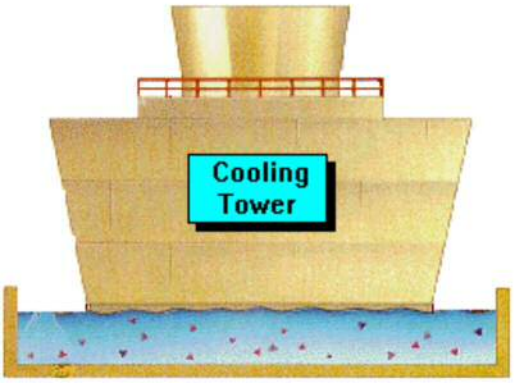
Cooling Tower Mathematics – Acid Feed Requirements



What you need to Know?	Example System	Result
Evaporation Rate	16000 Ton Chiller Plant (or use Recirc. Rate & Delta T & Evap Factor – *Dec 2012 Newsletter*)	3 gpm per 100 Tons or 480 GPM Evaporation
Cycles of Concentration (COC)	4 Cycles Actual ; 4 Cycles Desired (1)	4 Cycles
Makeup Rate	Evaporation + Blowdown	480 GPM +(Evap Rate/ (COC-1)) 480 GPM + 160 GPM = 640 GPM
Makeup Water Alkalinity	200 ppm	200 ppm
Desired Recirculating Water pH	Optimal pH Determination(2)	7.5
Estimated Cooling Water Alkalinity for Desired pH	See Attached pH vs Alkalinity Chart	70 ppm
Makeup Alkalinity for Desired pH	70 ppm/4 COC	17.5 ppm
Required Reduction in Cooling Water Alkalinity	200-17.5	182 ppm
Sulfuric Acid Required per ppm of Alkalinity Reduction	1 ppm of 93% (66 Baume) Acid per ppm Alkalinity reduction	182 ppm x 1 = 182 ppm
Pounds/day of Acid Required for Alkalinity Reduction	182 ppm X 7.7 M ppd (640 GPM X 1440 X 8.34/100000)	1401 pounds per day
Gallons /day of Acid Requied for Alkalinity Reduction	1401 ppd/ 15 #/gal.	93 gpd acid required

(1) Desired cycles of concentration determined by water chemistry and operating parameters

(2) Optimal pH determined by water chemistry guidelines

Chemical Treatment: Calcs:
pH/Acid relationships

Need to keep pH @ control point of 7.5.

What is M alkalinity at this point?

TA ppm	15-20	20-30	30-45	45-60	60-80	80-110	110-150
$\pm$ pH_{act}	6.8	7.0	7.2	7.4	7.6	7.8	8.0

Proposed recirculating water pH values ($\pm$ pH_{actual}), when sulfuric acid is dosed, based on residual total alkalinity (TA). pH is independent of cycles of concentration.

M Alkalinity = approx 70 ppm