A person from the air conditioning industry asked me why he couldn't get a result in my AHH software at an absolute air pressure of 0.5 bar, a temperature of 90°C and a relative humidity of 90%. According to the following explanations, the maximum relative humidity is 71.327%, which corresponds to an absolute humidity of ∞. It should be noted that the theory of Richard Mollier and W. H. Carrier assumed that the absolute humidity is much smaller than the amount of air. I therefore set the maximum humidity in the AHH software to 1 kg/kg, i.e. 1,000 g/kg, which is already far too much in my opinion. For such areas, it would be reasonable to use the theory of gas mixtures.

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Relative humidity of moist air			Unsinn	AHH max	Plausible
t	Temperature of moist air	°C	90.000	90.000	90.000
p_{lf}	Pressure of moist air	bar	0.500	0.500	0.500
p_d	Partial pressure of water vapor	Pa	70100.000	70100.000	70100.000
φ_{lf}	Relative humidity of moist air	%	71.327	44.114	17.408
x	Absolute humidity of moist air	g/kg	∞	1000.000	200.000

Richhard Mollier

W. H. Carrier

Background knowledge, page 7

$$x = \frac{M_w}{M_l}\frac{\varphi_{lf} p_d}{p_{lf} - \varphi_{lf} p_d} \quad \rightarrow \quad p_{lf} \geq \varphi_{lf} p_d \quad \rightarrow \quad \varphi_{lf} \leq p_{lf}/p_d$$

Background knowledge, page 5

t	cp_l	cp_d	p_d	h_w	h_d	r
-100	1007.20	1815.40	0.00160			
-90	1006.90	1817.50	0.00933			
-80	1006.63	1819.60	0.05333			
-70	1006.40	1821.70	0.258			
-60	1006.20	1823.80	1.076			
-50	1006.07	1826.00	3.939			
-40	1006.00	1828.10	12.870			
-30	1005.97	1830.30	38.101			
-20	1006.00	1832.50	103.450			
-10	1006.08	1834.70	259.980			
0	1006.18	1836.90	610.480	0	2500500	2500500
10	1006.31	1839.10	1230	42000	2518900	2476900
20	1006.45	1841.40	2340	83900	2537300	2453400
30	1006.60	1843.70	4240	125600	2555500	2429900
40	1006.81	1846.00	7370	167300	2573500	2406200
50	1007.03	1848.30	12300	209100	2591300	2382200
60	1007.30	1850.60	19900	250900	2608800	2357900
70	1007.60	1852.90	31100	292800	2625900	2333100
80	1007.90	1855.30	47300	334700	2642500	2307800
90	1008.30	1857.70	70100	376800	2658700	2281900
100	1008.70	1860.10	101300	418900	2674400	2255500
110	1009.00	1862.50	143300	461100	2689600	2228500
120	1009.50	1864.90	198500	503500	2704200	2200700
130	1009.90	1867.30	270100	546100	2718300	2172200
140	1010.30	1869.80	361400	588900	2731800	2142900
150	1010.80	1872.30	476000	631900	2744500	2112600
160	1011.30	1874.80	618000	675200	2756500	2081300
170	1011.80	1877.30	792000	718800	2767600	2048800
180	1012.40	1879.80	1002700	762700	2777600	2014900
190	1013.00	1882.40	1255200	807000	2786300	1979300
200	1013.60	1884.90	1555100	851800	2793700	1941900
210	1014.20	1887.50	1908000	897100	2799400	1902300
220	1014.80	1890.10	2320100	943000	2803400	1860400
230	1015.50	1892.70	2797900	989600	2805400	1815800
240	1016.20	1895.30	3348000	1036900	2805100	1768200
250	1016.90	1898.00	3978000	1085100	2802500	1717400
260	1017.60	1900.60	4694000	1134300	2797400	1663100
270	1018.40	1903.30	5505000	1184500	2789500	1605000
280	1019.20	1906.00	6419000	1236100	2778700	1542600
290	1020.10	1908.70	7445000	1289300	2764900	1475600
300	1021.00	1911.40	8592000	1344200	2748000	1403800

!!!

https://de.wikipedia.org/wiki/Gasgemisch

The properties of gas mixtures can be approximately calculated from the properties of the individual components by interpolation and mixing rules.

