SOLUBILITY OF SELECTED GASES IN WATER

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The values in this table are taken almost exclusively from the International Union of Pure and Applied Chemistry "Solubility Data Series". Unless noted, they comprise evaluated data fitted to a smoothing equation. The data at each temperature are then derived from the smoothing equation which expresses the mole fraction solubility X_1 of the gas in solution as:

$$\ln X_1 = A + B/T^* + C \ln T^*$$

where

$$T^* = T/100\ \mathrm{K}$$

All values refer to a partial pressure of the gas of 101.325 kPa (one atmosphere).

The equation constants, the standard deviation for $\ln X_1$ (except where noted), and the temperature range over which the equation applies are given in the column headed Equation constants. There are two exceptions. The equation for methane has an added term, DT^*. The equation for H_2Se and H_2S takes the form,

$$\ln X_1 = A + B/T + C \ln T + DT$$

where T is the temperature in kelvin.

Solubilities given for those gases which react with water, namely ozone, nitrogen oxides, chlorine and its oxides, carbon dioxide, hydrogen sulfide, hydrogen selenide and sulfur dioxide, are recorded as bulk solubilities; i.e., all chemical species of the gas and its reaction products with water are included.

Gas	T/K	Solubility (X_1)	Equation constants	Ref.
Hydrogen (H_2)	288.15	1.510×10^{-5}	$A = -48.1611$	1
$M_r = 2.01588$	293.15	1.455×10^{-5}	$B = 55.2845$	
	298.15	1.411×10^{-5}	$C = 16.8893$	
	303.15	1.377×10^{-5}	Std. dev. = ± 0.54%	
	308.15	1.350×10^{-5}	Temp.range = 273.15—353.15	
Deuterium (D_2)	283.15	$1.675 \times 10^{-5} \pm 0.57\%$	Averaged experimental	1
$M_r = 4.0282$	288.15	$1.595 \times 10^{-5} \pm 0.57\%$	values	
	293.15	$1.512 \times 10^{-5} \pm 0.78\%$	Temp. range = 278.15—303.15	
	298.15	$1.460 \times 10^{-5} \pm 0.52\%$		
	303.15	$1.395 \times 10^{-5} \pm 0.37\%$		
Helium (He)	288.15	7.123×10^{-6}	$A = -41.4611$	2
$A_r = 4.0026$	293.15	7.044×10^{-6}	$B = 42.5962$	
	298.15	6.997×10^{-6}	$C = 14.0094$	
	303.15	6.978×10^{-6}	Std. dev. = ±0.54%	
	308.15	6.987×10^{-6}	Temp.range = 273.15—348.15	
Neon (Ne)	288.15	8.702×10^{-6}	$A = -52.8573$	2
$A_r = 20.1797$	293.15	8.395×10^{-6}	$B = 61.0494$	
	298.15	8.152×10^{-6}	$C = 18.9157$	
	303.15	7.966×10^{-6}	Std. dev. = ±0.47%	
	308.15	7.829×10^{-6}	Temp.range = 273.15—348.15	
Argon (Ar)	288.15	3.025×10^{-5}	$A = -57.6661$	3
$A_r = 39.948$	293.15	2.748×10^{-5}	$B = 74.7627$	
	298.15	2.519×10^{-5}	$C = 20.1398$	
	303.15	2.328×10^{-5}	Std. dev. = ±0.26%	
	308.15	2.169×10^{-5}	Temp.range = 273.15—348.15	
Krypton (Kr)	288.15	5.696×10^{-5}	$A = -66.9928$	4
$A_r = 83.80$	293.15	5.041×10^{-5}	$B = 91.0166$	
	298.15	4.512×10^{-5}	$C = 24.2207$	

SOLUBILITY OF SELECTED GASES IN WATER (continued)

