APPENDIX J

Enthalpy-Concentration Data

Table J.1 Enthalpy-Concentration Data for the Single-Phase Liquid Region and Also the Saturated Vapor of the Acetic Acid–Water System at 1 Atmosphere
Reference state: Liquid water at 32°F and 1 atm; solid acid at 32°F and 1 atm

Liquid or Vapor		Enthalpy—Btu/lb Liquid Solution						
Mole Fraction Water	Weight Fraction Water	20°C 68°F	40°C 104°F	60°C 140°F	80°C 176°F	100°C 212°F	Saturated Liquid	Enthalpy Saturated Vapor Btu/lb
0.00	0.0	93.54	111.4	129.9	149.1	169.0	187.5	361.8
0.05	0.01555	93.96	112.2	130.9	150.4	170.6	186.9	
0.10	0.03225	93.82	112.3	131.5	151.3	172.0	186.5	374.6
0.20	0.0698	92.61	111.9	131.7	152.2	173.8	185.2	395.3
0.30	0.1140	90.60	110.7	131.3	152.6	175.0	183.8	423.7
0.40	0.1667	87.84	108.9	130.6	152.6	176.1	182.9	461.4
0.50	0.231	83.96	106.3	129.1	152.7	177.1	182.4	510.5
0.55	0.268	81.48	104.5	128.1	152.5	177.5	182.3	
0.60	0.3105	78.53	102.5	126.9	152.1	178.0	182.0	573.4
0.65	0.358	75.36	100.2	125.5	151.6	178.3	181.9	
0.70	0.412	71.72	97.71	123.9	151.1	178.8	181.7	656.0
0.75	0.474	67.59	94.73	122.2	149.9	179.3	182.1	
0.80	0.545	62.88	91.43	120.2	149.7	179.9	181.6	767.3
0.85	0.630	57.44	87.56	117.8	148.9	180.5	181.6	
0.90	0.730	51.03	83.02	115.1	147.8	180.8	181.7	921.6
0.95	0.851	43.74	77.65	111.7	146.4	181.2	181.5	
1.00	1.00	36.06	71.91	107.7	143.9	180.1	180.1	1150.4

SOURCE: Data calculated from miscellaneous literature sources and smoothed.

Table J.2 Vapor-Liquid Equilibrium Data for the Acetic Acid–Water System; Pressure = 1 Atmosphere

x Mole Fraction Water in the Liquid	y Mole Fraction Water in the Vapor
0.020	0.035
0.040	0.069
0.060	0.103
0.080	0.135
0.100	0.165
0.200	0.303
0.300	0.425
0.400	0.531
0.500	0.627
0.600	0.715
0.700	0.796
0.800	0.865
0.900	0.929
0.940	0.957
0.980	0.985

SOURCE: Data from L. W. Cornell and R. E. Montonna, *Ind. Eng. Chem.,* **25,** 1331–35 (1933).

