

# **Emission Model of Industrial Sources (EMIS)**

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## **ABSTRACT**

The Emission Model of Industrial Sources (EMIS) program is a tool for estimation, analysis, and reporting of facility emissions. Using basic process data, EMIS provides emission estimations for stack, fugitive, and storage tank sources. This process data can be obtained from measurements, or directly imported from thermodynamic simulations such as ChemCAD<sup>TM</sup> or Aspen Plus. The emission estimation methods include CMA's SOCOMI and Leak/No Leak emission factors for fugitive sources, and the EPA AP-42 TANKS algorithm for storage tank working and breathing losses. Included are various graphical analysis tools for sensitivity analyses of process parameters, such as specific operating conditions, emission control, and emission factors. Detailed emission results may be written to an external file for further analysis, compliance report requirements, or as input into a transport and diffusion model. EMIS was developed in Java, which is platform independent, and relies on an Oracle database for data management.

## **INTRODUCTION**

Emission estimations provide valuable insight with respect to maintaining a safe, environment-friendly, and economical operation. The number of variables associated with emission sources requires development of a standard mechanism for estimating emissions. EMIS is the foundation for developing this standard mechanism, and will expand along with the continual enhancement of emission estimation processes. EMIS is driven by the on-going efforts to record emission data and develop standard emission factors.

## Importing Process Data

Thermodynamic simulation software, such as ChemCAD™ or Aspen Plus™, outputs a report summarizing basic operating conditions for the process. EMIS reads the report and extracts the information necessary for the emission calculations. Any additional process specific information is noted by the user (entered as ChemCAD™ Parameters) and saved along with the process data. A diagram of the model is provided in a Process Flow Diagram (PFD) from ChemCAD, shown in Figure 1 below.

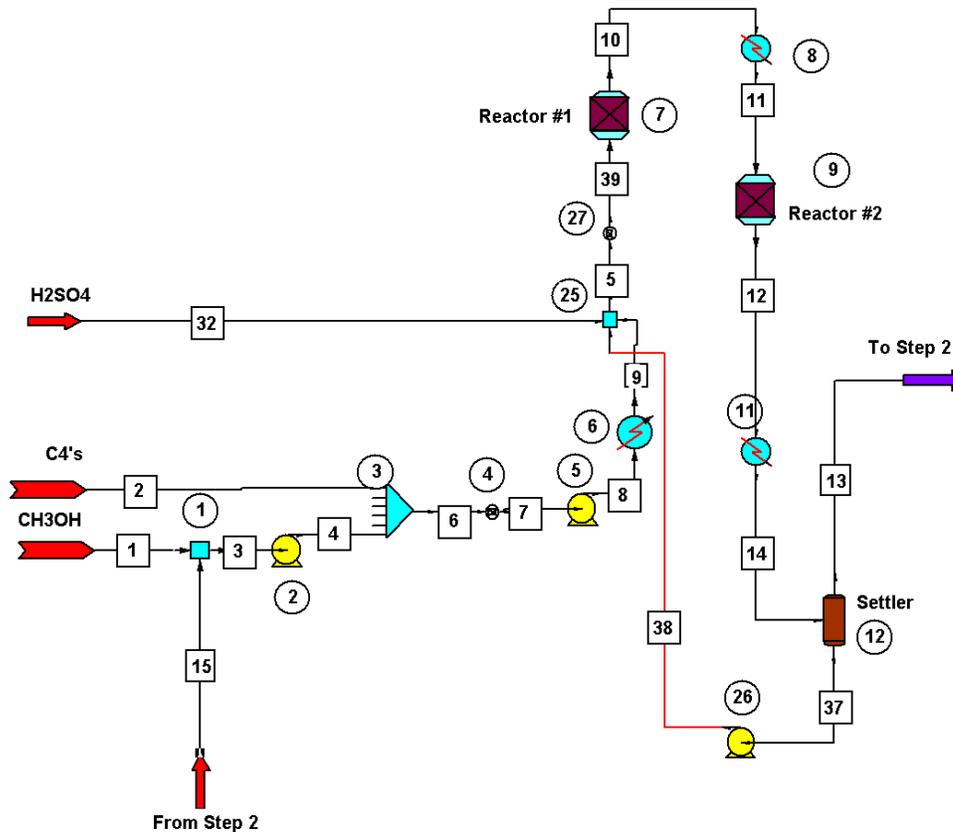


Figure 1. ChemCAD Process Flow Diagram (PFD).

