Sample _________Ton LEED Application

ID Credit 1.1   Chemical Free HVAC Water Treatment

Intent

To reduce air and water pollution, while improving energy efficiency and eliminating potential O&M hazards from the proximity to and handling of toxic chemicals.

Rationale

Water used in site or building-related systems, such as wastewater treatment facilities, cooling towers (for water-based HVAC systems), boilers, decorative fountains, and/or laboratory or manufacturing system processes, often utilizes chemicals to treat the water used in these systems. Chemical treatment is typically used to prevent mineral scale formation (such scaling decreases thermal performance of HVAC systems), control biological activity, and inhibit corrosion (which decreases the expected service life of such systems, leading to wasteful, and expensive premature replacement).

Requirements and Submittals

Item 1. State how the system works.
Item 2. Specifically state the environmental benefits of the alternative system over a conventional system.
Item 3. State how the treated water is discharged or disposed of.
Item 4. State the chemicals and the quantities thereof eliminated through the use of the alternative process.

The following information is required to complete the analysis and calculate the volume of eliminated chemicals:

1. Cooling Tower Tonnage.
2. Number of hours per day and months per year of operation.
3. Estimated number of gallons of system water volume.
4. Estimated number of cycles of system operation.

Item 1.   How Pulsed-Power Systems Work

Pulsed-Power Systems produce a pulsed, time-varying, induced electric field inside a PVC pipe that is plumbed into the cooling tower's re-circulating water system. The electric signal changes the way minerals in the water precipitate, totally avoiding hard-lime scale by instead producing a non-sticking mineral powder in the bulk solution. This powder is then easily removed via filtration. As this mineral powder flocculates into larger masses, bacteria is captured and is also removed via filtration.. Also, some bacteria (injured via electroporation on their membrane walls, causing cell lysis) cannot reproduce, thus resulting in an exceedingly low bacteria population.

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Item 2. Environmental Benefits

A. Quantity of Avoided Chemicals

Over the projected 30-year life expectancy, the _______ton cooling system would have required ______gallons of industrial strength chlorine plus ________________gallons of isothiazoline.
Every year of operation _______gallons of contaminated tower water would be released into the local sewer system, which would require treatment by the local wastewater system. An additional __________gallons will be released into the environment as uncontrolled drift from the tower. All of these chemicals and their subsequent release to the environment are completely unnecessary with pulsed-power technology. See the calculations under Item 4 to derive these numbers.

B. Improved Energy Efficiency and System Longevity

Even the most energy-efficient equipment frequently suffers from significant performance losses through operational effects and long-term degradation. One such performance degradation is the reduction of efficient heat transfer across heat transfer surfaces, principally those that exchange heat between the open and closed loops of chillers and other heat exchangers. Note that the actual efficiency of new technology centrifugal chillers is *25%* poorer than their maximum efficiency. As previously mentioned, much of this degradation is from waterside fouling on heat exchange surfaces and degradation in evaporative capacity on cooling towers because of fill fouling. While scale is a visible and detrimental effect of less than perfect water treatment, biofilm is actually a more serious issue. For an equal thickness, biofilm has nearly five times the insulating capacity of scale, and can rapidly degrade system performance. The application of pulsed-power technology provides excellent control over a wide range of circumstances that both simplify water treatment and allow continuous high-efficiency operation. Since 23% of the entire power grid demand is used to operate cooling or refrigerant systems, improvement in the actual operating efficiencies of these technologies is vitally important.

C. Improved Indoor Air Quality

If chemical treatment is utilized in a cooling towers system, it can complicate the designer's goal to provide natural ventilation for a facility. Eg. It can be difficult to locate the air intakes away from contaminant sources such as the cooling tower plumes. This is critical for a facility that is designed for natural ventilation (and mechanical ventilation) intakes.

Item 3. How Non Chemically Treated Water is Discharged

As long as the chlorides are below 1000-ppm, the blow down from a pulse-power cooling tower is acceptable for groundwater discharge (watering the grass) or will impose no burden from added chemicals on publicly-owned treatment works (POTWs).

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Item 4. State the Quantity (and type) of Chemicals Eliminated through the use of the Alternative Process

The following fill in the blank form is used to estimate the quantity of chemicals used and disposed of at any facility. Note that chemical treatment regimens do vary from building to building, but the example provided represents a typical approach.

