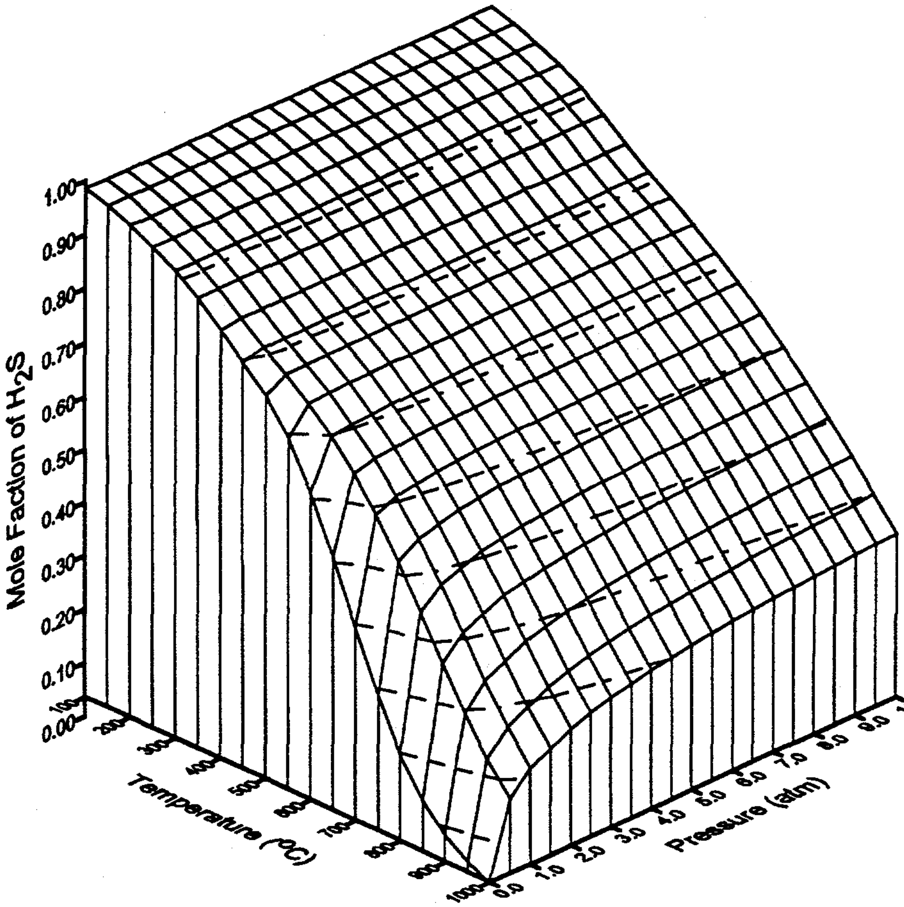


Figure 27. Effect of Temperature and Pressure on the Equilibrium Mole Fraction of H_2S in Sulfur Related Species (H_2S:CO_2= 1:9)

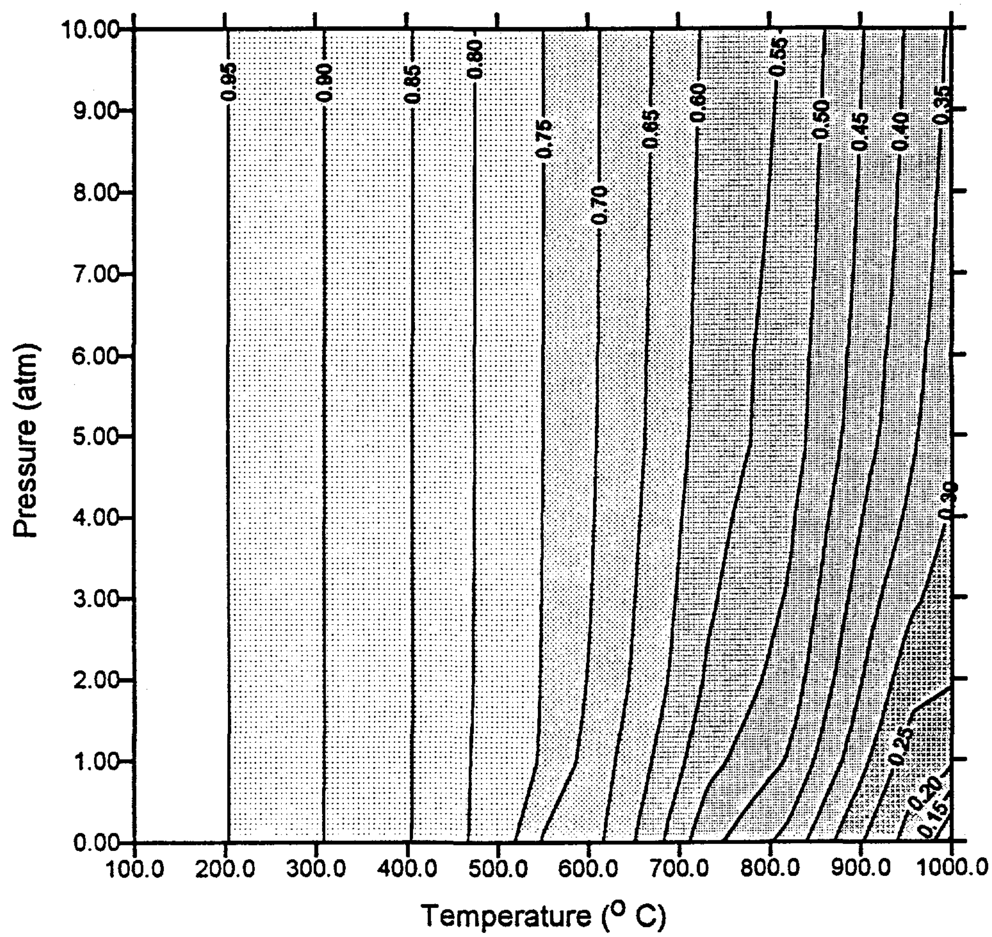


Figure 28. Effect of Temperature and Pressure on the Equilibrium Mole Fraction of H_2S in Sulfur Related Species (H_2S:CO_2=1:9)

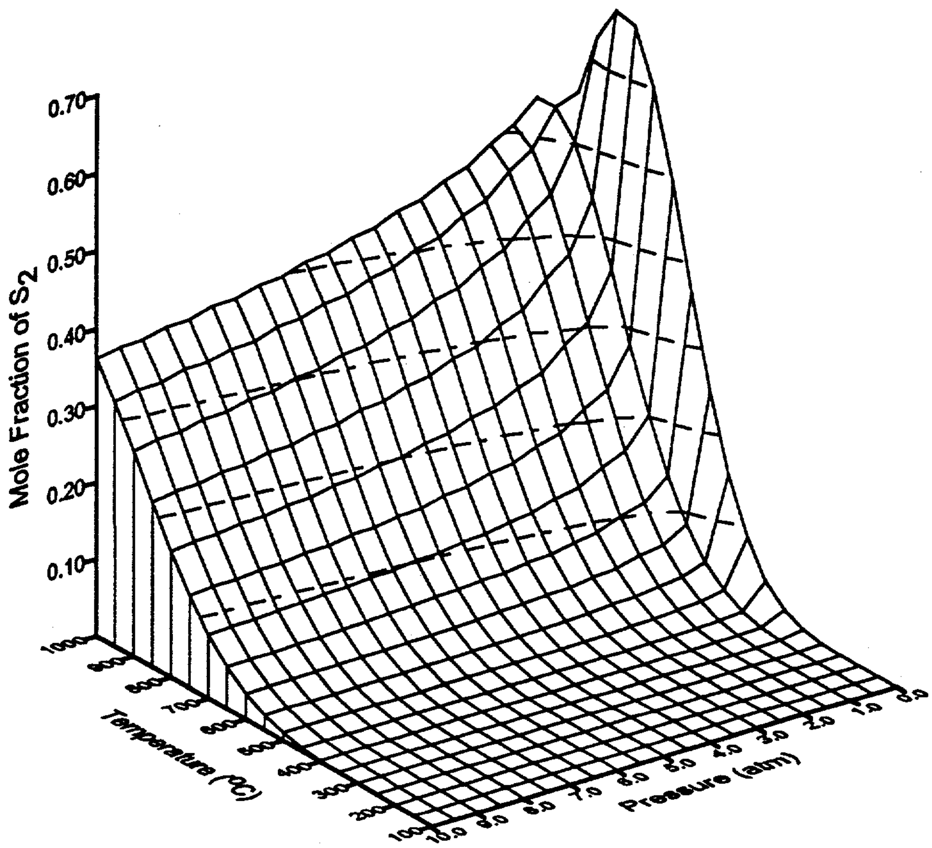


Figure 29. Effect of Temperature and Pressure on the Equilibrium Mole Fraction of S_2 in Sulfur Related Species

(H_2S:CO_2 = 1:9)

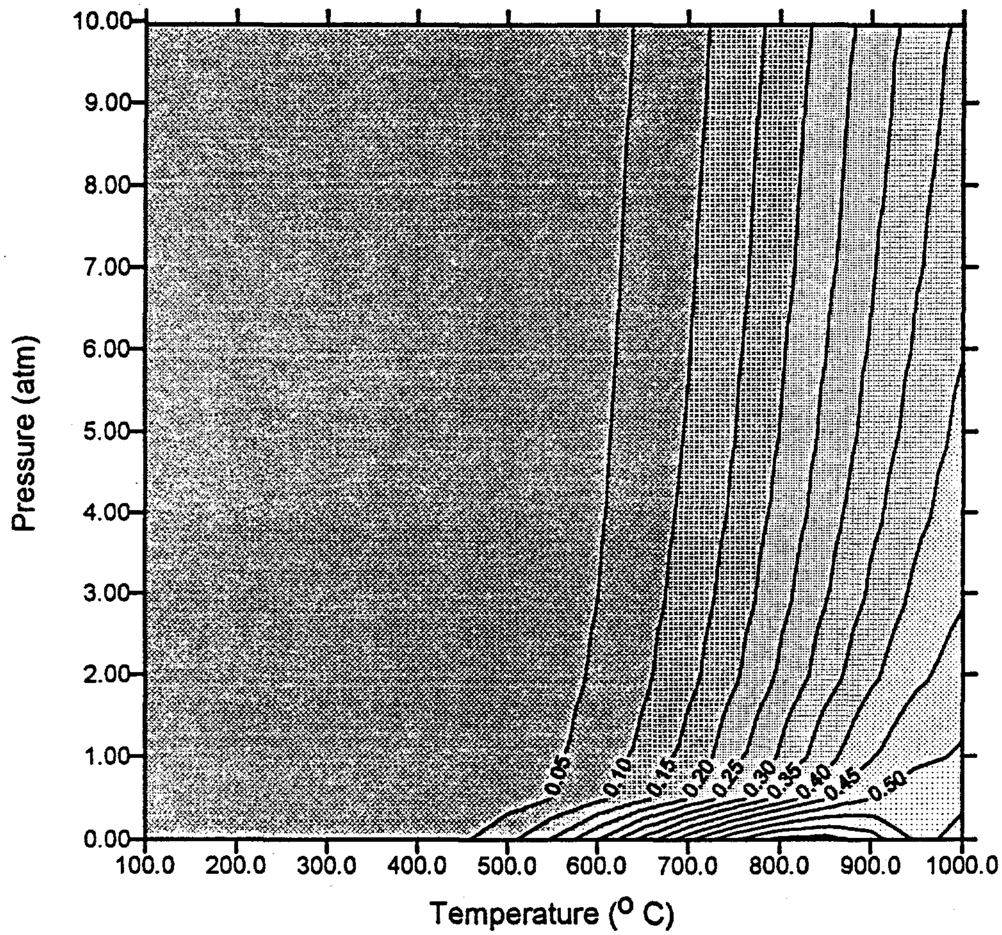


Figure 30. Effect of Temperature and Pressure on the Equilibrium Mole Fraction of S_2 in Sulfur Related Species (H_2S:CO_2= 1:9)

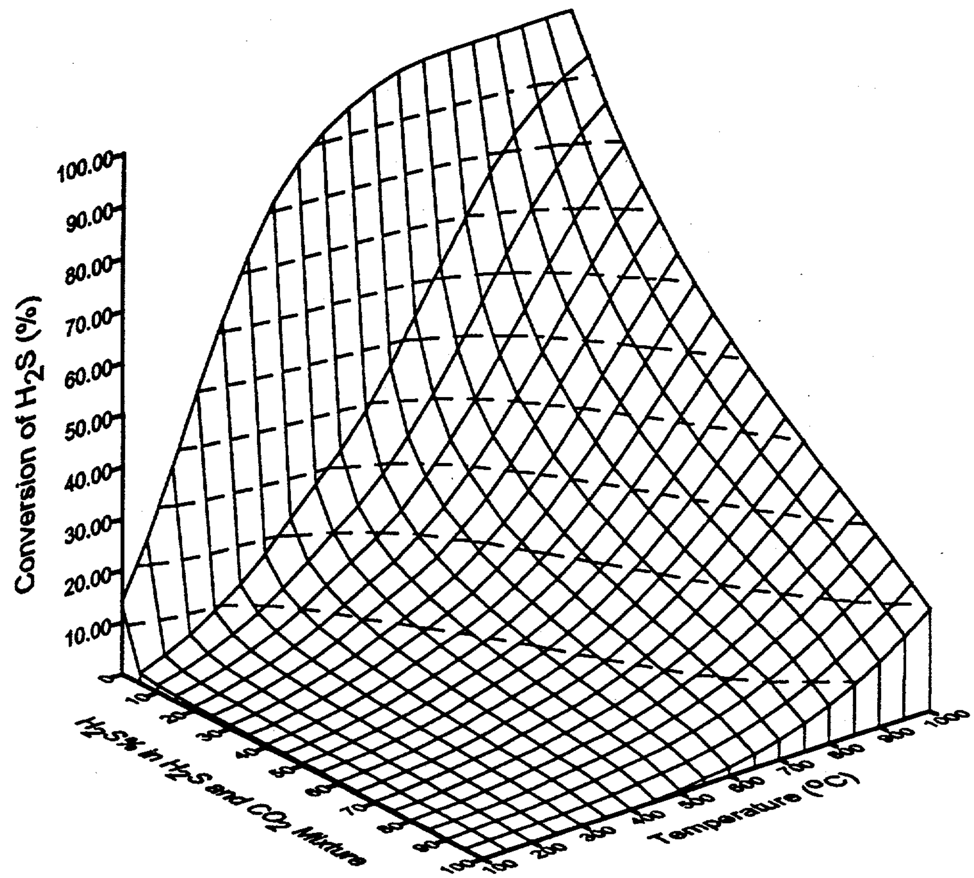


Figure 31. Conversion of H_2S as a Function of Temperature and Initial H_2S % in the H_2S and CO_2 Mixture (1 atm)

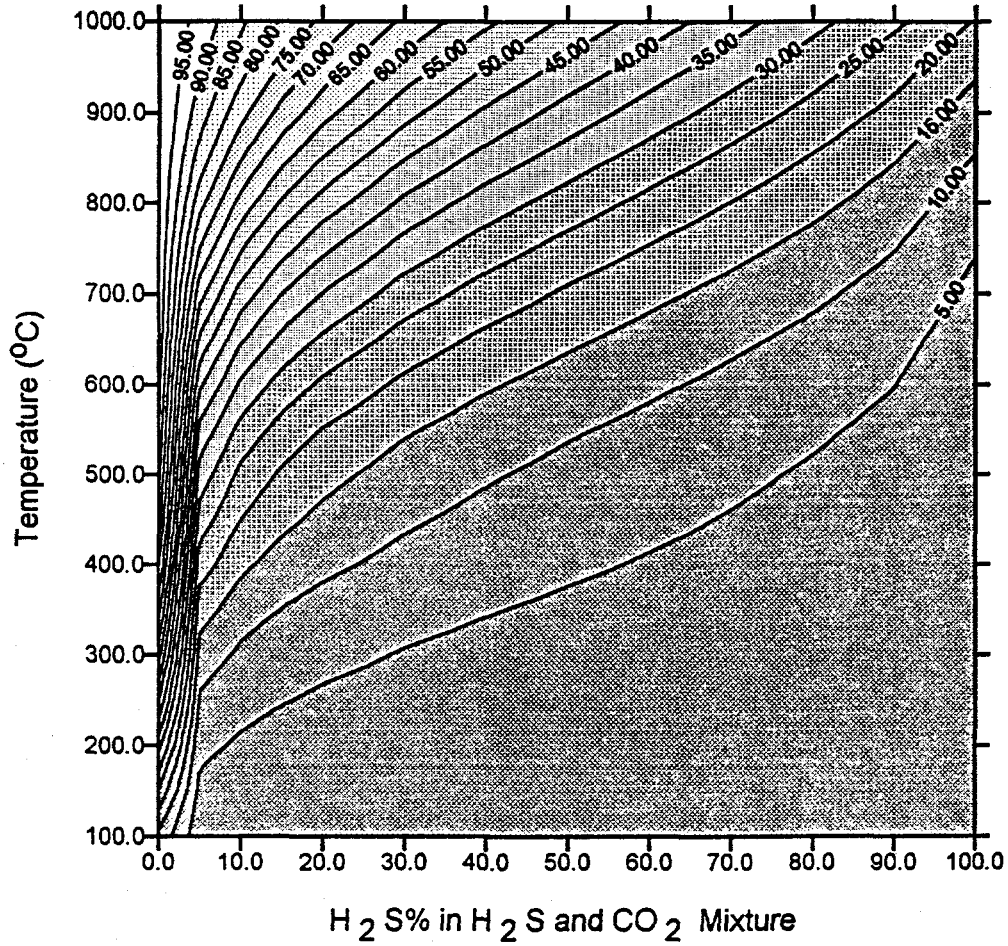


Figure 32. Conversion of H_2S as a Function of Temperature and Initial H_2S% in H_2S and CO_2Mixture (1 atm)

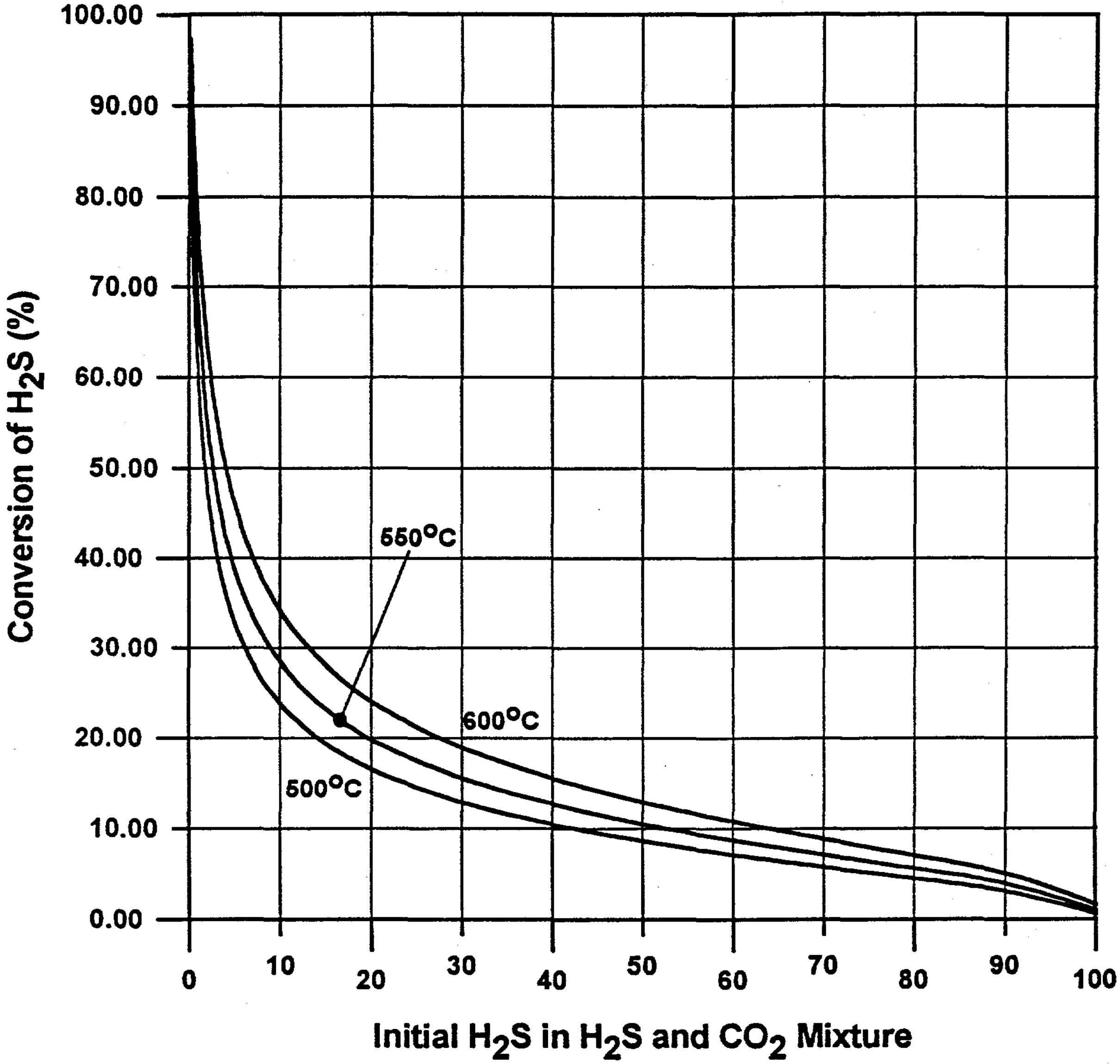


Figure 33. The Effect of the Initial H_2S% on the Conversion of H_2S at 500, 550, 600°C

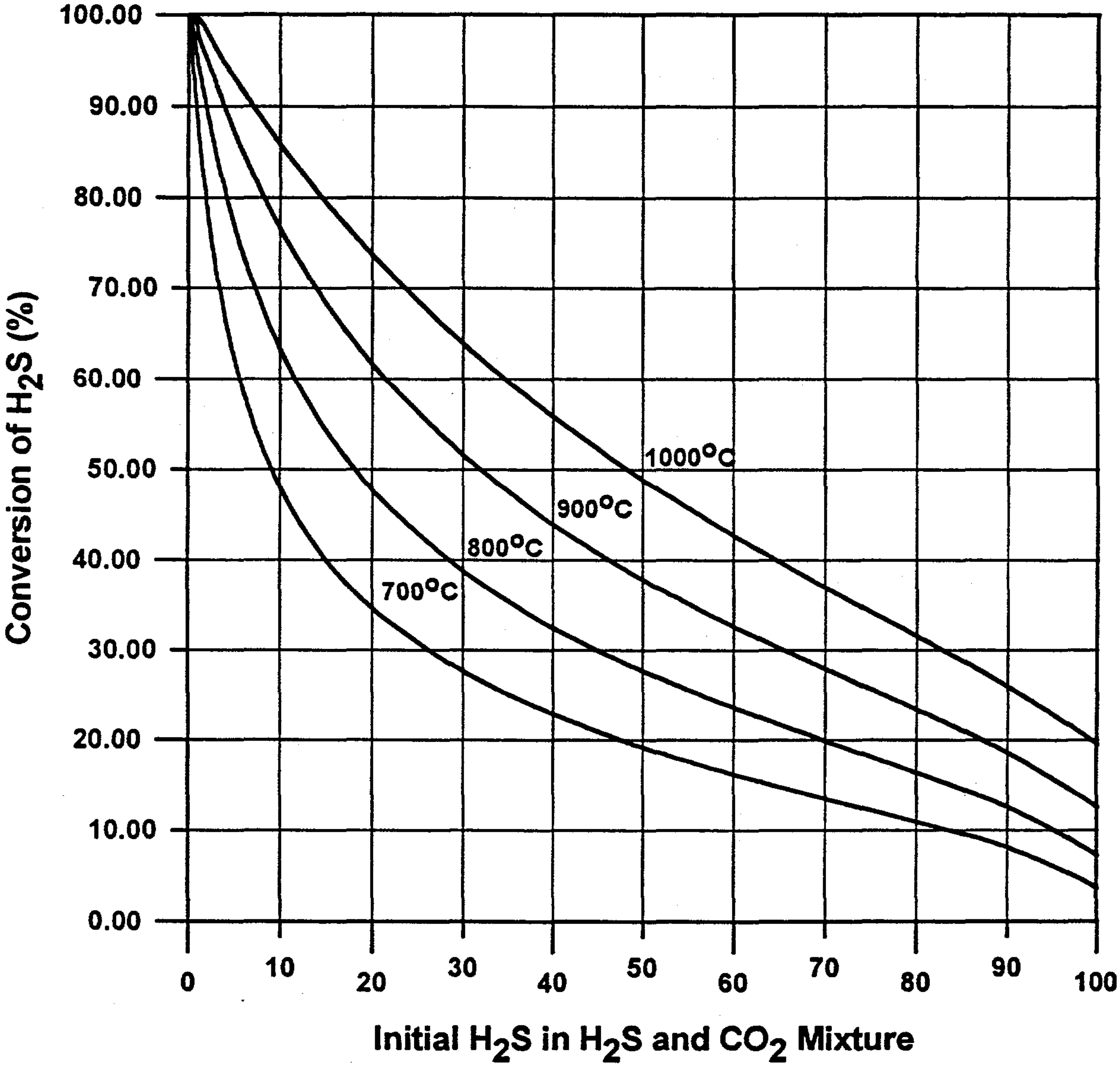


Figure 34. The Effect of the Initial H_2S% on the Conversion of H_2S at 700, 800, 900, 1000°C