## Emission Factors & Sensitivity Analyses

Sensitivity analyses include variation of parameters such as emission controls and emission factors. There are three methods for scrubbing emissions in EMIS: globally for an entire process, per process step, or per emission source type. Emission source types include stack/point, fugitive, and storage. Emission factors currently available in EMIS include:

- EPA/CMA Average, Leak/No-Leak, Stratified<sup>1,3</sup>
- European Council of Vinyl Manufacturers (ECVM)<sup>2</sup>
- Failed Devices

The emission factors available in EMIS will expand to also include both industry and equipment specific, as data becomes available.

Emission estimations include intentional emissions from stacks, accidental fugitives from leaking or malfunctioning equipment, working losses from the emptying and filling of storage tanks, and breathing losses from standing storage tanks.<sup>4,5</sup> Stack emissions are calculated from the mass flow taken directly from model simulation (ChemCAD™) report. Fugitive and storage emission calculations utilize an equipment configuration designed by the user, consisting of valves, flanges, etc. Working and breathing loss estimations are calculated using the EPA's TANKS algorithm.

## Standard Species List

The standardized species list in EMIS is a built in tool for developing and maintaining a standard list of chemicals and properties including:

- Name
- Formula
- Molecular Weight
- CAS #
- Alias (Other common names)
- Link to chemical used in other programs, such as ChemCAD™ or T&D Model.

This list can also be expanded to include additional physical properties, such as vapor pressure for the TANKS algorithm, or other relevant information.

## Graphical Displays

EMIS also contains a variety of flexible graphical analysis tools for data analysis. Several displays were developed for specific analyses, such as breaking down the total process emissions into emissions per process step. Recent development has been moving towards a more generic wizard format to increase flexibility. Current development includes break down of emissions by source type (point, fugitive, and storage). Figure 2 below displays the emission estimations for numerous chemicals in the production of MTBE.

