PROPIEDADES TERMOFÍSICAS DEL AGUA SATURADA

Adaptado principalmente de NIST Chemistry Webbook, SRD 69 (http://webbook.nist.gov/chemistry/fluid/). Algunos datos tomados de Poling (2000) y Çengel (2015).

Se indica en el encabezado si los valores han sido multiplicados por un factor constante. Por ejemplo: $\mu \times 10^3 = 1.7918$ significa $\mu = 1.7918 \times 10^{-3}$ Pa·s.

		LÍQUIDO SATURADO									VAPOR SATURADO					
T	P	ρ	c_p	h	$\mu \times 10^3$	k	Pr	$\sigma \times 10^3$	$\beta \times 10^4$	λ	ρ	c_p	h	$\mu \times 10^6$	k	Pr
°C	bar	kg/m³	kJ/kg·K	kJ/kg	Pa·s	W/m·K	—	N/m	K⁻¹	kJ/kg	kg/m³	kJ/kg·K	kJ/kg	Pa·s	W/m·K	—
0	0.0061121	999.792	4.2199	−0.04	1.7918	0.5610	13.478	75.648	−0.6760	2500.94	0.004851	1.8843	2500.90	9.2160	0.01707	1.0173
③ 0.01	0.0061165	999.793	4.2199	0.00	1.7912	0.5610	13.472	75.646	−0.6742	2500.91	0.004855	1.8844	2500.91	9.2163	0.01707	1.0173
2	0.007060	999.89	4.213	8.39	1.674	0.565	12.49	75.37	−0.3305	2496.17	0.005563	1.886	2504.56	9.26	0.0172	1.017
4	0.008135	999.93	4.208	16.8	1.567	0.569	11.60	75.08	−0.0005	2491.4	0.006365	1.888	2508.2	9.31	0.0173	1.017
6	0.009354	999.89	4.203	25.2	1.472	0.572	10.81	74.80	0.3085	2486.7	0.007266	1.890	2511.9	9.36	0.0174	1.017
10	0.01228	999.65	4.196	42.0	1.306	0.580	9.447	74.22	0.8757	2477.2	0.009407	1.895	2519.2	9.47	0.0176	1.017
15	0.01706	999.06	4.189	63.0	1.138	0.589	8.086	73.49	1.506	2465.4	0.01284	1.900	2528.3	9.59	0.0179	1.017
20	0.02339	998.16	4.184	83.9	1.002	0.598	7.004	72.74	2.066	2453.5	0.01731	1.906	2537.4	9.73	0.0182	1.017
25	0.03170	997.00	4.182	104.8	0.890	0.607	6.130	71.97	2.571	2441.7	0.02308	1.912	2546.5	9.87	0.0186	1.017
30	0.04247	995.61	4.180	125.7	0.797	0.615	5.415	71.19	3.032	2429.8	0.03042	1.918	2555.5	10.01	0.0189	1.017
35	0.05629	993.99	4.180	146.7	0.719	0.623	4.823	70.40	3.457	2417.9	0.03967	1.925	2564.5	10.16	0.0192	1.016
40	0.07385	992.18	4.180	167.5	0.653	0.631	4.328	69.60	3.853	2406.0	0.05124	1.931	2573.5	10.31	0.0196	1.016
45	0.09595	990.17	4.180	188.4	0.596	0.637	3.910	68.78	4.224	2394.0	0.06556	1.939	2582.4	10.47	0.0200	1.015
50	0.1235	988.00	4.182	209.3	0.547	0.644	3.553	67.94	4.575	2381.9	0.08315	1.947	2591.5	10.62	0.0204	1.015
55	0.1576	985.66	4.183	230.3	0.504	0.649	3.247	67.10	4.909	2369.8	0.1047	1.955	2600.1	10.77	0.0208	1.014
60	0.1995	983.16	4.185	251.2	0.466	0.654	2.983	66.24	5.229	2357.7	0.1304	1.965	2608.8	10.93	0.0212	1.014
65	0.2504	980.52	4.187	272.1	0.433	0.659	2.753	65.37	5.536	2345.4	0.1615	1.975	2617.5	11.10	0.0216	1.014
70	0.3120	977.73	4.190	293.1	0.404	0.663	2.552	64.47	5.834	2333.0	0.1984	1.986	2626.1	11.26	0.0221	1.013
75	0.3860	974.81	4.193	314.0	0.378	0.667	2.376	63.58	6.123	2320.6	0.2422	1.999	2634.6	11.43	0.0225	1.013
80	0.4741	971.77	4.197	335.0	0.354	0.670	2.220	62.67	6.405	2308.0	0.2937	2.012	2643.0	11.59	0.0230	1.014
85	0.5787	968.59	4.201	356.0	0.333	0.673	2.081	61.75	6.682	2295.3	0.3539	2.027	2651.3	11.76	0.0235	1.014
90	0.7018	965.30	4.205	377.0	0.314	0.675	1.958	60.82	6.954	2282.5	0.4239	2.043	2659.5	11.93	0.0240	1.015
95	0.8461	961.88	4.210	398.1	0.297	0.677	1.847	59.87	7.223	2269.5	0.5049	2.061	2667.6	12.10	0.0245	1.016