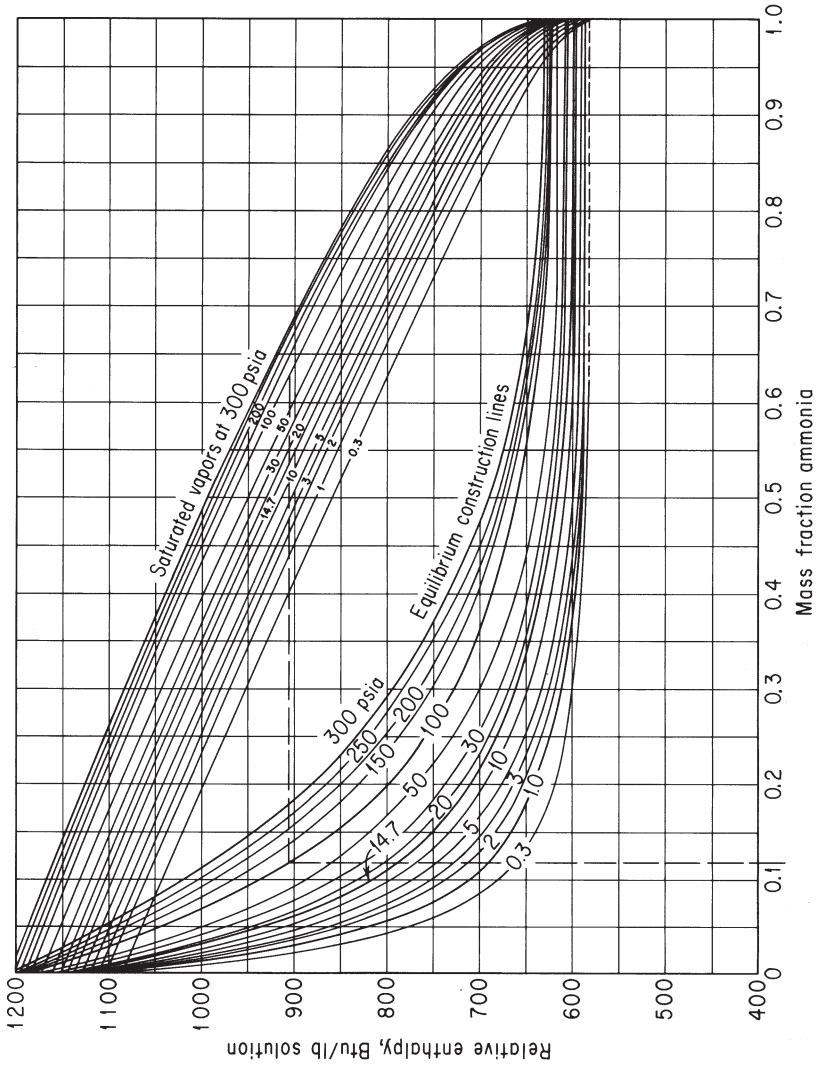


Figure J.1 Enthalpy-concentration chart for NH_3–H_2O

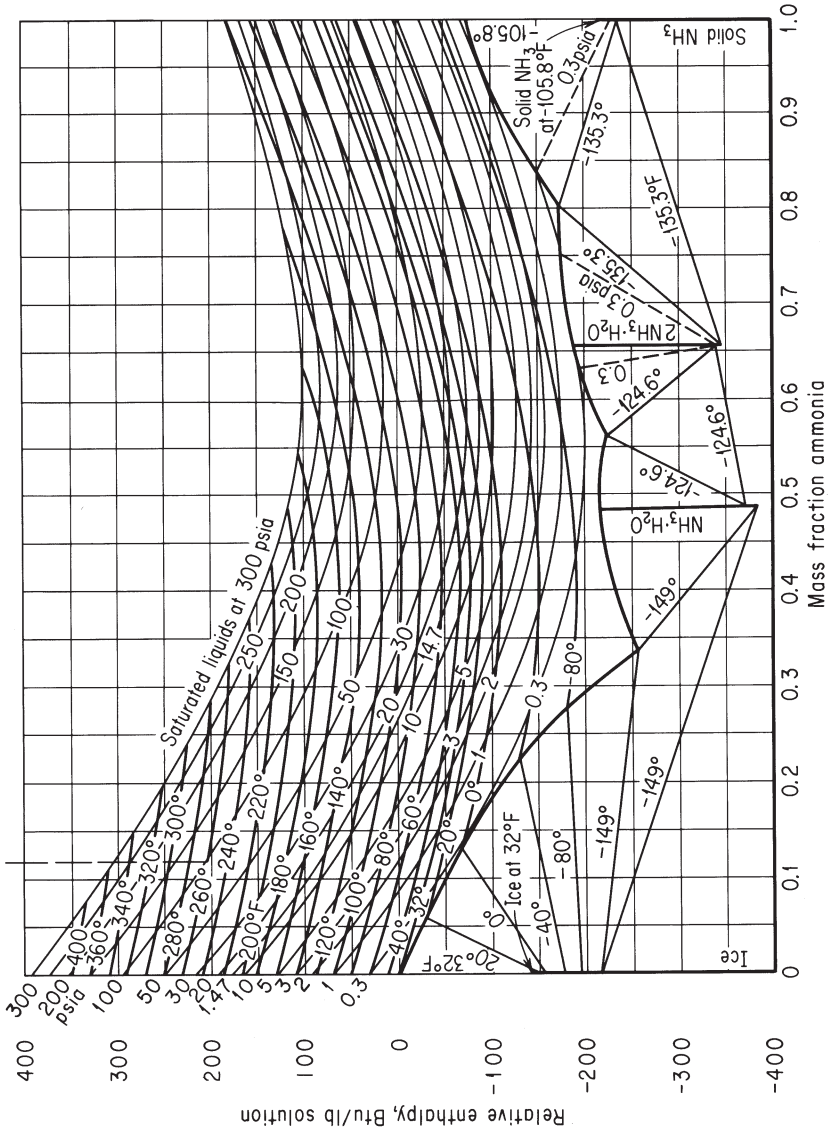