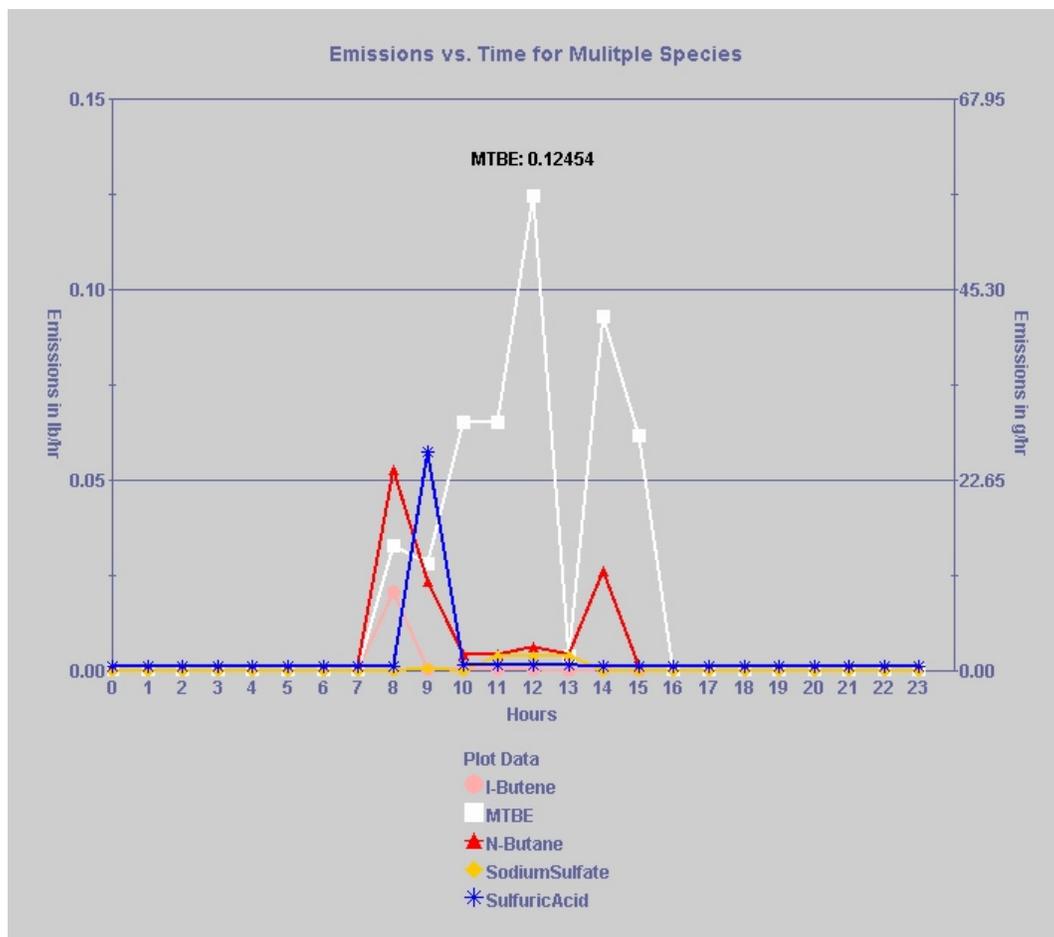


Figure 2. EMIS display of emission estimations.

## **Exporting Emission Data**

EMIS allows the emission profiles to be exported in the formats required by other programs, such as transport and diffusion models, and can also be adapted to interact with federal and state regulation forms for emission inventory compliance.

The software requirements for EMIS include Java and Oracle. The code is written in Java and the data is stored in an Oracle database. EMIS has also been constructed using a Microsoft Access database, with limited functionality.

Current capabilities include calculation of stack, fugitive, and storage emissions, import of process data from thermodynamic simulation software, "What-if" parameters for emission controls and emission factors, standard species list, flexible graphical analysis tools, and export of hourly emission rates to Transport & Diffusion Model

## **CONCLUSIONS**

EMIS computes standard emission estimations for chemical processes, and provides the ability to perform sensitivity analyses on key emission source variables. Future development plans include automation of the exportation of emission profiles to federal and state regulation forms for emission inventory compliance. Other developments, that depend on current emission study results, include expansion of both emission factors to include equipment & process specific factors and emission estimations from other sources such as waste ponds and research facilities. Finally, enhancement of database management and query functionality will provide more efficient access and use of emission data.

## **REFERENCES**

<sup>1</sup>AP-42, Fifth Edition, U.S. EPA, December 1999.

<sup>2</sup>Allard, Jean-Luc. Fugitive Emissions from VCM-PVC Units: Results of the ECVM Survey, SNC-Lavalin Environment Inc., Quebec, Canada, June 2001.

<sup>3</sup>Implications for Residual Risk under the Clean Air Act: Manual for Estimating Equipment Leaks, Chemical Manufacturers Association, August 1998.

<sup>4</sup>Preferred and Alternate Methods for Estimating Fugitive Emissions from Equipment Leaks, Volume II, Chapter 4, Eastern Research Group, Morrisville, North Carolina, November 1996.

<sup>5</sup>Protocols for Generating Unit-Specific Emission Estimates for Equipment Leaks of VOC and VHAP, U.S. EPA Emissions Standards Division, October 1998; EPA-450/3-88-010.

## **KEYWORDS**

Emission Inventories  
Fugitive Emissions  
Point Source Emissions  
Storage Tank Emissions  
SOCMI  
ChemCAD