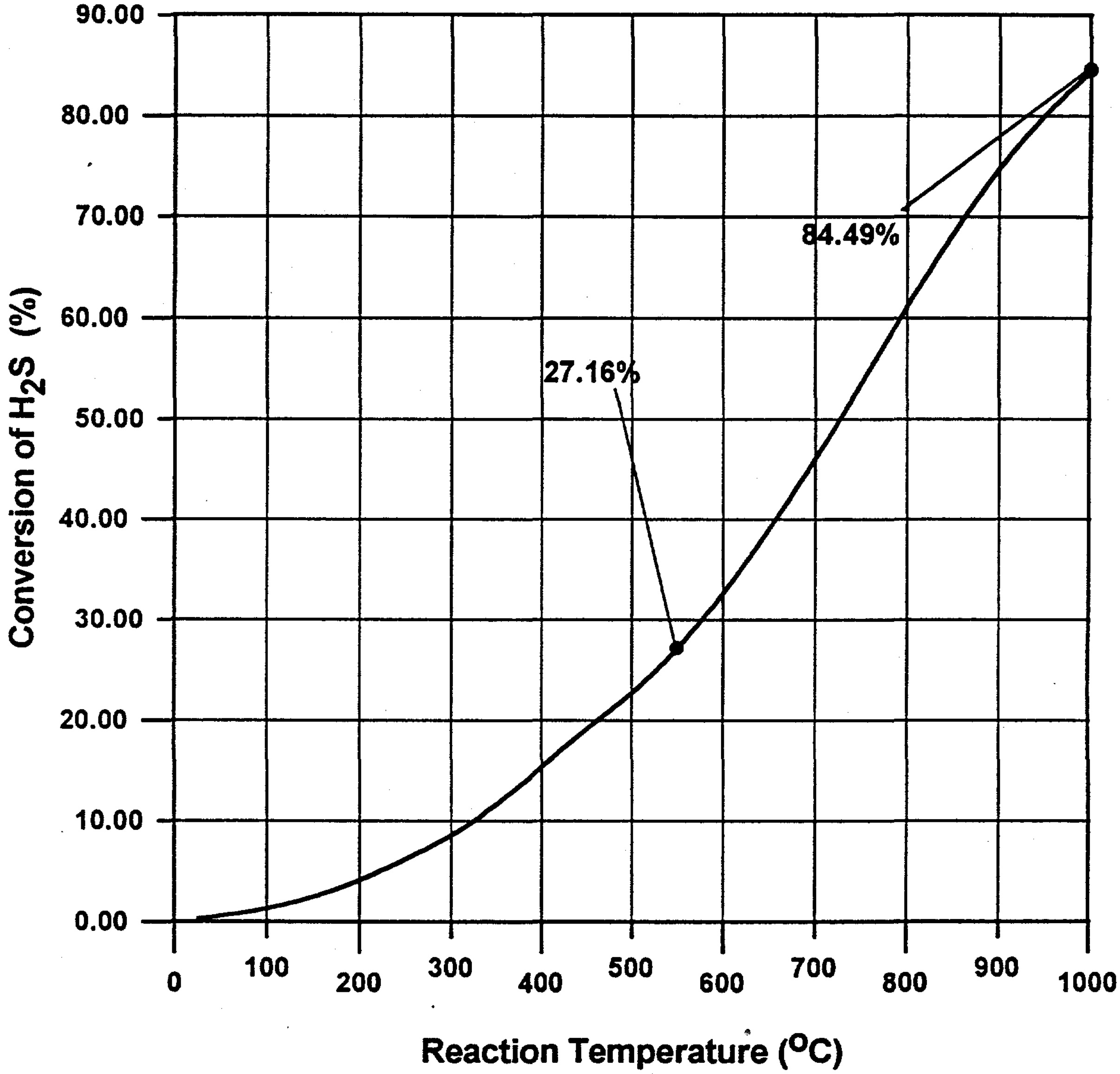


Figure 35. The Effect of Temperature on the Conversion of H_2S at Initial 11% H_2S in H_2S and CO_2 Mixture

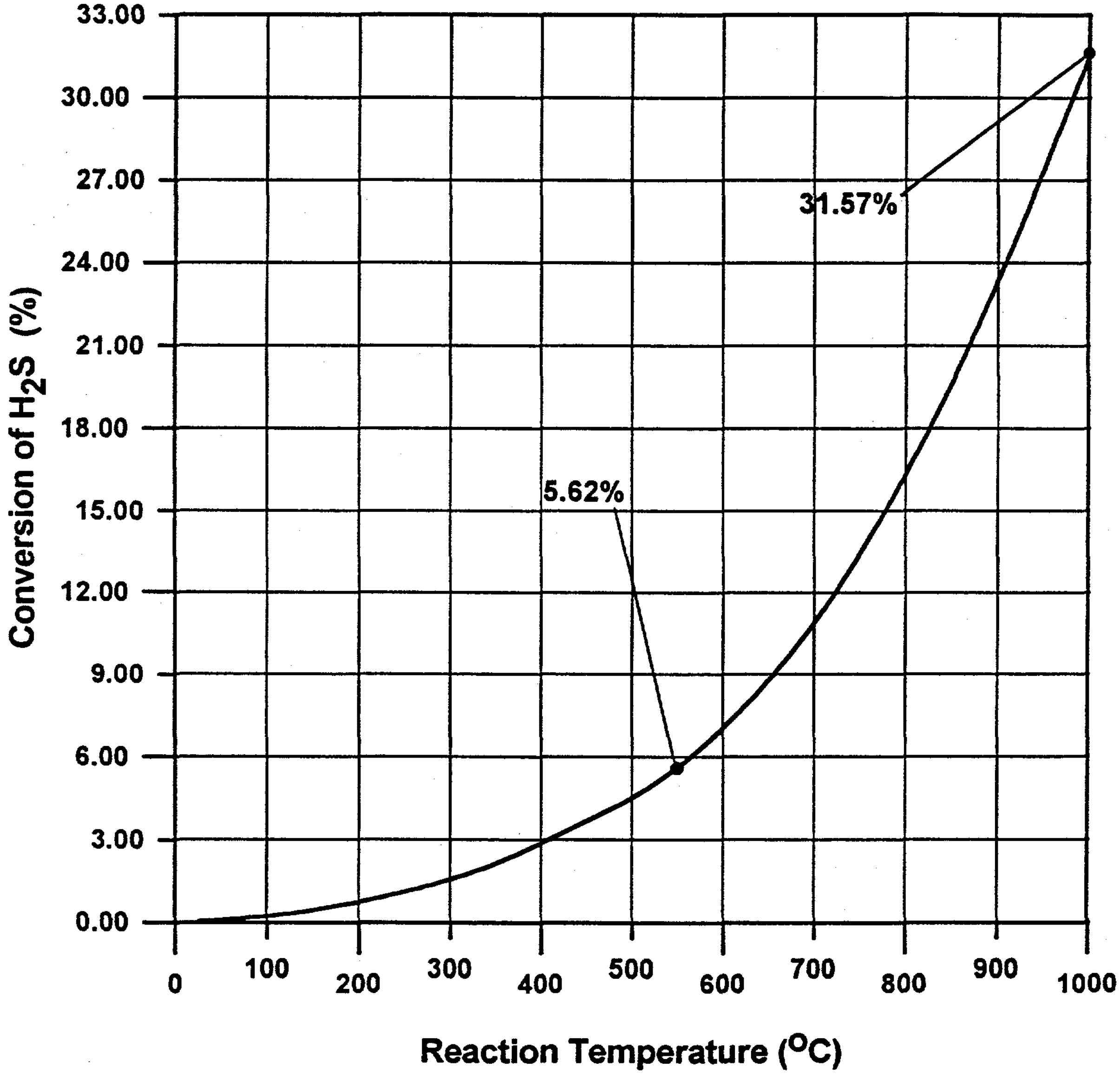


Figure 36. The Effect of Temperature on the Conversion of H_2S at Initial 80% H_2S in H_2S and CO_2 Mixture

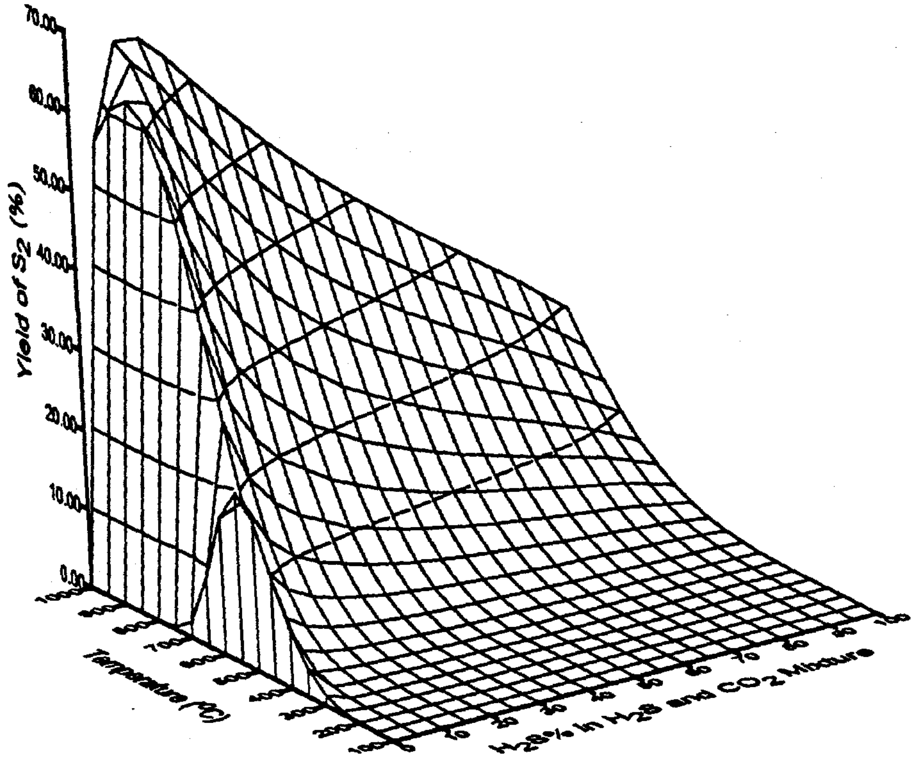


Figure 37. Yield of S_2 as a Function of Temperature and Intial H_2S% in H_2S and CO_2 Mixture (1 atm)

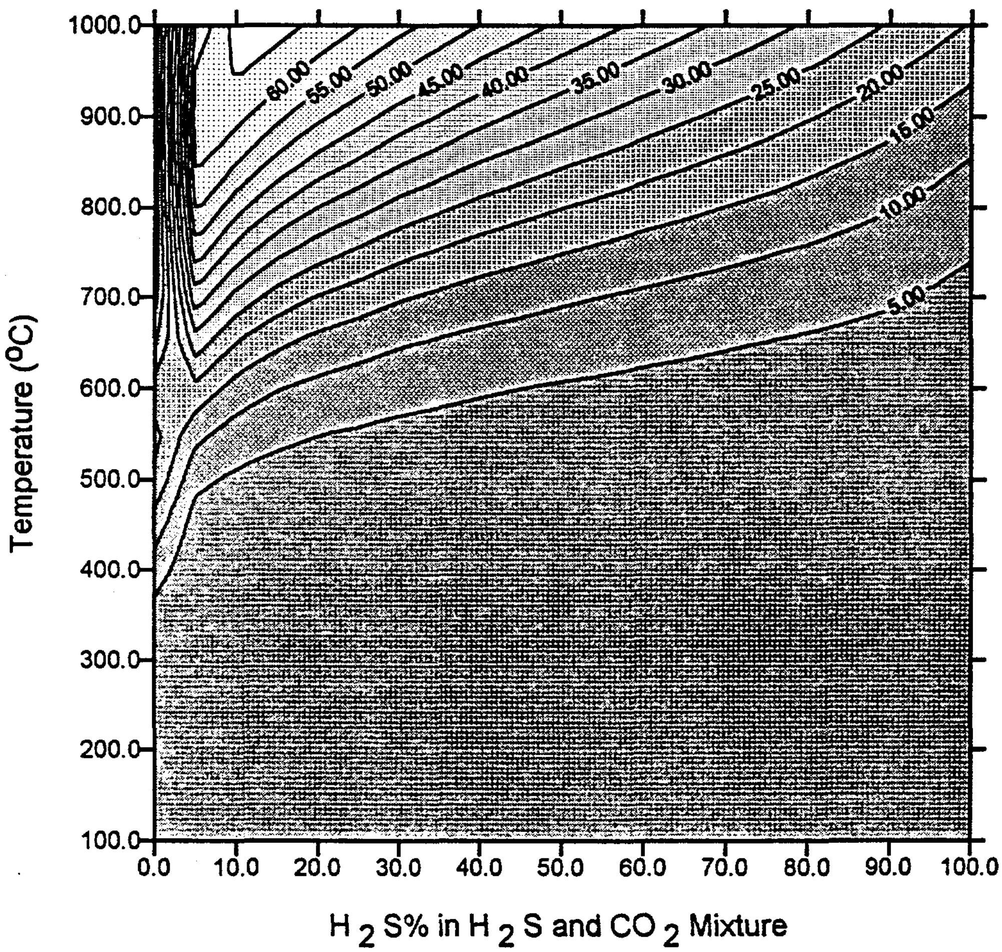


Figure 38. Yield of S_2 as a Function of Temperature and Intial H_2S% in H_2S and CO_2 Mixture (1 atm)

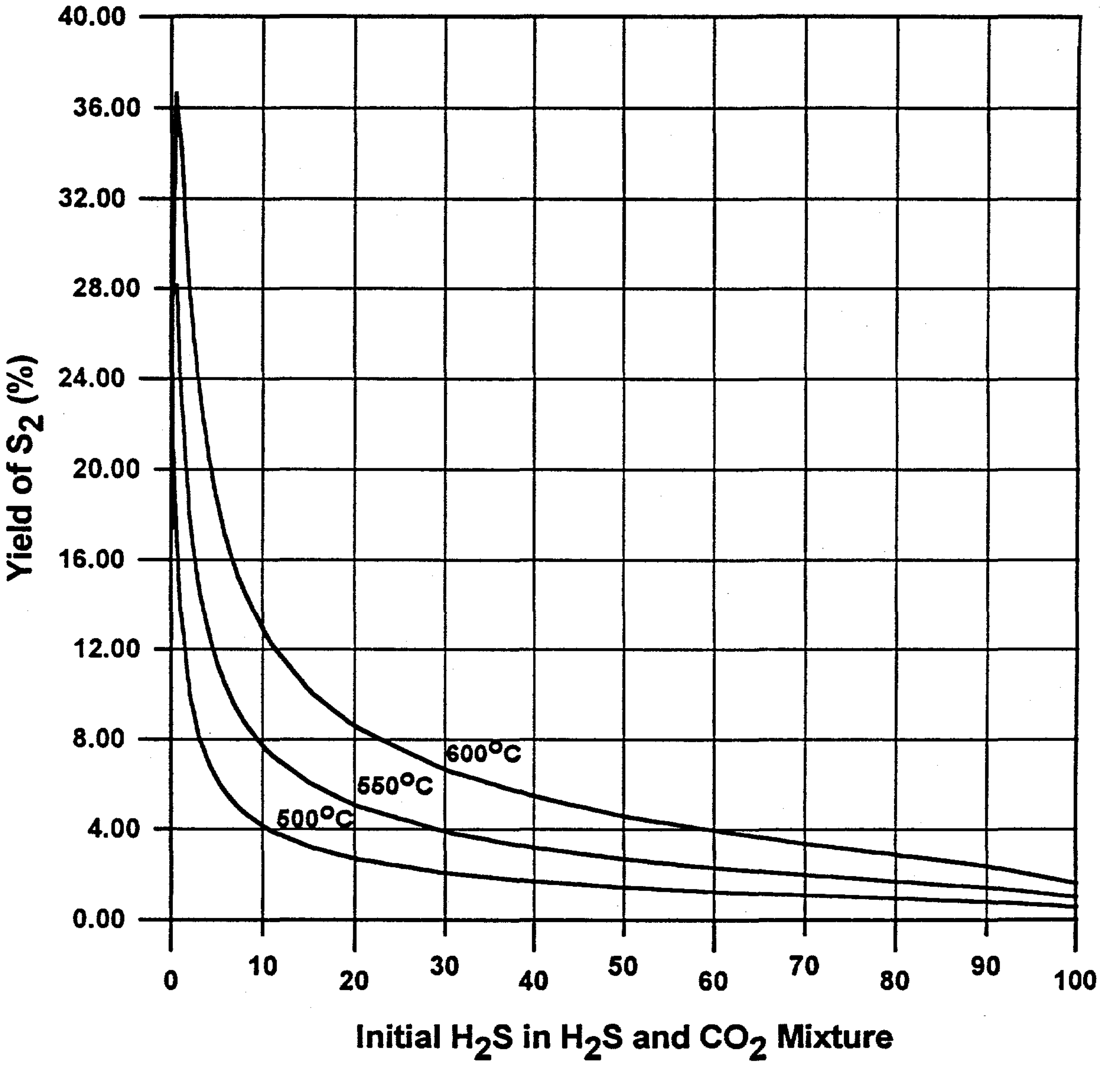


Figure 39. The Effect of the Initial H_2S% on the Yield of S_2 at 500, 550, 600°C

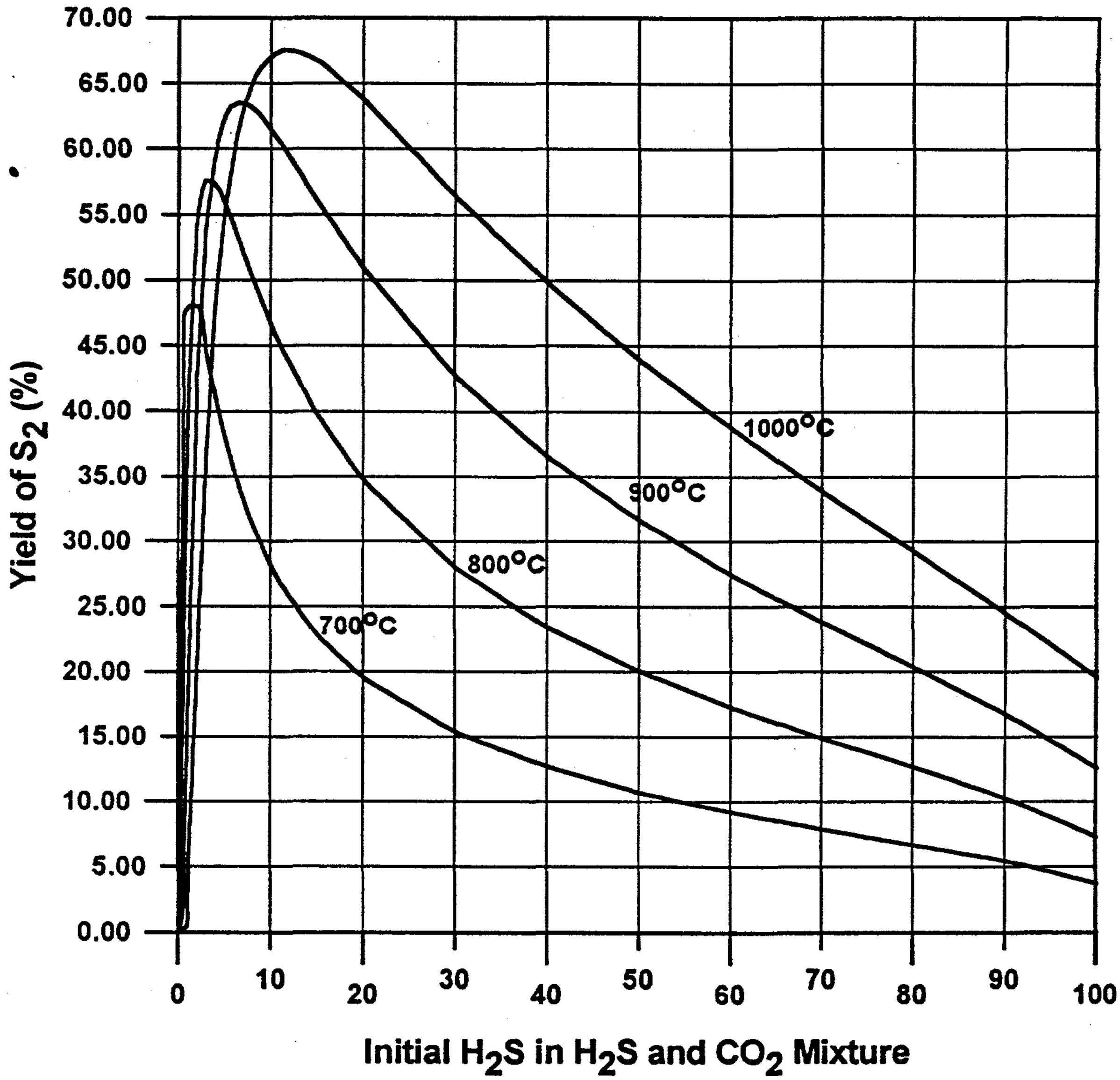


Figure 40. The Effect of the Initial H_2S% on the Yield of S_2 at 700, 800, 900, 1000°C

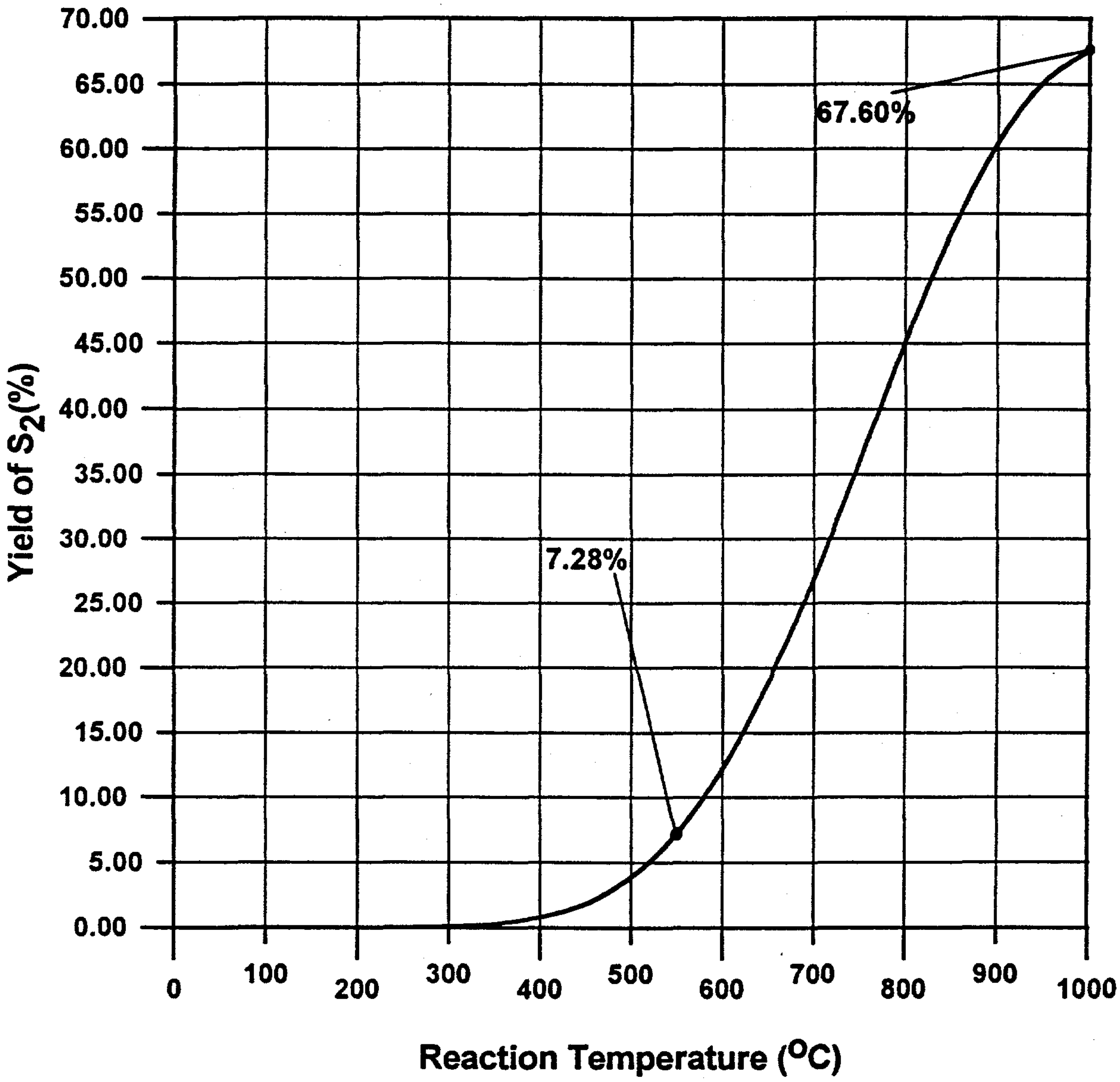


Figure 41. The Effect of Temperature on the Yield of S_2 at Initial 11% H_2S in H_2S and CO_2 Mixture