100	1.01325	958.35	4.216	419.2	0.282	0.679	1.749	58.91	7.489	2256.4	0.5982	2.080	2675.6	12.27	0.0251	1.017
110	1.434	950.9	4.228	461.4	0.255	0.682	1.580	56.96	8.016	2229.6	0.8269	2.124	2691.1	12.61	0.0262	1.021
120	1.989	943.1	4.244	503.8	0.232	0.683	1.441	54.97	8.545	2202.1	1.122	2.177	2705.9	12.96	0.0275	1.027
130	2.703	934.7	4.261	546.4	0.213	0.684	1.327	52.93	9.078	2173.7	1.497	2.239	2720.1	13.30	0.0288	1.035
140	3.615	926.1	4.283	589.2	0.197	0.683	1.232	50.86	9.624	2144.3	1.967	2.311	2733.4	13.65	0.0301	1.047
150	4.762	917.0	4.307	632.2	0.182	0.682	1.152	48.74	10.19	2113.7	2.547	2.394	2745.9	13.99	0.0316	1.060
160	6.182	907.4	4.335	675.5	0.170	0.680	1.085	46.59	10.77	2082.0	3.260	2.488	2757.4	14.34	0.0331	1.077
170	7.922	897.5	4.368	719.1	0.160	0.677	1.029	44.41	11.39	2048.8	4.122	2.594	2767.9	14.68	0.0347	1.096
180	10.03	887.0	4.405	763.1	0.150	0.673	0.982	42.19	12.05	2014.2	5.159	2.713	2777.2	15.03	0.0364	1.118
190	12.55	876.1	4.447	807.4	0.142	0.669	0.943	39.95	12.75	1977.9	6.395	2.844	2785.3	15.37	0.0382	1.143
200	15.55	864.7	4.496	852.3	0.134	0.663	0.910	37.67	13.50	1939.7	7.861	2.990	2792.0	15.71	0.0401	1.171
210	19.08	852.7	4.551	897.3	0.128	0.657	0.884	35.38	14.32	1899.6	9.588	3.150	2797.3	16.06	0.0421	1.202
220	23.20	840.2	4.615	943.6	0.122	0.650	0.863	33.07	15.22	1857.4	11.62	3.329	2800.9	16.41	0.0442	1.237
230	27.97	827.1	4.688	990.2	0.116	0.641	0.847	30.74	16.22	1812.7	13.99	3.528	2802.9	16.76	0.0464	1.276
240	33.47	813.4	4.772	1037.6	0.111	0.632	0.837	28.39	17.34	1765.4	16.75	3.754	2803.0	17.12	0.0487	1.319
250	39.76	798.9	4.870	1085.8	0.106	0.621	0.832	26.04	18.60	1715.2	19.97	4.011	2800.9	17.49	0.0513	1.369
260	46.92	783.6	4.986	1135.0	0.102	0.609	0.832	23.69	20.03	1661.6	23.71	4.308	2796.6	17.88	0.0540	1.425
270	55.03	767.5	5.123	1185.3	0.097	0.596	0.838	21.34	21.70	1604.4	28.07	4.656	2789.7	18.28	0.0571	1.490
280	64.17	750.3	5.289	1236.9	0.094	0.581	0.851	18.99	23.66	1543.0	33.16	5.073	2779.9	18.70	0.0606	1.565
290	74.42	731.9	5.493	1290.0	0.090	0.565	0.872	16.66	26.00	1476.7	39.13	5.582	2766.7	19.15	0.0647	1.652
300	85.88	712.1	5.750	1345.0	0.086	0.547	0.902	14.36	28.87	1404.7	46.17	6.220	2749.6	19.65	0.0696	1.755
310	98.65	690.7	6.085	1402.2	0.082	0.529	0.946	12.09	32.49	1325.7	54.54	7.045	2727.9	20.21	0.0758	1.877
320	112.84	667.1	6.537	1462.2	0.078	0.509	1.007	9.86	37.21	1238.4	64.64	8.159	2700.6	20.85	0.0839	2.027
330	128.58	640.8	7.186	1525.9	0.075	0.489	1.095	7.70	43.68	1140.2	77.05	9.753	2666.0	21.61	0.0949	2.219
340	146.01	610.7	8.208	1594.5	0.070	0.469	1.234	5.63	53.30	1027.3	92.76	12.24	2621.8	22.55	0.111	2.447
350	165.29	574.7	10.12	1670.9	0.066	0.447	1.490	3.67	69.92	892.7	113.6	16.69	2563.6	23.82	0.136	2.925
360	186.66	527.6	15.00	1761.7	0.060	0.426	2.126	1.88	107	719.8	143.9	27.36	2481.5	25.72	0.182	3.877
365	198.21	495.7	21.41	1817.8	0.057	0.416	2.920	1.08	147	605.2	166.3	41.80	2422.9	27.20	0.225	5.056
370	210.44	451.4	45.16	1890.7	0.052	0.425	5.532	0.39	257	443.8	201.8	96.60	2334.5	29.68	0.324	8.853
372	215.54	422.3	102.1	1935.3	0.049	0.467	10.72	0.16	452	340.3	226.8	207.4	2275.5	31.53	0.438	14.93
ⓒ373.99	220.64	322.0	∞	2083.1	0.047		∞	0	∞	0	322.0	∞	2083.1	47.0		∞

