Solubility of ClO_2 (Handbook of Chemistry and Physics, 88 ed.)

$\ln(X) = A + B/T^* + C.\ln(T^*)$ $T^* = T/100\ K$

Mw(ClO2) =	67,4515
Mw(H2O) =	18,01
A=	7,9163
B=	0,4791
C=	-11,0593

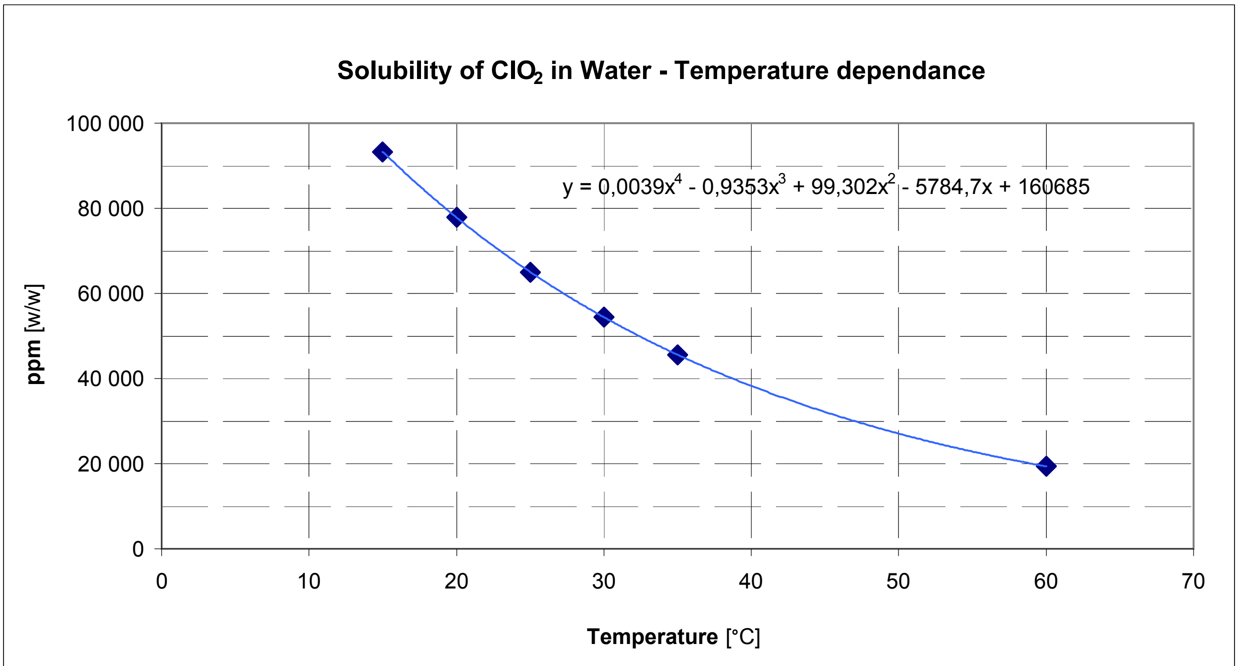
$$X = \frac{m(H2O)/Mw(H2O)}{m(ClO2)/Mw(ClO2) + m(H2O)/Mw(H2O)} \quad \text{Eq. (1)}$$

$$m(H2O) + m(ClO2) = 100 \quad \text{Eq. (2)}$$

k = Mw(ClO2) / Mw(H2O) = 3,745

Solution of Eq (1) and (2): Solubility (g ClO2 in 100 g of solution) = $\frac{100kX}{1 + X(k - 1)}$

					Molar ratio	Solubility	ppm	k_H
T/°K	T/100	T/°C	T/°F	ln(X)	X	g/100 g	w/w	mol/kg.bar
278,15	2,7815	5	41	-3,2250	0,03976	13,42	***134 242***	**0,502**
283,15	2,8315	10	50	-3,4251	0,03255	11,19	***111 896***	0,603
288,15	2,882	***15***	59	-3,6216	0,02674	9,33	***93 297***	0,723
293,15	2,932	***20***	68	-3,8147	0,02204	7,78	***77 850***	0,866
298,15	2,982	***25***	77	-4,0045	0,01823	6,5034	***65 034***	**1,037**
303,15	3,032	***30***	86	-4,1911	0,01513	5,44	***54 406***	1,240
308,15	3,082	***35***	95	-4,3745	0,01259	4,56	***45 591***	1,479
333,15	3,332	***60***	140	-5,2489	0,00525	1,94	***19 395***	3,478



By Tomas 2012/11

Content of ClO_2 [volume %] in air space in a bottle

Concentration and temperature dependance - safety consideration

Henry's law

$$p = k_H c$$

$k°_H$ calculated from solubility data HoCP for 25 °C at atmospheric presure =**1,037** mol/kg.bar is

in accoradnce 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

25 °C			
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
13 000	0,193	0,20	20,0
14 000	0,208	0,22	21,5
15 000	0,222	0,23	23,1
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	99,9

5 °C		
c	$p(ClO_2)$	$V(ClO_2)$
[ppm]	[bar]	[% v/v]
2 000	0,015	1,5
3 000	0,022	2,2
4 000	0,030	3,0
5 000	0,037	3,7
6 000	0,045	4,5
7 000	0,052	5,2
8 000	0,060	6,0
9 000	0,067	6,7
10 000	0,074	7,4
11 000	0,082	8,2
12 000	0,089	8,9
13 000	0,097	9,7
14 000	0,104	10,4
15 000	0,112	11,2
20 000	0,149	14,9
30 000	0,223	22,3
40 000	0,298	29,8
50 000	0,372	37,2
60 000	0,447	44,7
65 000	0,484	48,4

Chlorine dioxide (ClO_2, 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. Chlorin 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, it 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 grater than 6 000 ppm is dangerous (at temperatures above 25 °C).
As the vapor 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.

If the solution is kept at 5 °C (at fridge), the partial pressure and volume content of ClO2 in air in the bottle are lower (about one half of these at 25 °C). That means that the critical amount 10 % (v/v) in the air is not overstepped up to CDS concentration cca 13000 ppm.

Due to lower partial pressure at 5 °C the speed of gas off is slower, too - another beneficial of cold CDS solution.

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