

information bulletin

WATER QUALITY AND EVAPORATIVE COOLING

Evaporative cooling can be an effective and energy-efficient method for cooling homes, businesses, institutions and industrial facilities. Good maintenance procedures are needed to keep the evaporative coolers operating properly and safely. A key issue for proper maintenance is water quality.

Cambridge Engineering manufactures evaporative coolers for industrial and commercial applications. Cambridge chooses to install Munters Corporation media in their coolers (whether direct or indirect).

John M. Tiangco of Tiangco Consulting Services presented a paper titled *Munters Direct Evaporative Cooling Water Quality*. The following was extracted from his presentation:

Sources of water include rain, underground aquifers, wells, rivers and lakes. Mineral content and suspended solids can vary significantly. Water contains ions which come from minerals. Ions in solution are referred to as “*dissolved solids*”. When cations and anions join they precipitate to form salts such as sodium chloride. Metal cations can join with oxygen to form oxides, such as iron oxide.

Natural water supplies will often have seasonal variances for mineral content. A common mistake made by users of evaporative cooling is to rely on a water analysis from a single grab sample as opposed to getting comprehensive information showing minimum, maximum and average levels of minerals. This information should be available from the provider when dealing with potable supplies and many recycled supplies.

Impurities in water can cause problems with evaporative cooling systems if left untreated or uncontrolled.

Measurement of impurities

The sum of all dissolved solids in water is called *total dissolved solids* (TDS). The simplest method to determine an approximate level of TDS is an electrical measure of conductivity expressed as micromhos/cm ($\mu\text{M}/\text{cm}$). It won't provide an exact answer of TDS but it is practical for a given water supply and cycles of concentration values.

pH is a measure of acidity or alkalinity of a solution on a scale of 0 – 14. Pure water, considered neutral, has a pH of 7. Values less than 7 are increasingly acidic while values greater than 7 are increasingly more alkaline.

The meaning of “buffer” for pH

The term “buffer” as it relates to pH is the ability to resist change. A well buffered pH will be resistant to change. Alkalinity is a good buffering agent.

Water hardness

Other elements affecting water include may include: calcium, magnesium, silica. Total hardness is the sum of calcium hardness and magnesium hardness. It is the calcium levels *as*

ppm CaCO₃ that are used in the scale indices, including the Puckorius Scaling Index, that Munters prefers to use in determining optimal water quality for media.

An additional challenge to maintaining good water quality is that the evaporative process allows for mineral content of the water to increase. This leads to the concept referred to as *cycles of concentration* (coc). When the mineral content is 2X that of the makeup water supply, it is defined as 2 coc.

When mineral content exceeds saturation limits, salts are precipitated. *Scale* is a form of salt. The most commonly found scale is calcium carbonate. Other scales include calcium sulfate, calcium phosphate, calcium fluoride, magnesium silicate and barium sulfate. Oxide scales include iron oxide and manganese oxide.

The saturation point where minerals precipitate dictates the cycles of concentration that can be acceptable in an evaporative water system.

The goals of water treatment include:

1. Control scale and fouling
2. Control corrosion
3. Control biological growth, both micro and macro

Munters preferred approach

Munters has adopted many of the methods used for water treatment directly from the cooling tower industry, but with a more conservative approach. Cooling towers have much in common with evaporative coolers, but with some key differences that justify a more conservative approach.

For the control of scale and fouling, Munters prefers to use natural water chemistry that does not require inhibitor treatments, if possible. Water preparation technologies are approved.

Solubilizing type inhibitor treatment technologies are not recommended due to the high mineral loading when media experiences dry cycles.

Crystal modifier type inhibitor treatment technologies are approved for Munters media.

The Puckorius Scaling Index (PSI) is a tool that measures the calcium carbonate scale-forming tendencies of water. Other indices include the Langelier Scaling Index (LSI) and the Ryznar Scaling Index (RSI). Munters has found the PSI to be the most reliable and accurate index of these three.

Munters media requirements and recommendations include:

1. Maintain a pH of 7 – 9
2. Avoid oxidizers (exceptions are limited)
3. Maintain a *Puckorius Scaling Index* of 6 – 7