



# Guidelines for Calculating VOC Emissions from Printing Operations

Revised December 2024

The following methodology should be used to calculate VOC emissions from printing operations. This methodology has been developed by the South Coast AQMD in cooperation with the Printing Industries Association.

## Printing Inks

$$\text{Emissions} = Q * EF * (1 - RF) * (1 - CE_{\text{overall}}) \quad \text{Eq. (1)}$$

where:

Emissions	=	Emissions of volatile organic compounds (lb)
Q	=	Throughput (quantity of ink applied in lb or gallon)
EF	=	Emission Factor (lb/lb ink or lb/gal)
RF	=	Retention factor (ink type specific in decimal)
CE <sub>overall</sub>	=	Overall Efficiency of Control System (decimal)

- (1) User may refer to the product Safety Data Sheet (SDS) to determine the emission factor (EF) based on volatile organic compounds (VOC) content of the ink. This may include, but not limited to, one or more of the following:
  - a) Volatile organic compounds (VOC)
  - b) Lithographic oil content (LOC) such as:
    - Petroleum-based oils
    - Vegetable-based oils
    - Oxidizing oils
    - Middle distillates
    - Linseed oil
    - White mineral oil
    - Other oils

If SDS provides both VOC and LOC percentages or fractions, use the higher number for calculation purposes. **NOTE:** Unit of EF must be consistent with that of ink applied (Q), i.e., EF in weight fraction of lb/lb for Q in pounds.

(2) Depending on type of inks, the following retention factors are applicable for equation (1):

**HEATSET INKS: RF = 0.20**

**NON-HEATSET INKS: RF = 0.95**

**NOTES:**

- (1) RF is applicable to Conventional Products that contain VOC and/or LOC;
- (2) RF is not applicable to the following:
  - a. Printing inks in Flexography, Gravure, Screen, Letterpress, and Inkjet;
  - b. UV-curable inks

(3) Overall efficiency ( $CE_{overall}$ ) of a control system is defined as:

$$CE_{overall} = CE_{cap} * CE_{des} \quad \text{Eq. (2)}$$

Where,

$CE_{cap}$  = Capture Efficiency of Control System (values less than one)

$CE_{des}$  = Destruction Efficiency of Control Equipment (values less than one)

In general, control system performance is tested to determine capture and control efficiencies. In the absence of project-specific source tested capture efficiency results, a default **capture efficiency** of 99.5% ( $CE_{cap} = 0.995$ ) is allowed for **heatset materials only**. Any deviation from this default capture efficiency must be substantiated with supporting documentation.

### Assumptions for Other Printing Ink Operations

**Fountain solutions and blanket/roller washes** do not possess the same characteristics as inks; therefore, retention factors are not applicable to emissions from the use of these materials. However, in the absence of a specific source test, a carry-over factor is allowed as follows:

- ◆ 70% of emissions from **fountain solution** are allowed as default carry-over to the **heat set dryer**, provided that the dryer is vented to the afterburner. The VOC emissions from the use of fountain solutions ( $E_{fountain}$ ) are calculated using the following equation:

$$E_{fountain} = Q * EF * [1 - (0.70 * CE_{overall})] \quad \text{Eq. (3)}$$

- ◆ 40% of emissions from **blanket/roller washes** are allowed as default carry-over to the **heat set dryers only** for **automatic wash operations**, provided that the dryers are vented to afterburners. The VOC emissions from the use of blanket/roller washes ( $E_{wash}$ ) are calculated using the following equation:

$$E_{wash} = Q * EF * [1 - (0.40 * CE_{overall})] \quad \text{Eq. (4)}$$

Where,

$E_{\text{fountain}}$	= Emissions of VOC (lb) from the use of fountain solutions
$E_{\text{wash}}$	= Emissions of VOC (lb) from the use of blanket/roller washes
Q	= Throughput (quantity of material applied in lb or gallon)
EF	= Emission factor (lb/lb or lb/gal)
$C_{\text{overall}}$	= Overall Efficiency of Control System (decimal)

### **STEPS TO REPORT EMISSIONS**

**Example:** One web fed heat set printer used 4,000 pounds of black ink (VOC = 0.375 lb/lb per SDS); 20 gallons fountain solution (VOC = 0.8 lb/gal per SDS); and 10 gallons universal blanket/roller wash with an automatic cleaning system (VOC = 6.7 lb/gal per SDS) in this reporting period. The operation is vented to a control system operating at 99.5 % overall.