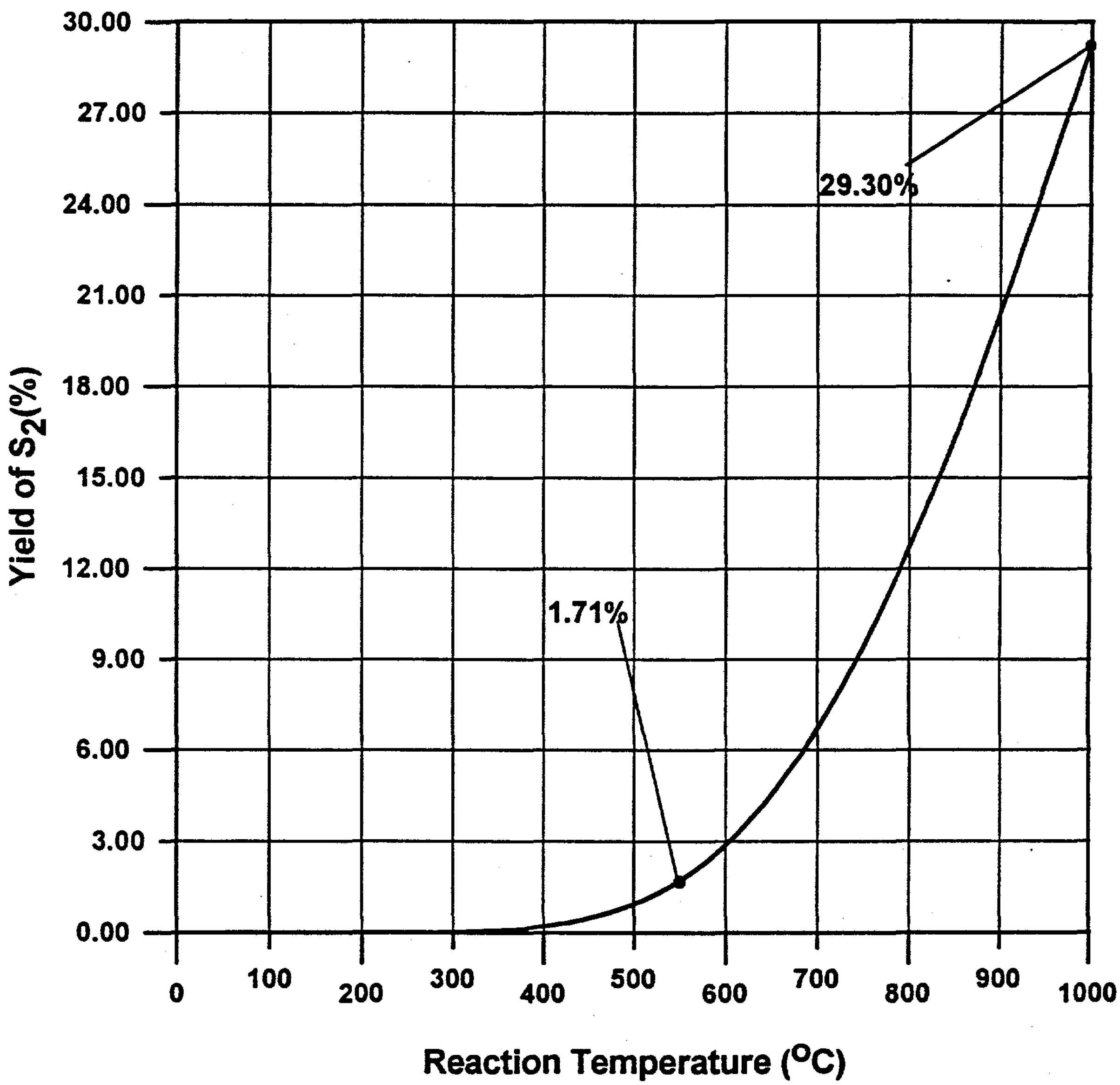


Figure 42. The Effect of Temperature on the Yield of S_2 at Initial 80% H_2S in H_2S and CO_2 Mixture

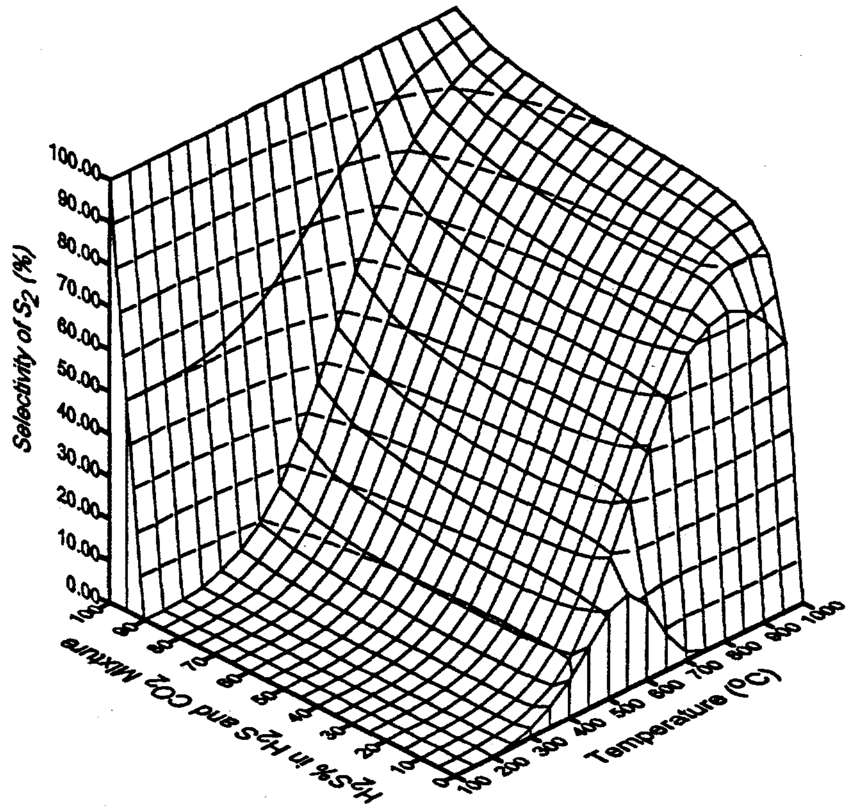


Figure 43. Selectivity of S_2 as a Function of Temperature and Initial H_2S% in H_2S and CO_2 Mixture (1 atm)

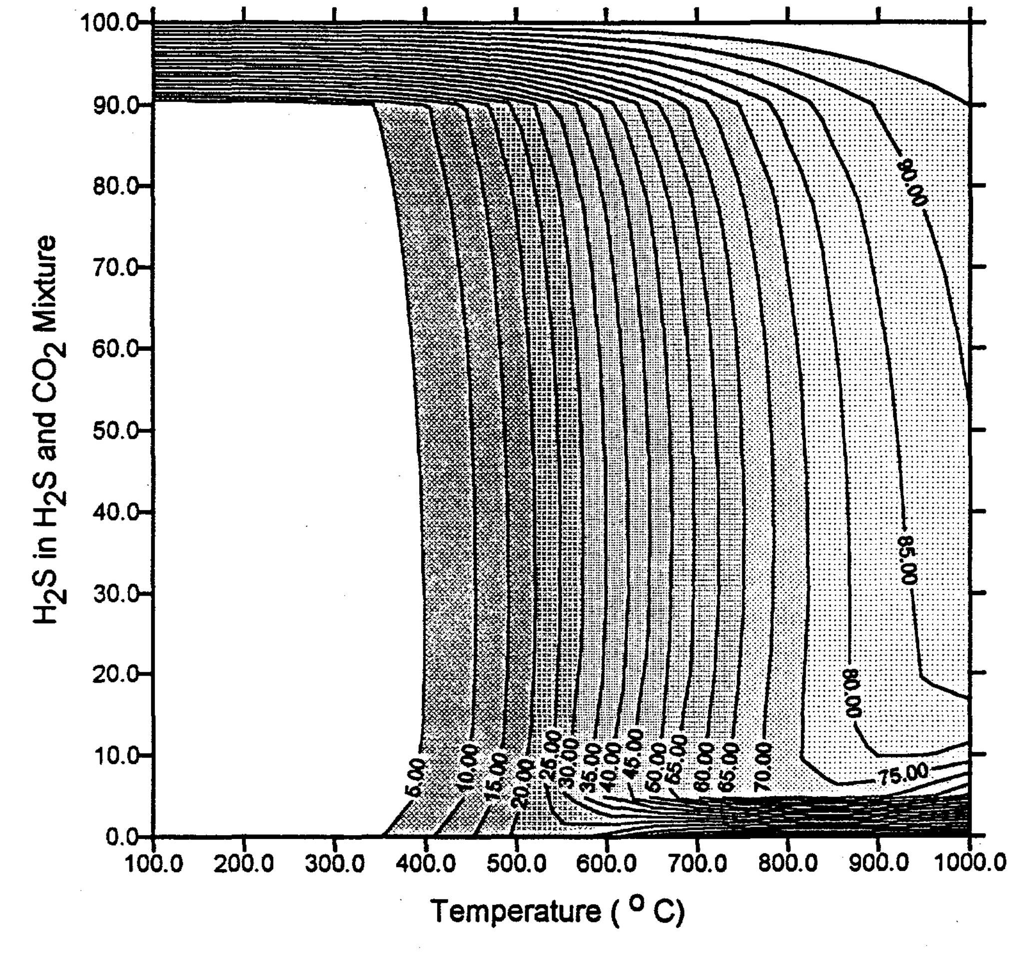


Figure 44. Selectivity of S_2 as a Function of Temperature and Initial H_2S% in H_2S and CO_2 Mixture (1 atm)

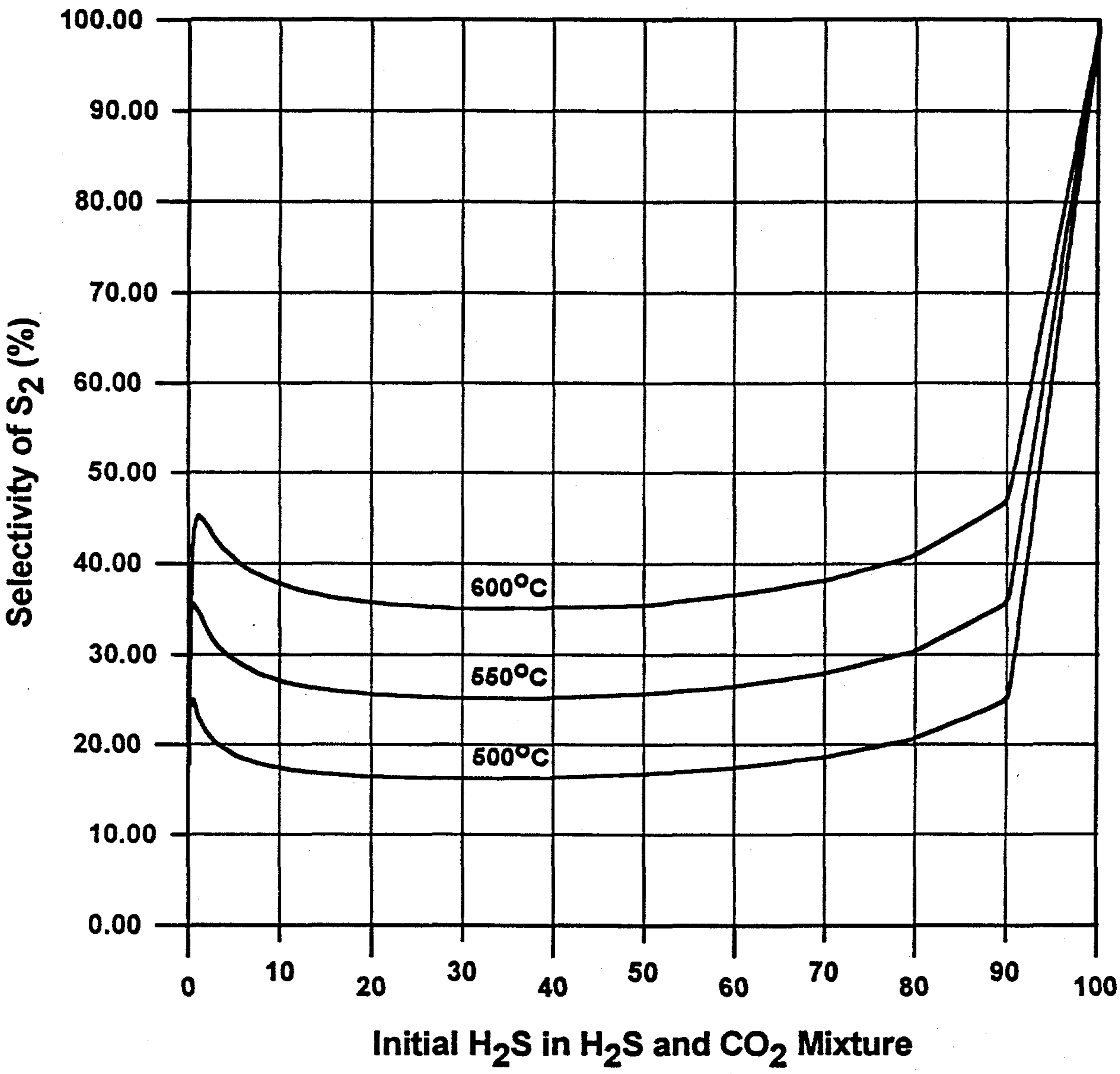


Figure 45. The Effect of the Initial H_2S% on the Selectivity of S_2 at 500, 550, 600°C

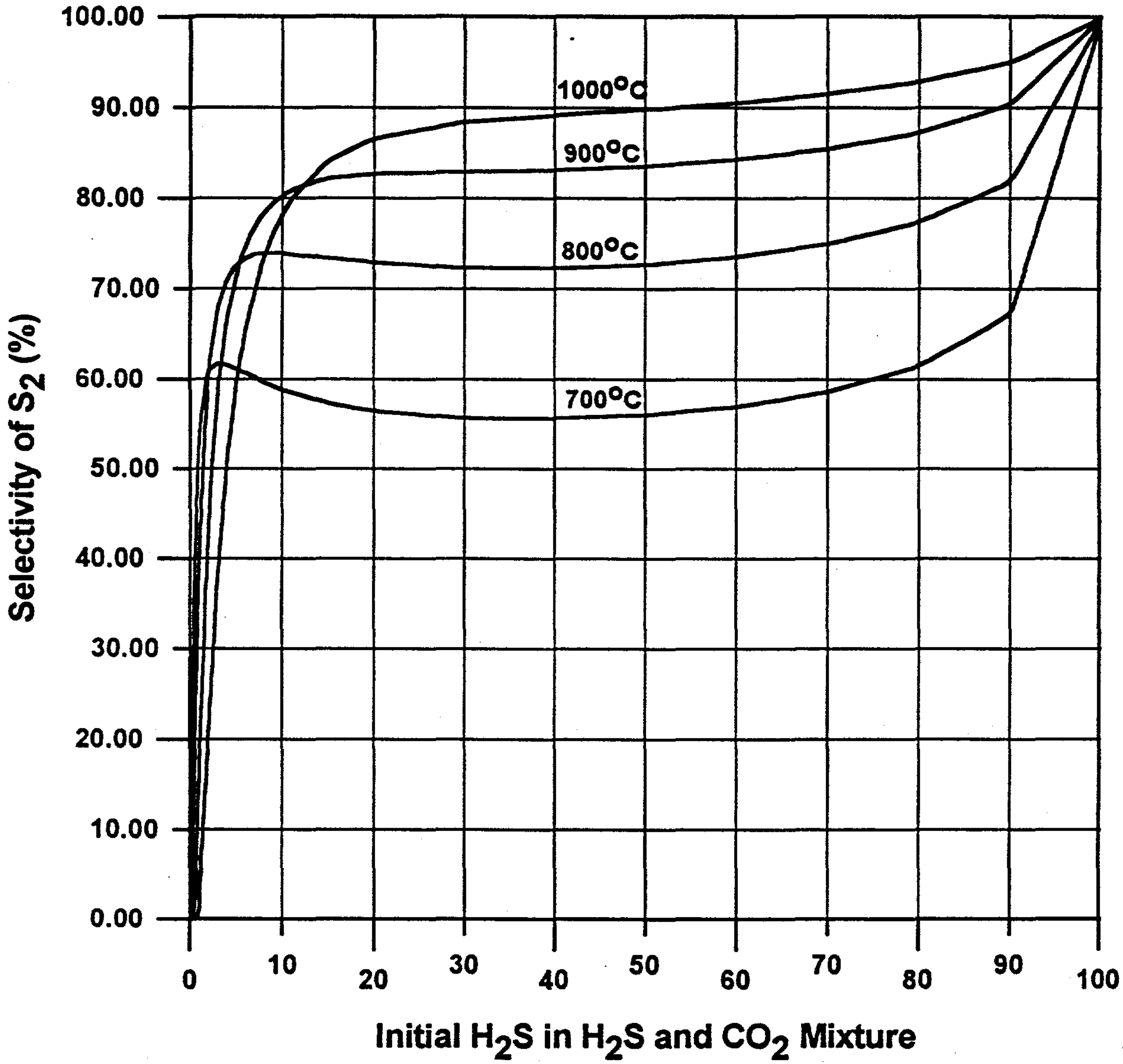


Figure 46. The Effect of the Initial H_2S% on the Selectivity of S_2 at 700, 800, 900, 1000°C

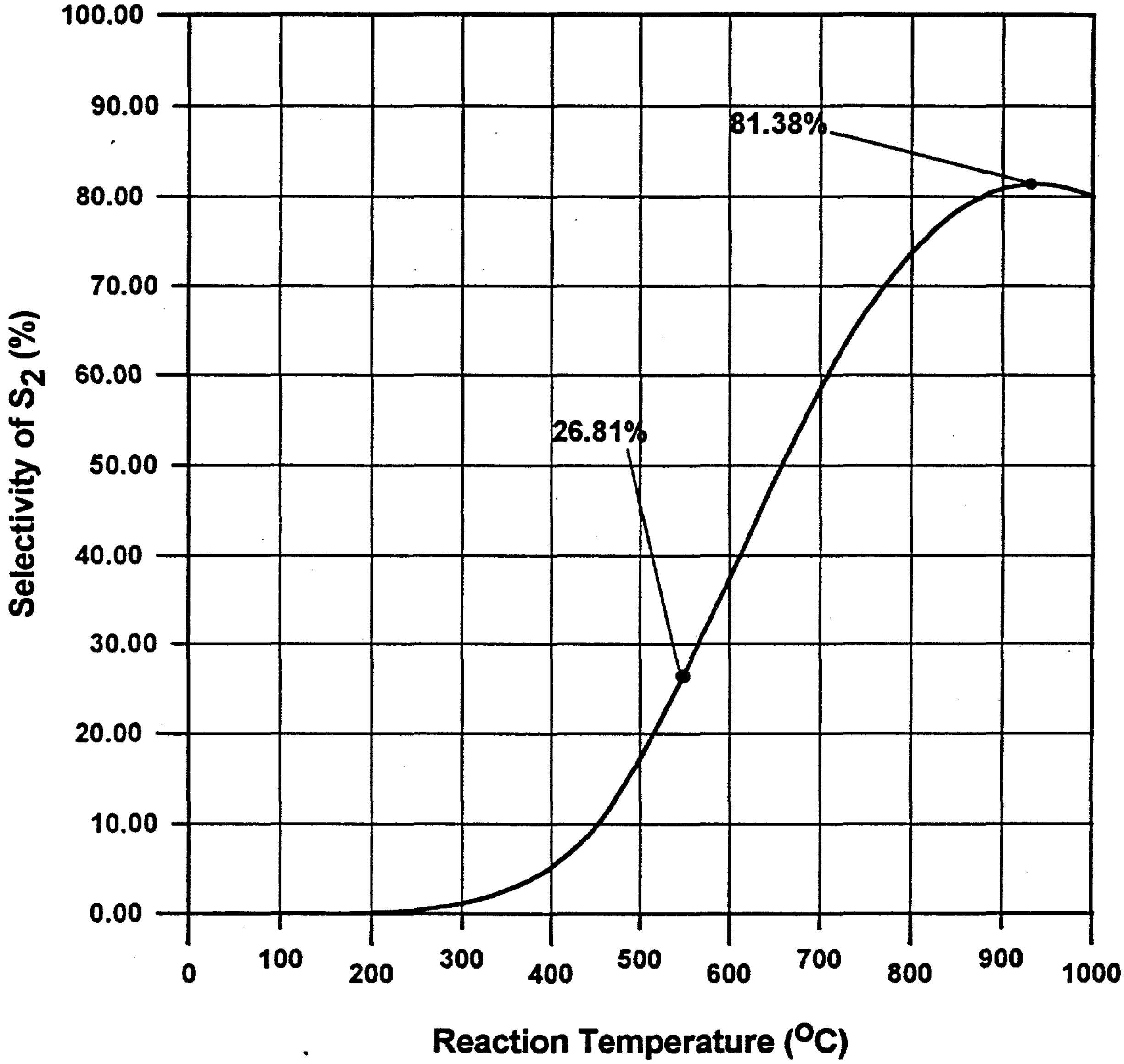


Figure 47. The Effect of Temperature on the Selectivity of S_2 at Initial 11% H_2S in H_2S and CO_2 Mixture

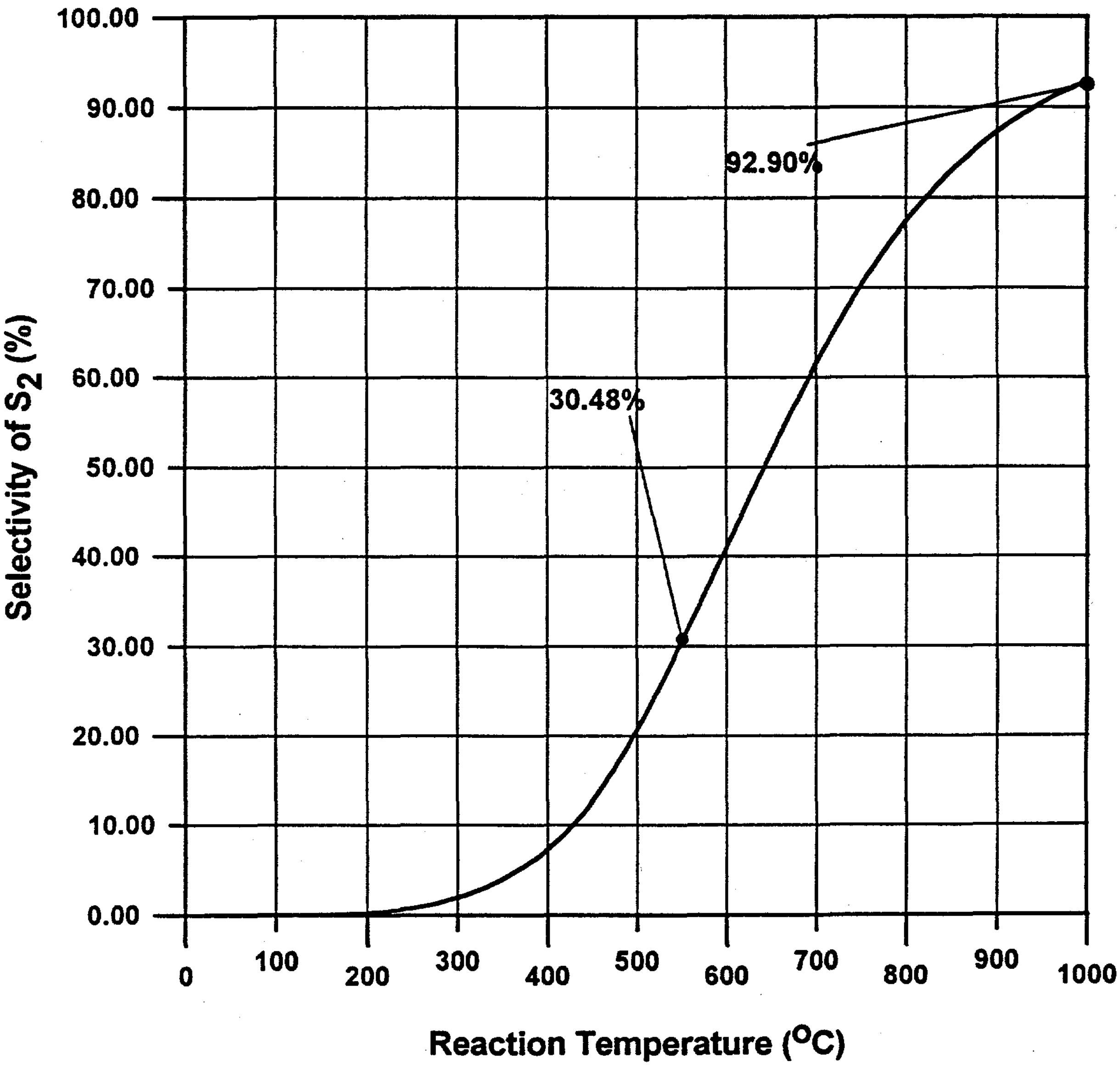


Figure 48. The Effect of Temperature on the Selectivity of S_2 at Initial 80% H_2S in H_2S and CO_2 Mixture

