Phosphate Stabilization in Cooling Water

By Dave Christophersen, CWT
Originally Published: CSTN – September 2005

\[
pHc = \frac{11.755 - \log(Ca) - \log(PO_4) - 2 \log(T)}{0.65}
\]

- \(pHc\) = pH of saturation of calcium phosphate
- \(Ca\) = Concentration of calcium as CaCO\(_3\) in recirculation water
- \(PO_4\) = Concentration of ortho-phosphate in recirculation water
- \(T\) = Temperature in degrees Celsius

Notes

- Calcium phosphate is very insoluble.
- If there is calcium present in the water above 20 ppm and ortho-phosphate is above 1-2 ppm, a phosphate stabilizing polymer should be used.
- As a rule, there should be at least 1 ppm phosphate stabilizing polymer per ppm ortho-phosphate, but more as the pH gets higher.
- The pH\(_c\) should be not more than 1 pH unit over actual pH.
- As the level of calcium or iron increases, the risk of precipitation with phosphate increases, so less phosphate should be maintained, and more polymer is needed.
- If calcium is very high, then phosphate levels should be on low side and polymer on the high side, etc.
- If the phosphate level is below the maximum target phosphate, then lower levels of polymer are possible.
- Iron levels above 1-3 ppm would create a desire to have higher polymer levels. Starting point would be 1-3 ppm active AR-540 per ppm of iron above the guidelines shown in Table 1 on the next page.
Table 1: Beginning Guidelines for Cooling Water Phosphate

<table>
<thead>
<tr>
<th>pH</th>
<th>Ca (ppm as CaCO₃)</th>
<th>Max. Target PO₄ ppm</th>
<th>Active AR-540 ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 – 7.5</td>
<td>20 – 1,200</td>
<td>8 – 15</td>
<td>8 – 15</td>
</tr>
<tr>
<td>7.5 – 8.0</td>
<td>20 – 1,000</td>
<td>6 – 10</td>
<td>8 – 15</td>
</tr>
<tr>
<td>8 – 8.5</td>
<td>20 – 800</td>
<td>4 – 8</td>
<td>8 – 15</td>
</tr>
<tr>
<td>8.5 – 9.0</td>
<td>20 – 800</td>
<td>2 – 4</td>
<td>8 – 15</td>
</tr>
<tr>
<td>9 – 9.5</td>
<td>20 – 800</td>
<td>1 – 3</td>
<td>8 – 15</td>
</tr>
</tbody>
</table>