1. Lead sulfite; PbSO₃; [7446-10-8]
2. Water; H₂O; [7732-18-5]

CRITICAL EVALUATION:

Lead sulfite crystallizes from aqueous solutions as the anhydrous salt, PbSO₃. The solubility of PbSO₃ in water has not been thoroughly investigated. Numerical data have been given by Terres et al. (1), Hanus et al. (2), Mangan (3), Ermolaev et al. (4), and Rodin et al. (5) (precipitate identified as PbSO₃·1/2H₂O (5) [7446-10-8]), but not under comparable experimental conditions. Thus only Hanus et al. (2) and Rodin et al. (5) reported on the solubility of lead sulfite in pure water, namely m(PbSO₃) = 8 x 10⁻⁶ mol kg⁻¹ in hot water (2) and c(PbSO₃) = 2.5 x 10⁻⁶ mol dm⁻³ at 293 K and 1.62 x 10⁻⁵ mol dm⁻³ at 363 K, respectively (5). The data given by Terres et al. (1), Mangan (3), and Ermolaev et al. (4), which were all obtained in the presence of a third component, may be extrapolated to pure water to be ≈ 2.8 x 10⁻³ mol kg⁻¹ (molality scale), < 3.0 x 10⁻⁴ mol dm⁻³, and < 1.1 x 10⁻⁶ mol dm⁻³ (both molarity scale), respectively, at room temperature. The scarce information on the temperature shift of the solubility of PbSO₃ is contradictory. A negative temperature coefficient of the solubility is reported by Terres et al. (1) and a positive temperature shift by Ermolaev et al. (4) and Rodin et al. (5). Mangan (3) has found a positive temperature coefficient of solubility below 315 K and a negative one at higher temperatures.

TENTATIVE VALUES

The solubility of PbSO₃ in water at room temperature is approximately 1 x 10⁻⁶ mol dm⁻³ (molarity scale) (3 x 10⁻⁴ g/dm³). The temperature coefficient of solubility is probably positive.

The solubility of lead sulfite in water is affected by the presence of a third compound. This is shown by the fragmentary experimental data on the systems PbSO₃-SO₂-H₂O (1), PbSO₃-NH₄CH₃CO₂-H₂O (3), and PbSO₃-NaNO₃-H₂O (4). The solubility of PbSO₃ increases to 4 x 10⁻² mole (10 g)/kg H₂O with increasing SO₂ content (1,6) at 298 K, to 1.3 x 10⁻⁵ mol dm⁻³ (molarity scale) (3.8 x 10⁻³ g/dm³) with NaNO₃ concentration increasing to 400 g/dm³ (4), and to 3.6 x 10⁻⁴ mol dm⁻³ (0.10 g/dm³) with pH value decreasing to 2.8 (4) and decreases with increasing concentration of ammonium acetate (3,7), all at 293.2 K. It has been further claimed that PbSO₃ is insoluble in aqueous alcohol (3) and soluble in solutions of sodium hydroxide (3) and that the solubility of PbSO₃ increases in the presence of citrate and tartrate (3).

REFERENCES

**COMPONENTS:**

1. Lead sulfite; PbSO$_3$; [7446-10-8]
2. Water; H$_2$O; [7732-18-5]

**EVALUATOR:**

H.D. Lutz,
Dept. of Chemistry,
University of Siegen,
FR Germany.
May 1983.

**CRITICAL EVALUATION:** (continued)

6. Rohrig, A. J. Prakt. Chem. 1889, 37, 217

COMPONENTS:
1. Lead sulfite; PbSO₃; [7446-10-8]
2. Water; H₂O; [7732-18-5]

ORIGINAL MEASUREMENTS:
Hanus, J.; Hovorka, V.

VARIABLES:
One temperature: "hot"

PREPARED BY:
H.D. Lutz

EXPERIMENTAL VALUES:
The authors report the solubility of PbSO₃ in hot water to be

\[ 2.2 \times 10^{-3} \text{ g/dm}^3 \text{ H}_2\text{O} \]

This value is equal to (compiler)

\[ m(\text{PbSO}_3) = 8.0 \times 10^{-6} \text{ mol kg}^{-1} \]

AUXILIARY INFORMATION

METHOD APPARATUS/PROCEDURE:
The loss of weight of lead sulfite was determined by washing with different amounts of hot water.