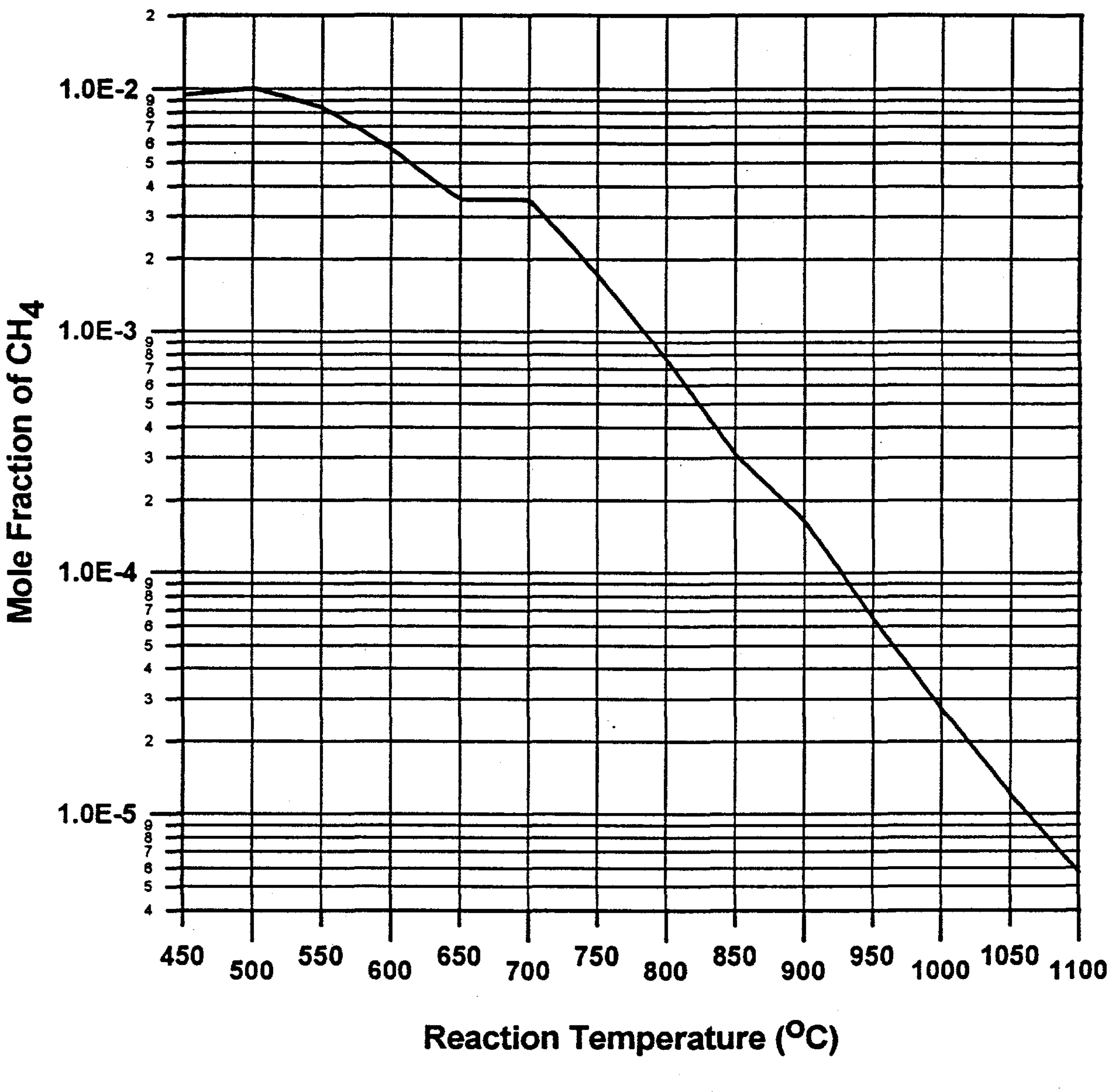


Figure 49. The Effect of Temperature on Equilibrium Mole Fraction of CH_4

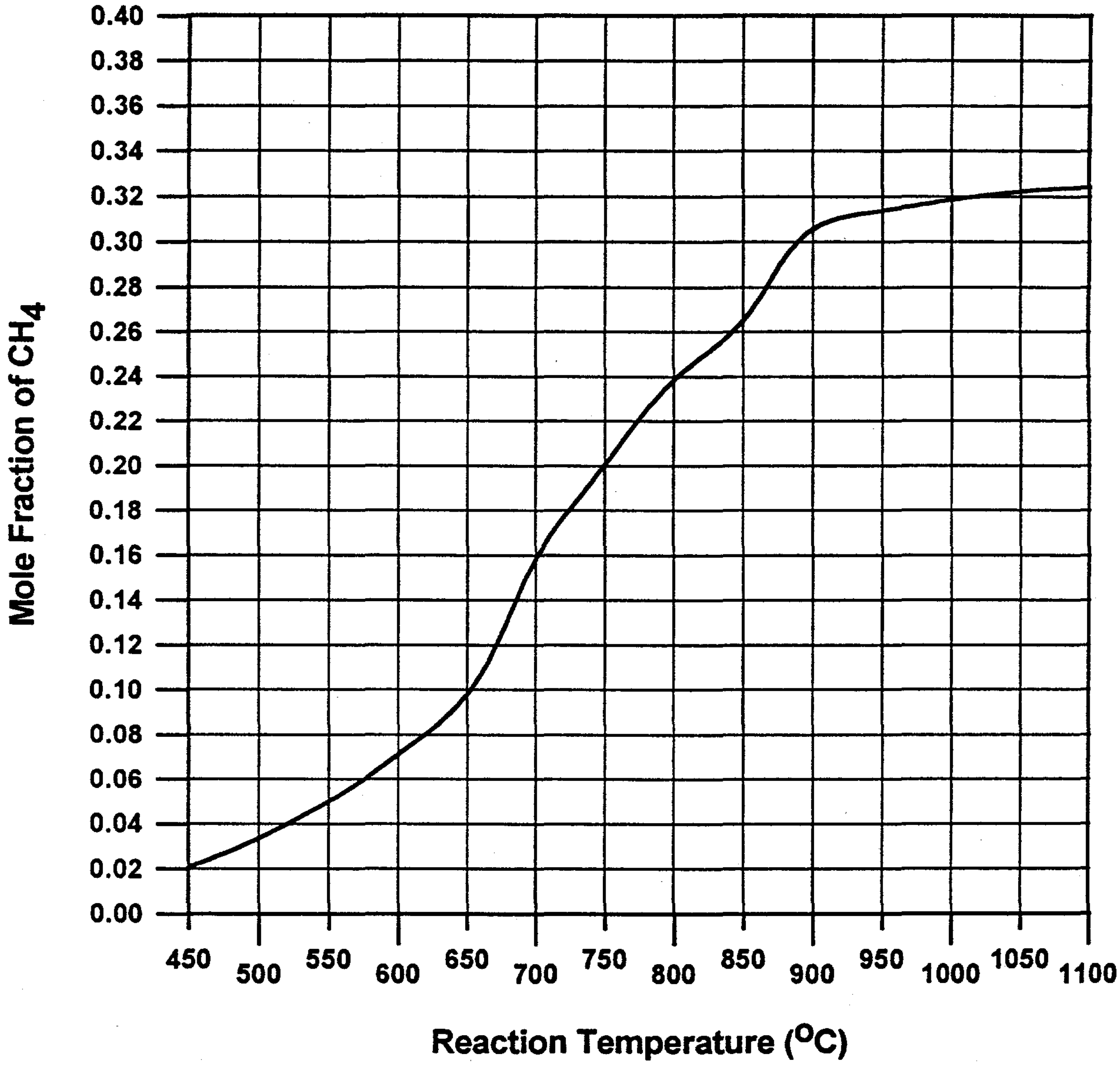


Figure 50. The Effect of Reaction Temperature on Equilibrium Mole Fraction of CH_4 after Cooling down the Reaction System to $25^{O}C$

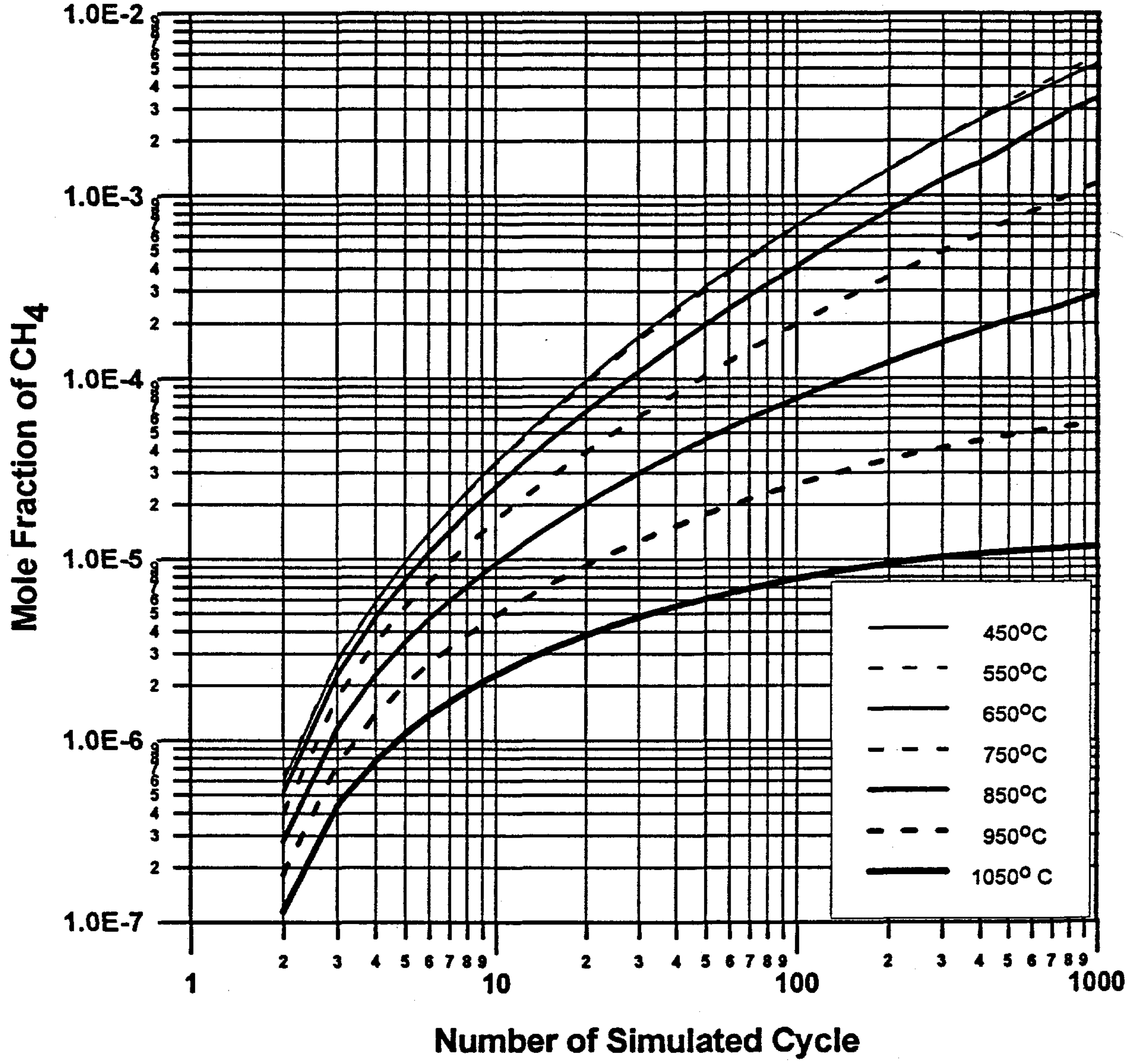


Figure 51. The Effect of Reaction Temperature and the Number of Simulated Cycles on Equilibrium Mole Fraction of CH_4

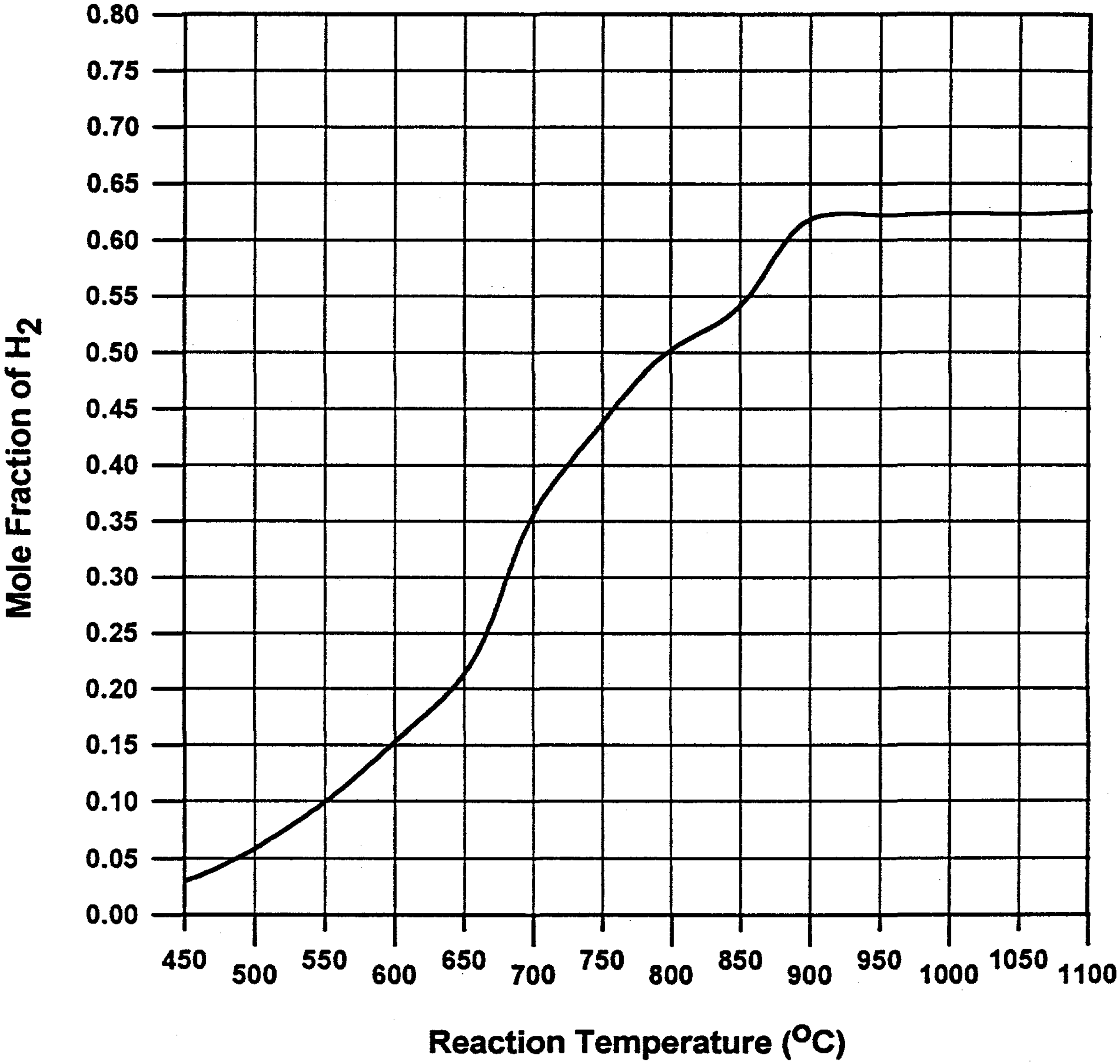


Figure 52. The Effect of Temperature on Equilibrium Mole Fraction of H_2

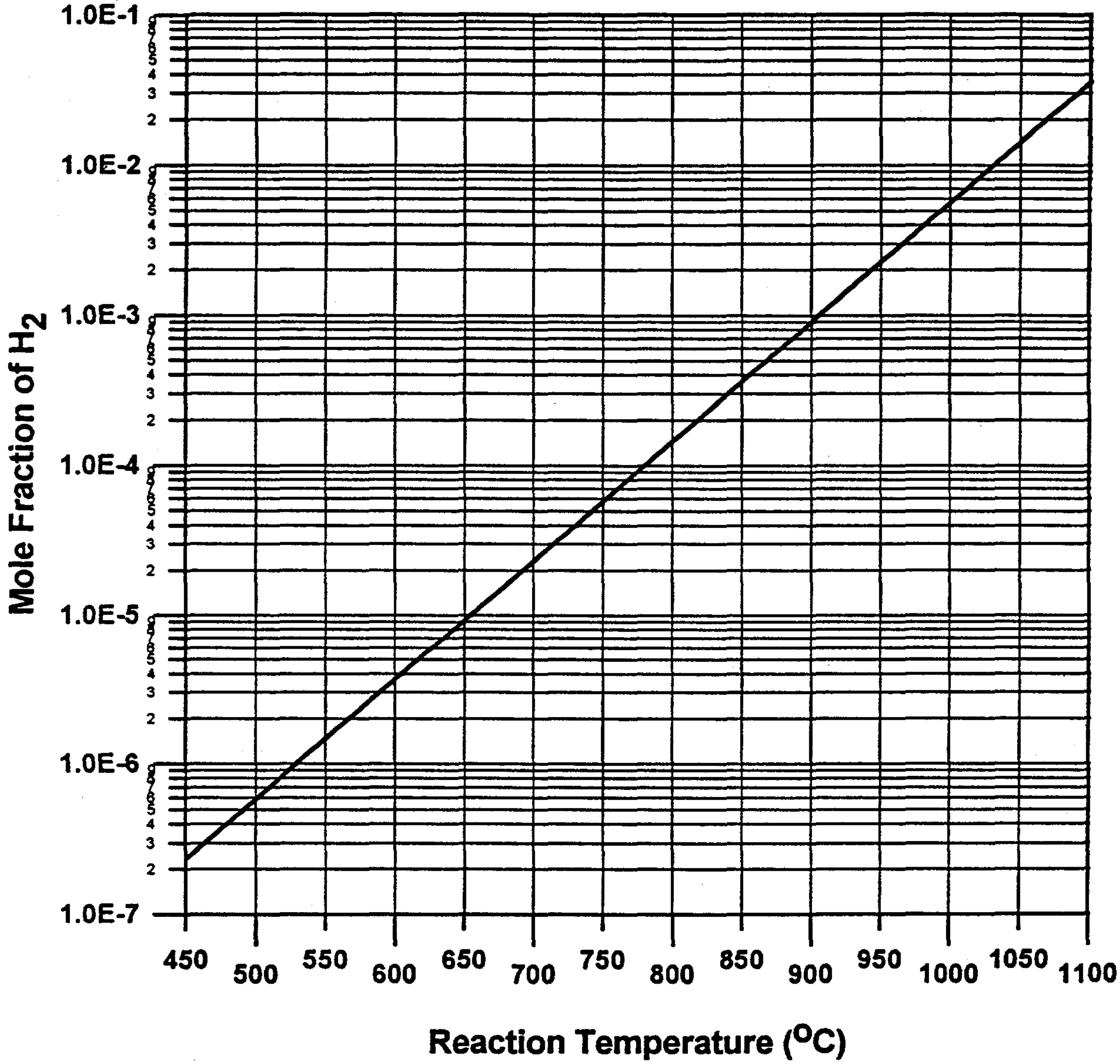


Figure 53. The Effect of Reaction Temperature on Equilibrium Mole Fraction of H_2 after Cooling down the Reaction System to 25^oC

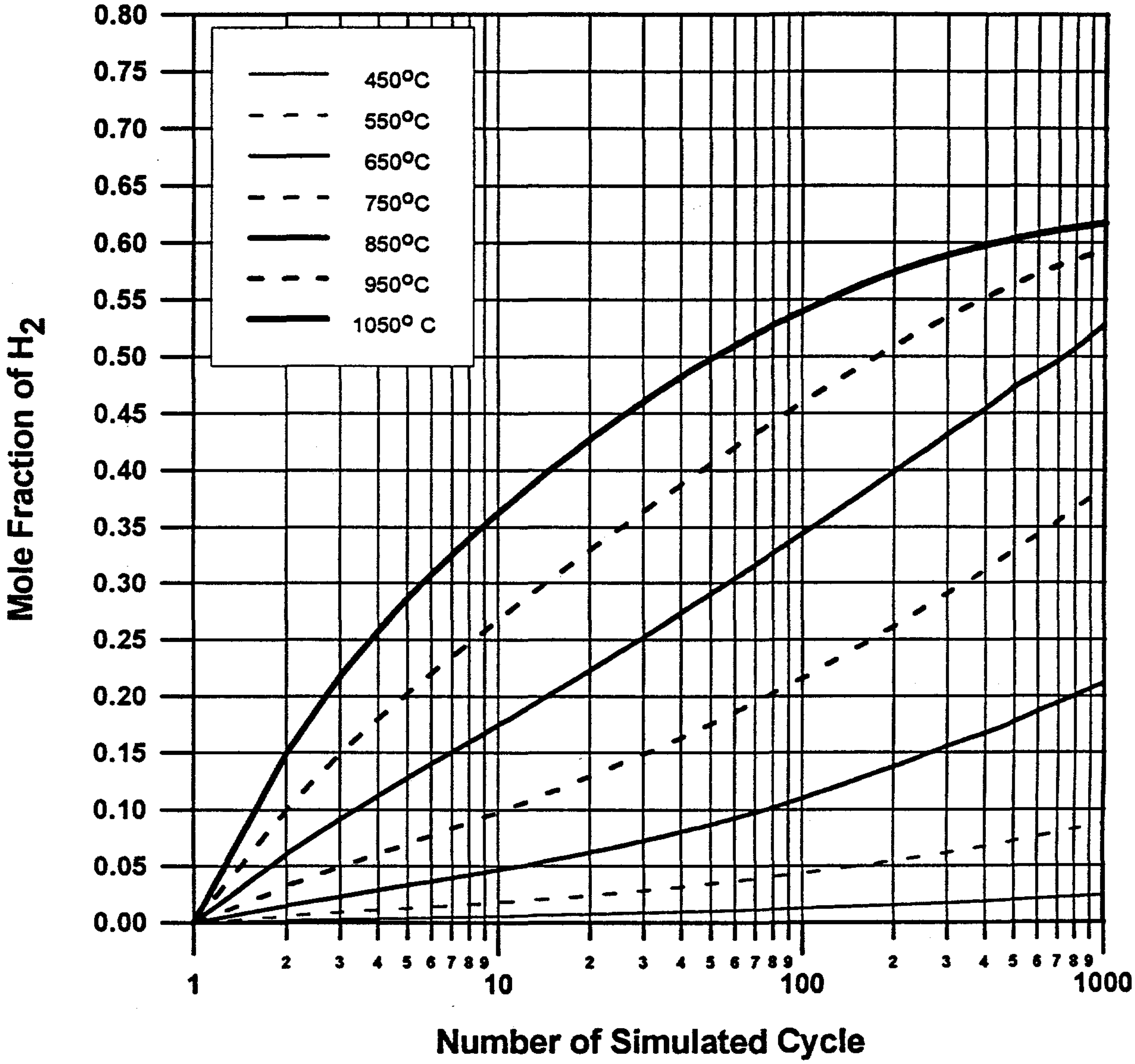


Figure 54. The Effect of Reaction Temperature and the Number of Simulated Cycles on Equilibrium Mole Fraction of H_2

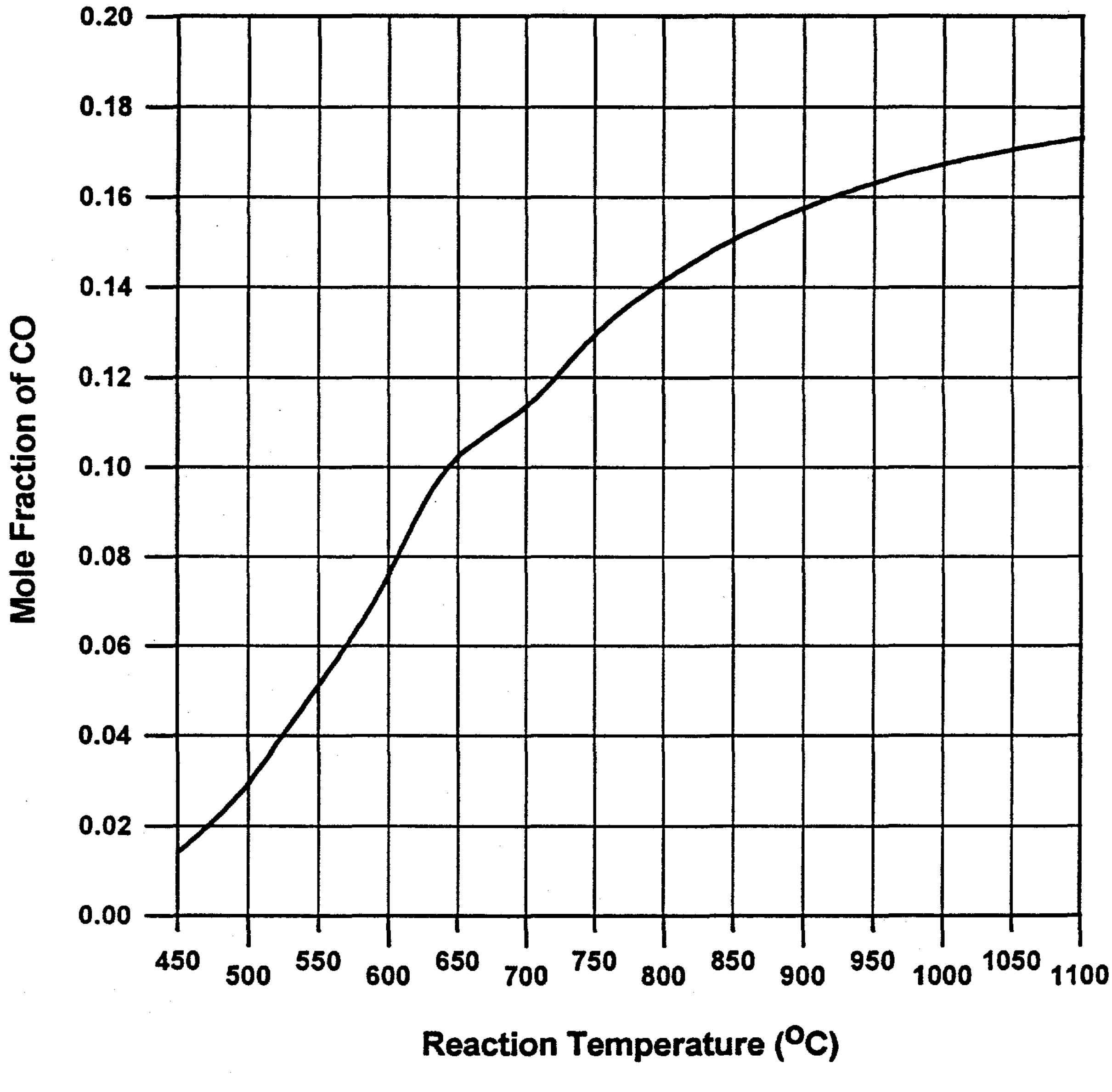


Figure 55. The Effect of Temperature on Equilibrium Mole Fraction of CO

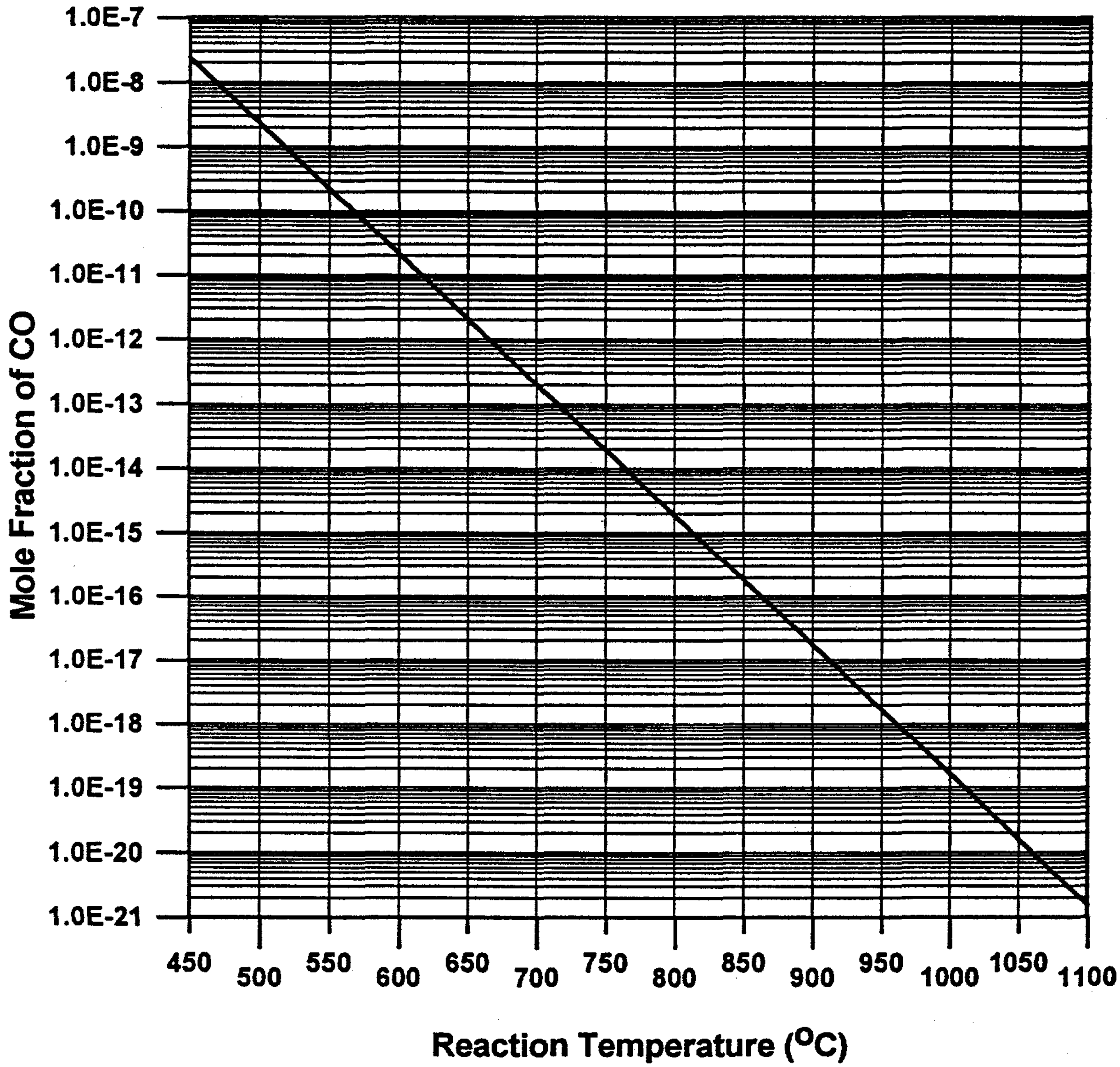


Figure 56. The Effect of Reaction Temperature on Equilibrium Mole Fraction of CO after Cooling down the Reaction System to 25 °C