Figure J.1 Enthalpy-concentration chart for NH_3–H_2O

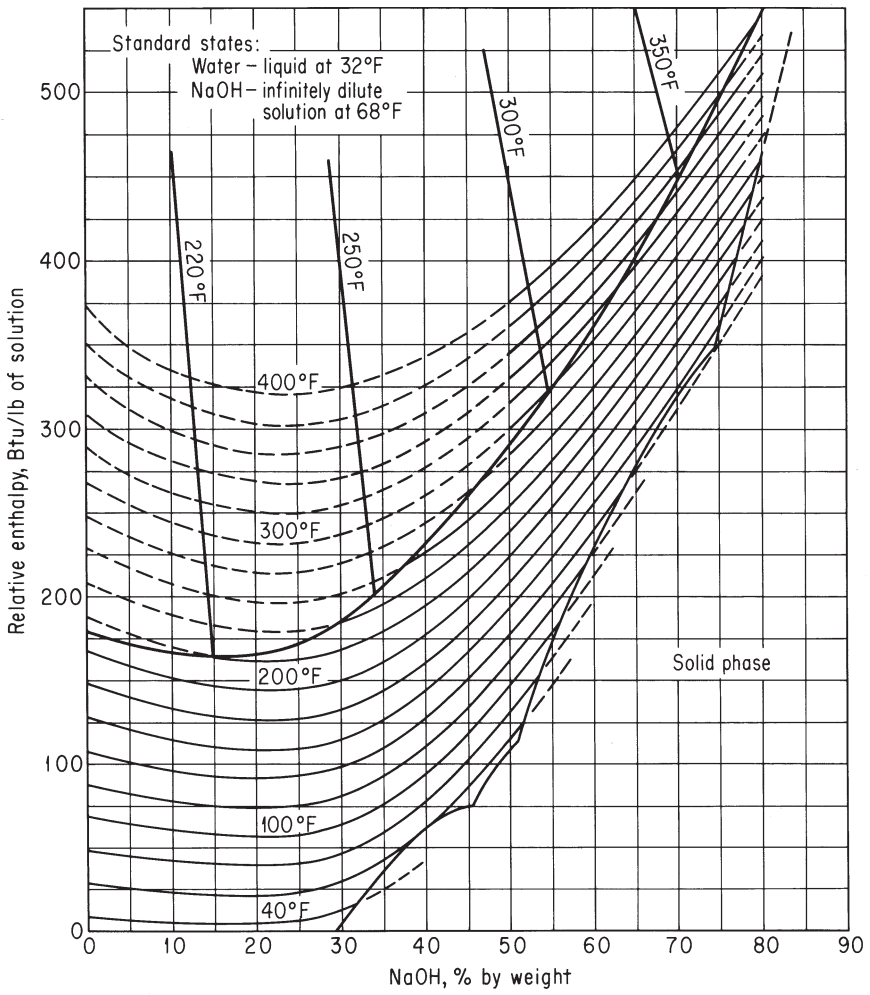


Figure J.2 Enthalpy-concentration chart for sodium hydroxide–water