SOURCE AND PURITY OF MATERIALS:
PbSO₃ was precipitated with Na₂S₂O₅.

ESTIMATED ERROR:
Data given are the results of several experiments with different amounts of hot water.

REFERENCES.
COMPONENTS:
1. Lead sulfite; PbSO₃; [7446-10-8]
2. Water; H₂O; [7732-18-5]

ORIGINAL MEASUREMENTS:
Rodin, I.V.; Margulis, E.V.

VARIABLES:
Three temperatures: 293, 323 and 363 K

PREPARED BY:
B. Engelen

EXPERIMENTAL VALUES:
The solubility of PbSO₃·0.5H₂O [7446-10-8] in water at various temperatures are reported. The solubility products reported are defined as $K_{s0}(\text{PbSO}_3·0.5\text{H}_2\text{O}) = [\text{Pb}^{2+}]^2$.

<table>
<thead>
<tr>
<th>t/°C</th>
<th>Pb mg/dm³</th>
<th>PbSO₃ mg/dm³</th>
<th>$10^5$c/mol dm⁻³</th>
<th>$10^{12}K_{s0}$ mol² dm⁻⁶</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>0.52</td>
<td>0.72</td>
<td>0.25</td>
<td>6.25</td>
</tr>
<tr>
<td>50</td>
<td>1.41</td>
<td>1.95</td>
<td>0.68</td>
<td>46.2</td>
</tr>
<tr>
<td>90</td>
<td>3.35</td>
<td>4.64</td>
<td>1.62</td>
<td>262</td>
</tr>
</tbody>
</table>

* Calculated by the compiler.

AUXILIARY INFORMATION

METHOD APPARATUS/PROCEDURE:
Saturation method. Equilibrium was established by stirring the saturated solutions in thermostatically controlled glass tubes. Equilibrium was tested for analytically - 2 hr was reported to be sufficient. Lead was determined polarographically.

SOURCE AND PURITY OF MATERIALS:
Lead sulfite was precipitated from Pb(CH₃COO)₂ solutions with Na₂SO₃.

ESTIMATED ERROR:
Temperature: ±0.5 K

REFERENCES:
COMPONENTS:
1. Lead sulfite; PbSO₃; [7446-10-8]
2. Sulfur dioxide; SO₂; [7446-09-5]
3. Water; H₂O; [7732-18-5]

ORIGINAL MEASUREMENTS:
1. Terres, E.; Rühl, G.
   Angew. Chem. 1934, 47, 322-4.
2. Terres, E.; Rühl, G.
   Beitrag zur Chemie der schwefligen
   Saure, Beiheft zu den Zeitschriften des
   Vereins deutscher Chemiker No 8, 1934.

VARIABLES:
Two temperatures: 288 and 298 K
Concentration of SO₂

PREPARED BY:
H.D. Lutz, B. Engelen

EXPERIMENTAL VALUES:
The authors report the solubility of lead sulfite in aqueous sulfurous acid solutions at
15 and 25°C. In the first paper, the experimental data are given in a graph.
Numerical data are reported in the second paper.

AUXILIARY INFORMATION

METHOD APPARATUS/PROCEDURE:
SO₂-H₂O mixtures were treated together with
solid PbSO₃ in closed glass ampoules at
the stated temperatures. The solutions
obtained were filtered through a fine glass
frit and, after oxidation of the sulfite,
analysed for sulfate and lead.

SOURCE AND PURITY OF MATERIALS:
PbSO₃ was precipitated from a solution of
lead acetate with Na₂SO₃.

ESTIMATED ERROR:

REFERENCES:
COMPONENTS:

1. Lead sulfite; PbSO₃; [7446-10-8]
2. Sulfur dioxide; SO₂; [7446-09-5]
3. Water; H₂O; [7732-18-5]

ORIGIONAL MEASUREMENTS:


EXPERIMENTAL VALUES (continued):