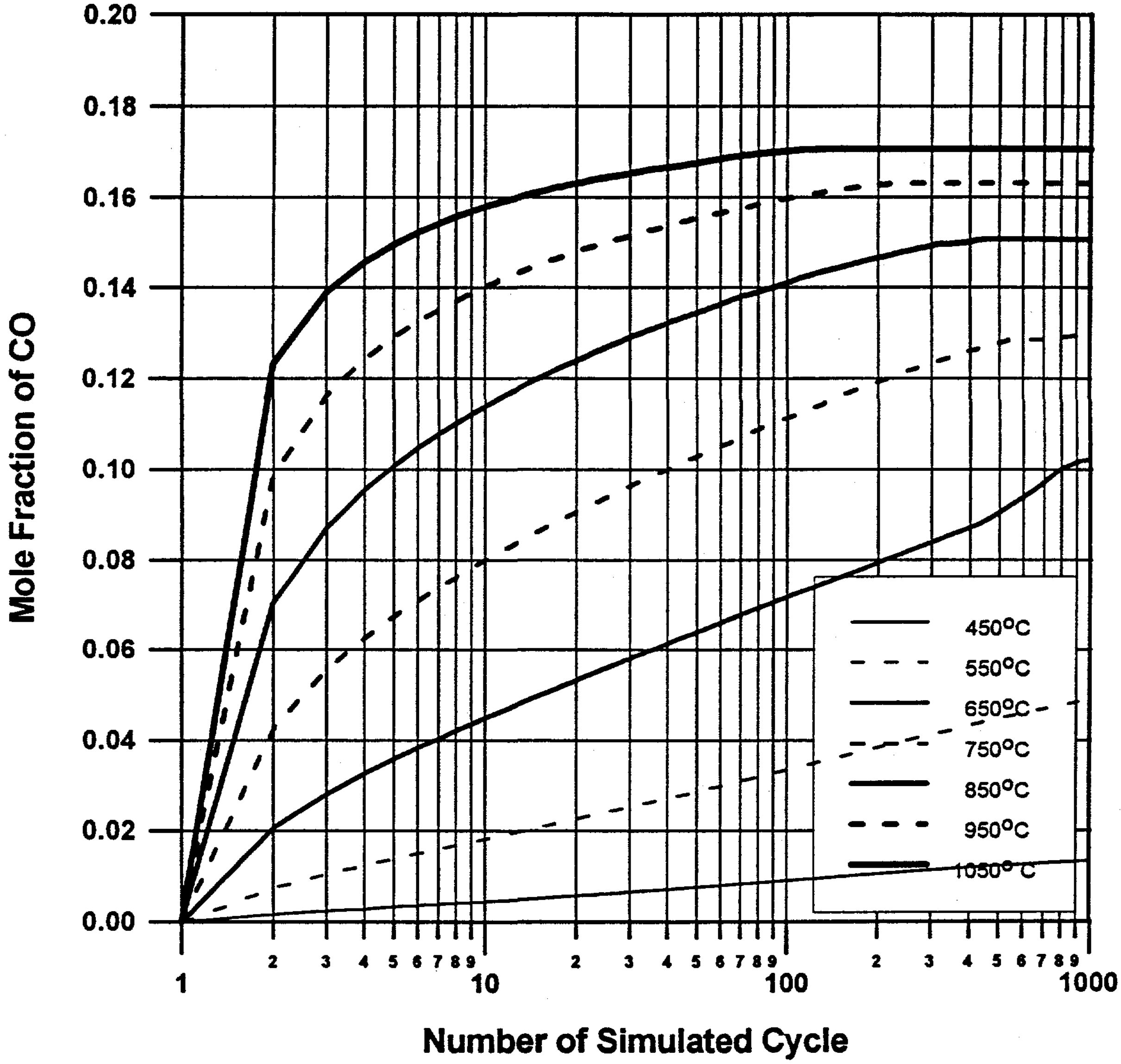


Figure 57. The Effect of Reaction Temperature and the Number of Simulated Cycles on Equilibrium Mole Fraction of CO

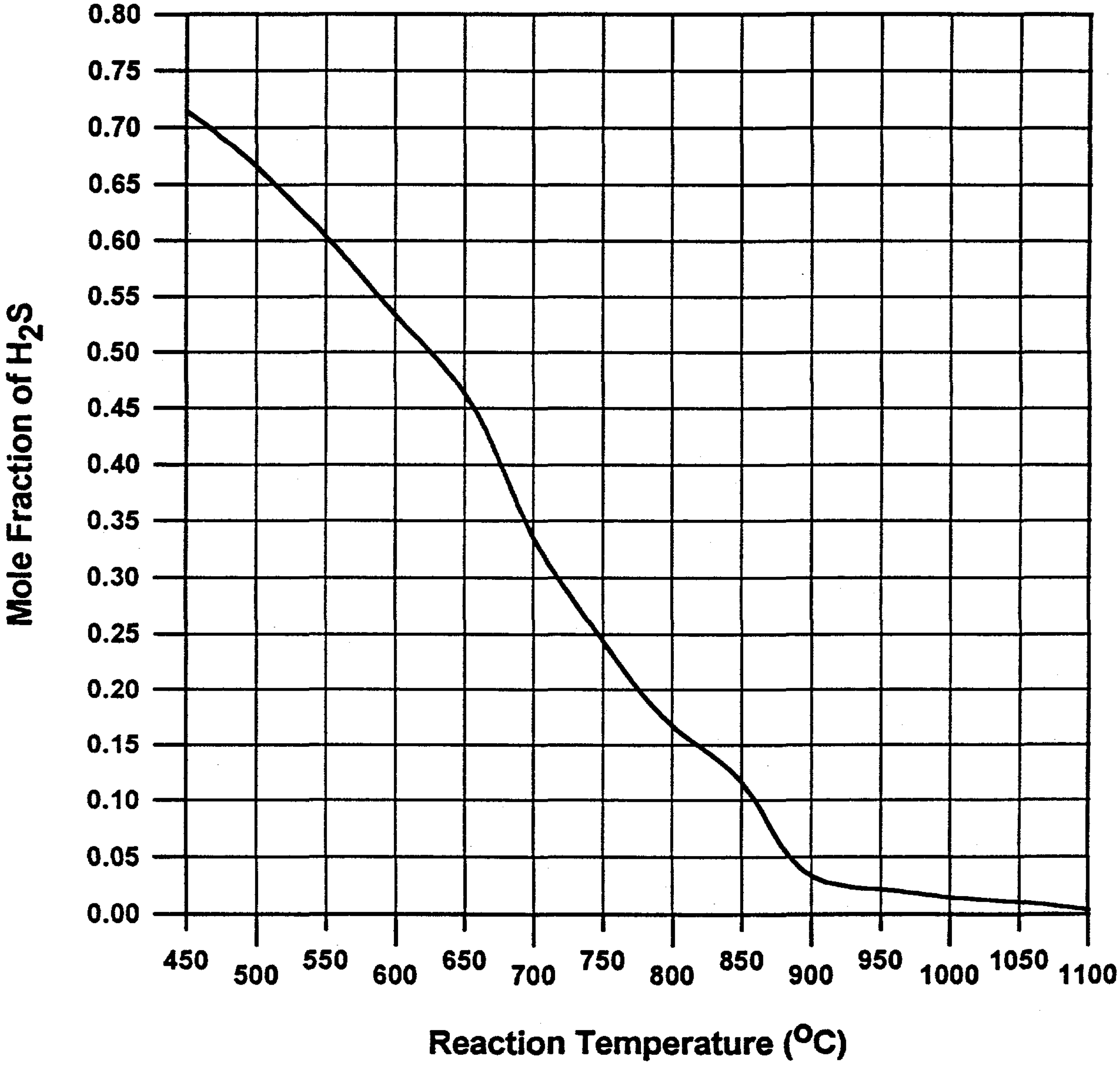


Figure 58. The Effect of Temperature on Equilibrium Mole Fraction of H_2S

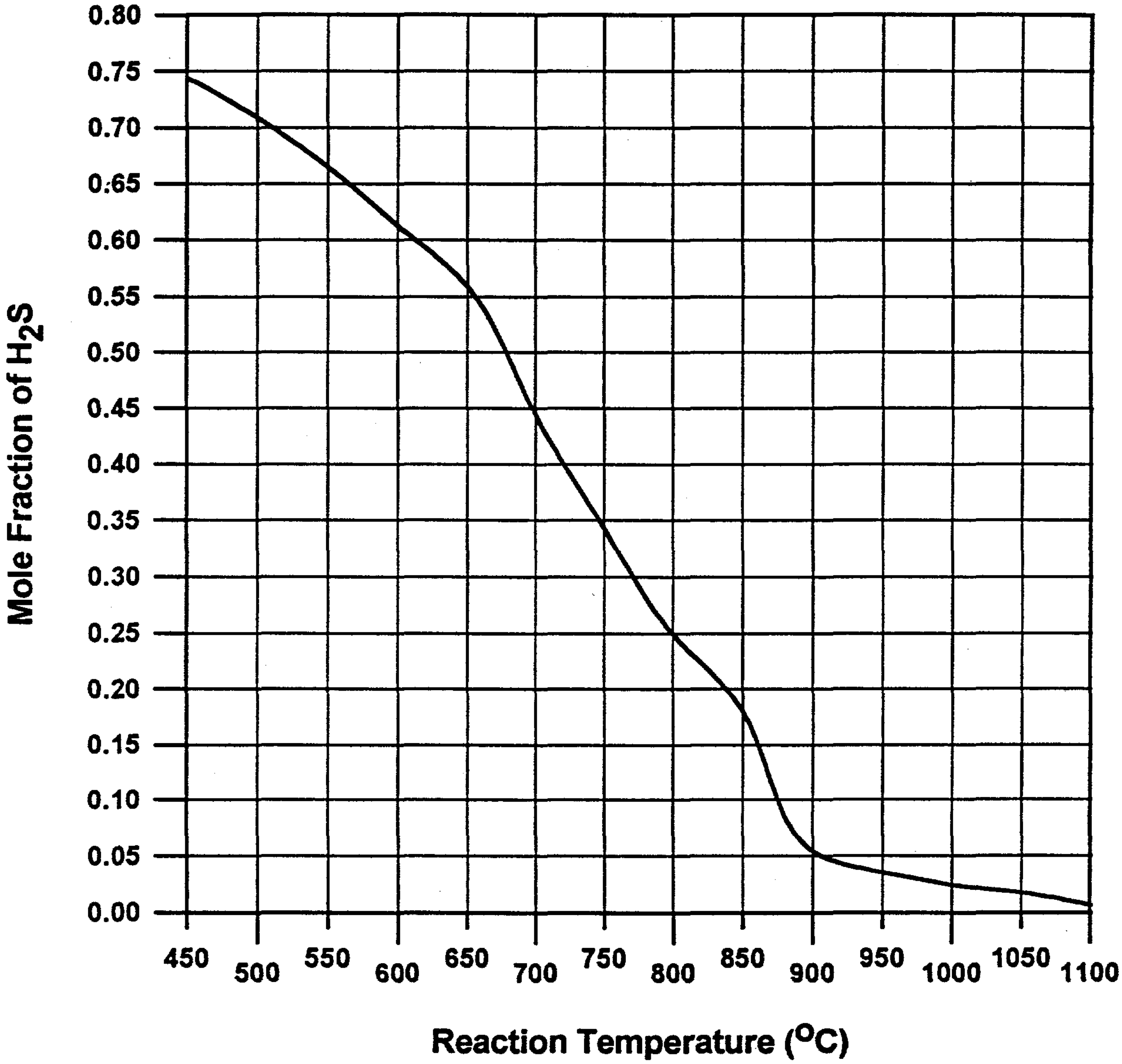


Figure 59. The Effect of Reaction Temperature on Equilibrium Mole Fraction of H_2S after Cooling down the Reaction System to $25^{O}C$

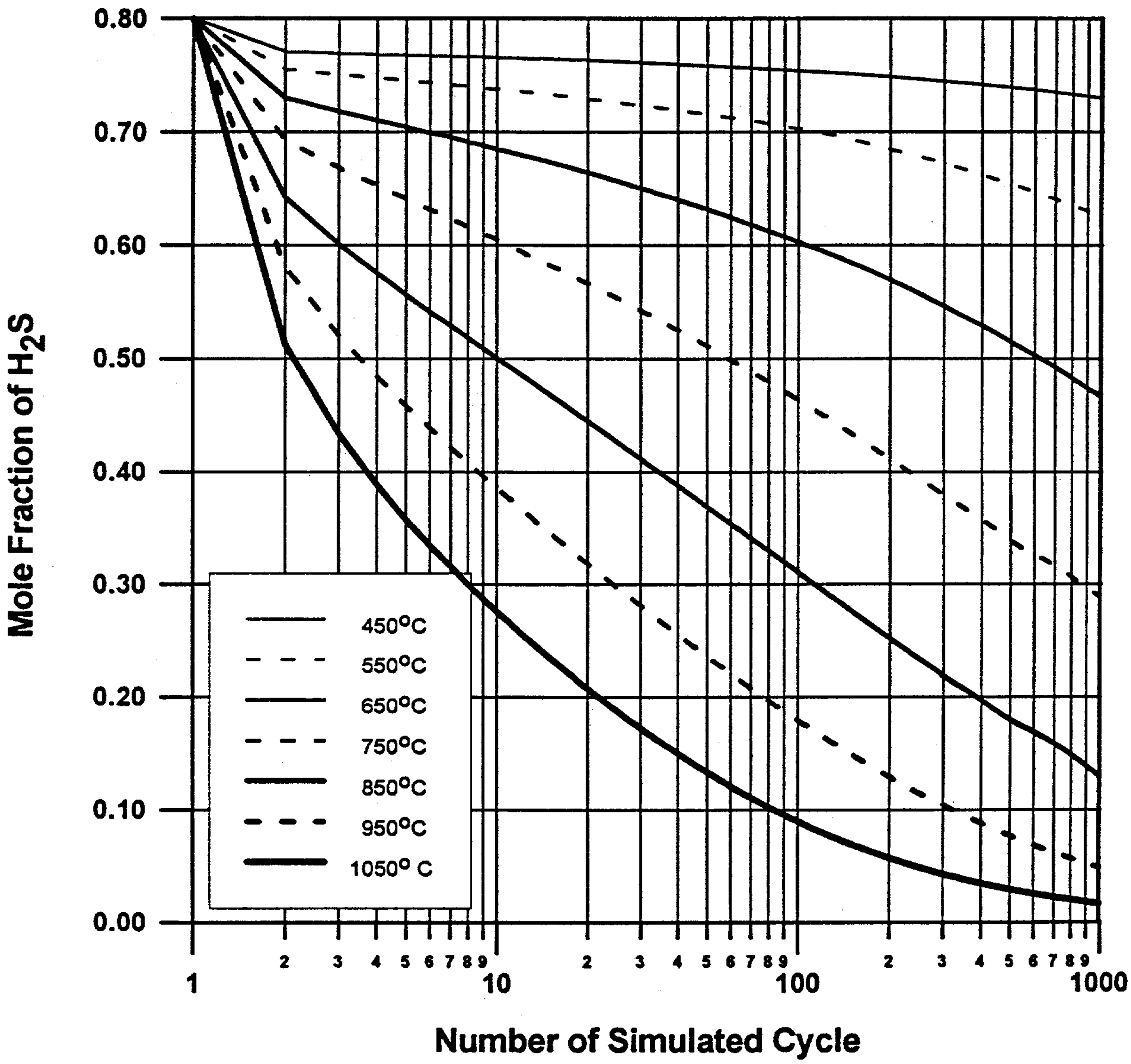


Figure 60. The Effect of Reaction Temperature and the Number of Simulated Cycles on Equilibrium Mole Fraction of H_2S

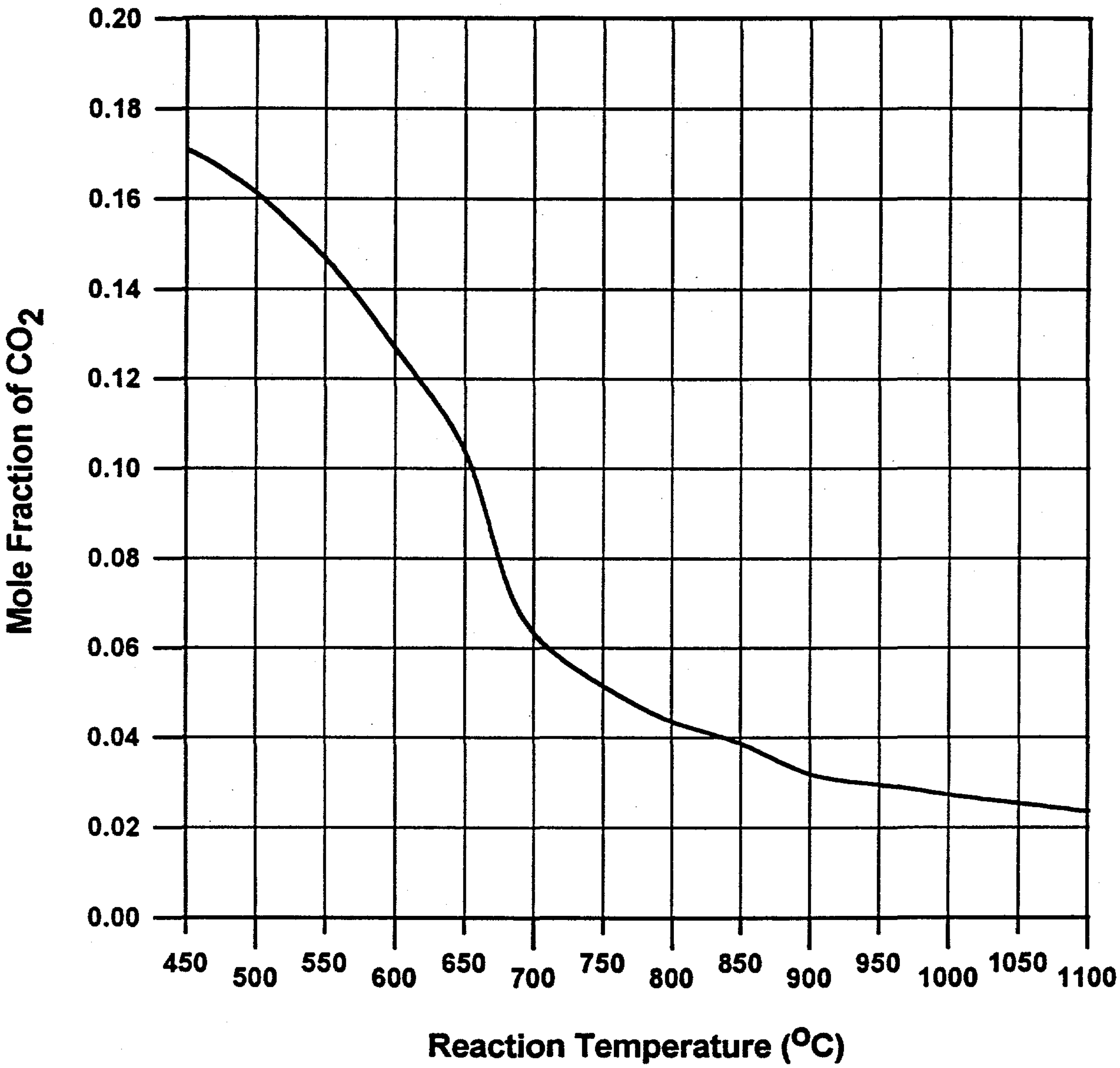


Figure 61. The Effect of Temperature on Equilibrium Mole Fraction of CO_2

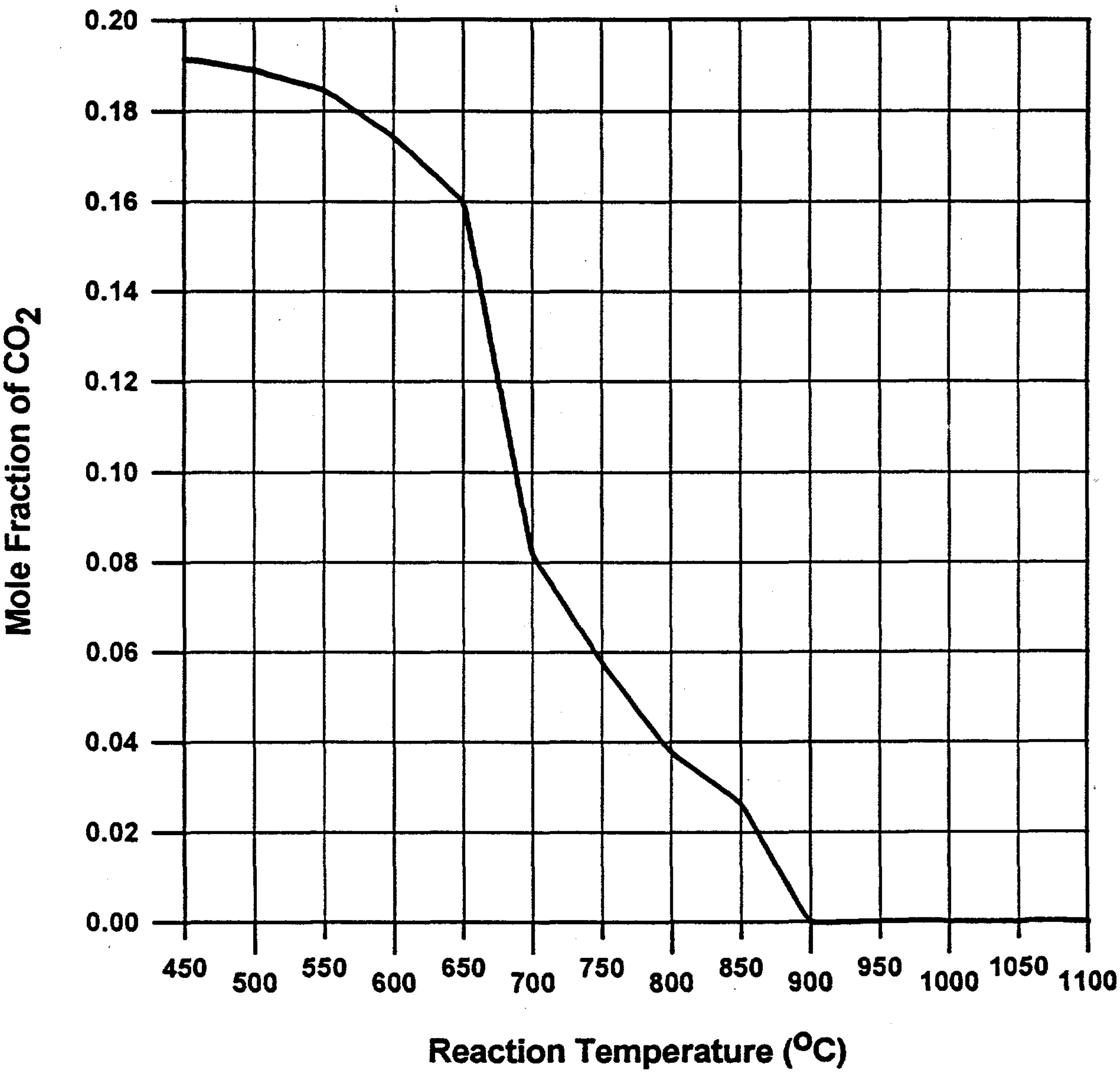


Figure 62. The Effect of Reaction Temperature on Equilibrium Mole Fraction of CO_2 after Cooling down the Reaction System to $25^{O}C$