Gas	T/K	Solubility (X_1)	Equation constants	Ref.
	303.15	4.079×10^{-5}	Std. dev. = ±0.32%	
	308.15	3.725×10^{-5}	Temp.range = 273.15—353.15	
Xenon (Xe)	288.15	10.519×10^{-5}	A = –74.7398	4
A_r = 131.29	293.15	9.051×10^{-5}	B = 105.210	
	298.15	7.890×10^{-5}	C = 27.4664	
	303.15	6.961×10^{-5}	Std. dev. = ±0.35%	
	308.15	6.212×10^{-5}	Temp.range = 273.15—348.15	
Radon-222(^{222}Rn)	288.15	2.299×10^{-4}	A = –90.5481	
A_r = 222	293.15	1.945×10^{-4}	B = 130.026	
	298.15	1.671×10^{-4}	C = 35.0047	
	303.15	1.457×10^{-4}	Std. dev. = ±1.02%	
	308.15	1.288×10^{-4}	Temp.range = 273.15—373.15	
Oxygen (O_2)	288.15	2.756×10^{-5}	A = –66.7354	5
M_r = 31.9988	293.15	2.501×10^{-5}	B = 87.4755	
	298.15	2.293×10^{-5}	C = 24.4526	
	303.15	2.122×10^{-5}	Std. dev. = ±0.36%	
	308.15	1.982×10^{-5}	Temp.range = 273.15—348.15	
Ozone (O_3)	293.15	$1.885 \times 10^{-6} \pm 10\%$	Experimental value derived	5
M_r = 47.9982		pH = 7.0	from Henry's Law Constant	
Nitrogen (N_2)	288.15	1.386×10^{-5}	A = –67.3877	6
M_r = 28.0134	293.15	1.274×10^{-5}	B = 86.3213	
	298.15	1.183×10^{-5}	C = 24.7981	
	303.15	1.108×10^{-5}	Std. dev. = ±0.72%	
	308.15	1.047×10^{-5}	Temp.range = 273.15—348.15	
Nitrous oxide (N_2O)	288.15	5.948×10^{-4}	A = –60.7467	7
M_r = 44.0129	293.15	5.068×10^{-4}	B = 88.8280	
	298.15	4.367×10^{-4}	C = 21.2531	
	303.15	3.805×10^{-4}	Std. dev. = ±1.2%	
	308.15	3.348×10^{-4}	Temp.range = 273.15—313.15	
Nitric oxide (NO)	288.15	4.163×10^{-5}	A = –62.8086	7
M_r = 30.0061	293.15	3.786×10^{-5}	B = 82.3420	
	298.15	3.477×10^{-5}	C = 22.8155	
	303.15	3.222×10^{-5}	Std. dev. = ±0.76%	
	308.15	3.012×10^{-5}	Temp.range = 273.15—358.15	
Carbon monoxide (CO)	288.15	2.095×10^{-5}	Derived from Henry's	8
M_r = 28.0104	293.15	1.918×10^{-5}	Law Constant Equation	
	298.15	1.774×10^{-5}	Std. dev. = ±0.043%	
	303.15	1.657×10^{-5}	Temp.range = 273.15—328.15	
	308.15	1.562×10^{-5}		
Carbon dioxide (CO_2)	288.15	8.21×10^{-4}	Derived from Henry's	9
M_r = 44.0098	293.15	7.07×10^{-4}	Law Constant Equation	
	298.15	6.15×10^{-4}	Std. dev. = ±1.1%	
	303.15	5.41×10^{-4}	Temp.range = 273.15—353.15	
	308.15	4.80×10^{-4}		
Hydrogen selenide (H_2Se)	288.15	1.80×10^{-3}	A = 9.15	10
M_r = 80.976	298.15	1.49×10^{-3}	B = 974	
	308.15	1.24×10^{-3}	C = –3.542	
			D = 0.0042	

SOLUBILITY OF SELECTED GASES IN WATER (continued)