Mittlere molare Masse:

$$M = \sum_i x_i M_i = \left(\sum_i \frac{w_i}{M_i}\right)^{-1}$$

Massenanteil:

$$w_i = \frac{x_i M_i}{M}$$

Dichte:

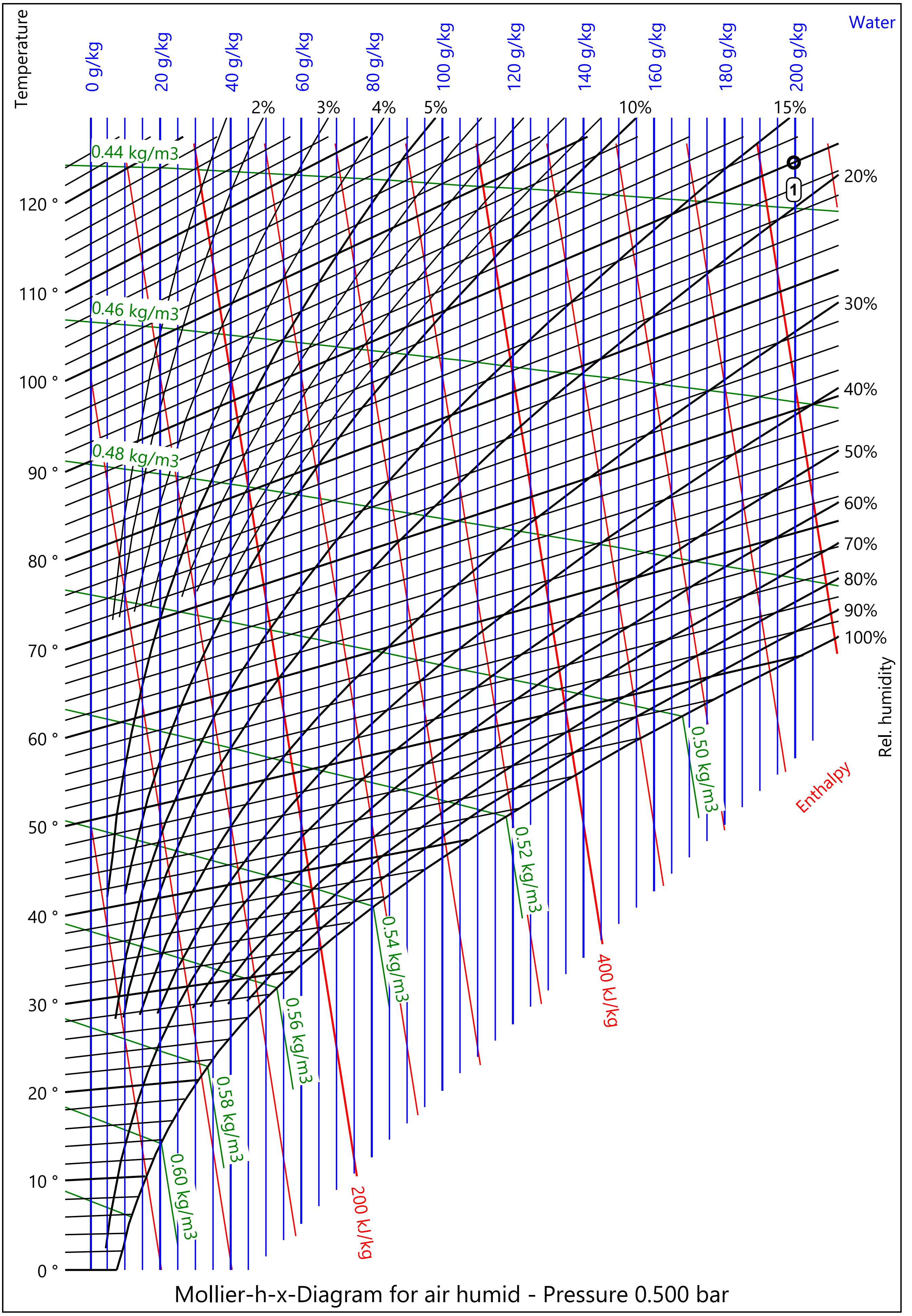
$$\rho(T) = \left(\sum_i \frac{w_i}{\rho_i(T)}\right)^{-1}$$

Spezifische Enthalpie:

$$h(T) = \sum_i w_i \cdot h_i(T)$$

Spezifische Wärmekapazität:

$$c(T) = \sum_i w_i \cdot c_i(T)$$



Mollier-h-x-Diagram for air humid - Pressure 0.500 bar