Development of Emission Factors for Pulp and Paper Mill Sources

ncasi

John Pinkerton

Arun Someshwar

David Word

Sources of Emission Data

- Major Multi-Mill Sampling Programs
  - $6 million NCASI effort for development of MACT emission standards for pulp & paper source category
  - Single company 10 mill study for MACT purposes
  - Texas and California special studies
  - Forest Products Assn. of Canada
  - Pulp & Paper Research Institute of Canada
  - NCASI pollutant-specific projects - methanol, MEK, acetaldehyde, propionaldehyde, acrolein, formaldehyde, Cl_2, ClO_2, $CHCl_3$, HCl, H_2SO_4, NO_x, SO_2, $PM_{2.5}$, PM_{10}, CPM
- Mill-generated data
  - Individual Mill Studies and Compliance Tests in both U.S. and Canada

Test Report Review

- Process information and production data
- Test methods and detection limits
- Identification of any process upsets, abnormal operating conditions, field sampling problems, laboratory analyses issues
- Representativeness of vents sampled on multi-vent sources such as paper machines, bleach plants, pulp washing systems
- Reasonableness of pollutant concentrations and stack parameters for type of process, pollution control device, and production rate
- Further contact with testing firm or mill personnel often resolves questions

Dealing with “Non-Detects”

- An emission test consists of sampling runs
- Concentrations may be below method detection limit on a sampling run
- Method detection limits are different for each sampling run due to variation in gas flow rates and run times

Dealing with “Non-Detects”

- For single stack/vent sources:
  - Use one-half method detection limit when at least one run is above the method detection limit
  - Use one-half lowest detection limit for any run when all runs are non-detect and flag the test as a non-detect

Dealing with “Non-Detects”

- For multiple vent sources:
  - Use one-half method detection limit when at least one run on any vent is above the method detection limit. This may give unrealistic sum when different vents have much different flow rates, and the NDs occur on high flow rate vents.
  - When all runs on all vents are non-detect, use one-half lowest detection limit for each vent tested and flag the sum as a non-detect

Grouping of Emission Tests

- First by major process unit, e.g. kraft recovery furnace, smelt dissolving tank, lime kiln, thermal oxidizer
- Further subgrouping as necessary, by pollutant, according to
  - Equipment type
  - Pollution control device
  - Fuel type
  - Wood species
  - Process operating conditions

Emission Data Sets

- Emission data set – grouping of tests for a particular pollutant, unit process, unit process subgroup
- Multiple tests on the same unit under similar operating conditions are averaged and treated as a single value

Analysis of Emission Data Sets

- If any unit has a non-detect value (all sampling runs below method detection limits), and one-half the non-detect value is greater than the highest detect value, the non-detect is removed from the data set
- Necessary because different sampling methods with much different method detection limits may have been used

Analysis of Emission Data Sets

- Review for outliers
- Application of statistical tests
  - Used if data set has >50% detect values
  - 25 or less data points – Dixon's Extreme Value Test
  - Over 25 points – Rosner's Test
  - Normal distribution needed
- Decision to retain or delete an outlier based on further review of available information

Analysis of Emission Data Sets

- <15% non-detects
  - mean, median, range
- >15% but <50% non-detects
  - 15% trimmed mean if more than 7 values in data set (otherwise straight mean), median, range
- >50% non-detects
  - Central tendency via SDln (<3 detects) or NOR-PLOT (>3 detects). Replacement of these approaches with options described by Helsel are under consideration
- 100% non-detects – lowest detection limit

Emission Factor Summary Information for Users

- For each pollutant/process unit/subgroup
  - number of units, number of detects
  - <50% detects
    - mean or trimmed mean, median, range
  - >50% non-detects
    - Central tendency, range
  - 100% non-detects
    - lowest method detection limit value

Emission Factor Supporting Information for Users

- For each pollutant/process unit
  - emission unit and control equipment description
  - operating information relevant to pollutant
  - test method used
  - year(s) of testing
  - range for individual sampling runs
  - average emission factor

Format of Emission Factor Information

- Currently made available to NCASI member companies in three hard copy reports – criteria pollutants, 'air toxics', and reduced sulfur compounds – with extensive tables
- Working on user-friendly Excel electronic database for release in 2009

Use of Emission Factor Information

- Emission inventory submissions
- TRI and NPRI annual release reporting
- Air quality permit applications

- Widely used by North American industry
- Considered a reliable source for pulp and paper mill emission factors by many state and provincial agencies
- Represents extensive body of emission test data not contained in AP-42 or WebFIRE