**Water Treatment on Evaporative Condenser and Cooling Towers**

These notes are intended to complement Technical Bulletin No 17 on “Cooling Tower Maintenance”. They aim to provide information on the subject of water treatment and to emphasise the importance of bleed-off to the efficiency operation of evaporative condensers and cooling towers. This document has been revised to draw attention to the need to avoid the use of copper pipework upstream from an evaporative condenser particularly where a water softener is being used.

The revision issue is now a letter sequence.

**1.0 General**

All water (except distilled water) contains dissolved salts. No matter the source of the water it will certainly cause trouble in an evaporative device if there is not either a bleed or treatment or both.

Most of our evaporative condensers have galvanised steel coils. If copper ions are present in the water feed to the coils and if there is no corrosion inhibition chemicals in use then the pitting and corrosion of the coils is a strong possibility. Non chemical treatment systems can suffer badly.

We should always consult a specialist and ensure that he is aware that the condenser has a galvanised coil and that he takes the location into account.

Undesirable water impurities for industrial use fall into the following main groups:

1. Dissolved minerals
2. Dissolved gases
3. Turbidity
4. Colour
5. Taste and odour
6. Micro-organisms

The amount of each tolerated in any given water depends on what the water is used for.

Evaporative condensers and cooling towers which use recirculating water to remove heat can cut water usage by about 95% compared to “once-through” mains water systems by employing the high latent heat capacity. (The ratio of latent heat to sensible heat for water at atmospheric pressure is of the order of 100 to 1).

Incorrect water-treatment can lead to one or all of the following:

1. Corrosion
2. Growth of algae and slime
3. Formation of hard scale
4. Pitting corrosion due to copper particles in soft water. **Note,** we should avoid the use of copper pipework upstream of the condenser and particularly after a water softener. We should also avoid having “dead-legs” in our pipework
5. Uncontrolled growth of harmful bacteria, for example Legionella Pneumophilia.
2.0 **Treatment Methods**

These include:

2.1 **Bleed Control**

When evaporation takes place, the dissolved solids are left behind. If the only water loss from the system is by evaporation then the continual addition of make-up produces higher and higher solids concentration until the tubes become coated and the performance of the condenser is affected. To keep the concentration of the recirculating water within limits it is necessary to bleed off some of it to waste.

For example, suppose 1 m$^3$ of water contains $x$ g/m$^3$ of dissolved solids. If the bleed rate is $B$ times the rate of evaporation, then the concentration of dissolved solids in the recirculating water will become:

$$C = \frac{(1 + B)x}{B}$$

So if the bleed rate is equal to the evaporation rate, i.e. $B = 1$ then $C = 2x$ or twice that of the make-up.

But if the bleed rate is only half that of the evaporation rate, i.e. $B = \frac{1}{2}$ then $C = 3x$ or three times that of the make-up. This is sometimes called “three cycles of concentration”.

2.2 **Dosing**

Chemical dosing with sulphuric acid may be employed to keep scale forming salts of calcium and magnesium in solution by lowering the pH of the recirculating water. Further chemical inhibitors are then necessary to prevent corrosion damage. Water treatment specialists should be consulted.

2.3 **Demineralisation**

This needs special expensive equipment and even then could still allow corrosion.

3.0 **Summary Notes**

3.1 If there is no other treatment it is ESSENTIAL to BLEED – even if the water is reckoned to be “good”.

3.2 Water bleed off is still necessary when a water treatment package is used, and care should be taken not to use too high a concentration. For example the saving in total water usage between 3 cycles and 4 cycles is only 4% but this increases the level of dissolved solids by 33%.

3.3 When estimating jobs which include evaporative condensers or cooling towers it is important to advise customers to seek reports from a water consultant, but we should normally exclude water treatment. **Remember**, we are not specialists in this area.
3.4 Non-chemical biocidal treatments, even with suitable bleed-off, are probably not sufficient to prevent long term corrosion. Water treatment experts will give advise on suitable systems to suit the location.

<table>
<thead>
<tr>
<th>Date</th>
<th>Issue No</th>
<th>Issued by</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 1983</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>April 2000</td>
<td>2</td>
<td>DJH</td>
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<td>August 2003</td>
<td>C</td>
<td>DJH</td>
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