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1.0 Introduction

Calcatenate is a program designed to calculate the emissions of most equipment found at industrial sources. The tool can be used in many different ways. Refer to specific sections of the instructions to accomplish the desired task.

1.1 Definitions

Capture efficiency: Capture efficiency is the amount of the emissions that reach the control device instead of leaking to the environment between the source and the control device.
Combustion efficiency: Combustion efficiency is a measure of the complete combustion of hydrocarbons to carbon dioxide and water.
Control efficiency: Control efficiency is a measure of the combined processes to remove waste streams from the environment.
Destruction efficiency: Destruction efficiency is a measure of the conversion of molecules into different forms. Destruction efficiency is greater than or equal to combustion efficiency.
Operating efficiency: Operating efficiency is the fraction of time the control equipment is operating.

1.2 Installation:

Note: MS Access must be installed to use this program.
Download file.
Put file somewhere that makes sense.
Extract the files. Don't run the zipped file.
Open extracted Calcatenate file.

2.0 Loading and Migrating Data

2.1 Loading data from calculation file:

Calcatenate comes without equipment. If you have a file with equipment for your particular facility, it can be loaded. Do not load a file unless you have previously saved (or been provided) a file specifically for the facility you are working on.
Press "Load Emission Calculation File" to load a file.
Navigate to file ("Nov3 calcat export.xml" is provided as example to demonstrate file loading).

Select that file, and all the information will be imported.
Click "Open Facility Form" to view the facility.

2.2 Loading data from Emission Inventory file:

If you have downloaded an XML file from AEIR or someone has given you an Emission Inventory XML file, it can be loaded into Calcatenate to assist in the emission calculations.
Press "Load Emission Inventory File" to load a file.
The Emission Inventory tables can hold many facilities at one time, but only one facility may be loaded into the emissions calculation engine at one time.
Select the NMED facility ID in the dropdown menu below, "Select NMED Agency Interest ID to migrate information to calculation tables," to fill out the available information for that facility.
If a different facility is already loaded, you will be asked to delete that facility first.
Before deleting a facility, it is recommended you "Export Emission Calculation File" using the button with that name first.
You will need to provide the missing information on various forms before the emissions will be calculated using instructions found throughout this document.

2.3 Exporting calculation data:

On the "Control" form, press the button "Export Emission Calculation File". You will be prompted for a file name and location. Give the facility an appropriate name (and date) and save it where you can find it. The XML file created can be loaded to work on later or sent to AQB for permit documentation. (This export button does not remove the data currently loaded).
Note that this XML file is a different format from the Emission Inventory XML file and cannot populate the emission inventory submittal in AEIR. The file to upload into AEIR is produced by the "Export Emission Inventory File" button described below.

2.4 Working on a new facility:

Once you have completed working on a facility and exported the data, press the button "Clear Emission Calculation Tables", on the "Control" form. This will clear all the user data (but not the reference tables). You can then create a facility from scratch or import an existing facility.

2.5 Returning calculated emissions to Emission Inventory tables:

Once emissions have been calculated and saved/exported, they can be migrated to the Emission Inventory tables.
Press the, "Send Emissions to Inventory Tables" button and the hours per year and emissions will be added or updated in the Emission Inventory tables.
Then you will be ready to calculate emission of the next facility or to export the emission inventory file that can be uploaded into AEIR.

2.6 Quality Assurance of Emission Inventory data:

Three buttons on the lower right of the Emission Inventory section of the control form are designed to eliminate errors when uploading Emission Inventory XML files to AEIR.
"Perform QA Check" removes invalid pollutants and emissions below 0.0005 tons per year.
"Identify Duplicate" will identify when multiple pieces of equipment use the same facility "Designation". When using the "Designation" to identify a piece of equipment, only one piece of equipment may use the exact same name.

"Remove Designations" will remove the "Designation" from each piece of equipment that has an "EquipmentID". "EquipmentID" is the preferred way to identify a piece of equipment when submitting the inventory to AEIR. "Designation" is also an acceptable way to identify a piece of equipment, but if one piece of equipment has both "EquipmentID" and "Designation" then there will be and "expected one, found two" error when uploading the XML to AEIR. Before removing the designations, back up the entire database file or export EI XML to retain record of the facility names for pieces of equipment for easier reference if additional inventory work is needed later.