Emissions for the black ink are calculated below using Eq. (1):

$$E_{\text{ink}} = 4000 \text{ lb} * 0.375 \text{ lb/lb} * (1-0.2)] * (1 - 0.995) = 6.0 \text{ lb}$$

Emissions for the fountain solution are calculated using Eq. (3):

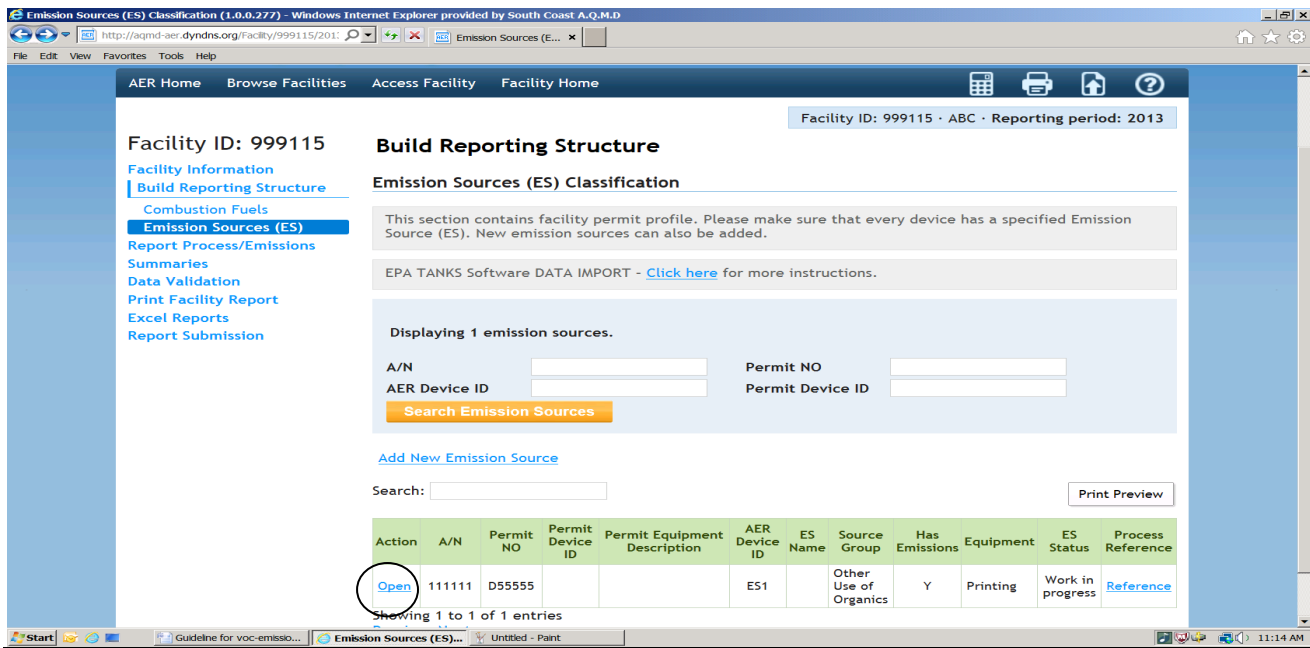
$$E_{\text{fountain}} = 20 \text{ gal} * 0.8 \text{ lb/gal} * [1 - (0.70 * 0.995)] = 4.86 \text{ lb}$$

Emissions for the blanket wash are calculated using Eq. (4):

