

Solubility of ClO₂ (Handbook of Chemistry and Physics, 88 ed.)

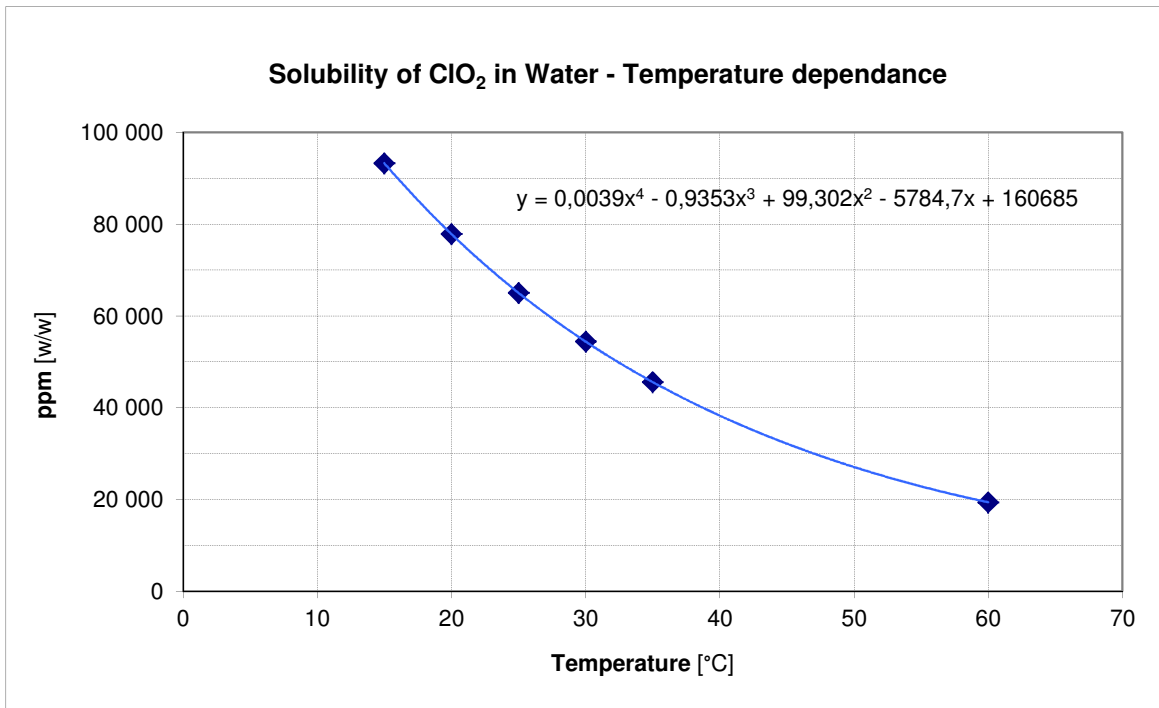
$$\ln(X) = A + B/T^* + C \cdot \ln(T^*) \quad T^* = T/100 \text{ K}$$

$$\begin{array}{l} \text{Mw(ClO}_2\text{)} = 67,4515 \\ \text{Mw(H}_2\text{O)} = 18,01 \end{array} \quad X = \frac{m(\text{H}_2\text{O})/\text{Mw}(\text{H}_2\text{O})}{m(\text{ClO}_2)/\text{Mw}(\text{ClO}_2) + m(\text{H}_2\text{O})/\text{Mw}(\text{H}_2\text{O})} \quad \text{Eq. (1)}$$

$$\begin{array}{l} A = 7,9163 \\ B = 0,4791 \\ C = -11,0593 \end{array} \quad \begin{array}{l} m(\text{H}_2\text{O}) + m(\text{ClO}_2) = 100 \\ k = \text{Mw}(\text{ClO}_2) / \text{Mw}(\text{H}_2\text{O}) = 3,745 \end{array} \quad \text{Eq. (2)}$$

$$\text{Solution of Eq (1) and (2):} \quad \text{Solubility (g ClO}_2\text{ in 100 g of solution)} = \frac{100kX}{1 + X(k - 1)}$$

T/°K	T/100	T/°C	T/°F	ln(X)	Molar ratio X	Solubility g/100 g	ppm w/w
288,15	2,882	15	59	-3,6216	0,02674	9,33	93 297
293,15	2,932	20	68	-3,8147	0,02204	7,78	77 850
298,15	2,982	25	77	-4,0045	0,01823	6,50	65 034
303,15	3,032	30	86	-4,1911	0,01513	5,44	54 406
308,15	3,082	35	95	-4,3745	0,01259	4,56	45 591
333,15	3,332	60	140	-5,2489	0,00525	1,94	19 395



Henry's law

$$p = k_H c$$

k_H calculated from solubility data HoCP for 25 °C at atmospheric pressure = **1,037** mol/kg.bar is
in accordance with NIST - <http://webbook.nist.gov/cgi/cbook.cgi?ID=C10049044&Units=SI&Mask=10> :

k_H = Henry's law constant for solubility in water at 298.15 K (mol/kg*bar) = 1; 0,84; 1; three sources

<http://www.inchem.org/documents/cicads/cicads/cicad37.htm#FOREWORD>

c		p(ClO ₂)	V(ClO ₂)
[ppm]	[mol/kg]	[bar]	[% v/v]
2 000	0,030	0,03	3,1
3 000	0,044	0,05	4,6
4 000	0,059	0,06	6,2
5 000	0,074	0,08	7,7
6 000	0,089	0,09	9,2
7 000	0,104	0,11	10,8
8 000	0,119	0,12	12,3
9 000	0,133	0,14	13,8
10 000	0,148	0,15	15,4
11 000	0,163	0,17	16,9
12 000	0,178	0,18	18,5
20 000	0,297	0,31	30,8
30 000	0,445	0,46	46,1
40 000	0,593	0,62	61,5
50 000	0,741	0,77	76,9
60 000	0,890	0,92	92,3
65 000	0,964	1,00	100,0

Chlorine dioxide (ClO₂, Chemical Abstracts Service [CAS] No. 10049-04-4), a free radical, exists as a greenish yellow to orange gas at room temperature with a characteristic pungent chlorine-like odour. Chlorine dioxide gas is strongly oxidizing; **it is explosive in concentrations in excess of 10% v/v** at atmospheric pressure and will easily be detonated by sunlight or heat (Budavari et al., 1996). Its melting point is -59 °C, its boiling point is 11 °C (at 101.3 kPa), and its vapour density is 2.34 (air = 1).

<http://www.inchem.org/documents/cicads/cicads/cicad37.htm#2>.

If the information in bold above and my calculations are correct, then CDS with concentration greater than 6 000 ppm is dangerous (at temperatures above 25 °C).

As the vapour density of chlorine dioxide is rather high, it can concentrate at the bottom (similar to carbon dioxide accumulation in lowest parts of caves).

According to many literature sources CDS concentration up to 3 000 - 4 000 ppm only is considered safe at adequate manipulation.