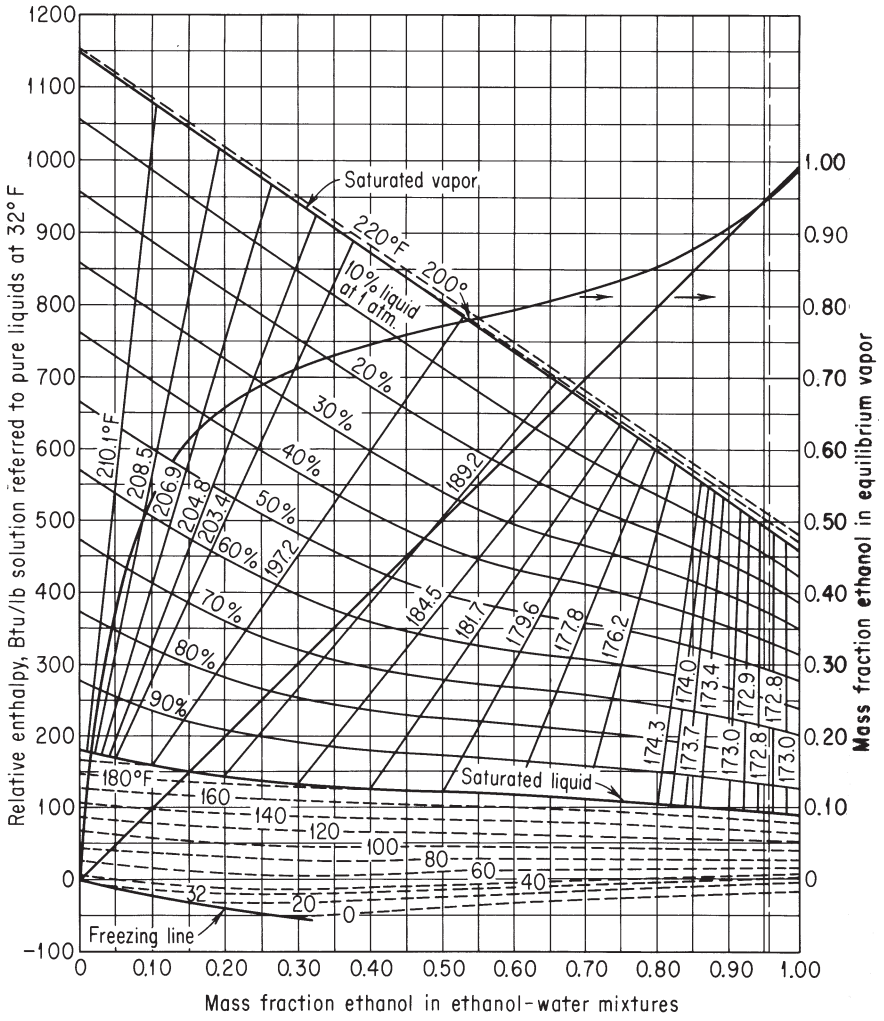


Figure J.3 Enthalpy-composition diagram for the ethanol-water system, showing liquid and vapor phases in equilibrium at 1 atm

