TECHNICAL SUPPLEMENT 2: COOLING TOWERS

Technical Disclaimer

This technical supplement is intended to help you accurately determine and correctly report cooling tower emissions. It does not supersede or replace any state or federal law, regulation, or rule.

This guidance, which reflects our current understanding of how cooling towers work and how they generate emissions, how they are monitored or tested, and what data are available for emissions determination, may change over time as we continue our scientific studies and as new information becomes available. We welcome any data, information, or feedback that may improve our understanding of cooling tower emissions and thereby further improve emissions inventory emission determinations.

The represented calculation methods are intended as an emissions calculation aid; alternate calculation methods may be equally acceptable if they are based upon, and adequately demonstrate, sound engineering assumptions or data. If you have a question about the acceptability of a given emissions determination method, contact the Industrial Emissions Assessment Section at 512/239-1773.

Introduction

This technical supplement provides guidance on identifying, quantifying, and correctly reporting cooling tower emissions on the annual emissions inventory. It does not address devices such as fin-fan coolers and the cooling towers used exclusively in HVAC systems.

Definition of Terms

In this document, cooling tower refers to the equipment that, through the process of direct contact with atmospheric air, reduces the temperature of water used to cool either process equipment or process fluid streams. Cooling tower heat exchange system refers to the cooling tower and all associated heat exchangers, pumps, and ancillary equipment where water is used as a cooling medium to which the heat from process fluids is transferred.

Cooling Tower Structure

Each account cooling tower in VOC service must be represented as a FIN on the EI. To add a cooling tower in VOC service to the EI, use the Facility Information for Cooling Towers form. For cooling towers that exist in the EI, ensure that the appropriate FINs have a cooling tower FIN group and profile, and that all FIN profile characteristics are complete. If a cooling tower FIN has the incorrect FIN group, strike through the incorrect FIN group on the EI and write “cooling tower,” and then update

the FIN by attaching a completed Facility Information for Cooling Towers form to the EI; be sure to write “UPDATE FIN” across the top of the form.

Each cooling tower FIN must have a **stack** type EPN. This stack type EPN should have:

- a stack diameter equal to the diameter
  - of the tower top for natural draft towers; or
  - of the fan for mechanical draft towers; or
  - of one fan for multicell towers;
- a stack velocity of 10-20 feet per second;
- a temperature ranging from ambient to 15 degrees above ambient;
- a nonzero moisture content (generally between 5 to 10 percent); and
- no horizontal discharge, except for crossflow towers (possibly).

Cooling Tower Source Classification Codes (SCCs)

Use either SCC 38500101 for mechanical draft cooling towers, or SCC 38500102 for natural draft cooling towers.

Expected Emissions

Cooling towers operate in such a manner that they may emit particulate matter, dissolved solids, or chemicals entrained in the cooling water. Cooling tower emissions fall into three categories: particulate matter, inorganic compounds, and volatile organic compounds (VOCs). Any tower has the potential to emit all three of these emissions types in varying amounts, depending on the cooling tower's service.

Particulate Matter

Particulate emissions result from the presence of minerals or any dissolved or suspended solids in the cooling water. Air flowing through the tower can entrain water droplets and carry them out of the cooling tower in a process referred to as drift. Once these drift droplets leave the tower and evaporate, they deposit dissolved or suspended solids as fine particulate matter (PM_{10} or smaller).

Cooling towers are generally designed with drift eliminators, which are typically mesh, or a series of angled slates placed above the water inlet.

Note that, despite its name, a drift eliminator will reduce drift but will not eliminate it.

Inorganic Compounds

Inorganic emissions may result from inorganic process fluids leaking into the cooling water or from water treatment chemicals or other additives used in the cooling water system. The air flowing through the tower may strip these inorganic compounds from the water, resulting in their emission. Typical inorganic emissions may consist of chlorinated compounds, brominated compounds, or any other inorganic substance present in the cooling water.

