LSNReviews

From: Joseph A. Rard [rard1@llnl.gov]
Sent: Friday, May 19, 2006 11:46 AM
To: Roberto T Pabalan
Subject: Fwd: tables
Attachments: NaNO3+KNO3+H2O.jpg; NaNO3+KNO3+H2O_1.jpg

Bobby,

I have annotated the NaNO3 + KNO3 + H2O tables to give the number of moles of each solute. You will notice that there are several experiments with the same number of moles of of NaNO3 but with different number of moles of KNO3. Those experiments were done by adding a large amount of NaNO3 followed by increasing amounts of KNO3. Similarly, some experiments were done by adding a large amount of KNO3 followed by increasing amounts of NaNO3. In other cases the samples were used for a single experiment and then discarded.

There were several cases when the same samples were used for two or more measurements on different days, and the second experiment (with more solid phase from evaporation of water) gave boiling temperatures 1 to 2 degrees C higher. However, when this was done at x(NaNO3) =
0.4568 and 0.4569 larger differences of 6 to 7 degrees C were found.
This was probably the result of the change from NaNO3 + KNO3 being present initially in the solid phase with increasing formation of the solid solution with each reheating.

There was generally a large amount of solid phase present, which can explain why the b.t.s are generally slightly higher that those calculated for minimal precipitation. However, the slight mismatch for x(NaNO3) = 1 suggests to me that the solubilities of NaNO3 in SteamAnalyzer are a bit low.

I will try to get the NaCl + KNO3 data to you next week.

The YMP personnel at LLNL is about 1/3 of the level two years ago, and many of those remaining are only partially covered and looking for work elsewhere at LLNL.

Joe

Date: Thu, 18 May 2006 16:22:10 -0500
From: Roberto T Pabalan <roberto.pabalan@swri.org>
Subject: Re: boiling point measurements
To: "Joseph A. Rard" <rard1@llnl.gov>
X-Accept-Language: en
Priority: normal
X-Scanned-By: MIMEDefang 2.39

Joe,

The NaCl-KNO3 and NaNO3-KNO3 systems are both of interest, but I would say the NaCl-KNO3 system is more interesting because more salts potentially can form. I have attached two files. The NaNO3-KNO3 file compares your experimental boiling points with values calculated using StreamAnalyzer. There is fairly good agreement considering the X-axis is in terms of mole fraction of NaNO3 added, and my assumed moles of NaNO3 and KNO3 may not correspond with actual moles used in the experiments. The file NaCl-KNO3 also compares your data (closed
circles) with StreamAnalyzer results. In this file, the curves are calculated by assuming minimal amount of precipitated solids (trial and error) and the open circles are not constrained with respect to the total amount of salts added. There is more scatter in your data and in the calculated values, likely due to use of X-

NaCl(added) to plot the boiling points. Knowing the actual moles of salt used would enable a better comparison of exper imental and calculated values.

Thanks.

bobby

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Date: Fri, 19 May 2006 08:46:08 -0700
From: "Joseph A. Rard" <rard1@llnl.gov>
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Table II. Boiling Temperatures for Saturated Aqueous Solutions of $NaNO_3$ + KNO_3 + H_2O[a]

$x(NaNO_3)$	$x(KNO_3)$	pressure (bar)	temperature/°C corrected	moles $NaNO_3$	moles KNO_3
0	1.0000	0.995±0.004	115.0±0.7 [b]		
0.0523	0.9477	0.9918	116.5	0.2345	4.2453
0.1085	0.8915	0.9918	119.3	0.5164	4.2453
0.1665	0.8335	0.9919	122.6	0.8479	4.2453
0.1665	0.8335	0.9951	123.5 [c]	0.8479	4.2453
0.2205	0.7795	0.9950	127.2	1.2011	4.2453
0.2500	0.7500	1.0061	129.6	1.4789	4.4370
0.2729	0.7271	0.9947	131.0	1.5933	4.2453
0.3334	0.6666	0.9947	136.1	2.1235	4.2453
0.3619	0.6381	0.9947	143.7	2.9999	5.2903
0.4329	0.5671	0.9906	154.8	3.8604	5.0580
0.4568	0.5432	0.9957	152.7	3.7802	4.4948
0.4568	0.5432	0.9964	158.8 [c]	3.7802	4.4948
0.4568	0.5432	0.9964	159.0 [c]	3.7802	4.4948
0.4568	0.5432	0.9964	159.8 [c]	3.7802	4.4948
0.4568	0.5432	0.9968	159.7 [c]	3.7802	4.4948
0.4569	0.5431	0.9946	154.3	4.4503	5.2903
0.4569	0.5431	0.9935	160.5 [c]	4.4503	5.2903
0.4804	0.5196	0.9908	153.4	3.8604	4.1758
0.4982	0.5018	0.9966	152.3	3.6508	3.6769
0.5001	0.4999	1.0047	163.6	4.8986	4.8862

				moles $NaNO_3$	moles KNO_3
unknown	unknown	1.0047	165.1 [d]		
0.5545	0.4455	0.9912	147.2	3.8604	3.1013
0.6207	0.3793	0.9912	140.4	3.8604	2.3543
0.6895	0.3105	0.9948	132.4	3.8604	1.7382
0.6895	0.3105	0.9914	134.8 [c]	3.8604	1.7382
0.7500	0.2500	0.9915	129.4	3.8714	1.2905
0.7500	0.2500	0.9939	129.3 [c]	3.8714	1.2905
0.7732	0.2268	0.9949	128.1	3.8604	1.1322
0.8419	0.1581	0.9949	125.2	3.8604	0.7251
0.9007	0.0993	0.9949	122.5	3.8604	0.4256
0.9516	0.0484	0.9949	120.9	3.8604	0.1965
1.0000	0	0.994±0.001 [e]	119.7±0.4 [e]		

[a] The reported compositions are the solute mole fractions (not including water) that were calculated from the mass of each solute component added to the solution. The initially liquid solutions were heated to evaporate solvent until precipitation occurred. Because the amount of solid present is not known, the reported mole fractions may not be accurate reflections of the solution compositions. [b] This is the average of nine determinations for $KNO_3 + H_2O$ reported in Table I. [c] This initial composition of this solution is identical to the one immediately above. These measurements involved partial dissolution of the glassy-looking solid that was produced after the solution from the previous experiment cooled to room temperature. These variations in boiling temperatures for the re-equilibrated solutions reflect small changes in the composition of the solid phase, and, above about 150 °C, the gradual transformation of the discreet solid phases $NaNO_3(s)$ and $KNO_3(s)$ into a solid solution. [d] The previous solution having the starting composition $x(NaNO_3) = 0.5001$ and $x(KNO_3) = 0.4999$ was boiled down until the maximum boiling temperature composition was reached. This boiling temperature corresponds to MDRH/MERH = 14.3 ± 0.3 % assuming that the temperature uncertainty is 0.7_5 °C. [e] This is the average of six determinations for $NaNO_3 + H_2O$ reported in Table I.