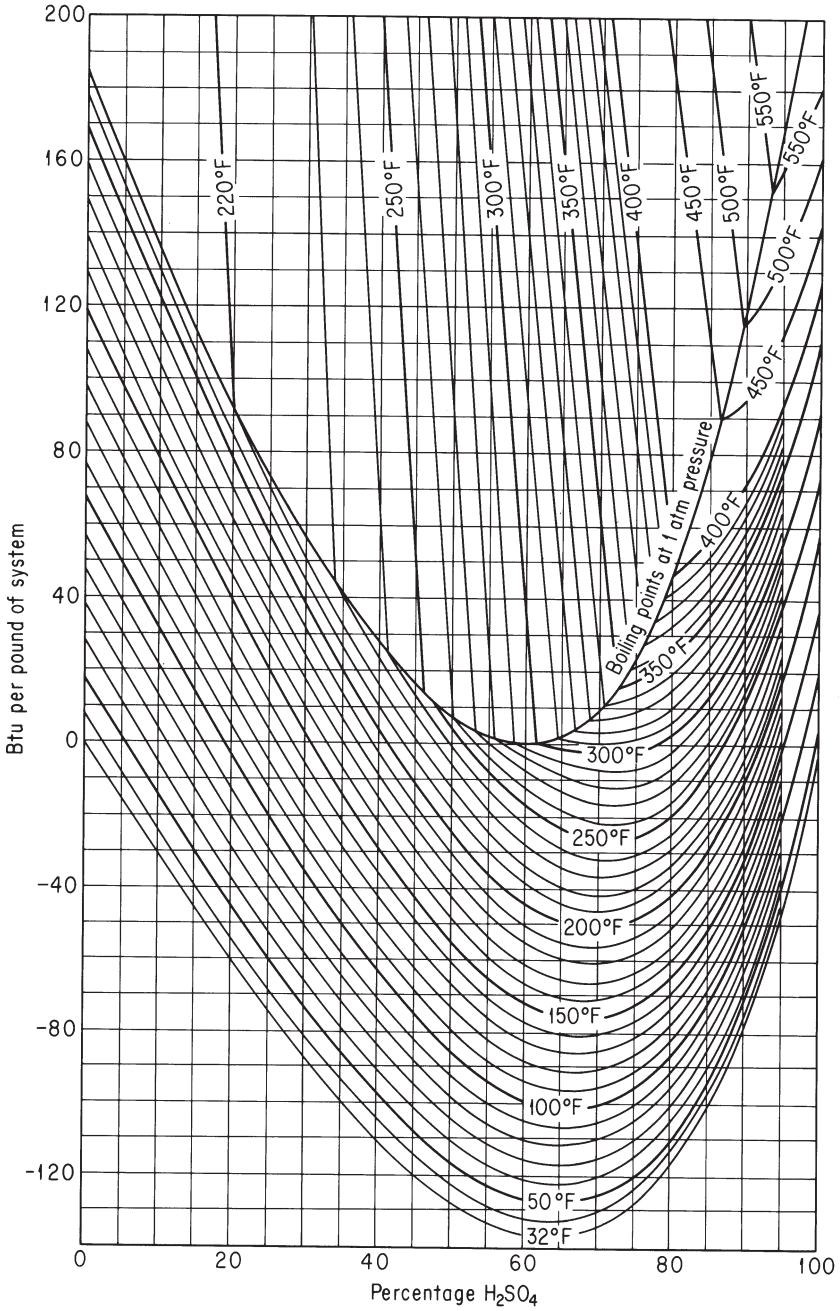


Figure J.4 Enthalpy-concentration of sulfuric acid–water system relative to pure components (water and H_2SO_4 at 32°F and own vapor pressure) (Data from International Critical Tables, © 1943 O. A. Hougen and K. M. Watson)

Table J.3 Thermodynamic Charts Showing Enthalpy Data for Pure Compounds*

Compound	Reference†
Acetone	2
Acetylene	1
Air	V.C. Williams, *AIChE Trans.*, v. 39, p. 93 (1943); *AIChE J.*, v. 1, p. 302 (1955).
Benzene	1
1,3-Butadiene	C.H. Meyers, *J. Res. Natl. Bur. Stand.*, v. A39, p. 507 (1947).
i-Butane	1, 3
n-Butane	1, 3, 4
n-Butanol	L.W. Shemilt, in *Proceedings of the Conference on Thermodynamic Transport Properties of Fluids*, London, 1957, Institute of Mechanical Engineers, London, 1958.
t-Butanol	F. Maslan, *AIChE J.*, v. 7, p. 172 (1961).
n-Butene	1
Chlorine	R.E. Hulme and A.B. Tilman, *Chem. Eng.* (January 1949).
Ethane	1, 3, 4
Ethanol	R.C. Reid and J.M. Smith, *Chem. Eng. Prog.*, v. 47, p. 415 (1951).
Ethyl ether	2
Ethylene	1, 3
Ethylene oxide	J.E. Mock and J.M. Smith, *Ind. Eng. Chem.*, v. 42, p. 2125 (1950).
Fatty acids	J.D. Chase, *Chem. Eng.*, p. 107 (March 24, 1980).
n-Heptane	E.B. Stuart et al., *Chem Eng. Prog.*, v. 46, p. 311 (1950).
n-Hexane	1
Hydrogen sulfide	J.R. West, *Chem. Eng. Prog.*, v. 44, p. 287 (1948).
Isopropyl ether	2
Mercury	General Electric Company Report GET-1879A, 1949.
Methane	1, 3, 4
Methanol	J.M. Smith, *Chem. Eng. Prog.*, v. 44, p. 52 (1948).
Methyl ethyl ketone	2
Monomethyl hydrazine	F. Bizjak and D.F. Stai, *AIAA J.*, v. 2, p. 954 (1964).
Neon	Cryogenic Data Center, National Bureau of Standards, Boulder, Colo.
Nitrogen	G.S. Lin, *Chem. Eng. Prog.*, v. 59, no. 11, p. 69 (1963).

*For mixtures, see V.F. Lesavage et al., *Ind. Eng. Chem.*, v. 59, no. 11, p. 35 (1967).

†1. L.N. Cajar et al., *Thermodynamic Properties and Reduced Correlations for Gases*, Gulf Publishing Company, Houston, 1967. (Series of articles which appeared in the magazine *Hydrocarbon Processing* from 1962 to 1965.)

2. P.T. Eubank and J.M. Smith, *J. Chem. Eng. Data*, v. 7, p. 75 (1962).

3. W.C. Edmister, *Applied Hydrocarbon Thermodynamics*, Gulf Publishing Company, Houston, 1987.

4. K.E. Starling et al., *Hydrocarbon Processing*, 1971 and following. *Note:* Charts available separately from Gulf Publishing Company, Houston.