OTROS DATOS: $M = 18.015$ g/mol. $c_p^\circ = 1.7896 + 1.0674 \times 10^{-4} T + 5.8562 \times 10^{-7} T^2 - 1.9956 \times 10^{-10} T^3$ (c_p° en kJ/kg·K, T en K, 273 K – 1800 K). ρ_{hielo} = 961.7 kg/m³ a 0 °C. λ_{fus} = 333.6 kJ/kg a 0 °C.

③ – punto triple. ⓒ – punto crítico. T – temperatura de saturación. P – presión de saturación. ρ – densidad. c_p – capacidad calorífica a presión constante. h – entalpía específica. μ – viscosidad. k – conductividad térmica. Pr – número de Prandtl. σ – tensión superficial. β – coeficiente de expansión térmica. λ – entalpía de vaporización. M – peso molecular. c_p° – capacidad calorífica de gas ideal a presión constante. λ_{fus} – entalpía de fusión.

PROPIEDADES TERMOFÍSICAS DEL AIRE SECO (1 atm)

Adaptado principalmente de la Tabla A.4 de Incropera y DeWitt, "Fundamentos de Transferencia de Calor", 6a edición, Prentice-Hall.

Se indica en el encabezado si los valores han sido multiplicados por un factor constante. Por ejemplo: $\mu \times 10^6 = 8.70$ significa $\mu = 8.70 \times 10^{-6}$ Pa·s.

