South Coast Air Quality Management District
21865 Copley Drive, Diamond Bar, CA 91765-4178
(909) 396-2000 · www.aqmd.gov

Guidelines for Calculating Emissions from Cooling Towers
JUNE 2006

Introduction:

Beginning with FY 2005-2006 reporting cycle, facilities are required to report the particulate matter (PM) in addition to volatile organic compounds (VOCs), and toxics air contaminant (TAC) emissions from their cooling towers. The PM emissions are the result of the total dissolved solids in the circulating water which are carried out with the water that is entrained in the air being discharged from the tower. VOC emissions typically result from the leakage from process heat exchangers that service hydrocarbon (HC) process streams as well as from chemical treatment with VOC containing material added to the circulating water. VOC emissions are expected from cooling towers used in refineries and chemical plants, where the circulating water is used to cool down the process stream. VOC emissions are not expected from cooling towers used in other industries such as power plant facilities, high rise buildings, hotels, hospitals, etc). TACs emissions are typically from the toxic constituents of PM and/or VOC in the circulating water.

Emission Calculations Procedures:

Facilities may use the default emission factors (EFs) listed in Table 1 with equation (1), to estimate the PM and VOC emissions. Alternatively, facilities may use equation (2) to estimate the PM emissions (if the required site specific parameters are available). Equation (2) is listed in the Alternative Emission Calculation Section. Facility may also use equation (3) to estimate their TACs emissions (if applicable).

$$E = Q \times EF \qquad (1)$$

Where:

E = Annual Emissions in pounds per year (lb/yr)

Q = Cooling tower circulating water rate in **million gallons/day**

EF = Annual (365 days/yr) emission factor given in Table 1 and expressed in lb/million gallon per day

Table 1-Default Emission Factors for Cooling Towers:

Type of Industry	Applicable AER Form	Process Unit / Throughputs	VOC Emission Factors	PM Emission Factors
Refineries	R5	Million gallon /day	256[*]	6,935[**]
Chemical mfg Plant	B4	Million gallon /day	256[*]	6,935[**]
Others	B4	Million gallon /day	_	6,935[**]

[*] This emission factor is consistent with the default emission factor provided in AP-42, Section 5.1, Table 5.1-2. It is 0.7 (lb/million gallons/day) multiplied by 365. The 365 multiplier is used to convert from a daily to a yearly basis.

[**] This emission factor is consistent with the default emission factor provided in AP-42, Section 13.4, Table 13.4-1. It is 0.019 (1000 gallon/day) multiplied by 365 and 1000. The 365 multiplier is used to convert from a daily to a yearly basis and 1000 multiplier is used to convert from lb/1000 gallons to lb/million gallon

Alternative PM Emission Calculation Method:

Facilities may also use the equation (2), as listed below (if the site specific parameters are available) to estimate the PM emissions. If you choose to use this method, make sure to report your throughputs on Form B4 or R5 in million gallons per day and calculate the annual emission factors in pounds per million gallons per day. Your annual emission factor is calculated by dividing the PM emissions (lb/yr) estimated using equation (2), by throughput which is expressed in lbs/million gallons per day.

$$E \ = \dot{V} \times \frac{TDS}{10^6} \times \frac{\eta_{Drift}}{100} \times \rho_{H_2O} \times 60 \times OH \qquad (2)$$

Where:

E	= Annual Emissions in pounds per year (lb/yr)
$\dot{V}$	= Cooling tower circulating water rate (**gal/min**)
TDS	= Concentration of total dissolved solids in circulating water (PPM by weight)
η_{Drift}	= Drift loss of circulating water (%).
ρ_{H_2O}	= Density of water: 8.34 lb/gal
60	= Conversion from minutes to hours
OH	= Annual Operating hours (hours/year)

Emission Estimation of Toxic Air Contaminants:

If the toxic compounds are constituents of PM or VOCs, the annual toxic emission factor may be estimated by multiplying the weight percentage of the TAC in PM or VOC by the PM or VOC emission factor from form R5 or B4 as shown in equation (3) and report it on Form TAC.

$$EF_{TAC} = EF_{VOC\,or\,PM} \times W \qquad\qquad (3)$$

Where:

EF_{TAC} = Toxics air contaminants emission factor (lbs/million gallons/day)

$EF_{VOC\,or\,PM}$ = VOC or PM emission factor used to report cooling towers emissions (lbs/million gallons/day) listed in the above Table 1.

W = Weight fraction of TAC in VOC or PM (decimal format)

To report your TAC, on Form TAC, use the same throughput used on Form R5 or B4 (million gallons/day) and the emission factor calculated by equation (3) to report toxic emissions.

Convenient Conversion:

To convert from gallon per minute ($\dot{V}$ in equation (2)) to million gallons per day (Q in equation (1)) for cooling towers operating 24 hours per day and 365 days per year:

gallon/min x 0.0014 (or 1.44×10^{-3}) = million gallon/day
gallon/hr x 0.000024 (or 2.4×10^{-5}) = million gallon/day
gallon/year x 0.00000000274 (or 2.74×10^{-9}) = million gallon/day