System Operating Parameters

The system is assumed to be operating at ***50%*** capacity for ____hours per day for _____months of the year.

The system parameters are then as follows:

a. Hours per Year of Operation
______months X 30 days/month X _____hours/day =_____ **hours/year**

b. Average Load
______Cooling Tower Tons X ***50%*** = ______**tons average load**

c. Re-circulating Water Flow
______Cooling Tower Tons X 3 gpm/ton = _______**Recirculating Water Flow (gpm)**

d. Drift Rate (0.01% recirculation rate)
______Re-circulating Water Flow gpm X 0.000 1 recirculation rate = ______**Drift Rate (gpm)**
______Drift Rate gpm X 60 minutes/hour X ______hours/year = _____**Drift Gallons per Year**

e. Evaporation Rate
______Cooling Tower Tons X 1.8 gph/ton = ______**Evaporation Rate (gph)**
______Evaporation Rate (gph) X _____hours/year = ______**Evaporation gallons per year**

f. Blow down *(*gallons per year)
Blow down + Drift at ______Cycles of Concentration is calculated as follows:
(Evaporation Rate (gph)/(Cycles-1))
______Evaporation Rate **(**gph)***/***(_____cycles-1) =_____**Blow down + Drift(gph)**
______Blowdown + Drift (gph) X _____hours/year operation =_____ **Blow down + Drift gallons per year**
______Blowdown + Drift gallons per year - ______drift gallons per year = ________ **Blow down gallons per year**.

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System Water Volume

Estimate of system water volume including basins and piping is ______gallons.

Standard Chemical Treatment Regime

As noted above, there are a variety of ways to chemically treat this system. Probably the most common is continuous chlorination with weekly slugs of a non-oxidizing biocide for microbial control, and a zinc/polyphosphate/triazole combination for corrosion and scaling control. CTI (Cooling Technology Institute) has a rule of thumb of 0.3 to *0.5* pounds of chlorine gas (or 0.3 to *0.5* gallons of *12.5%* industrial strength liquid bleach) for every million pounds of water re-circulated. Chlorine addition is based on the recirculation rate since most of the chlorine in the water is stripped away as chlorine gas as the water passes through the tower. Isothiazoline in a *1.5%* solution slug fed once per week to achieve a 2-ppm residual in the tower is the non-oxidizing biocide. Zinc at 2-ppm, polyphosphate at 20-ppm and triazole at 3-ppm are maintained at all times. Since the primary loss of these occurs through blow down and drift, sufficient additional chemicals to replace these losses are required. The blow down and drift would contain this level of contamination.

Estimate of Chlorine for Treatment (0.4 lbs/million lbs of recirculation)

_________**Re-circulating Water Flow (gpm)** X 8.337 pounds/gallon X 60 minutes/hour X **Hours of Operation per Year** X .000004 = _____**pounds per year of Industrial Bleach.**

This treatment will result in about 1-ppm of total chlorine in the cooling tower water (0.5-ppm free chlorine, 0.5-ppm disinfection by-products such as chloroform).

There will be .000001 X __________**Drift Gallons per Year** X 8.337 pounds/gallon = _______**pounds of chlorine and disinfection by-products released with the tower drift.**

There will be .000001 X _________**Blow down gallons/year** X 8.337 pounds/gallon = __________**pounds of chlorine and disinfection by-products released with the tower blow down.**

The balance of the chlorine added to the tower is released into the atmosphere as chlorine gas.

__________pounds per year of **industrial bleach -** _________pounds of **chlorine and disinfection by-products** released with the tower drift **-** ________pounds of **chlorine and disinfection by-products** released with the tower blowdown = _______**# of chlorine gas**

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Estimate of Isothiazoline for Microbial Treatment

Once per week the system would be slugged with sufficient isothiazoline to maintain 2-ppm residual in the tower for a few hours. Assuming that a 1.5% concentration was added, the quantity of isothiazoline used each week is as follows:

System Water Volume ________gallons X .000002 / 1.5% = _______gallons per week.

Since the system is assumed operating for _______months (______weeks) the annual usage of isothiazoline would be _______gallons/week X _____weeks = _______gallons per year.

Summary

The quantities of chemical released annually from the operation of the cooling towers are as follows:

_____pounds of chlorine
_____pounds of isothiazoline
_____gallons of Blowdown water containing 2-ppm zinc, 20-ppm polyphosphate, and 3 ppm triazole.

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