Supplementary Materials: Concentration Dependencies of Diffusion Permeability of Anion-Exchange Membranes in Sodium Hydrogen Carbonate, Monosodium Phosphate, and Potassium Hydrogen Tartrate Solutions

Natalia Pismenskaya *, Veronika Sarapulova, Ekaterina Nevakshenova, Natalia Kononenko, Maria Fomenko and Victor Nikonenko

Department of Physical Chemistry, Kuban State University, 149 Stavropolskaya st., 350040 Krasnodar, Russia; vsarapulova@gmail.com (E.N.); nevakshenova-ekaterina@yandex.ru (V.S.); kononenk@chem.kubsu.ru (N.K.); mfomenkokubsu@gmail.com (M.F.); v_nikonenko@mail.ru (V.N.)

* Correspondence: n_pismen@mail.ru; Tel.: +7-918-48-91-292

Received: 25 November 2019; Accepted: 8 December 2019; Published: date

(a)

(b)
Figure S1. Distribution of molar fractions of the carbonic (a), phosphoric (b) and tartaric (c) acid species depending on pH.

Table S1. pKα values [41] for carbonic, phosphoric and tartaric acids

<table>
<thead>
<tr>
<th>Acid</th>
<th>pKα1</th>
<th>pKα2</th>
<th>pKα3</th>
</tr>
</thead>
<tbody>
<tr>
<td>H₂CO₃</td>
<td>6.35</td>
<td>10.32</td>
<td>-</td>
</tr>
<tr>
<td>H₃PO₄</td>
<td>2.12</td>
<td>7.21</td>
<td>12.34</td>
</tr>
<tr>
<td>H₂T</td>
<td>2.98</td>
<td>4.34</td>
<td>-</td>
</tr>
</tbody>
</table>

The Equations (S1) – (S6) represent schematically protolysis reactions involving tribasic acid (phosphoric acid) species and water molecules, which take into account the acid dissociation (Kₐ), water dissociation (K₀) and the base ionization (Kₐ⁻) equilibrium constants; \( K_b = \frac{K_W}{K_a} \), where pK₀=14.

\[
\begin{align*}
H_2A^- + H_2O & \underset{k_1}{\overset{k_{-1}}{\rightleftharpoons}} H_3A + OH^-; & K_{b1} &= \frac{C_{H_2A^-}C_{OH^-}}{C_{H_3A^+}} \quad (S1) \\
H_3A + H_2O & \overset{k_2}{\underset{k_{-2}}{\rightarrow}} H_2A^- + H_3O^+; & K_{a1} &= \frac{C_{H_3A^-}C_{H^+}}{C_{H_2A^-}} \quad (S2) \\
HA^{2-} + H_2O & \overset{k_3}{\underset{k_{-3}}{\rightarrow}} H_2A^- + OH^-; & K_{b2} &= \frac{C_{H_2A^-}C_{OH^-}}{C_{HA^{2-}}} \quad (S3) \\
H_2A^- + H_2O & \overset{k_4}{\underset{k_{-4}}{\rightarrow}} HA^{2-} + H_3O^+; & K_{a2} &= \frac{C_{H_2A^-}C_{H^+}}{C_{HA^{2-}}} \quad (S4) \\
A^{3-} + H_2O & \overset{k_5}{\underset{k_{-5}}{\rightarrow}} HA^{2-} + OH^-; & K_{b3} &= \frac{C_{HA^{2-}}C_{OH^-}}{C_{A^{3-}}} \quad (S5) \\
HA^{2-} + H_2O & \overset{k_6}{\underset{k_{-6}}{\rightarrow}} A^{3-} + H_3O^+; & K_{a3} &= \frac{C_{A^{3-}}C_{H^+}}{C_{HA^{2-}}} \quad (S6)
\end{align*}
\]