<table>
<thead>
<tr>
<th>SO₂</th>
<th>PbO</th>
<th>m(PbO)²⁺</th>
<th>Solid phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>mol %</td>
<td>mol %</td>
<td>10⁻² mol kg⁻¹</td>
<td></td>
</tr>
<tr>
<td><strong>Temperature = 15°C</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.15</td>
<td>0.01</td>
<td>0.56</td>
<td>lead sulfite</td>
</tr>
<tr>
<td>2.35</td>
<td>0.02</td>
<td>1.14</td>
<td>&quot;</td>
</tr>
<tr>
<td>5.71</td>
<td>0.03</td>
<td>1.77</td>
<td>&quot;</td>
</tr>
<tr>
<td>7.82</td>
<td>0.08</td>
<td>4.82</td>
<td>&quot;</td>
</tr>
<tr>
<td>8.50</td>
<td>0.11</td>
<td>6.68</td>
<td>&quot;</td>
</tr>
<tr>
<td>9.18</td>
<td>0.12</td>
<td>7.34</td>
<td>&quot;</td>
</tr>
<tr>
<td>9.80</td>
<td>0.09</td>
<td>5.54</td>
<td>Pb(HSO₃)²⁺</td>
</tr>
<tr>
<td>10.92b</td>
<td>0.12</td>
<td>7.49</td>
<td></td>
</tr>
<tr>
<td><strong>Temperature = 25°C</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.71</td>
<td>0.02</td>
<td>1.15</td>
<td>lead sulfite</td>
</tr>
<tr>
<td>6.85</td>
<td>0.04</td>
<td>2.38</td>
<td>&quot;</td>
</tr>
<tr>
<td>9.14</td>
<td>0.06</td>
<td>3.67</td>
<td>&quot;</td>
</tr>
<tr>
<td>9.62</td>
<td>0.07</td>
<td>4.30</td>
<td>Pb(HSO₃)²⁺</td>
</tr>
<tr>
<td>10.08b</td>
<td>0.06</td>
<td>3.71</td>
<td></td>
</tr>
</tbody>
</table>

a Compilers.

b Between 11 and 95 mol % SO₂ the mixtures separate into two liquid layers.
COMPONENTS:

1. Lead sulfite; PbSO₃; [7446-10-8]
2. Ammonium acetate; NH₄CH₃CO₂; [631-61-8]
3. Water; H₂O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Mangan, J.L.

PREPARED BY:
H.D. Lutz

EXPERIMENTAL VALUES:

The author reports the solubility of PbSO₃ in aqueous solutions containing various amounts of ammonium acetate at different temperatures and pH values. The author also reports that lead sulfite is insoluble in aqueous alcohol but soluble in sodium hydroxide solutions, and that the solubility of lead sulfite is considerably increased in the presence of citrate and tartrate.

<table>
<thead>
<tr>
<th>NH₄CH₃CO₂ mol/dm³ soln</th>
<th>10³°C g/dm³</th>
<th>pH</th>
<th>10³°C g/dm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>1.80</td>
<td>4.8</td>
<td>1.04</td>
</tr>
<tr>
<td>1.0</td>
<td>1.20</td>
<td>5.1</td>
<td>0.86</td>
</tr>
<tr>
<td>1.5</td>
<td>1.40</td>
<td>5.6</td>
<td>0.72</td>
</tr>
<tr>
<td>2.0</td>
<td>1.40</td>
<td>5.9</td>
<td>0.56</td>
</tr>
<tr>
<td>3.0</td>
<td>1.40</td>
<td>6.1</td>
<td>0.44</td>
</tr>
<tr>
<td>4.0</td>
<td>1.00</td>
<td>7.9</td>
<td>0.36</td>
</tr>
<tr>
<td>5.0</td>
<td>1.60</td>
<td>9.0</td>
<td>0.74</td>
</tr>
</tbody>
</table>

a  20°C, pH 6, measured before adding PbSO₃.

b  20°C, non-saturating solute NH₄CH₃CO₂, 1 mol/dm³ soln.

(continued on next page)

METHOD APPARATUS/PROCEDURE:

PbSO₃ was suspended in ammonium acetate solutions of the given concentration and maintained by shaking in a thermostatically controlled flask at the given temperatures for 2 - 3 hr. To prevent oxidation, 5 mass % of sucrose was added to the ammonium acetate solution. The suspended solid was allowed to settle and the saturated solution was filtered rapidly. Sulfite was determined iodometrically. The pH was measured with a glass electrode.

SOURCE AND PURITY OF MATERIALS:

Lead sulfite was precipitated from a solution of lead acetate, washed thoroughly with a 5 mass % sucrose soln, and finally washed with the appropriate ammonium acetate solutions before the solubility was determined.