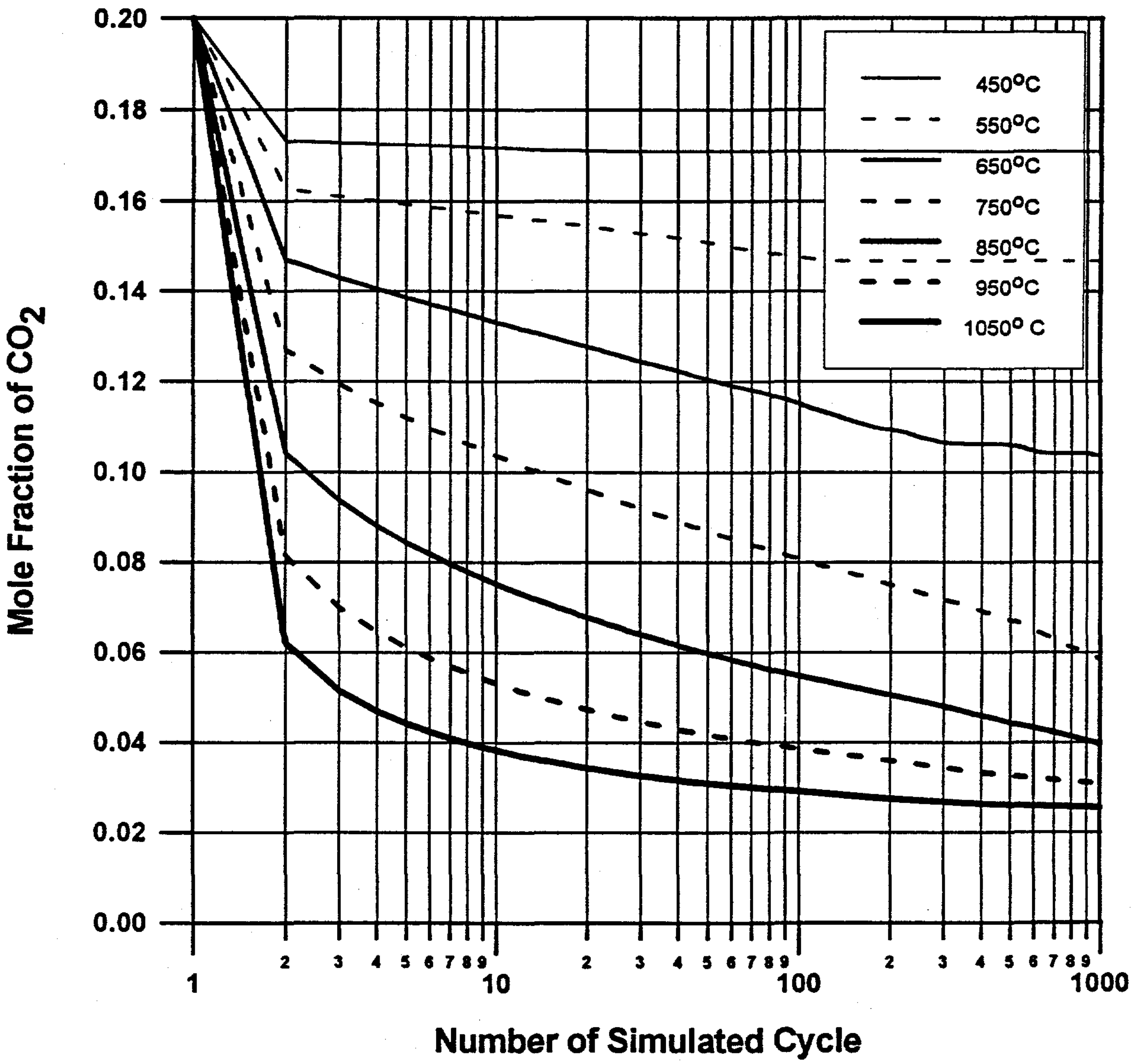


Figure 63. The Effect of Reaction Temperature and the Number of Simulated Cycles on Equilibrium Mole Fraction of CO_2

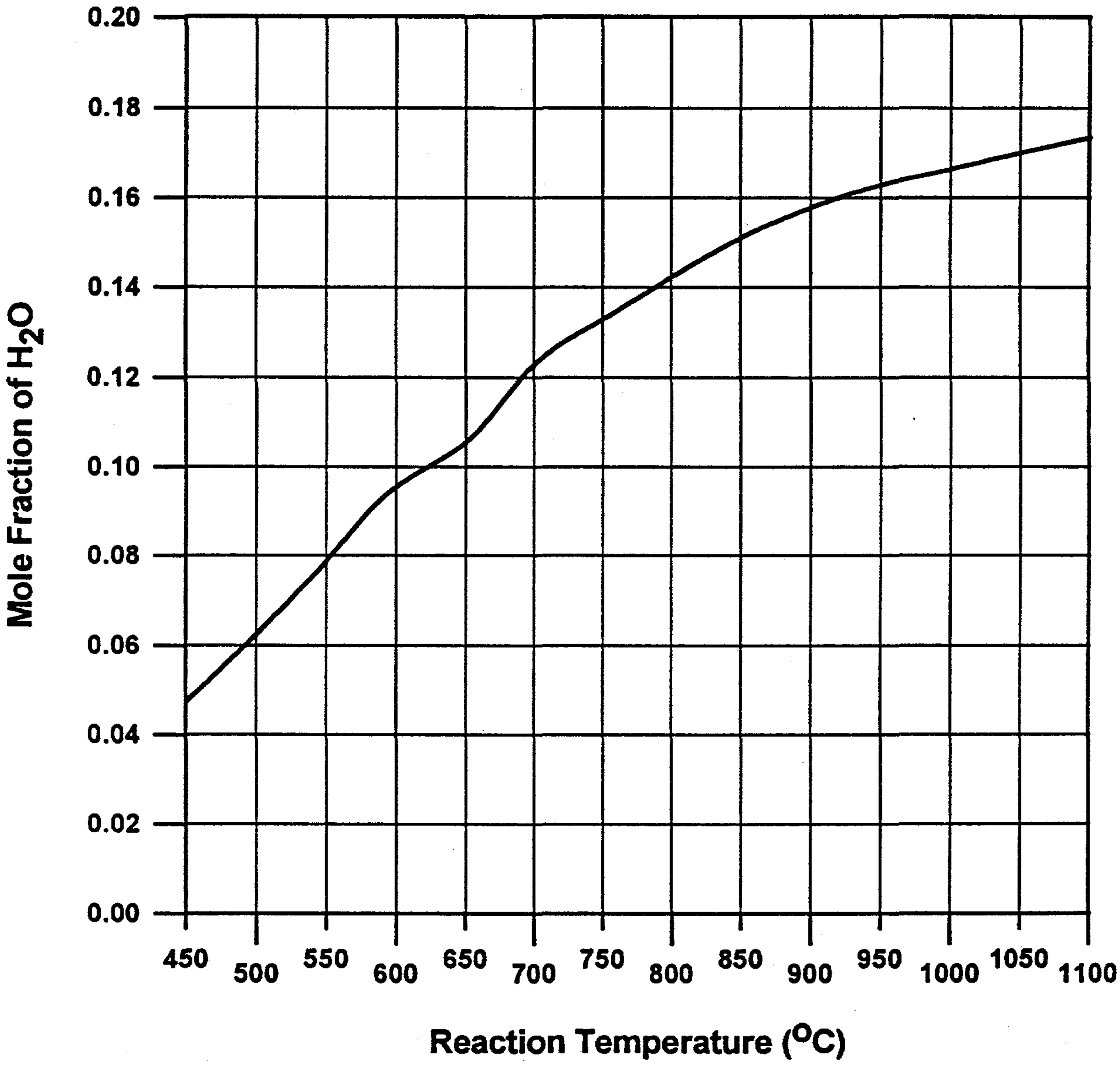


Figure 64. The Effect of Temperature on Equilibrium Mole Fraction of H_2O

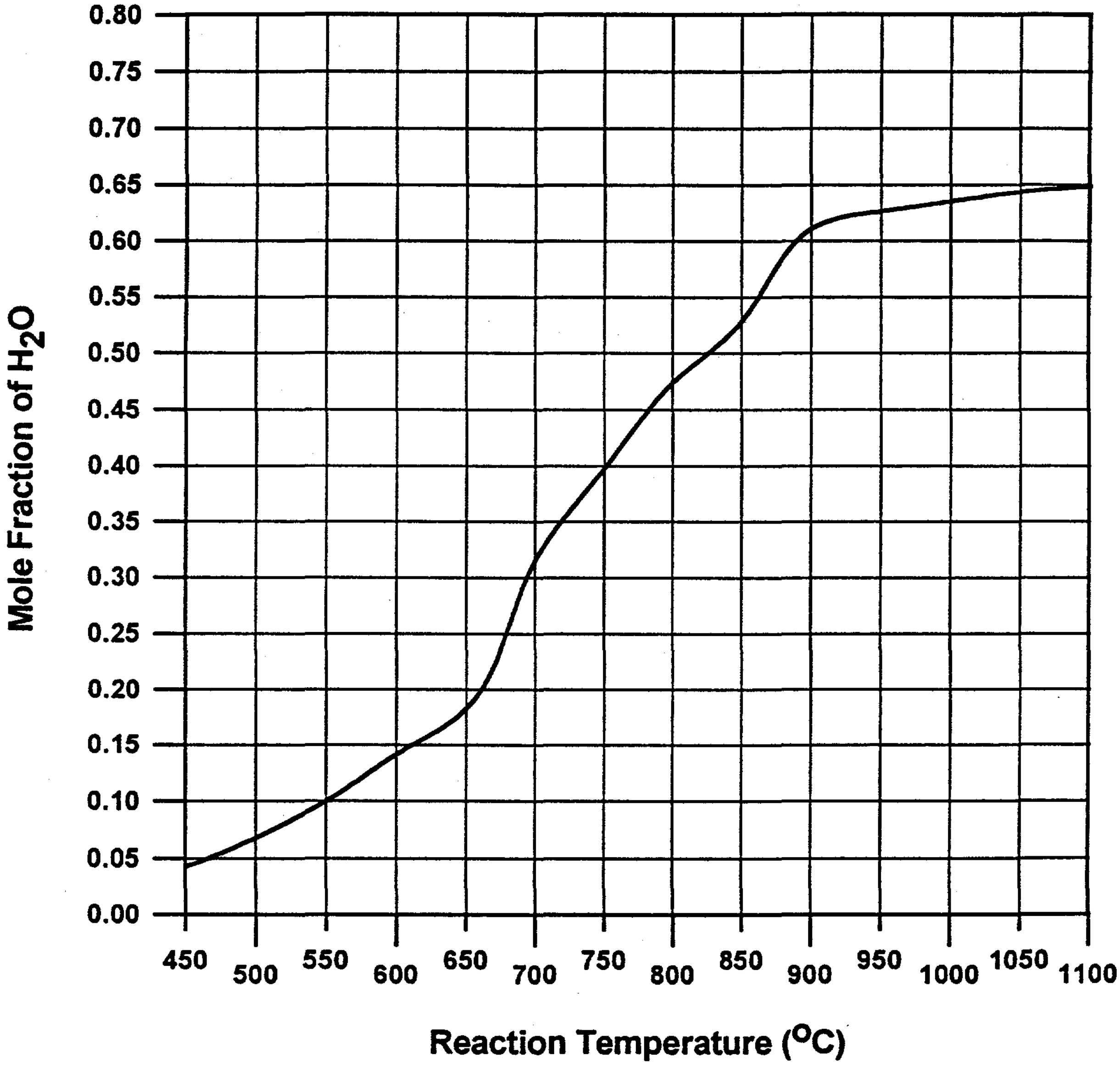


Figure 65. The Effect of Reaction Temperature on Equilibrium Mole Fraction of H_2O after Cooling down the Reaction System to 25^oC

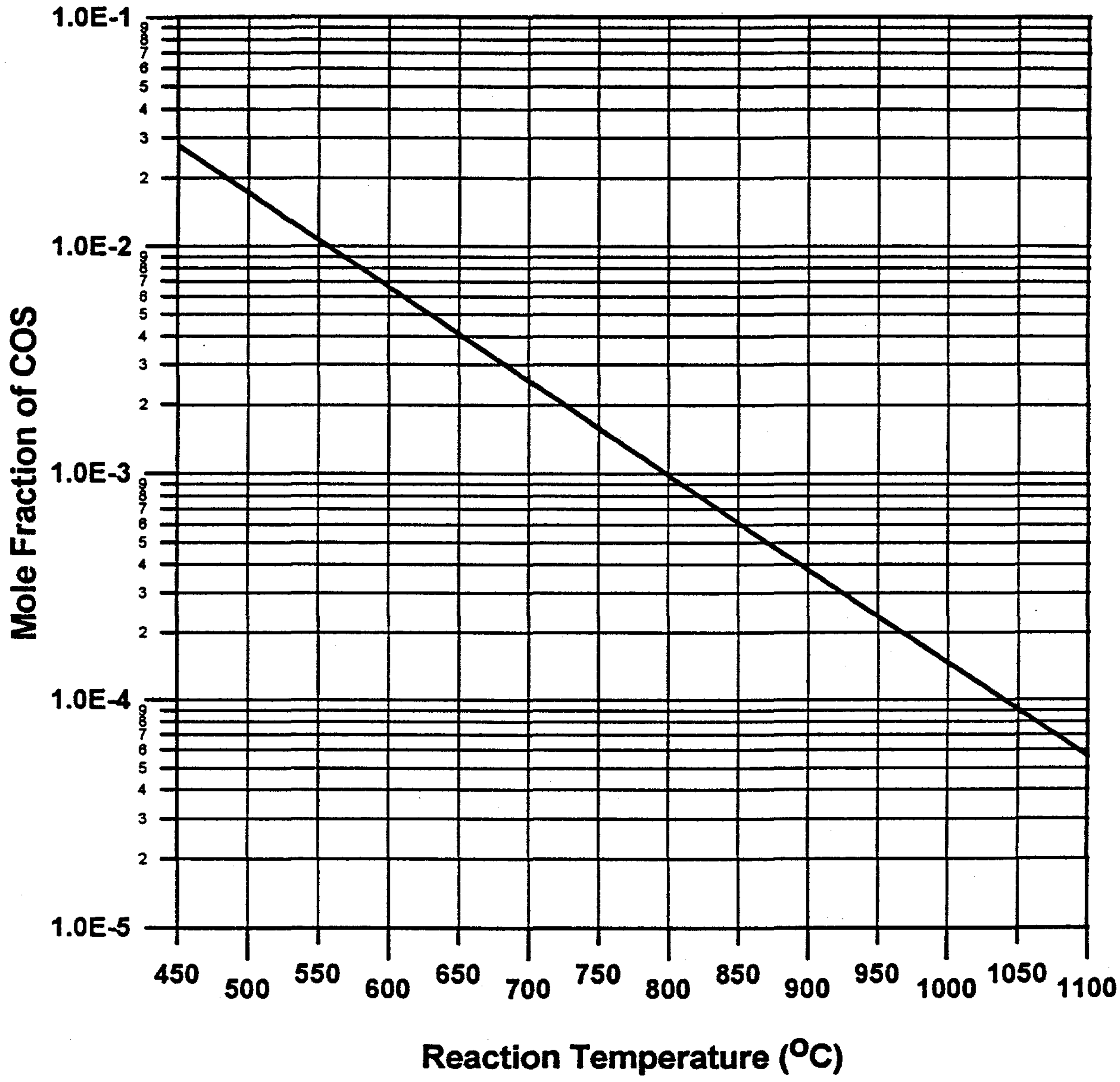


Figure 66. The Effect of Temperature on Equilibrium Mole Fraction of COS

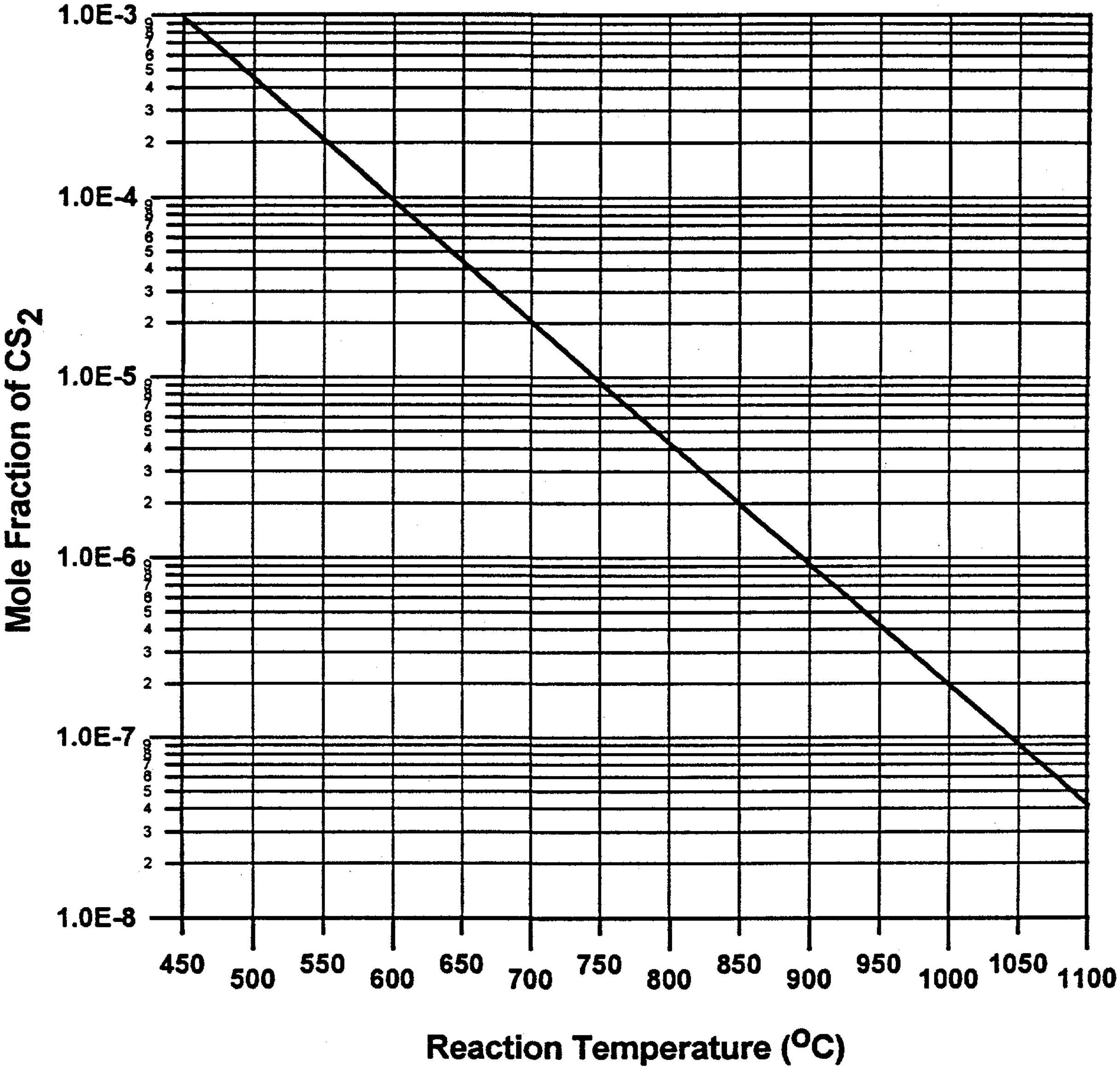


Figure 67. The Effect of Temperature on Equilibrium Mole Fraction of CS_2

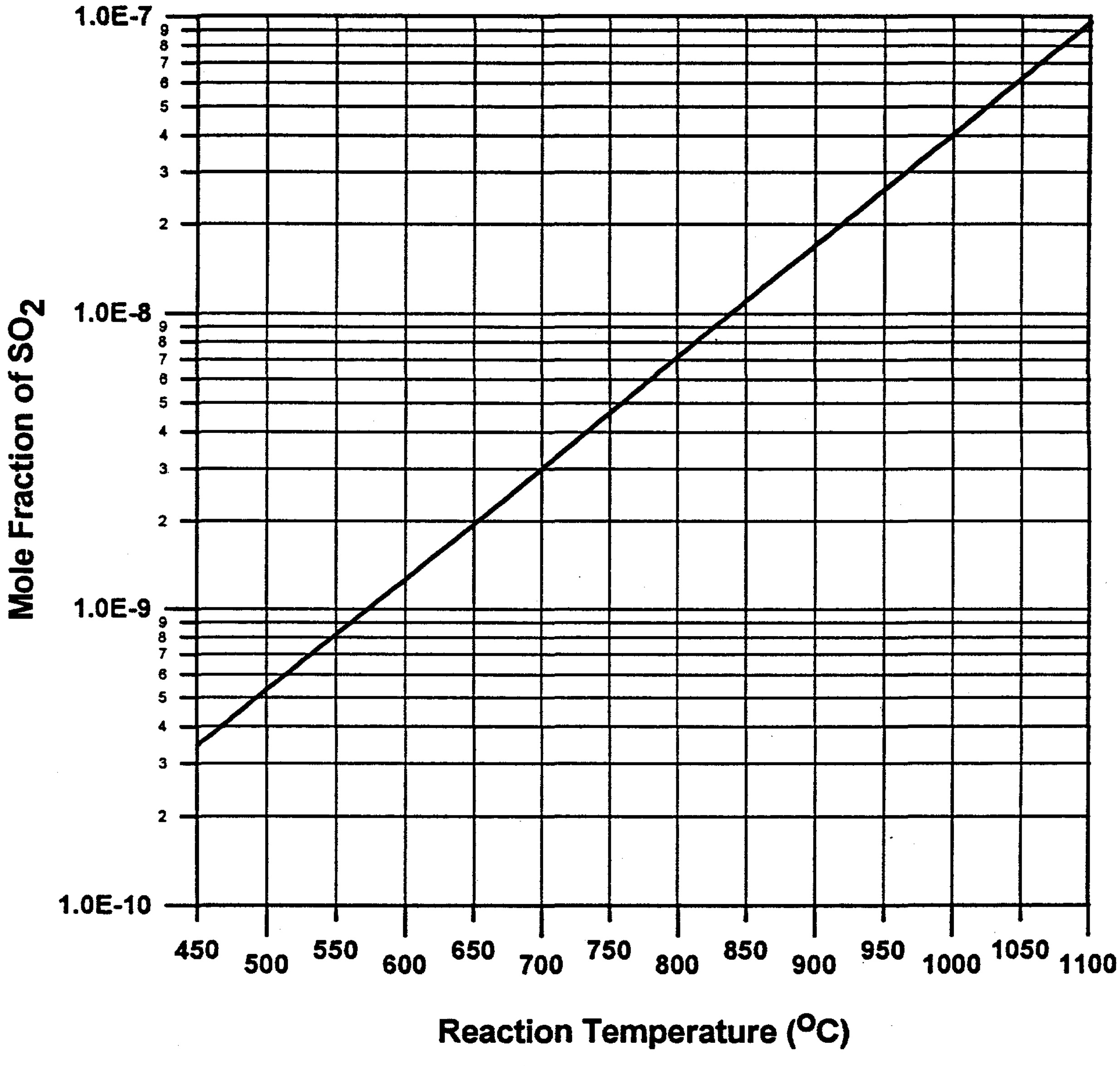


Figure 68. The Effect of Temperature on Equilibrium Mole Fraction of SO_2

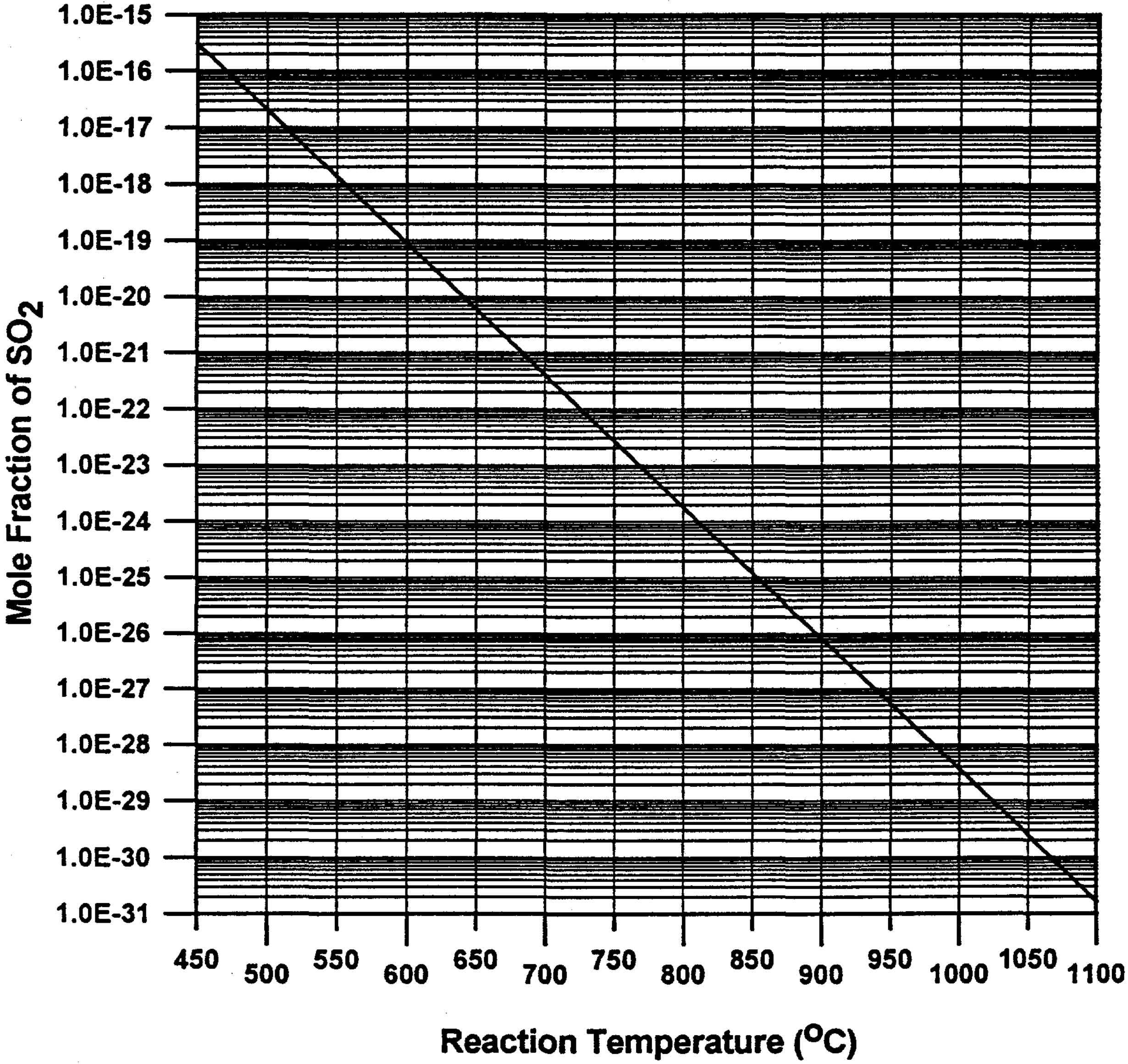


Figure 69. The Effect of Reaction Temperature on Equilibrium Mole Fraction of SO_2 after Cooling down the Reaction System to $25^{o}C$

