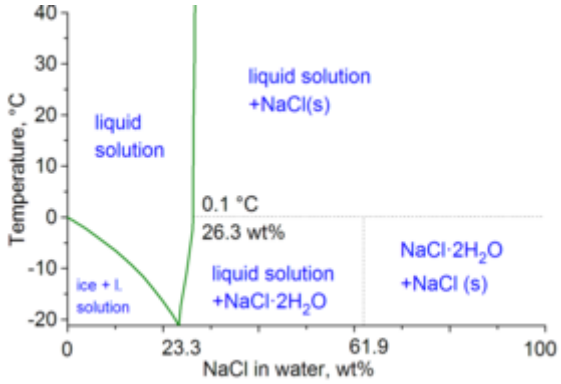
Saline water

Saline water (more commonly known as **salt water**) is water that contains a high concentration of dissolved salts (mainly sodium chloride). The salt concentration is usually expressed in parts per thousand (permille, ‰) or parts per million (ppm). The United States Geological Survey classifies saline water in three salinity categories. Salt concentration in slightly saline water is around 1,000 to 3,000 ppm (0.1–0.3%), in moderately saline water 3,000 to 10,000 ppm (0.3–1%) and in highly saline water 10,000 to 35,000 ppm (1–3.5%). Seawater has a salinity of roughly 35,000 ppm, equivalent to 35 grams of salt per one liter (or kilogram) of water. The saturation level is only nominally dependent on the temperature of the water.[1] At 20 °C one liter of water can dissolve about 357 grams of salt, a concentration of 26.3% w/w. At boiling (100 °C) the amount that can be dissolved in one liter of water increases to about 391 grams, a concentration of 28.1% w/w.

Contents

Properties



Water-NaCl phase diagram

Properties of water-NaCl mixtures[2]

NaCl, wt%	Freezing point (°C)	Density[a] (g/cm^3)	Refractive index[b] at 589 nm	Viscosity[c] (cP)
0	0	0.99984	1.3330	1.002
0.5	−0.3	1.0018	1.3339	1.011
1	−0.59	1.0053	1.3347	1.02
2	−1.19	1.0125	1.3365	1.036
3	−1.79	1.0196	1.3383	1.052
4	−2.41	1.0268	1.3400	1.068
5	−3.05	1.0340	1.3418	1.085
6	−3.7	1.0413	1.3435	1.104
7	−4.38	1.0486	1.3453	1.124
8	−5.08	1.0559	1.3470	1.145
9	−5.81	1.0633	1.3488	1.168
10	−6.56	1.0707	1.3505	1.193
12	−8.18	1.0857	1.3541	1.25
14	−9.94	1.1008	1.3576	1.317
16	−11.89	1.1162	1.3612	1.388
18	−14.04	1.1319	1.3648	1.463
20	−16.46	1.1478	1.3684	1.557
26	−19.18	1.193	1.3721	1.676

a. At some ambient temperature
b. At some ambient temperature
c. At some ambient temperature (20°C)

At 100 °C (373.15 K, 212 °F), saturated sodium chloride brine is about 28% salt by weight. At 0 °C (273.15 K, 32 °F), brine can only hold about 26% salt.[3] At 20 °C one liter of water can dissolve about 357 grams of salt, a concentration of 26.3%.[4]

The thermal conductivity of seawater (3.5% dissolved salt by weight) is 0.6 W/mK at 25 °C.[5] The thermal conductivity decreases with increasing salinity and increases with increasing temperature. [6] [7] The salt content can be determined with a salinometer.

Density ρ of brine at various concentrations and temperatures from 200 °F to 575 °F can be approximated with a linear equation:[8]

$$\rho[lb/ft^3] = a_3 - (a_2 \cdot T[F])$$

where the values of a_n are:

Weight %	a_2	a_3
5	0.043	72.60
10	0.039	73.72
15	0.035	74.86
20	0.032	76.21
25	0.030	77.85

Electrolysis

About four percent of hydrogen gas produced worldwide is created by electrolysis. The majority of this hydrogen produced through electrolysis is a side product in the production of chlorine.

- $2\ NaCl(aq) + 2\ H_2O(l) \rightarrow 2\ NaOH(aq) + H_2(g) + Cl_2(g)$

See also

- Brackish water
- Brine
- Salinity
- Seawater

References

1. "Sodium Chloride MSDS" (https://www.sigmaaldrich.com/catalog/product/sial/s7653?lang=en&region=CA&cm_sp=Insite-_-caSrpResults_srpRecs_srpModel_sodium%20chloride-_-srpRecs3-1). *Sigma Aldrich*. 10-01-2004. Check date values in: `|date=` (help)
2. Lide, D. R., ed. (2005). *CRC Handbook of Chemistry and Physics* (86th ed.). Boca Raton (FL): CRC Press. pp. 8–71, 8–116. ISBN 0-8493-0486-5.
3. CRC Handbook of Chemistry and Physics, 63rd Edition 1982-1983.
4. "Solubility" (https://www.chem.wisc.edu/deptfiles/genchem/sstutorial/Text11/Tx112/tx112.html). *University of Wisconsin Fundamentals of Chemistry*. Archived (https://web.archive.org/web/20160331150210/https://www.chem.wisc.edu/deptfiles/genchem/sstutorial/Text11/Tx112/tx112.html) from the original on 31 March 2016. Retrieved 6 November 2014.
5. Thermophysical properties of seawater: a review of existing correlations and data (http://web.mit.edu/lienhard/www/Thermophysical_properties_of_seawater-DWT-16-354-2010.pdf) Paper published in April 2010 on *web.mit.edu*. Retrieved 2021-03-11.
6. https://handbook.ashrae.org/Handbooks/F17/SI/F17_Ch31/figures/F31sf08.jpg Plots of thermal conductivity vs. temperature for 0, 5, ... 25 w/w NaCl/water solutions. Retrieved 2020-11-27.
7. "Thermal conductivity of seawater and its concentrates" (http://twt.mpei.ac.ru/tthb/2/Tab-5-5-13-2-Ther-Cond-Seawater.html). *twt.mpei.ac.ru*. Retrieved 2018-02-16.
8. Dittman, Gerald L. (February 16, 1977). "Calculation of Brine Properties" (https://www.osti.gov/bridge/servlets/purl/7111583-l9lvkU/native/7111583.pd). *Lawrence Livermore Laboratories*. Livermore CA.

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