REFERENCES:
**COMPONENTS:**

1. Lead sulfite; PbSO₃; [7446-10-8]
2. Ammonium acetate; NH₄CH₃CO₂; [631-61-8]
3. Water; H₂O; [7732-18-5]

**ORIGINAL MEASUREMENTS:**

Mangan, J.L.


**EXPERIMENTAL VALUES (continued):**

<table>
<thead>
<tr>
<th>t/°C</th>
<th>10³c mol dm⁻³</th>
<th>g/dm³ (compiler)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.20</td>
<td>0.345</td>
</tr>
<tr>
<td>15</td>
<td>1.35</td>
<td>0.388</td>
</tr>
<tr>
<td>42</td>
<td>1.70</td>
<td>0.488</td>
</tr>
<tr>
<td>56</td>
<td>1.40</td>
<td>0.402</td>
</tr>
</tbody>
</table>

c pH 6, measured before adding PbSO₃. Non-saturating solute - NH₄CH₃CO₂ 1 mol/dm³ soln.
COMPONENTS:
1. Lead sulfite; PbSO₃; [7446-10-8]
2. Sodium nitrate; NaN₂₃; [7631-99-4]
3. Acetate buffer; CH₃CO₂H-NaCH₃CO₂; [64-19-7]; [127-09-3]
4. Water; H₂O; [7732-18-5]

VARIABLES:
Temperature: 293 - 353 K
pH value
Concentration of NaN₂₃

EXPERIMENTAL VALUES:
The authors report the solubility of lead sulfite in solutions of various NaN₂₃ concentrations for various pH values and temperatures. Experimental data are given in three graphs and as some numerical figures. The solubility increases from 1.1 x 10⁻⁶ to 1.32 x 10⁻⁵ mol/dm³ soln with NaN₂₃ concentration increasing from 100 g to 400 g/dm³ soln at 20°C (Fig. 1), decreases from 3.64 x 10⁻⁴ to 1.76 x 10⁻⁵ mol/dm³ soln with pH value increasing from 2.8 to 7.0 at 20°C and a NaN₂₃ concentration of 200 g/dm³ soln (Fig. 2) and increases with increasing temperature; data in Fig. 3 are for pH 4.49 and a NaN₂₃ concentration of 200 g/dm³ soln.

AUXILIARY INFORMATION

METHOD APPARATUS/PROCEDURE:
Saturation method. Equilibrium was established after 8 hr. To avoid oxidation of the sulfite, 0.005% phenylenediamine was added to the solutions. Lead was determined colorimetrically.

REFERENCES:
Ermolaev, M.I.; Kudrina, L.T.
**COMPONENTS:**
1. Lead sulfite; PbSO$_3$; [7446-10-8]
2. Sodium nitrate; NaNO$_3$; [7631-99-4]
3. Acetate buffer; CH$_3$CO$_2$H–NaCH$_3$CO$_2$ [64-19-7]; [127-09-3]
4. Water; H$_2$O; [7732-18-5]

**EXPERIMENTAL VALUES (continued):**

The following figures are estimated by the compilers from the graphs given by the authors.

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Solubility of PbSO$_3^a$</th>
<th>Solubility of PbSO$_3^b$</th>
<th>Solubility of PbSO$_3^c$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t/°C</td>
<td>10$^4$c mol dm$^{-3}$</td>
<td>pH</td>
</tr>
<tr>
<td>25</td>
<td>1.3</td>
<td></td>
<td>2.8</td>
</tr>
<tr>
<td>30</td>
<td>1.3</td>
<td></td>
<td>3.3</td>
</tr>
<tr>
<td>35</td>
<td>1.5</td>
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<td>3.7</td>
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<td>70</td>
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<td>6.2</td>
</tr>
<tr>
<td>80</td>
<td>9.0</td>
<td></td>
<td>7.0</td>
</tr>
</tbody>
</table>

$^a$ Non-saturating solute 200 g NaNO$_3$/dm$^3$, pH 4.49.

$^b$ Non-saturating solute 200 g NaNO$_3$/dm$^3$, temperature 20°C.

$^c$ 20°C.

**ORIGINAL MEASUREMENTS:**
Ermolaev, M.I.; Kudrina, L.T.