Gas	T/K	Solubility (X_1)	Equation constants	Ref.
			Std. dev. = $\pm 2.3 \times 10^{-5}$ Temp. range = 288.15—343.15	
Hydrogen sulfide (H_2S) M_r = 34.082	288.15 293.15 298.15 303.15 308.15	2.335×10^{-3} 2.075×10^{-3} 1.85×10^{-3} 1.66×10^{-3} 1.51×10^{-3}	A = –24.912 B = 3477 C = 0.3993 D = 0.0157 Std. dev. = $\pm 6.5 \times 10^{-5}$ Temp. range = 283.15—603.15	10
Sulfur dioxide (SO_2) M_r = 64.0648	288.15 293.15 298.15 303.15 308.15	3.45×10^{-2} 2.90×10^{-2} 2.46×10^{-2} 2.10×10^{-2} 1.80×10^{-2}	A = –25.2629 B = 45.7552 C = 5.6855 Std. dev. = ±1.8% Temp.range = 278.15—328.15	11
Chlorine (Cl_2) M_r = 70.9054	283.15 293.15 303.15 313.15	$2.48 \times 10^{-3} \pm 2\%$ $1.88 \times 10^{-3} \pm 2\%$ $1.50 \times 10^{-3} \pm 2\%$ $1.23 \times 10^{-3} \pm 2\%$	Experimental data Temp.range = 283.15—333.15	11
Chlorine monoxide (Cl_2O) M_r = 86.9048	273.15 276.61 283.15 293.15	$5.25 \times 10^{-1} \pm 1\%$ $4.54 \times 10^{-1} \pm 1\%$ $4.273 \times 10^{-1} \pm 1\%$ $3.353 \times 10^{-1} \pm 1\%$	Experimental data Temp. range = 273.15—293.15	11
Chlorine dioxide (ClO_2) M_r = 67.4515	288.15 293.15 298.15 303.15 308.15	2.67×10^{-2} 2.20×10^{-2} 1.823×10^{-2} 1.513×10^{-2} 1.259×10^{-2}	A = 7.9163 B = 0.4791 C = 11.0593 Std. dev. = ±4.6% Temp.range = 283.15—333.15	11
Methane (CH_4) M_r = 16.0428	288.15 293.15 298.15 303.15 308.15	3.122×10^{-5} 2.806×10^{-5} 2.552×10^{-5} 2.346×10^{-5} 2.180×10^{-5}	A = –115.6477 B = 155.5756 C = 65.2553 D = –6.6170 Std. dev. = ±0.056% Temp.range = 273.15—328.15	12
Ethane (C_2H_6) M_r = 30.0696	288.15 293.15 298.15 303.15 308.15	4.556×10^{-5} 3.907×10^{-5} 3.401×10^{-5} 3.002×10^{-5} 2.686×10^{-5}	A = –90.8225 B = 126.9559 C = 34.7413 Std. dev. = ±0.13% Temp.range = 273.15—323.15	13
Propane (C_3H_8) M_r = 44.097	288.15 293.15 298.15 303.15 308.15	3.813×10^{-5} 3.200×10^{-5} 2.732×10^{-5} 2.370×10^{-5} 2.088×10^{-5}	A = –102.044 B = 144.345 C = 39.4740 Std. dev. = ±0.012% Temp.range = 273.15—347.15	14
Butane (C_4H_{10}) M_r = 58.123	288.15 293.15 298.15 303.15 308.15	3.274×10^{-5} 2.687×10^{-5} 2.244×10^{-5} 1.906×10^{-5} 1.645×10^{-5}	A = –102.029 B = 146.040 C = 38.7599 Std. dev. = ±0.026% Temp.range = 273.15—349.15	14
2-Methyl propane (Isobutane)	288.15	2.333×10^{-5}	A = –129.714	14

SOLUBILITY OF SELECTED GASES IN WATER (continued)

Gas	T/K	Solubility (X_1)	Equation constants	Ref.
(C_4H_{10})	293.15	1.947×10^{-5}	B = 183.044	
M_r = 58.123	298.15	1.659×10^{-5}	C = 53.4651	
	303.15	1.443×10^{-5}	Std. dev. = ±0.034%	
	308.15	1.278×10^{-5}	Temp.range = 278.15—318.15	

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