General data

Table 1 – Atom mass of important elements in water chemistry.

Element	Atom mass	Element	Atom mass
H	1	S	32
C	12	Cl	35,5
N	14	K	39
O	16	Ca	40
F	19	Mn	55
Na	23	Fe	56
Mg	24	As	75
Al	27	Pb	207
P	31		

Table 2 - Dynamic and kinematic viscosity as function of temperature.

Temperature [°C]	Dynamic viscosity [10^{-3} Pa·s]	Kinematic viscosity [10^{-6} m^2/s]
0	1,79	1,79
5	1,52	1,52
10	1,31	1,31
15	1,15	1,15
20	1,01	1,01
25	0,90	0,90
30	0,80	0,80

Relevant formulas in water chemistry

bij T = 10°C

$CO_2 + 2H_2O$ <--> $H_3O^+ + HCO_3^-$ $K_1 = 3{,}44 \cdot 10^{-7}$ $pK_1 = 6{,}46$

$HCO_3^- + H_2O$ <--> $H_3O^+ + CO_3^{2-}$ $K_2 = 3{,}25 \cdot 10^{-11}$ $pK_2 = 10{,}48$

$CaCO_3 + CO_2 + H_2O$ <--> $Ca^{2+} + 2HCO_3^-$ $K_a = 4{,}11 \cdot 10^{-5}$

$NH_3 + H_2O$ <--> $NH_4^+ + OH^-$

$NH_4^+ + 2O_2 + H_2O$ <--> $NO_3^- + 2H_3O^+$

$CH_2O + O_2$ <--> $CO_2 + H_2O$

$H_3O^+ + CaCO_3$ <--> $Ca^{2+} + HCO_3^- + H_2O$

$5CH_2O + 4NO_3^-$ <--> $2N_2 + 4HCO_3^- + CO_2 + 3H_2O$

FeS <--> $Fe^{2+} + S^{2-}$

$SO_4^{2-} + 2CH_2O$ <--> $H_2S + 2HCO_3^-$

$S^{2-} + 2H_3O^+$ <--> $H_2S + 2H_2O$

$2CH_2O$ <--> $CH_4 + CO_2$

$NaOH + Ca^{2+} + HCO_3^-$ <--> $CaCO_3 + Na^+ + H_2O$

$Ca(OH)_2 + Ca^{2+} + 2HCO_3^-$ <--> $2CaCO_3 + 2H_2O$

$4Fe^{2+} + O_2 + 2H_2O + 8OH^-$ <--> $4Fe^{3+} + 12OH^-$

$Fe^{3+} + 3OH^-$ <--> $Fe(OH)_3$

$2Mn^{2+} + O_2 + 4OH^-$ <--> $2MnO_2 + 2H_2O$

Table 3 - k_D-values for different gasses as function of temperature.

k_D	0°C	10°C	20°C
Nitrogen	0,023	0,019	0,016
Oxygen	0,049	0,039	0,033
Methane	0,055	0,043	0,034
Carbon dioxide	1,710	1,230	0,942
Hydrogen sulfide	4,690	3,650	2,870
Tetrachloroethene	-	3,380	1,880
Trichloroethene	-	4,100	2,390
Chloroform	-	9,620	5,070

Universal gas constant R = 8,3142 J/(K.mol)

Table 4 – Composition of air in atmosphere (T = 10°C, p = $1 \cdot 10^5$ Pa)

Gas	Volume percentage [%]
Nitrogen	78,1
Oxygen	20,95
Carbon dioxide	0,003
Argon	0,93
Rest gasses	0,0002

Relevant formula

$$c = \frac{p}{R \cdot T} \cdot MW$$

$$\frac{dc}{dt} = k_2 \cdot (c_s - c)$$

$$RQ = \frac{Q_l}{Q_w}$$

$$K = \frac{c_e - c_0}{c_s - c_0}$$

$$K_1 = 1 - \exp(-k_2 \cdot t)$$

$$K_2 = \frac{1}{1 + \frac{1}{k_2 \cdot t}}$$

$$K_3 = \frac{1 - \exp\left(-k_2 \cdot t \cdot \left(1 + \frac{k_D}{RQ}\right)\right)}{1 + \frac{k_D}{RQ}}$$

$$K_4 = \frac{1 - \exp\left(-k_2 \cdot t \cdot \left(1 - \frac{k_D}{RQ}\right)\right)}{1 - \frac{k_D}{RQ} \cdot \exp\left(-k_2 \cdot t \cdot \left(1 - \frac{k_D}{RQ}\right)\right)}$$

$$K_5 = \frac{1}{1 + \frac{1}{k_2 \cdot t} + \frac{k_D}{RQ}}$$

$$K = 1-(1-k)^n$$

$$I_0 = \frac{H_0}{L} = 180 \cdot \frac{\nu}{g} \cdot \frac{(1 - p_0)^2}{{p_0}^3} \cdot \frac{v}{d^2}$$

$$H = 130 \cdot \frac{\nu^{0.8}}{g} \cdot \frac{(1 - p_e)^{1.8}}{{p_e}^3} \cdot \frac{v^{1.2}}{d^{1.8}} \cdot L_e$$

$$H_{max} = (1 - p) \cdot L \cdot \frac{\rho_f - \rho_w}{\rho_w}$$

$$q_{max} = \frac{x}{m} = K \cdot {c_s}^n$$

$$\frac{c_0}{c_e} = 1 + \exp\left(k_2 \cdot EBCT \cdot \left(1 - \frac{BV \cdot c_0}{q \cdot \rho}\right)\right)$$

$$BV = \frac{Q \cdot T}{V} = \frac{T}{EBCT}$$

$$J = \frac{Q}{A_{mem}} = \frac{K_w \cdot (TMD - \Delta\pi)}{\nu}$$

$$TMD = \frac{P_f + P_c}{2} - P_p = P_f - \frac{\Delta P_{hydr}}{2} - P_p$$

$$\pi = \sum \frac{R \cdot T \cdot c_i \cdot z_i}{MW_i}$$

$$\gamma = \frac{Q_p}{Q_f}$$

$$Ret = 1 - \frac{c_p}{c_f}$$

$$\beta = \exp\left(\frac{J \cdot \delta}{D_i}\right)$$

$$G = \sqrt{\frac{P}{\mu \cdot V}}$$

$$P = \rho \cdot g \cdot Q \cdot \Delta H$$

$$s_0 = \frac{Q}{B \cdot H}$$

$$r = (1 - p_0) + \frac{1}{s_0} \cdot \int_0^{p_e} s\,dp$$

$$Re = \frac{v_0 \cdot R}{\nu}$$

$$Fr = \frac{{v_0}^2}{g \cdot R}$$

$$R = \frac{B \cdot H}{B + 2 \cdot H}$$

$$\tau = \frac{\lambda}{8} \cdot \rho_w \cdot {v_s}^2$$