Volatile Organic Compounds

Although some VOC emissions may result from the stripping of organic water treatment chemicals, the primary sources of VOC emissions are hydrocarbon-containing process fluids leaked into the cooling water by components of the cooling tower heat exchange system. Once the hydrocarbon-contaminated cooling water reaches the tower, the VOCs either flash out of the water or are stripped out by the tower's air flow. This may result in many tons of VOC emissions.

Emissions Determination

The process serviced by the cooling tower will largely determine how emissions should be determined and reported. For each contaminant type, determination methods and special concerns are discussed in the following sections.

Particulate Matter

Some manufacturers provide drift factors that may help you to determine particulate emissions. If you use a vendor-supplied drift factor, code the associated emissions with a determination methodology of "V" for vendor data.

If no drift data are available from the manufacturer, determine particulate emissions using the appropriate factor from AP-42, Chapter 13. Code the associated emissions with a determination methodology of "A."

Inorganic Compounds

Very little research has focused on inorganic compound emissions from cooling towers. Emissions due to water additives may be determined based on the additive's chemical characteristics, the amount of additive used, the total cooling water volume, and a scientifically-based assumption about the percentage of additive stripped from the cooling

water at the tower. Code the associated emissions with at determination methodology of "E" for estimated.

Volatile Organic Compounds

Emissions Determination Methodologies: Order of Preference

The appropriate VOC emissions determination methodologies for cooling towers are, in order of preference:

- emissions data from an approved monitoring and control program plan on file with the TCEQ (code as “B”);
- emissions data from a nonapproved monitoring and control program (code as “E”);
- AP-42 **uncontrolled** factor.

The use of the AP-42 controlled factor is not allowed. Detailed explanations of these emissions determination methodologies may be found in the following sections.

Emissions Determination Methodologies

If cooling water is used to cool VOC process streams, emissions will result from process fluid leaks into the cooling water, with one exception. If the cooling water is maintained at a pressure at least 5 psi greater than the process fluid pressure throughout the entire cooling tower heat exchange system, then any leak in the heat exchanger will result in water leaking into the process fluid. For such systems, heat exchanger leaks do not generate VOC emissions from the cooling tower. For all other cooling tower heat exchange systems, where the cooling water is not maintained at a pressure at least 5 psi greater than the process fluid pressure throughout the entire cooling tower heat exchange system, use the following guidelines to determine emissions.

When available, emissions determinations based on actual measured cooling water VOC concentrations and flow rate data are preferred. When using such data to determine emissions, assume that VOCs were present at the measured concentration for the entire period between samples. If analytical test methods indicate that VOC measurements are below the minimum detection limit (that is, non-detected), then half of the detection limit(s) must be used to calculate VOC emissions, unless otherwise specified by permit condition, TCEQ or federal rule, or commission order.

Because these methods measure the amount of pollutant contained in the cooling water rather than the amount of pollutant released to the atmosphere, the emissions are not to be coded with a determination methodology of "M" for measured. The appropriate determination methodology will depend upon whether data are gathered following an approved monitoring and control program plan on file with the TCEQ. If so, code the associated emissions with a determination methodology of

"B" for material balance. If not, code them with a determination methodology of "E" for estimated. Please note that, in the case of cooling towers, such estimates are still preferred to the use of AP-42 factors.

If cooling water VOC concentration is measured, but a large leak occurs between sampling events and no monitoring data are available for the period of the leak, then use the AP-42 uncontrolled emission factor to determine emissions for the leak period. If you do not know when the leak began, assume that it began immediately after the previous sampling event. If the majority of annual emissions are determined using the measured data, then code them as described in the preceding paragraph.

If VOC emissions are determined using a factor from Section 5.1 of AP-42, the uncontrolled emission factor (6 lb/MMgal) must be used. According to AP-42, use of the controlled factor (0.7 lb/MMgal) is contingent upon the use of applicable control technology to minimize hydrocarbon leaks into the cooling water system and the monitoring of cooling water for hydrocarbons. If a monitoring system is sufficient to provide such control, then the associated data should be sufficiently detailed to allow for the derivation of an emission rate. If the monitoring system is insufficient to provide data for determining emissions, then the system is insufficient to provide reliable control and so the "uncontrolled" VOC emission factor is appropriate. If you determine emissions in this manner, code them with a determination methodology of "A."

