National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material 2201

Sodium Chloride

(Standard for Ion-Selective Electrodes)

This Standard Reference Material (SRM) is intended primarily for use in the calibration of ion-selective electrodes for sodium and chloride ions. It conforms to the American Chemical Society specifications for analytical reagent-grade material, but should not be considered entirely free from impurities such as occluded water and traces of bromide and heavy metals. Coulometric analysis of this material indicates 99.9% purity, and upon drying at 450 °C for 24 h, 99.99% of the calculated chloride was found. SRM 2201 is provided in a unit of 125 g.

This material is certified for the activity coefficients at 25 °C of the sodium and chloride ions at various concentrations and the related values, pNa and pCl. These values are given in the table on the reverse page. The accuracies of the pNa and pCl values are estimated to be ± 0.01. The mean activity coefficient may be represented by the equation:

$$\log \gamma \pm = \frac{-|Z_+ Z_-| AI^{1/2}}{1 + BI^{1/2}} + \beta I + CI^2 + DI^3$$

where I is the ionic strength at 25 °C, Z_+ the charge on the cation, Z_- the charge on the anion, and A and B the Debye-Huckel constants. Both Z_+ and Z_- are 1 in the case of sodium chloride. The numerical values of the constants are 25 °C are:

A =	0.5108
B =	1.4495
β =	2.0442×10^{-2}
C =	5.7927×10^{-3}
D =	$(-)2.8860 \times 10^{-4}$

These constants are valid to 6.144 molal (saturation). The amounts of interfering ions in this material (bromide, potassium, etc.) were each less than 100 mg/kg.

Expiration of Certification: This certification is valid for five years from date of shipment from NIST.

This Certificate of Analysis has undergone editorial revision to reflect program and organizational changes at NIST and at the Department of Commerce. No attempt was made to reevaluate the certificate values or any technical data presented on this certificate.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of R.A. Durst.

Gaithersburg, MD 20899
May 24, 1993
(Revision of certificate dated 3-30-84)

Thomas E. Gills, Acting Chief
Standard Reference Materials Program

(over)

The technical and support aspects involved in the original certification and issuance of this SRM were coordinated through the Standard Reference Materials Program by T.W. Mears. Revision of this certificate was coordinated thorough the Standard Reference Materials Program by J.C. Colbert.

Certified values of activity, activity coefficients (γ) pNa and pCl at 25 °C

Molality (m)	Molarity (M)	Concentration* g/L Na^+	Concentration* g/L Cl^-	Mean Molal $\gamma\pm$	Activity Na^+	$\gamma+$	Activity Cl^-	$\gamma-$	pNa	pCl
0.001	0.000997	0.0229	0.0353	0.965	0.000965	0.965	0.000965	0.965	3.015	3.015
0.01	0.00997	0.2292	0.3535	0.093	0.00903	0.903	0.00902	0.902	2.044	2.045
0.1	0.0995	2.287	3.528	0.779	0.0784	0.784	0.0774	0.774	1.106	1.112
0.2	0.1987	4.568	7.045	0.734	0.149	0.743	0.145	0.726	0.828	0.838
0.3	0.2975	6.839	10.547	0.709	0.216	0.721	0.209	0.697	0.665	0.680
0.5	0.4941	11.359	17.517	0.681	0.350	0.701	0.331	0.662	0.455	0.480
1.0	0.9789	22.505	34.705	0.657	0.696	0.696	0.620	0.620	0.157	0.208
1.5	1.4543	33.434	51.559	0.657	1.077	0.718	0.904	0.602	----	0.046
2.0	1.9200	44.140	68.070	0.668	1.504	0.752	1.187	0.593	----	----

*To convert to parts per million (mg/L) multiply by 10^{-3}.

The mean activity coefficient at temperatures from 15 to 45 °C and for any concentration up to 0.1 molal may be calculated by using the equation on the face of the certificate and these temperature-dependence expressions for its constants, A, B, and β. (Constants C and D are unimportant at 0.1 molal and below.)

$$A = 0.5108 + 8.4705 \times 10^{-4} (t-25) + 3.5498 \times 10^{-6} (t-25)^2$$
$$B = 1.4495 (1.0 + 4.7218 \times 10^{-4} (t-25))$$
$$\beta = 0.020442 + 6.21 \times 10^{-4} (t-25) - 2.00 \times 10^{-5} (t-25)^2$$

The values for pNa and pCl may be calculated from log $\gamma\pm$ using the procedure described in Reference [1].

Preparation of Standard Solutions

To prepare a 1.0 molal solution, transfer 57.198 g of sodium chloride (weight in air) to a l-L volumetric flask. Dissolve and fill to the mark with distilled water at 25 °C. The distilled water should have a conductivity no greater than 2×10^{-6} siemens/cm. The sodium chloride should be dried for 2 h at 110 °C before use. Similarly, a 0.1 molal solution may be prepared by the transfer of 5.815 g of sodium chloride (weight in air) to a l-L volumetric flask, dissolving, and diluting to mark with distilled water at 25 °C. Appropriate dilution of either standard solution should be used to obtain standards in the concentration range of interest to the user.

Electrode Calibration

It is recommended that reference standards be used at a concentration similar to that of the sample to minimize liquid junction potential errors. Use of a bracketing technique will minimize errors due to non-Nernstian response of the electrodes. The use of two standard solutions that bracket the concentration of the sample solution increases the reliability of the measurement. Thus, if standard solutions of concentrations slightly higher and lower than the sample solution are used to calibrate the pH/millivolt meter, the errors due to liquid junction potential will be small.

REFERENCES

[1] Bates, R., Staples, B.R., Anal. Chem 42, 867, (1970).