T	ρ	c_p	$\mu \times 10^6$	$\nu \times 10^6$	k	$\alpha \times 10^6$	Pr
°C	kg/m³	kJ/kg·K	Pa·s	m²/s	W/m·K	m²/s	—
−150	2.8664	1.020	8.70	3.035	0.0114	3.9	0.776
−100	2.0386	1.009	11.66	5.717	0.0158	7.7	0.745
−50	1.5819	1.006	14.43	9.125	0.0200	12.6	0.726
−40	1.5140	1.006	14.97	9.887	0.0208	13.7	0.723
−30	1.4517	1.006	15.50	10.68	0.0217	14.7	0.720
−20	1.3944	1.006	16.02	11.49	0.0225	16.0	0.717
−10	1.3414	1.006	16.54	12.33	0.0233	17.3	0.714
0	1.2923	1.006	17.05	13.19	0.0241	18.5	0.712
10	1.2467	1.007	17.55	14.08	0.0249	19.8	0.709
20	1.2041	1.007	18.05	14.99	0.0257	21.2	0.707
30	1.1644	1.007	18.54	15.92	0.0265	22.6	0.705
40	1.1272	1.008	19.02	16.87	0.0273	24.0	0.703
50	1.0923	1.008	19.50	17.85	0.0281	25.5	0.701
60	1.0596	1.009	19.97	18.85	0.0288	27.0	0.699
70	1.0287	1.009	20.44	19.87	0.0296	28.5	0.697
80	0.9996	1.010	20.90	20.91	0.0303	30.1	0.696
90	0.9720	1.011	21.36	21.97	0.0311	31.7	0.694
100	0.9460	1.011	21.81	23.05	0.0318	33.3	0.693
110	0.9213	1.012	22.25	24.15	0.0326	34.9	0.691
120	0.8979	1.013	22.69	25.27	0.0333	36.6	0.690
130	0.8756	1.014	23.12	26.41	0.0340	38.3	0.689
140	0.8544	1.016	23.55	27.57	0.0347	40.1	0.688
150	0.8342	1.017	23.98	28.74	0.0355	41.8	0.687
160	0.8149	1.018	24.40	29.94	0.0362	43.6	0.687
170	0.7966	1.020	24.81	31.15	0.0369	45.4	0.686
180	0.7790	1.021	25.22	32.37	0.0376	47.2	0.686
190	0.7622	1.023	25.62	33.62	0.0382	49.0	0.686
200	0.7460	1.025	26.02	34.88	0.0389	50.9	0.685
210	0.7306	1.027	26.41	36.15	0.0396	52.8	0.685
220	0.7158	1.029	26.80	37.45	0.0402	54.7	0.685
240	0.6879	1.033	27.57	40.08	0.0415	58.5	0.685
260	0.6621	1.037	28.32	42.77	0.0428	62.4	0.686
280	0.6381	1.042	29.05	45.52	0.0441	66.3	0.687
300	0.6159	1.047	29.77	48.33	0.0453	70.3	0.688
350	0.5665	1.057	31.49	55.59	0.0482	80.5	0.691
400	0.5244	1.069	33.12	63.16	0.0510	90.9	0.695
450	0.4881	1.080	34.68	71.04	0.0536	101.6	0.699
500	0.4566	1.092	36.17	79.21	0.0561	112.4	0.704
600	0.4043	1.115	38.97	96.40	0.0608	134.7	0.715
700	0.3627	1.136	41.61	114.7	0.0653	158.4	0.724
800	0.3289	1.154	44.17	134.3	0.0699	184.1	0.729
900	0.3009	1.170	46.70	155.2	0.0749	212.9	0.729
1000	0.2773	1.185	49.29	177.8	0.0809	246.0	0.722
1100	0.2571	1.202	51.99	202.3	0.0881	285.2	0.709
1200	0.2396	1.223	54.88	229.1	0.0973	332.0	0.690

T – temperatura. ρ – densidad. c_p – capacidad calorífica a presión constante. μ – viscosidad. ν – viscosidad cinemática. k – conductividad térmica. α – difusividad térmica. Pr – número de Prandtl.