Note that the information from devices such as lower explosive limit detectors, chlorine residual measurements, and total carbon measurements do not qualify as adequate monitoring or control technology and therefore do not allow use of the controlled VOC emission factor from AP-42.

Annual and Ozone Season Rates

If measured data are available for a cooling tower, then the reported emissions should be calculated using actual, rather than average, test data. Use test data from each sampling event to determine emissions released since the prior sampling event. Sum the different sampling periods' emissions to obtain the annual total. If analytical test methods indicate that VOC measurements are below the minimum detection limit (that is, non-detected), then half of the detection limit(s) must be used to calculate VOC emissions, unless otherwise specified by permit condition, TCEQ or federal rule, or commission order.

For example, suppose that weekly tests are performed to determine a cooling tower's VOC emission rate. Using the test results from each week and the associated water flow for the seven days preceding the sample time, one would calculate the total emissions for each seven-day period

during the year, then sum these weekly emissions to arrive at the annual total.

To obtain ozone season emission rates, average over 92 days the total emissions during the months of June, July, and August.

Speciation

If samples were tested for VOCs, then use the measured data to speciate emissions. For more information on speciation requirements, see *2005 Emissions Inventory Guidelines*, Chapter 4. For guidance regarding method detection limits and speciated compounds, follow the general guidance outlined in the “Minimum Detection Limits” section of *2005 Emissions Inventory Guidelines*, Chapter 4.

Supporting Documentation

Provide documentation with your emissions inventory that supports and validates the emissions reported in the inventory. The relevant supporting documentation for cooling towers includes, but may not be limited to, representative samples of the following types of data:

- VOC test results, especially from times when leaks were discovered;
- cooling water and process fluid pressure reading data for systems that maintain cooling water at a pressure at least 5 psi greater than the process fluid pressure throughout the entire cooling tower heat exchange system;
- annual water treatment chemical usage data for all chlorinated or brominated chemicals;
- annual and daily flow rate data for cooling water; and
- emission rate calculations from measured data.

Frequently Asked Questions

1. What if I share a cooling tower with another company?
The answer to this question depends upon the business decision for a site. Please call the IEAS for guidance in your particular situation.

2. Are there any circumstances under which I may use the AP-42 controlled VOC factor?
No. According to AP-42, use of the "controlled" factor (0.7 lb/MMgal) is contingent upon the use of applicable control technology to minimize hydrocarbon leaks into the cooling water system and the monitoring of cooling water for hydrocarbons. If a monitoring system is sufficient to provide such "control,” then the associated data should be sufficiently detailed to allow for the derivation of an emission rate. If the monitoring

system is insufficient to provide data for determining emissions, then the system is insufficient to provide reliable "control" and so the "uncontrolled" VOC emission factor is appropriate.

3. Must I report particulate matter emissions?
Yes. While drift eliminators greatly reduce cooling tower drift, the drift droplets that do escape are so small and of such little mass that they can remain airborne for some time and travel a significant distance.

4. My cooling tower's emission point is currently shown as a fugitive area. Must I change this?
Yes. Your cooling tower's emission point should be shown as a stack. For more information, see the guidance under “Cooling Tower Structure” in ths chapter, as well as instructions for completing the Emission Point Information: Stack Profile form in *2005 Emissions Inventory Guidelines*.

References

Robert H. Perry, et al., *Perry's Chemical Engineers' Handbook* 7th edition, McGraw-Hill, New York, 1997.

Compilation of Air Pollutant Emission Factors, Volume I. Stationary Point and Area Sources 5th edition, AP-42, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina, 1995.

Air Permits Technical Guidance for Chemical Sources: Cooling Towers, Draft RG-108.