2.7 Facility Active and Leased equipment:

The Emission Inventory facility table ("FacilityAEIR") contains questions about whether the facility operated during the inventory year and how much leased equipment was used at that facility that year.
"FacilityActive" should be answered "Yes" if the facility operated or "No" if the facility was shut down for the entire inventory year.
"FacilityRanLeasedFleetTempEquipment" should be answered "Yes" if any leased equipment operated at the facility during the inventory year. Otherwise, answer "No".
"FacilityLeasedTempEngineCount" is the number of leased engines that operated that year.
"FacilityLeasedTempTankCount" is the number of leased tanks that operated that year.
"FacilityLeasedTempFlareCount" is the number of leased flares that operated that year.
"FacilityLeasedTempHeaterCount" is the number of leased heaters that operated that year.
"FacilityLeasedTempOtherCount" is the number of other leased equipment hat operated that year.

2.8 Exporting Emission Inventory data:

On the "Control" form, press the button "Export Emission Inventory File". You will be prompted for a file name and location. Give the facility an appropriate name (and date) and save it where you can find it. The XML file created can be loaded to work on later or uploaded into AEIR to fill out the Emission Inventory.

3.0 Adding and completing equipment information

3.1 Adding equipment for calculation:

If a piece of equipment is missing, it can be added.

Press the "Open Facility Form" button on the "Control" tab.

From the form, "Facility", press "Equipment" button.

At the bottom of the form, enter the facility's equipment ID.

Optionally enter the TEMPO Category ID and TEMPO unit number.

Choose the type of equipment.

Press "Open details form" to add any additional required information for that piece of equipment.

Petroleum and gas storage devices have special instructions below to address control equipment.

Combustion control devices have special instructions below to address gas stream sources.

Once the required fields have been completed, the emissions should appear on the tabs on the bottom of the equipment page. If they do not, then required fields may have been skipped, and should be completed.

3.2 Changing equipment type:

Equipment that is in the same calculation group can be changed from one type to another on the specific form for that equipment. If the desired equipment type does not show up in the dropdown menu, then close the equipment-specific form for that piece of equipment and change the equipment type on the "Equipment" form, which lists all equipment options in the dropdown menu.

3.3 Removing equipment:

From the form, "Facility", press "Equipment" button.

Select the rectangle to the left of the piece of equipment to be removed and hit the "delete" key on the keyboard. Any emissions that have been calculated for this equipment will remain until either "Calculate emissions" or "Remove All Equipment" buttons have been pressed.

3.4 Petroleum and gas storage devices (tanks, oil truck loading, gunbarrel separator, etc):

Add and open the combustor on the "Equipment" tab as described in "Adding Equipment", above.

Choose the calculation method. Different calculation methods have different parameters that must be completed to calculate the emissions. Many of the methods rely on outside programs to calculate the emissions.

Assume all the fields on the main form are required and fill out all the information.

If emissions were calculated by an outside program, add those emissions to the "Raw emissions before controls" tab.

If the equipment is controlled, select the control devices as follows:

3.4.1 Control devices (for tanks, etc.):

Open the equipment form for a tank.

The control devices tab at the bottom of the page lists all the control devices for the facility, not just the tank in question. Add any missing control devices.

Combustion control devices must also be created as equipment on the "equipment" form, as described in "Combustion control devices", below.

Each control device needs to list the control efficiency for each pollutant it controls. Once the control devices have been created, use the "Controlled by" tab to identify the order they apply to the unit in question.

Choose the control device from the dropdown menu. The first control device (or only control device) will be labeled "1" in the "Control sequence order". The second control device applied to that equipment will be labeled "2". The third device would be labeled "3", and so forth. If a control device is missing, go back to the "Control devices" tab to add it.

3.5 Combustion control devices (combustion devices such as flares, ECDs, VCUs, and thermal oxidizers):

Add and open the combustor on the "Equipment" tab as described in "Adding Equipment", above.

Choose the unit sub-type.

Choose the calculation method. "Test results" or "manufacturer guarantee" are strongly preferred. AP42, if selected, will be applied to units that were not of the type included in the studies. Thermal oxidizers and most enclosed combustion devices were not tested and must use individual testing or information from the manufacturer.

3.5.1 Control factors:

Fill in the control factors and units. For SO_2 and H_2S use "percent" as the unit of measure. VOC also frequently uses "percent" as the unit of measure, but the exception is that AP42 uses heat input to determine VOC emission rates. Other pollutants (CO, NO_2, etc.) will typically use "lb/MMBtu" to base output on heat input.

3.5.2 Combustion Device Stream:

Equipment stream section is required. This is the source of the material that is going to the flare. One of the streams should be the pilot light that burns to keep the equipment ready to burn the other streams it receives.

For streams that come from tanks or other equipment being controlled, the tank must be created before the link from flare to tank can be completed. Pilot and upset streams that are

independent of equipment do not require the creation of other equipment (besides the combustor) for those streams.

Fuel higher heating value (HHV) is used for AP42 NO_2 calculation. Lower heating value is used for most other calculations that don't rely on mass balance or control efficiency.

