Improving Knowledge

Dear reader, how many times has your consulting work or job review required detailed knowledge on almost forgotten know-how? Wouldn’t it be nice to have a place to reference and review those small, but important, bits of information? New fields in alternative energy are expanding areas of potential work and current fields of science are being exposed to greater amounts of new research.

Welcome to The Learning Center, a new column that aims to fulfill these needs and keep you fine-tuned to what’s happening in the environmental industry. With each edition, we plan to present a digest of simplified scientific and mathematical topics to support our more experienced readers, while also providing some expertise for our newer professionals.

Some of the topics this column will cover in 2013 include:

**Atmospheric Emissions Inventory**
- Reasons for emissions inventories
- Inventory types
- Methods to compute emissions

**Meteorology**
- Its importance
- Measurement
- Data use and formats
- Meteorological model types

**Air Dispersion Modeling**
- Reasons for air dispersion modeling
- Types of models
- A simple hand calculation example

**Climate Change**
- Theory behind global warming
- Accepted methodology to estimate greenhouse gas emissions
- Example applications

**Sustainability**
- History of sustainability
- What companies need
- Reporting types
- Example applications

**Computational Fluid Dynamics (CFD)**
- Reasons for CFD models
- Types of models
- Example applications

by Prof. Jesse Thé, Ph.D., P.Eng.

Jesse Thé is president of Lakes Environmental Software Inc., editor-in-chief of ENN.com, and executive editor of the Elsevier journal ENERGY (the leading scientific journal in the energy field). E-mail: JesseThe@ENN.com.
Introduction to Atmospheric Emissions Inventory

We begin this inaugural column with a look at Emissions Inventory (EI). An emissions inventory is a summary of the emissions produced by a group of sources in a given time period. Air pollution emission inventories are the basis for trends analysis, regional- and local-scale air quality modeling, regulatory impact assessments, and human exposure modeling.

Reasons for Emissions Inventories

Most emissions inventories are conducted to either satisfy a regulatory requirement, such as air toxics programs, or for voluntary programs, such as those in greenhouse (GHG) reporting. EI is the process of capturing information on atmospheric releases of pollutant matter. Some of this information can be the actual measurements from monitors placed directly at the emissions point. Although these measurements may be the most accurate way of collecting information on atmospheric releases, it is not always a feasible method of data collection for all types of sources. As an example, current technology does not support measuring emissions—on a continuous basis—from each vehicle, construction equipment, and thousands of other types of emissions. For this reason, emissions methods exist to estimate total atmospheric releases.

EI requires comprehensive data gathering, including guidance documents, preliminary studies for the sources with existing emissions data, emission factors, models, and activity data references. The information gathered in an emissions inventory should include:

- Pollutant name and CAS number
- Pollutant sources, location, release parameters, and operating mode
- Emission rates over time for each pollutant

For air dispersion modeling and air toxic risk assessments, the following additional information is required:

- Source coordinate location
- Source parameter, such as exit temperature, exit velocity, diameter at release point, and release height
- Building dimensions for assessing downwash

Emissions Inventories Types

The EI type depends on the objective of the application. Facilities conduct EI for regulatory reporting and to serve as input data for air dispersion models. Governments may perform EI to analyze the major drivers of poor air quality. EI can be accomplished by two basic processes:

- Direct measurement
- Emission estimation models

Calling All A&WMA Volunteer Leaders

Please join us April 12–14, 2013, in Pittsburgh, PA, for A&WMA’s annual Leadership Training Academy. We are delighted to present a program created exclusively for our volunteers that will strengthen your leadership skills, give you ideas that can be implemented within your local member units committees, councils, and boards, and provide you with outstanding networking opportunities. This will be your connection to exciting ideas, essential tools, and exceptional people.

The program will take place at the Renaissance Pittsburgh Hotel (107 Sixth St., Pittsburgh PA; +1-412-562-1200–GROUP RATE $169). Your participation would be a great contribution. Please RSVP to Stephanie Glyptis at sglyptis@awma.org, regarding your attendance. We hope you will take advantage of this excellent opportunity. We look forward to seeing you!
A Simple Equation to Compute Emissions

Most emissions are calculated using simple linear relationships. The general equation for emissions estimation is:

\[ E = A \times EF \times (1 - ER/100) \]

where

- \( E \) = emissions,
- \( A \) = activity rate,
- \( EF \) = emission factor, and
- \( ER \) = overall pollution control efficiency in % (e.g., from filters).

An emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of the pollutant divided by a unit weight, volume, distance, or duration of the activity (e.g., kilograms of particulate emitted per megagram of coal burned). In most cases, these factors are simply averages of all available data of acceptable quality and are assumed to be representative of long-term averages for all facilities in the source category (i.e., a population average).

Emission factors can be obtained from direct measurements on the equipment. The U.S. Environmental Protection Agency (EPA) provides extensive documentation on emission factors via the AP-42, Compilation of Air Pollutant Emission Factors documentation (see “Additional Resources” above).

For a screening-level emissions assessment, it may be possible to obtain an estimate of maximum emissions in one of two ways:

1. When sufficient data are available, the assessment could use the highest available value; or
2. If no data are available, the assessor may need to rely on professional judgment based on similar types of sources.

Frequently, emission factors contain an associated confidence level by pollutant, which assists in determining the appropriate emission factor.

There are processes that may not derive any emissions linear relationships. However, for these processes a combination of parameters can be identified that affect emissions, but which individually does not provide a linear correlation. In such cases, emission estimation models are used. Models perform a large number of complex calculations in order to estimate a given emission. EPA provides a variety of peer-reviewed emission estimation models to determine point, nonpoint, and mobile source emissions based on a variety of known input parameters (again see “Additional Resources”).

We sincerely hope that EM’s readers will find this and future columns useful. We look forward to your feedback and comments. Feel free to contact me at JesseThe@ENN.com.