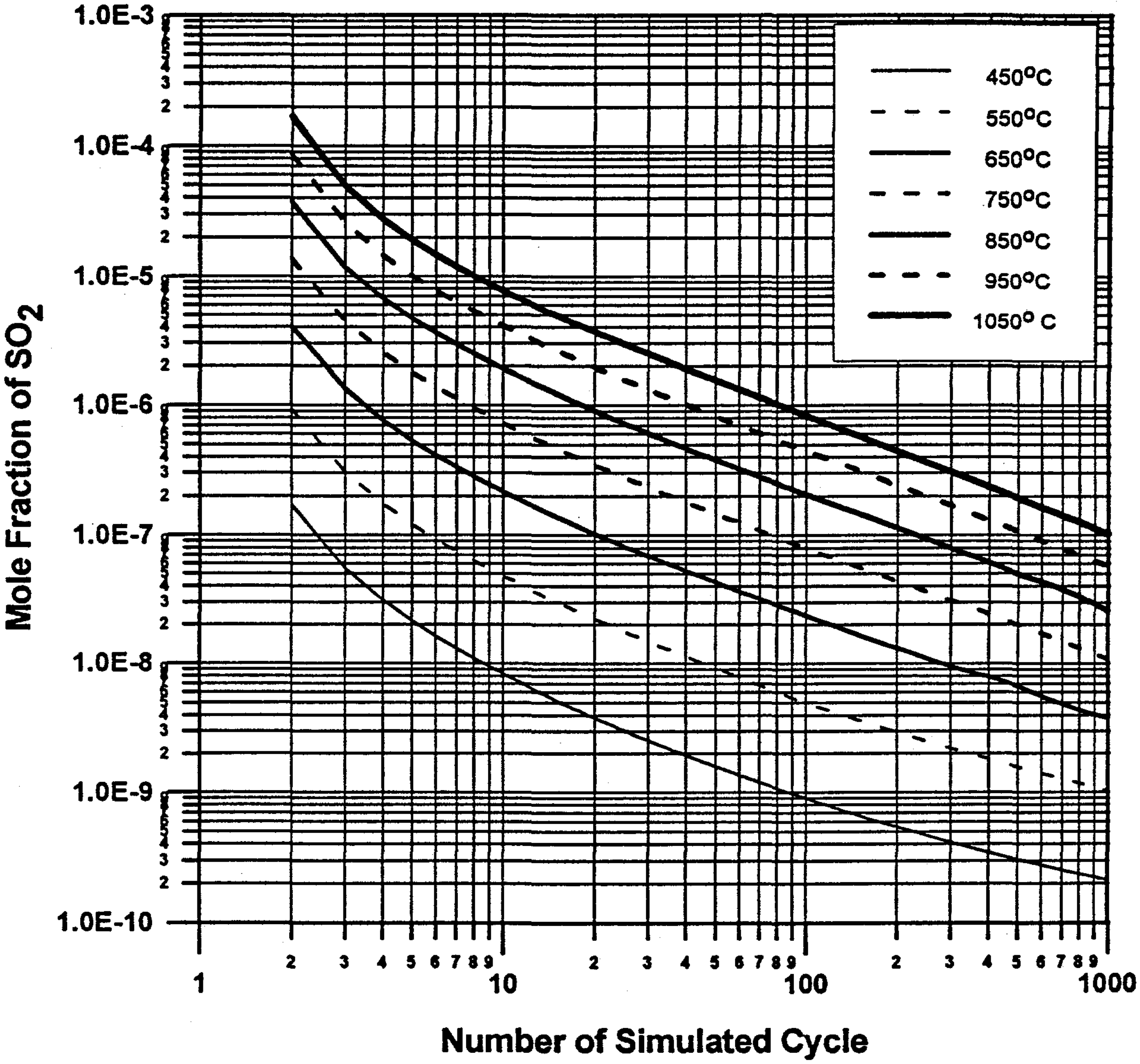


Figure 70. The Effect of Reaction Temperature and the Number of Simulated Cycles on Equilibrium Mole Fraction of SO_2

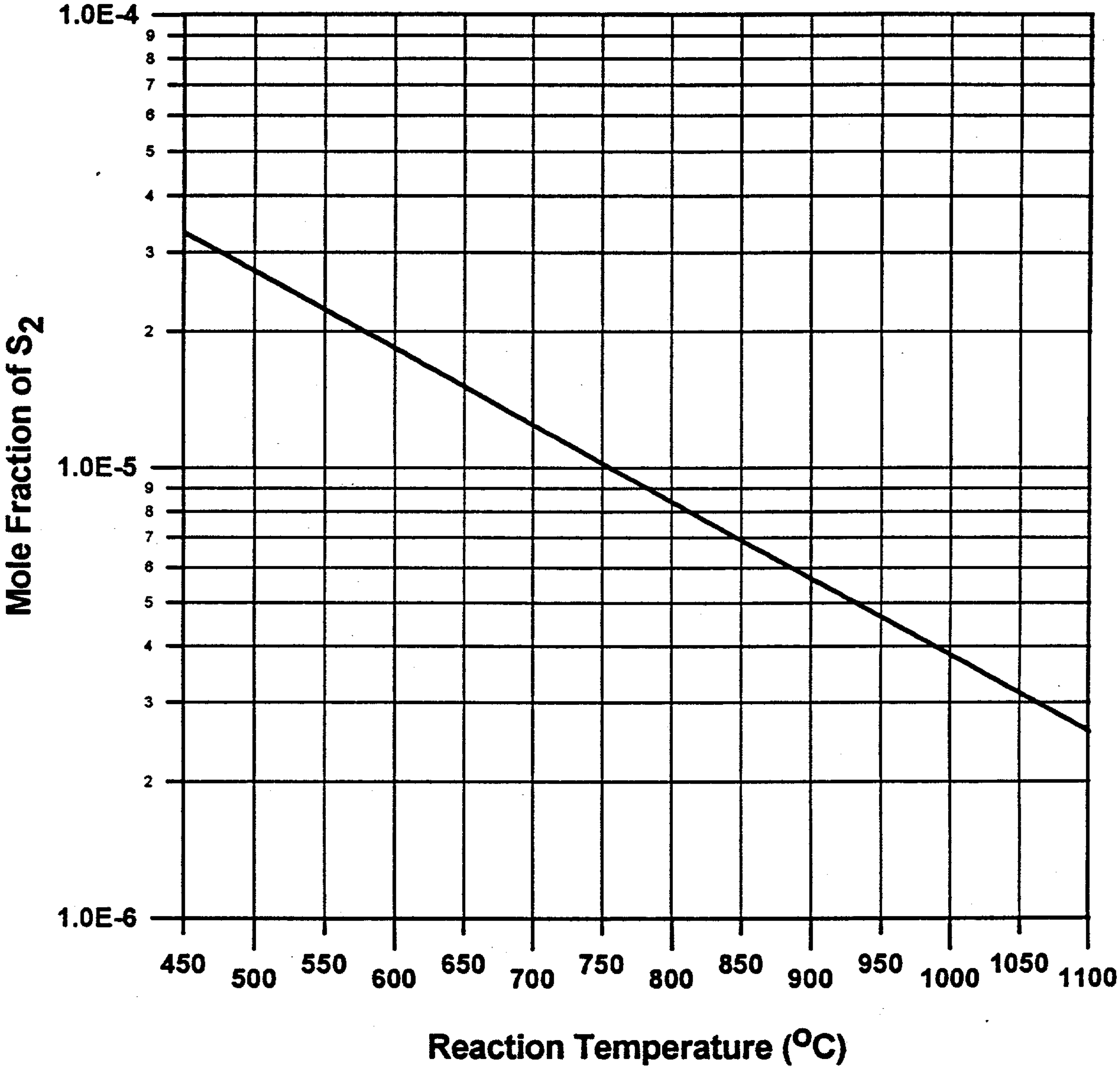


Figure 71. The Effect of Temperature on Equilibrium Mole Fraction of S_2

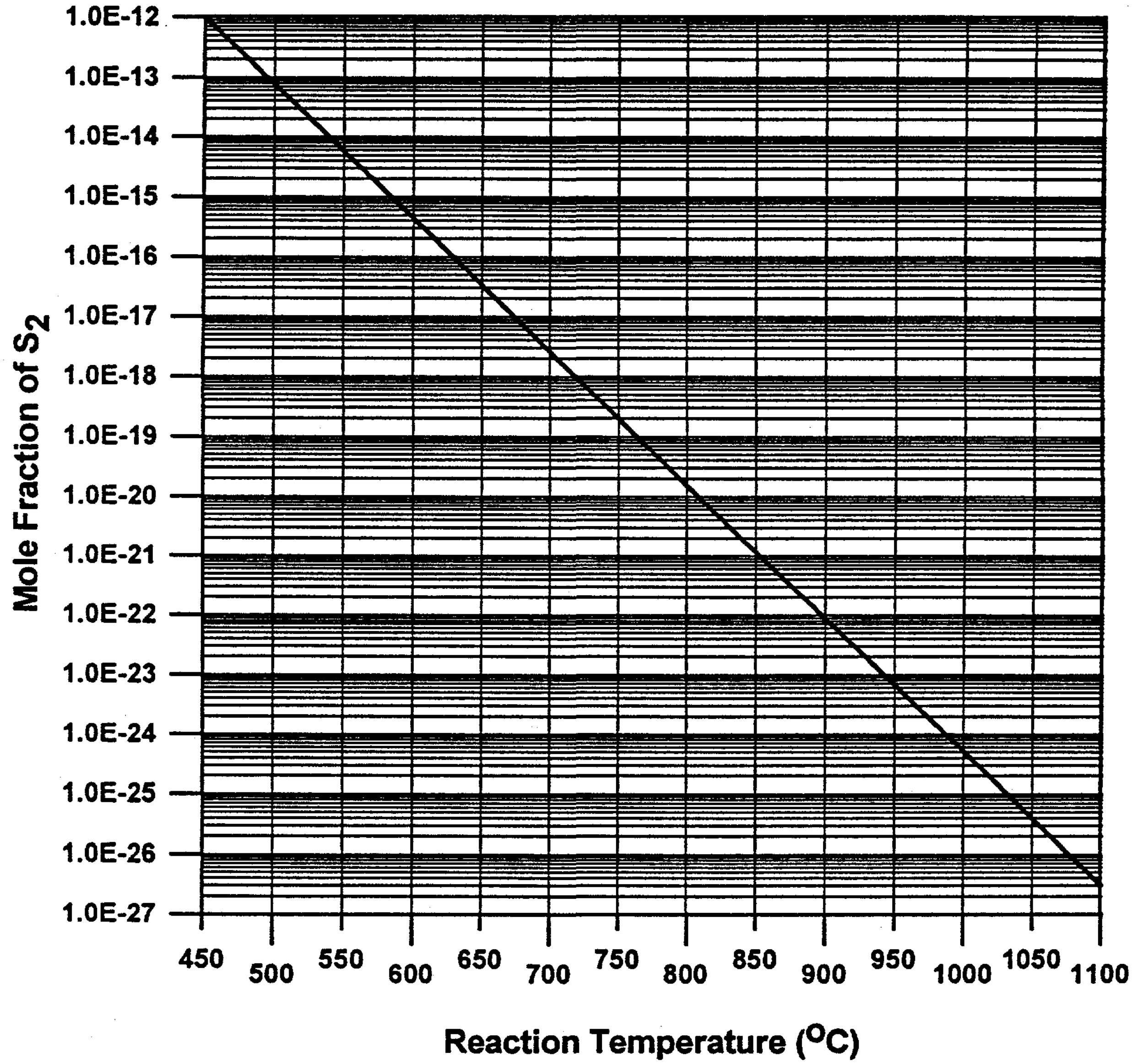


Figure 72. The Effect of Reaction Temperature on Equilibrium Mole Fraction of S_2 after Cooling down the Reaction System to $25^{o}C$

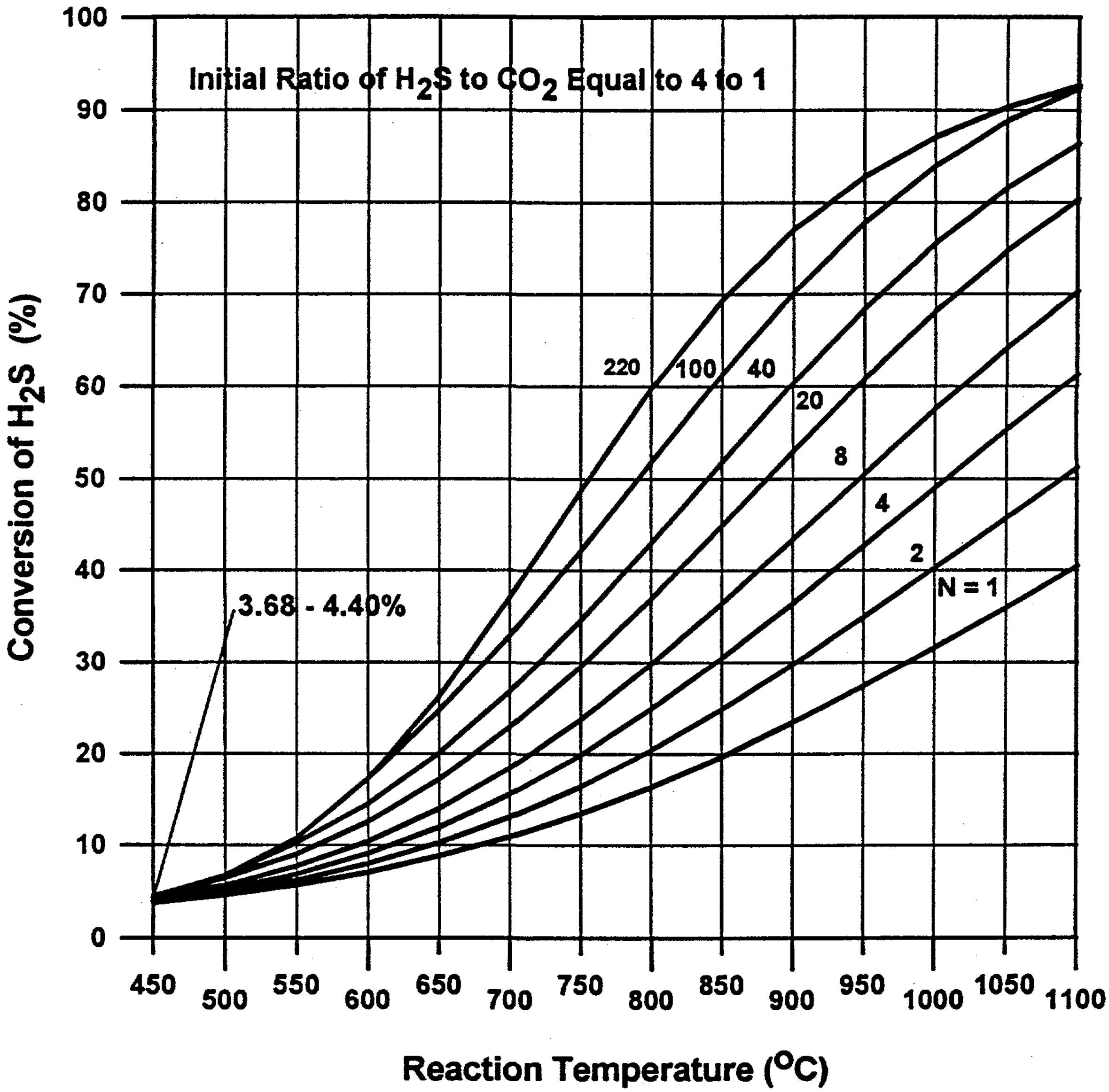


Figure 73. Effects of Reaction Temperature and Number of Simulated Stages on the Conversion of H_2S with Sulfur Sink Temperature at 150°C

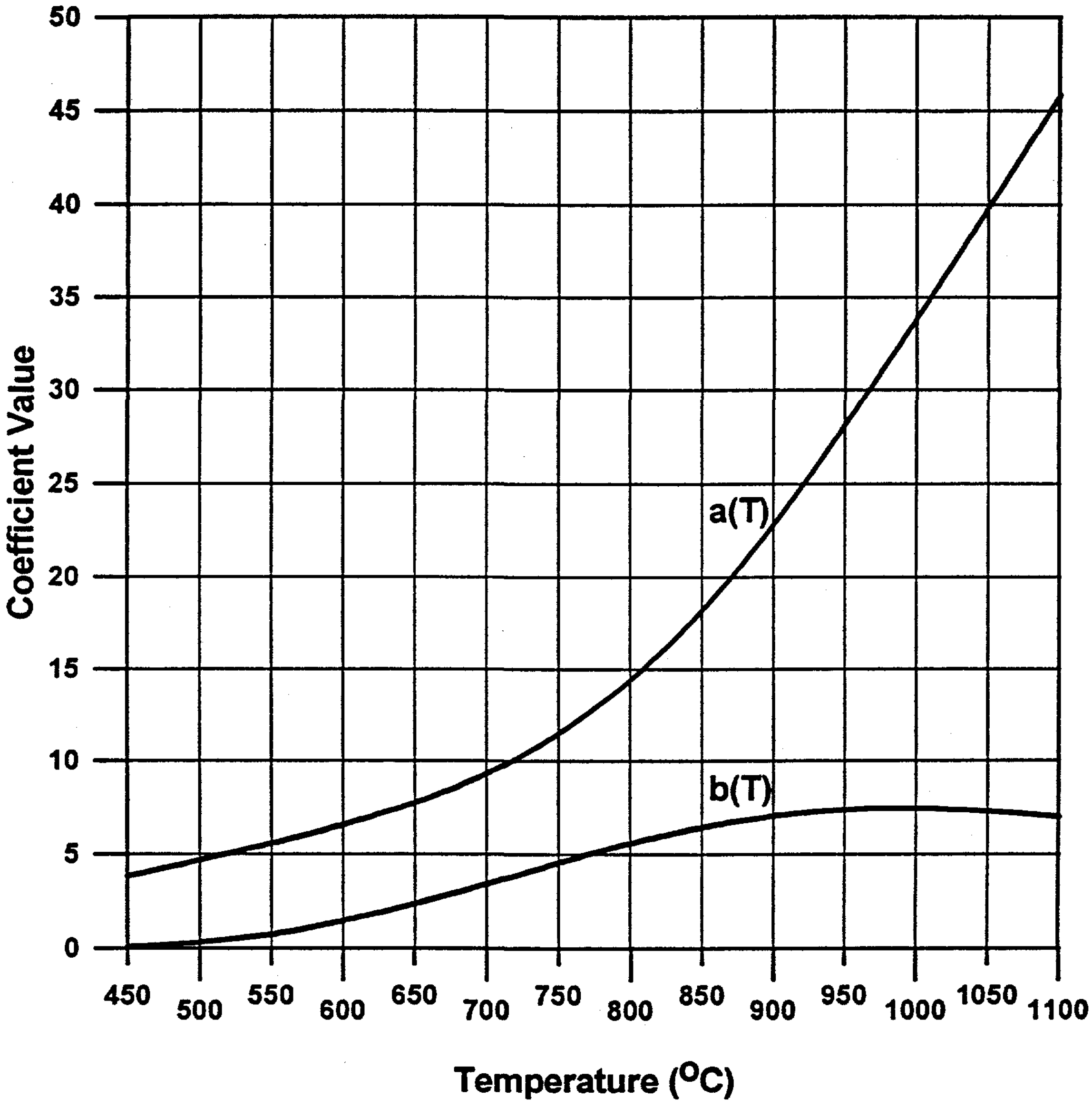


Figure 74. Coefficient Value of a(T) & b(T) v.s. Temperature

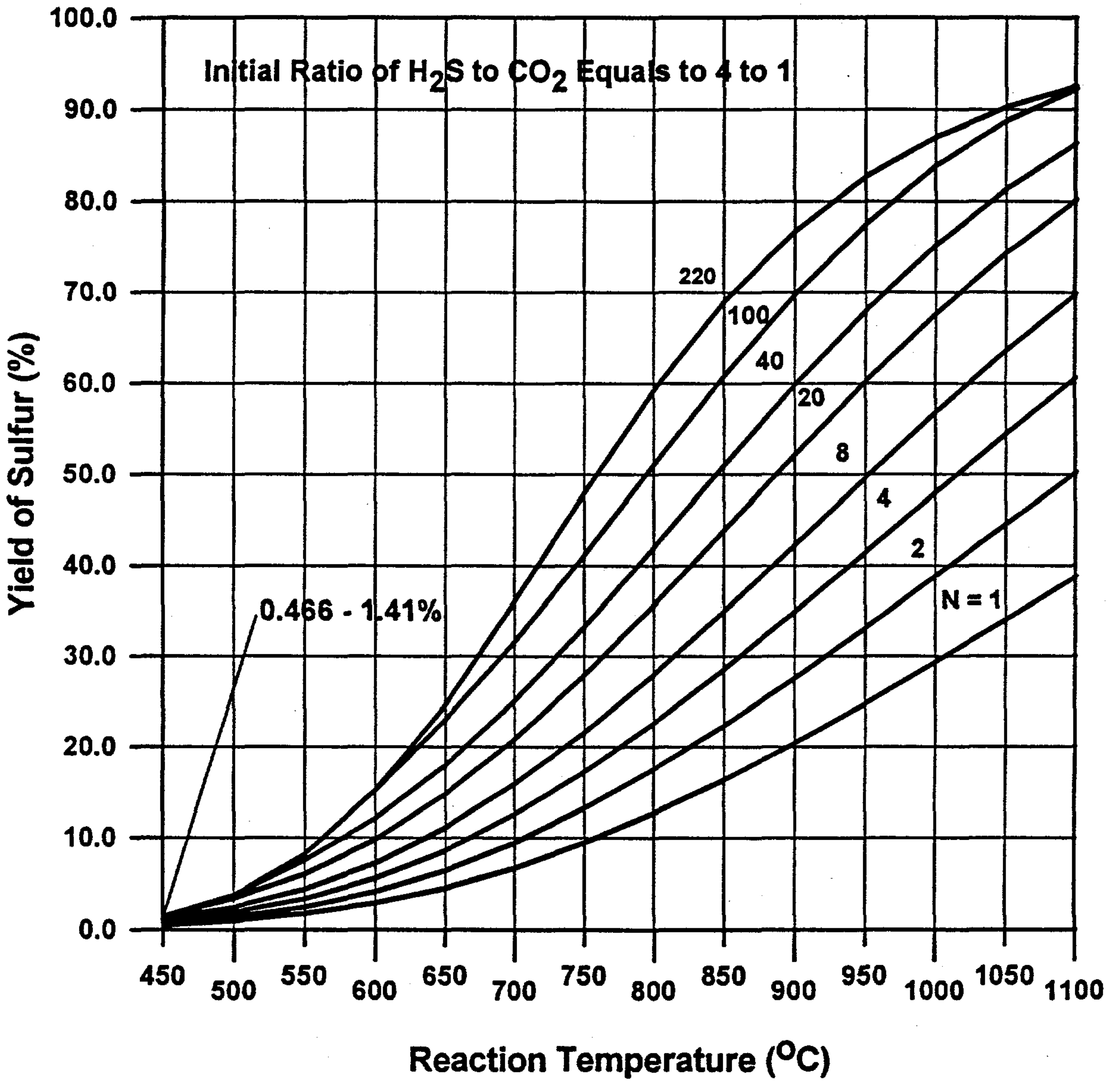


Figure 75. Effects of Reaction Temperature and Number of Simulated Stages on the Yield of Sulfur with Sulfur Sink Temperature at 150^{O}C