Gas flow rates are required to determine most types of emissions that are not based on control efficiency.

Mol fraction sulfur is used to calculate SO_2 and H_2S emissions.

Capture efficiency is the percentage of the stream from the controlled device or stream that reaches the flare. Default is 100%.

3.6 Equipment Fugitives (Oil and Gas):

Fugitive emissions from oil and gas treatment and/or compression facilities are entered in "equipment fugitives".

One single piece of equipment should be added to account for all the fluid releases at a facility.

After adding or identifying the "equipment fugitives" equipment, press "Open details form" next to that equipment.

Add one row for each combination of device type (pumps, flanges, valves, etc.) and type of fluid.

On the "Equipment Fugitives" form, select the unit subtype from the dropdown menu.

Choose the product associated with this group of equipment.

A suffix will be appended to the unit ID to identify the device type and fluid type. For example, "Fugitives=CO=LO" would be assigned to the equipment named "Fugitives" for connectors using light oil. Users do not need to track this, but this ID can help check emissions calculations.

Enter the weight percent of VOC, HAP, benzene, and H_2S for that product and group. The total of these numbers should not exceed 100%.

Complete the first row before adding additional rows.

When the fluid composition is filled out before adding additional devices that use the same fluid type (e.g., heavy oil) then the percentages will be copied to the new equipment from the first piece of equipment that uses that fluid.

Each piece of equipment can be used for any number of devices of that sort, e.g., 10 flanges.

Enter the control percent (or leave as 0 if uncontrolled).

Enter the number of sources of this type in the group.

The total equipment fugitives emissions should now be available on the "Emissions" tab.

The "Emissions Calculation" tab will show the calculation for each combination of device type and fluid. The calculation to sum all the emissions together will not be shown but is just the sum total grouped by pollutant.

If needed to separate devices at different parts of a facility or with different fluid composition for the same fluid type (e.g., heavy oil), add that equipment an extra time on the "equipment" form for each different group or area.

3.7 Tank emission calculation programs:

If an outside program is used to calculate raw tank emissions then those emissions are entered on the "Raw emissions before controls" tab on that tank's page. The emissions calculator will apply the control equipment specified to determine the controlled emissions rates.

3.8 Tank emission control devices:

For tanks controlled by flares and similar devices, create or update the flare to make sure it has a pilot stream before linking the tank emission stream to the flare.

> 1. Create combustion control device and add pilot stream.
> 2. Create tank and tank emissions.
> 3. Select control device at tank page.
> 4. Return to flare page to complete the addition of the tank stream.

3.9 Asphalt plants:

Asphalt plants may be composed of several components: "asphalt loadout", "batch hot mix asphalt dryer, hot screen, or mixer", "drum hot mix asphalt dryer", "hot oil system", and "tank (oil or condensate)". These names in the calculation tables are primarily based on the AP-42 naming conventions. Many of these types will be mapped to "Asphalt Drum/Burner" or "Tank - Above Ground" in NMED databases. "Asphalt fumes" emission rates are calculated, but they are not migrated to Emission Inventory because EPA collects the pollutants that make up asphalt fumes by the components and not by that group of components.

4.0 Caclulating Emissions

4.1 Calculate emissions:

Emissions should be calculated as soon as there is enough information to calculate them entered on the form for that piece of equipment. Each change of data will recalculate the emissions unless the information needed to calculate emissions has been removed. (See "Removing Equipment", above.)

To summarize and recalculate all the emissions, use the following instructions.
From the form, "Facility", press "Calculate emissions" button.
Emissions from each piece of equipment will be calculated and displayed.
Once emissions have been calculated, the "Show total emissions" button will open a table with facility-wide totals for each pollutant.

4.2 Manufacturer specification or test results:

Engines have an area to enter manufacturer emission guarantees or test results. If a factor is not entered for a given pollutant, then AP42 methods will be used for that pollutant. "Uncontrolled factor" is ignored when "percent" is selected.

When "percent" control is applied to control devices, such as flares, the controlled factor is applied to the source stream, such as the VOCs from a tank being controlled.

When "percent" control is applied to other equipment, the uncontrolled emissions are calculated by AP-42 or other standard method, and the control efficiency is applied to the uncontrolled emission rate.

To supply both a controlled and an uncontrolled emission rate, use a unit of measure ("factor units") other than "percent".

5.0 Suspected or known issues:

Want button to duplicate equipment.

Want report to summarize calculations.

Need to verify flare SO_2 calculation. (Copied AECT equation may have used wrong standard temperature).

Tanks AP42 calculation not completed.

Gunbarrel separator is not complete.

6.0 Errors:

If you detect an error, email eric.peters@env.nm.gov specific details about the error or desired feature or modification.