System Volumes
To properly design and apply a water treatment program, it is necessary to know the system volume. This is especially important when adding biocides to either a closed loop or cooling tower system. Accurate knowledge of the system volume ensures the right amount of treatment is added. An easy and accurate means of estimating the system volume is using chemical treatment additions. Salt is commonly used as it is easy to test for, very soluble, and inexpensive. However, the same general method can be used when adding many treatment products. In fact, it is often preferable to use a chemical treatment product since it will eliminate the need to subsequently flush the system and will reduce concerns about the corrosiveness of high chloride levels. There are three ways to determine system volumes
1. Estimate the volume based on system tonnage: 3-10 gallons per ton depending on the type of tower. This is not an accurate method and can result in underfeed or overfeed of chemicals.
2. Calculate an estimate based on the dimensions of the system piping and sump dimensions. This is more accurate if all dimensions are measured accurately, which is often difficult to do.
3. Use a chemical addition calculation, which is based on the addition of a measured amount of chemical into the system and testing for the residual of that chemical in the system water.

Chemical Addition Procedure
The following procedure can be used when adding many of Chem-Aqua's treatment products. The product used must contain a component that is easily tested for and not consumed by chemical reactions occurring in the system water. The density of the treatment product and the percent activity of the component being measured must also be known.
1. Eliminate all sources of water loss, such as bleed, overflow, etc.
2. Discontinue chemical feed to system
3. Determine the initial chemical level in system water
4. Add a predetermined amount of chemical to the system (dissolve dry products before adding)
5. Allow the system to circulate until it is well mixed
6. As soon as complete mixing has occurred, recheck the chemical level of the system water. Complete mixing can be assumed when the component level stabilizes. Do not allow evaporative systems to operate for extended periods of time without bleed.
7. Calculate the increase in the chemical level due to the treatment product addition
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   \text{ppm Chemical Level Increase} = \frac{\text{Chemical Level}_{\text{final}} - \text{Chemical Level}_{\text{initial}}}{\text{ppm Chemical Increase}}
   \]
8. Estimate the system volume in gallons
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   \text{Volume (gal)} = \frac{\text{Lbs Product} \times 120,000 \times \% \text{Activity}}{\text{ppm Chemical Increase}}
   \]
   Be sure to convert the percent activity to a decimal equivalent (25% = 0.25)

Example One: Method Using Chem-Aqua 15000MT for Cooling Tower System
Consider a cooling tower system you think holds 30,000-40,000 gallons. The initial molybdenum level is 0.42 ppm. You add 19.1 lbs or 2 gallons of Chem-Aqua 33150 to the system. Chem-Aqua 33150 is 0.25% active molybdenum and has a density of 9.55 lbs/gal. After mixing, you find the molybdenum level has increased to 0.54 ppm. What is the estimated system volume?

ppm Mo increase = \text{Mo level}_{\text{final}} - \text{Mo level}_{\text{initial}} = 0.54 \text{ ppm Mo} - 0.42 \text{ ppm Mo} = 0.12 \text{ ppm Mo}

\[
\frac{\text{Lbs Product} \times 120,000 \times 0.25}{0.12 \text{ ppm Mo}} = \frac{19.1 \text{ lbs} \times 120,000 \times 0.0025}{0.12 \text{ ppm Mo}}
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Volume (gal) = 47,750 gallons
Example Two: Method using Chem-Aqua 888 for Closed Loop System

Consider a closed loop system you think holds 3,000-5,000 gallons. Chem-Aqua 52885 is 4.7% active molybdenum and has a density of 9.8 lbs/gal. The initial molybdenum level is 42 ppm. You add 2.45 lbs or 1/4 gallon of Chem-Aqua 52885 to the system. After mixing, you find the molybdenum level has increased to 45 ppm. What is the estimated system volume?

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\text{ppm Mo increase} = \text{Mo level}_{\text{final}} - \text{Mo level}_{\text{initial}} = 45 \text{ ppm Mo} - 42 \text{ ppm Mo} = 3.0 \text{ ppm Mo}
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\[
\text{Volume (gal)} = \frac{\text{Lbs Product} \times 120,000 \times \% \text{ Activity}}{\text{ppm Chemical Increase}} = \frac{2.45 \text{ lbs} \times 120,000 \times 0.047}{3.0 \text{ ppm Mo}}
\]

Volume (gal) = 4,606 gallons