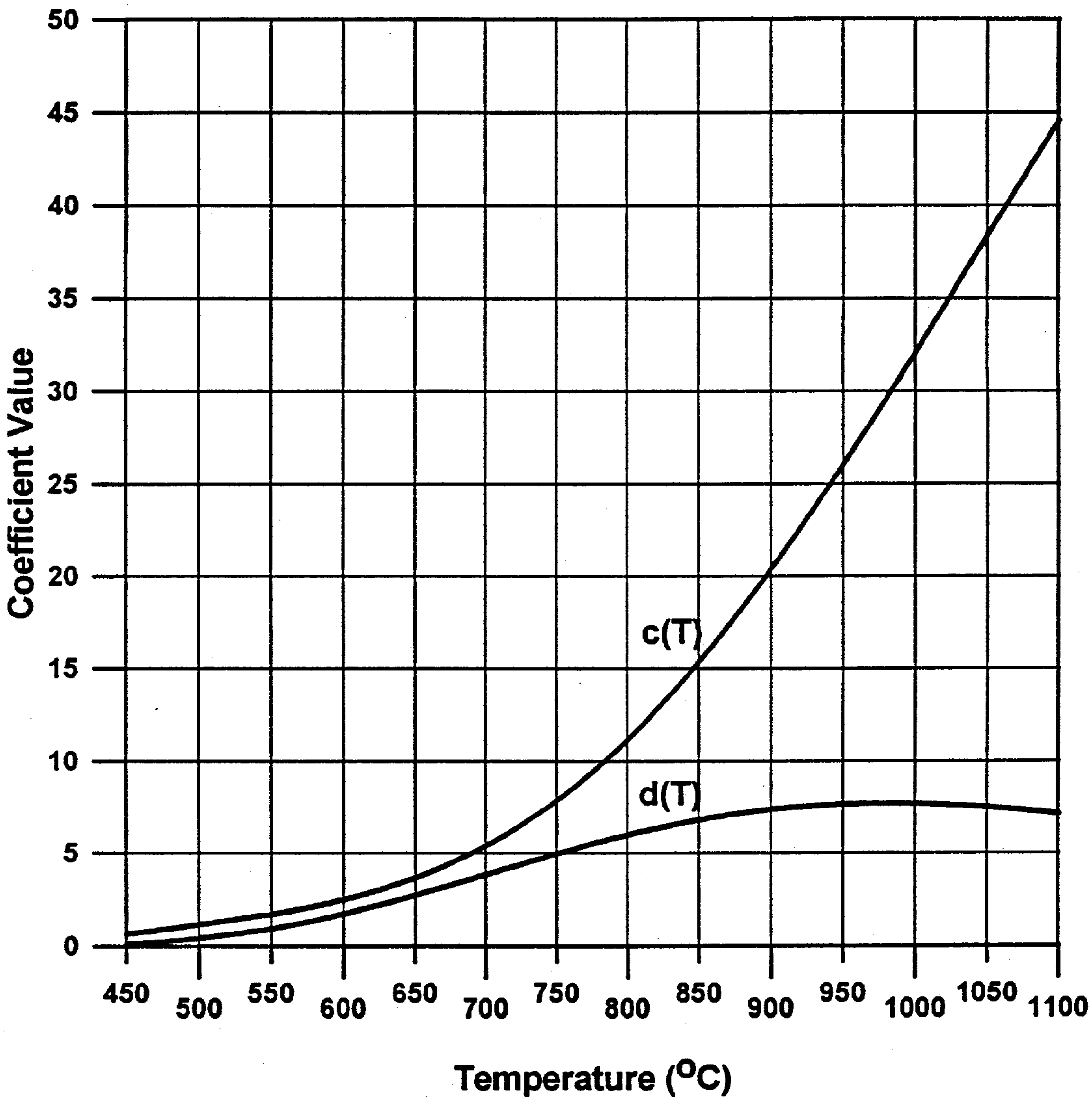


Figure 76. Coefficient Value of c(T) & d(T) v.s. Temperature

Table 1. Experimental Conditions and Results for the H_2S and CO_2 System

Run Number	T (°C)	Reactant	Flow Rate (cc/min)	Bed Packed with	Conversion (%)
F1	500	Pure H_2S	40.0	Empty Bed	(No Sulfur Observed)
F2	600	Pure H_2S	42.0	Empty Bed	(Trace Amount of Sulfur Observed)
S16	500	Pure H_2S	50.0	Quartz Wool	0.071
S14	600	Pure H_2S	50.0	Quartz Wool	0.140
S18	500	Pure H_2S	50.0	Alumina catalyst	0.151
S15	500	Pure H_2S	50.0	CoO-MoO_3-Alumina catalyst	0.337
S22	500	Pure H_2S	50.0	CoO-MoO_3-Alumina catalyst	0.359
F6	505	Pure H_2S	47.2	CoO-MoO_3-Alumina catalyst	0.346
S13	550	Pure H_2S	50.0	CoO-MoO_3-Alumina catalyst	0.657
S23	550	Pure H_2S	50.0	CoO-MoO_3-Alumina catalyst	0.862
S32	600	Pure H_2S	50.0	CoO-MoO_3-Alumina catalyst	1.062

F9	600	$H_2S:CO_2$=4:1	50.0 (40:10)	Empty Bed	(Little Sulfur, Difficult to Collect)
F10	500	$H_2S:CO_2$=4:1	50.0 (40:10)	Quartz Wool	(Trace Amount of Sulfur Observed)
F11	600	$H_2S:CO_2$=4:1	50.0 (40:10)	Quartz Wool	(Little Sulfur, Difficult to Collect)
S17	500	$H_2S:CO_2$=4:1	50.0 (40:10)	CoO-MoO_3-Alumina catalyst	0.825
S21	500	$H_2S:CO_2$=4:1	50.0 (40:10)	CoO-MoO_3-Alumina catalyst	0.868
S19	550	$H_2S:CO_2$=4:1	50.0 (40:10)	CoO-MoO_3-Alumina catalyst	1.412
S20	550	$H_2S:CO_2$=4:1	50.0 (40:10)	CoO-MoO_3-Alumina catalyst	1.392
S27	600	$H_2S:CO_2$=4:1	50.0 (40:10)	CoO-MoO_3-Alumina catalyst	2.046
S24	500	$H_2S:CO_2$=1:1	50.0 (25:25)	CoO-MoO_3-Alumina catalyst	1.227
S25	550	$H_2S:CO_2$=1:1	50.0 (25:25)	CoO-MoO_3-Alumina catalyst	2.283
S26	600	$H_2S:CO_2$=1:1	50.0 (25:25)	CoO-MoO_3-Alumina catalyst	4.336
S28	600	$H_2S:CO_2$=1:1	50.0 (25:25)	CoO-MoO_3-Alumina catalyst	4.515
S29	600	$H_2S:CO_2$=1:1	50.0 (25:25)	CoO-MoO_3-Alumina catalyst	4.022

S8	500	$H_2S:CO_2$=4:1	100.0 (80:20)	CoO-MoO_3-Alumina catalyst	0.713
S9	500	$H_2S:CO_2$=4:1	100.0 (80:20)	CoO-MoO_3-Alumina catalyst	0.987
S10	550	$H_2S:CO_2$=4:1	100.0 (80:20)	CoO-MoO_3-Alumina catalyst	1.149
S11	550	$H_2S:CO_2$=4:1	100.0 (80:20)	CoO-MoO_3-Alumina catalyst	1.156
S12	550	$H_2S:CO_2$=4:1	100.0 (80:20)	CoO-MoO_3-Alumina catalyst	1.131
S31	600	$H_2S:CO_2$=4:1	100.0 (80:20)	CoO-MoO_3-Alumina catalyst	2.269
S6	500	$H_2S:CO_2$=1:1	100.0 (50:50)	CoO-MoO_3-Alumina catalyst	0.842
S7	500	$H_2S:CO_2$=1:1	100.0 (50:50)	CoO-MoO_3-Alumina catalyst	0.784
S2	550	$H_2S:CO_2$=1:1	100.0 (50:50)	CoO-MoO_3-Alumina catalyst	1.273
S3	550	$H_2S:CO_2$=1:1	100.0 (50:50)	CoO-MoO_3-Alumina catalyst	1.346
S4	550	$H_2S:CO_2$=1:1	100.0 (50:50)	CoO-MoO_3-Alumina catalyst	1.518
F17	575	$H_2S:CO_2$=1:1	94.0 (47:47)	CoO-MoO_3-Alumina catalyst	1.697
S30	600	$H_2S:CO_2$=1:1	100.0 (50:50)	CoO-MoO_3-Alumina catalyst	3.776

Table 2. Amount of Sulfur Adsorbed (wt % of adsorbent) at 290 ± 5°C

Time (hours)	Activated Carbon	Co-Mo-alumina (extruded)	Alumina (sphere type)	Alumina (cylinder type)
0.17	4.3	-	-	-
0.5	20.1	0.0	0.0	2.6
1.0	43.9	0.0	0.0	2.8
2.0	47.2	3.3	0.0	6.3
3.0	52.9	5.4	12.3	5.0
5.0	70.8	2.6	11.7	6.1
5.0	-	3.2	-	-
8.0	74.2	28.9	12.5	8.7

Table 3. Amount of Sulfur Adsorbed (wt % of adsorbents) at 220 ± 5°C

Time (hours)	Activated Carbon
5.0	8.9
8.0	23.6

Table 4. Test Results from Thermogravimetric Analysis (TGA)

Sample No. (Catalytic Reaction)	Test No. (TGA)	Sample Name	Weight Lost in Helium 112-500°C (%)	Sample Information (T is the decomposition temperature.) (Final TGA temperature is 700°C)				
				T (°C)	H_2S (cc/min)	CO_2 (cc/min)	Other	TGA File Name
C18	1	Carbon	5.0	460	25	25		J001.38
C19	1	Carbon	4.2	461	25	25		J001.39
C20	1	Carbon	4.1	461	25	25		J001.40
C21	1	Carbon	4.6	464	25	25		J001.41
C24	1	Carbon	3.8	460	25	25		J001.44
C7	1	Carbon	4.2	500	25	25		J001.24
C8	1	Carbon	3.6	500	25	25		J001.25
C10	1	Carbon	5.9	503	25	25	Final TGA temperature is 500°C	J001.29
C10	2	Carbon	6.8	503	25	25	Final TGA temperature is 550°C	J001.30

C10	3	Carbon	7.1	503	25	25		J001.31
C25	1	Carbon	3.4	501	25	25		J001.45
C26	1	Carbon	5.1	551	25	25		J001.46
C16	1	Carbon	3.9	555	25	25		J001.35
C14	1	Carbon	4.9	556	25	25		J001.33
C15	1	Carbon	3.7	556	25	25		J001.34
C27	1	Carbon	4.2	601	25	25		J001.47
C6	1	Carbon	5.1	499	25	0		J001.22
C6	2	Carbon	4.6	499	25	0	Final TGA temperature is 800°C	J001.20
F33	1	FeS	-0.5	550	25	25	0.5% weight increase at 500°C	J002.33
F34	1	FeS	-1.2	550	25	25	1.2% weight increase at 500°C	J002.34
F35	1	FeS	-0.1	600	25	25	0.1% weight increase at 500°C	J002.35
F36	1	FeS	-0.4	500	25	25	Keeping FeS in the bed for 5 min	J002.36

F37	1	FeS	-0.1	500	25	25	Keeping FeS in the bed for 10 min	J002.37
F38	1	FeS	-0.2	500	25	25	Keeping FeS in the bed for 20 min	J002.38
F39	1	FeS	0.4	500	25	25	Keeping FeS in the bed for 40 min	J002.39
F40	1	FeS	-0.9	500	25	0	Keeping FeS in the bed for 5 min	J002.40
F41	1	FeS	-0.3	500	25	0	Keeping FeS in the bed for 10 min	J002.41
CoMo51	1	Co-Mo	6	502	25	25		J003.51
CoMo52	1	Co-Mo	2.4	502	25	25	After 700 desorption°C	J003.52

Table 5. Test Results from Total Sulfur Analyzer (TSA)

Sample No. (Process)	Test No. (TSA)	Sample Name	Sulfur Adsorbed in Weight (%)	Sample Information (T is the decomposition temperature.)			
				T (°C)	H_2S (cc/min)	CO_2 (cc/min)	Other
C24	1	Carbon	4.04	459	25	25	
C24	2	Carbon	4.92	459	25	25	
C24	3	Carbon	4.95	459	25	25	
C24	4	Carbon	4.39	459	25	25	
C20	1	Carbon	6.38	461	25	25	
C25	1	Carbon	6.47	501	25	25	
C25	2	Carbon	6.51	501	25	25	
C25	3	Carbon	6.96	501	25	25	
C25	4	Carbon	6.55	501	25	25	
C25	5	Carbon	5.85	501	25	25	

C10	1	Carbon	5.56	503	25	25	
C26	1	Carbon	8.95	551	25	25	
C26	2	Carbon	9.70	551	25	25	
C26	3	Carbon	9.30	551	25	25	
C26	4	Carbon	9.00	551	25	25	
C26	5	Carbon	8.82	551	25	25	In vacuum oven at 125°C for 12 hours
C26	6	Carbon	8.88	551	25	25	In vacuum oven at 125°C for 12 hours
C30	1	Carbon	8.03	551	25	25	
C30	2	Carbon	8.33	551	25	25	
C30	1	Carbon	4.29	551	25	25	After 12 hrs of 20 cc/min N_2 purging at 700°C
C30	2	Carbon	4.23	551	25	25	After 12 hrs of 20 cc/min N_2 purging at 700°C
C30	3	Carbon	4.53	551	25	25	After 12 hrs of 20 cc/min N_2 purging at 700°C
C29	1	Carbon	7.50	555	25	25	

C29	2	Carbon	7.80	555	25	25	
C29	3	Carbon	7.15	555	25	25	
C29	4	Carbon	6.11	555	25	25	After 9.5 hrs of 20 cc/min N_2 purging at 550°C
C29	5	Carbon	5.88	555	25	25	After 9.5 hrs of 20 cc/min N_2 purging at 550°C
C14	1	Carbon	5.85	556	25	25	
C27	1	Carbon	8.09	601	25	25	
C27	2	Carbon	6.81	601	25	25	
C27	3	Carbon	6.65	601	25	25	
C31	1	Carbon	4.13	21	25	25	
C31	2	Carbon	4.32	21	25	25	
C32	1	Carbon	4.31	21	25	25	
C32	2	Carbon	4.59	21	25	25	

Table 6. When the reaction temperature is 900°C (in zone one) the equilibrium component distribution is changed as following after gradually cooling down to 25°C (in zone two)

Species	H_2S	CO_2	CH_4	H_2	CO	H_2O	COS	S_2	SO_2	CS_2
Initial Mole Fraction (900°C)	80.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Final Mole Fraction (900°C)	3.34	3.18	0.02	61.88	15.76	15.97	0.03	0.00*	0.00	0.00
Final Mole Fraction (25°C)	5.43	0.00	30.58	2.87	0.00	61.12	0.00	0.00*	0.00	0.00

*S_2 has already been extracted from the system during the each equilibrium stage and recovered. (mole fraction in percentage)

Table 7. Equilibrium Mole Fractions of the Related Species at the First Stage before Sulfur Extraction (the Same Situation as no Recycle)

T (°C)	CH_4	CO	COS	CO_2	CS_2	H_2	H_2O	H_2S	SO_2	S_2
450	5.998E-07	0.00168	0.02436	0.17290	0.00067	0.00204	0.02738	0.76910	0.00000	0.00186
500	6.289E-07	0.00374	0.02674	0.16780	0.00095	0.00371	0.03239	0.76090	0.00000	0.00373
550	6.183E-07	0.00732	0.02856	0.16150	0.00123	0.00630	0.03833	0.74990	0.00000	0.00681
600	5.731E-07	0.01272	0.02998	0.15360	0.00141	0.01010	0.04552	0.73530	0.00000	0.01141
650	5.141E-07	0.02023	0.03031	0.14440	0.00152	0.01539	0.05358	0.71680	0.00000	0.01781
700	4.490E-07	0.02982	0.02946	0.13390	0.00155	0.02247	0.06236	0.69430	0.00001	0.02613
750	3.823E-07	0.04109	0.02769	0.12250	0.00150	0.03159	0.07175	0.66760	0.00001	0.03632
800	3.184E-07	0.05343	0.02529	0.11030	0.00139	0.04295	0.08145	0.63710	0.00002	0.04816
850	2.602E-07	0.06612	0.02253	0.09784	0.00124	0.05660	0.09106	0.60330	0.00004	0.06131
900	2.091E-07	0.07847	0.01968	0.08568	0.00108	0.07249	0.10020	0.56690	0.00005	0.07540
950	1.658E-07	0.08989	0.01694	0.07423	0.00092	0.09044	0.10850	0.52890	0.00008	0.09005
1000	1.298E-07	0.10000	0.01441	0.06381	0.00077	0.11010	0.11570	0.49010	0.00011	0.10490
1050	1.005E-07	0.10860	1.217E-02	0.05462	0.00065	0.13120	0.12180	0.45120	0.00015	0.11970
1100	7.699E-08	0.11570	1.023E-02	0.04671	0.00053	0.15310	0.12660	0.41290	0.00020	0.13410

Table 8. Equilibrium Mole Fractions of the Related Species at the Final Stage of Sulfur Extraction before Cooling down the Reaction System to 25°C

T (°C)	CH_4	CO	COS	CO_2	CS_2	H_2	H_2O	H_2S	SO_2	S_2
450	0.0094	0.0142	0.0130	0.1710	0.0002	0.0301	0.0473	0.7149	0.0000	0.0000
500	0.0101	0.0294	0.0117	0.1614	0.0002	0.0586	0.0626	0.6661	0.0000	0.0000
550	0.0084	0.0513	0.0102	0.1468	0.0002	0.1000	0.0789	0.6042	0.0000	0.0000
600	0.0057	0.0760	0.0086	0.1269	0.0001	0.1532	0.0956	0.5339	0.0000	0.0000
650	0.0035	0.1024	0.0071	0.1038	0.0001	0.2138	0.1056	0.4635	0.0000	0.0000
700	0.0035	0.1137	0.0034	0.0633	0.0000	0.3574	0.1229	0.3357	0.0000	0.0000
750	0.0017	0.1294	0.0023	0.0515	0.0000	0.4382	0.1329	0.2439	0.0000	0.0000
800	0.0008	0.1415	0.0015	0.0436	0.0000	0.5028	0.1423	0.1675	0.0000	0.0000
850	0.0003	0.1506	0.0010	0.0386	0.0000	0.5419	0.1511	0.1164	0.0000	0.0000
900	0.0002	0.1576	0.0003	0.0318	0.0000	0.6188	0.1579	0.0334	0.0000	0.0000
950	0.0001	0.1632	0.0002	0.0294	0.0000	0.6224	0.1629	0.0218	0.0000	0.0000
1000	0.0000	0.1674	0.0001	0.0271	0.0000	0.6239	0.1665	0.0148	0.0000	0.0000
1050	0.0000	0.1707	0.0001	0.0253	0.0000	0.6233	0.1701	0.0105	0.0000	0.0000
1100	0.0000	0.1732	0.0000	0.0234	0.0000	0.6262	0.1734	0.0037	0.0000	0.0000

Table 9. Equilibrium Mole Fractions of the Related Species at the Final Stage of Sulfur Extraction after Cooling down the Reaction System to 25°C

T (°C)	CH_4	CO	COS	CO_2	CS_2	H_2	H_2O	H_2S	SO_2	S_2
450	0.0210	0.0000	0.0000	0.1915	0.0000	0.0000	0.0429	0.7447	0.0000	0.0000
500	0.0336	0.0000	0.0000	0.1890	0.0000	0.0000	0.0681	0.7093	0.0000	0.0000
550	0.0500	0.0000	0.0000	0.1845	0.0000	0.0000	0.1004	0.6650	0.0000	0.0000
600	0.0712	0.0000	0.0000	0.1743	0.0000	0.0000	0.1416	0.6130	0.0000	0.0000
650	0.0981	0.0000	0.0000	0.1597	0.0000	0.0000	0.1828	0.5594	0.0000	0.0000
700	0.1586	0.0000	0.0000	0.0820	0.0000	0.0000	0.3156	0.4437	0.0000	0.0000
750	0.2006	0.0000	0.0000	0.0577	0.0000	0.0000	0.3979	0.3438	0.0000	0.0000
800	0.2388	0.0000	0.0000	0.0377	0.0000	0.0000	0.4742	0.2494	0.0000	0.0000
850	0.2653	0.0000	0.0000	0.0262	0.0000	0.0000	0.5288	0.1797	0.0000	0.0000
900	0.3058	0.0000	0.0000	0.0000	0.0000	0.0287	0.6112	0.0543	0.0000	0.0000
950	0.3139	0.0000	0.0000	0.0000	0.0000	0.0235	0.6268	0.0358	0.0000	0.0000
1000	0.3188	0.0000	0.0000	0.0000	0.0000	0.0207	0.6359	0.0245	0.0000	0.0000
1050	0.3225	0.0000	0.0000	0.0000	0.0000	0.0162	0.6439	0.0174	0.0000	0.0000
1100	0.3242	0.0000	0.0000	0.0000	0.0000	0.0210	0.6486	0.0062	0.0000	0.0000

Table 10. The Possible Side Reactions Expected to Occur at 550°C and 1 atm

$H_2S \rightleftharpoons H_2 + 0.5\ S_2$	$\Delta G = 87.468$	kJ/mol	$K=2.808\times10^{-6}$
	$\Delta H = 94.794$	kJ/mol	Endothermic
$CO_2 + H_2 \rightleftharpoons CO + H_2O$	$\Delta G = 8.824$	kJ/mol	$K=2.754\times10^{-1}$
	$\Delta H = 36.601$	kJ/mol	Endothermic
$2\ CO + S_2 \rightleftharpoons 2\ COS$	$\Delta G = -44.644$	kJ/mol	$K=6.817\times10^{2}$
	$\Delta H = -98.69$	kJ/mol	Exothermic
$H_2S + CO_2 \rightleftharpoons CO + 0.5\ S_2 + H_2O$	$\Delta G = 52.558$	kJ/mol	$K=4.614\times10^{-4}$
	$\Delta H = 83.998$	kJ/mol	Endothermic
$H_2S + CO \rightleftharpoons COS + H_2$	$\Delta G = 21.412$	kJ/mol	$K=4.375\times10^{-2}$
	$\Delta H = -1.948$	kJ/mol	Exothermic
$H_2S + CO_2 \rightleftharpoons COS + H_2O$	$\Delta G = 30.236$	kJ/mol	$K=1.205\times10^{-2}$
	$\Delta H = 34.653$	kJ/mol	Endothermic
$2\ H_2S + SO_2 \rightleftharpoons 1.5\ S_2 + 2\ H_2O$	$\Delta G = -19.197$	kJ/mol	$K=16.538$
	$\Delta H = -78.264$	kJ/mol	Exothermic
$H_2S + COS \rightleftharpoons CS_2 + H_2O$	$\Delta G = 40.014$	kJ/mol	$K=2.886\times10^{-3}$
	$\Delta H = 34.605$	kJ/mol	Endothermic
$H_2S + CO \rightleftharpoons COS + H_2$	$\Delta G = 21.412$	kJ/mol	$K=4.375\times10^{-2}$
	$\Delta H = -1.948$	kJ/mol	Exothermic
$CO_2 + 0.75\ S_2 \rightleftharpoons COS + 0.5\ SO_2$	$\Delta G = 38.835$	kJ/mol	$K=2.962\times10^{-3}$
	$\Delta H = 73.785$	kJ/mol	Endothermic
$2\ COS \rightleftharpoons CO_2 + CS_2$	$\Delta G = 9.778$	kJ/mol	$K=2.395\times10^{-1}$
	$\Delta H = -0.0478$	kJ/mol	Exothermic

Table 10. cont.

$2\ H_2 + SO_2 \rightleftharpoons 2\ H_2O + 0.5\ S_2$	$\Delta G = -106.665$	kJ/mol	$K=5.890x10^{6}$
	$\Delta H = -173.058$	kJ/mol	Exothermic
$2\ CO + SO_2 \rightleftharpoons 2\ CO_2 + 0.5\ S_2$	$\Delta G = -124.313$	kJ/mol	$K=7.767x10^{7}$
	$\Delta H = -246.26$	kJ/mol	Exothermic
$SO_2 + 3\ H_2 \rightleftharpoons H_2S + 2\ H_2O$	$\Delta G = -150.399$	kJ/mol	$K=3.515x10^{9}$
	$\Delta H = -220.455$	kJ/mol	Exothermic
$COS + H_2O + H_2 \rightleftharpoons CH_4 + SO_2$	$\Delta G = 111.638$	kJ/mol	$K=8.207^{-8}$
	$\Delta H = -0.7600$	kJ/mol	Exothermic
$CS_2 + 2\ H_2S \rightleftharpoons CH_4 + 2\ S_2$	$\Delta G = 96.160$	kJ/mol	$K=7.882x10^{-7}$
	$\Delta H = -66.233$	kJ/mol	Exothermic
$4\ H_2 + CS_2 \rightleftharpoons 2\ H_2S + CH_4$	$\Delta G = -78.776$	kJ/mol	$K=1.000x10^{5}$
	$\Delta H = -255.821$	kJ/mol	Exothermic
$3H_2 + CO \rightleftharpoons CH_4 + H_2O$	$\Delta G = -17.350$	kJ/mol	K=12.624
	$\Delta H = -223.163$	kJ/mol	Exothermic
$CO_2 + 4\ H_2 \rightleftharpoons CH_4 + 2\ H_2O$	$\Delta G = -8.526$	kJ/mol	K=3.477
	$\Delta H = -186.562$	kJ/mol	Exothermic

Table 11. Relative Concentration of Possible Products at 550°C and 1 atm (Initial Percentage of H_2S in H_2S and CO_2 is 80%)

Component	Mole Fraction
CH_4	7.21×10^{-7}
CO	7.59×10^{-3}
COS	2.84×10^{-2}
CO_2	1.61×10^{-1}
CS	2.48×10^{-9}
CS_2	1.21×10^{-3}
H_2	6.56×10^{-3}
H_2O	3.84×10^{-2}
H_2S	7.49×10^{-1}
SO_2	8.33×10^{-7}
SO_3	1.62×10^{-17}
S_2	6.77×10^{-3}
S_3	1.65×10^{-4}
S_4	1.71×10^{-5}
S_5	4.01×10^{-6}
S_6	4.06×10^{-6}
S_7	6.51×10^{-7}
S_8	9.90×10^{-8}