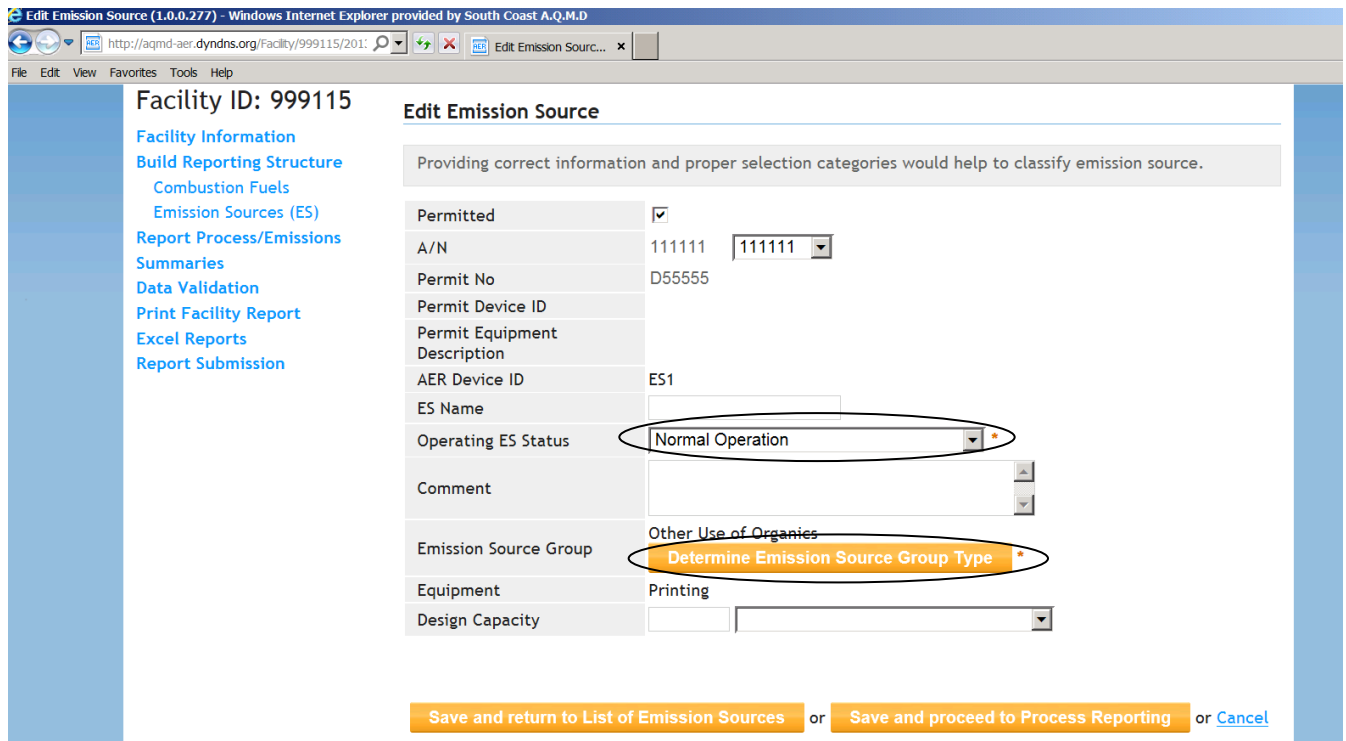
$$E_{\text{wash}} = 10 \text{ gal} * 6.7 \text{ lb/gal} * ([1 - (0.4 * 0.995)] = 40.33 \text{ lb}$$

## AER Tool Data Entry For The Above Example

- Click **Emissions Sources (ES)** to see the equipment list (left side of split screen). Click **Open** to access AER device ID ES1.



- Click down arrow for **Operating ES Status** and select **normal operation** from the drop down menu. Next, click on the button for **Determine Emission Source Group Type**.



- The following screen will appear and click on **click here** number 4 **Other Use of Organics**. Select **Click Here**
- Checkmark **Printing** box by clicking on it
- Click **Save**

Determine Emission Source Group Type

Permitted	A/N	Permit No	Permit Device ID	Permit Equipment Description	AER Device ID	ES Name
Yes	111111	D55555			ES1	

1. External Combustion Equipment (e.g., boiler, dryer, oven, furnace, heater, afterburner, flare, kiln or incinerator) [click here](#) to select one of the following Equipment:
2. Internal Combustion Equipment (e.g., internal combustion engine (excluding vehicles), turbine or micro turbine) [click here](#) to select one of the following Equipment:
3. Spray Coating/Spray Booth (e.g., coatings, solvents, adhesives, etc.) [click here](#) to select one of the following Equipment:
4. Other Use of Organics (e.g., coatings, solvents, inks, adhesives, etc.) except in Spray Coating/Spray Booth, [click here](#) to select one of the following Equipment:
  - Degreaser
  - Printing
  - Coating (Flow / Dip / Roll / Hand Application)
  - Other evaporative sources
5. Storage Tank (e.g. Underground, Aboveground, Small Tanks, Dispensing Systems) [click here](#) to select one of the following Equipment:
6. Fugitive Components (Emission Leaks from Process Components per Rule 1173 and 1176), [click here](#) to select all applicable Equipment:
7. Other Processes (does not fit in any of the groups mentioned above), click [click here](#) to mark "Other Process Equipment":

[Save](#) [Cancel](#)

Display returns to previous image.

- Click **Save and Proceed to Process Reporting**.

Facility ID: 999115

Providing correct information and proper selection categories would help to classify emission source.

Permitted	<input type="checkbox"/>
A/N	
Permit No	
Permit Device ID	11111
Permit Equipment Description	
AER Device ID	ES1
ES Name	Printing
Operating ES Status	Normal Operation
Comment	
Emission Source Group	Other Use of Organics Determine Emission Source Group Type
Equipment	Printing
Design Capacity	

[Save and return to List of Emission Sources](#) OR [Save and proceed to Process Reporting](#) OR [Cancel](#)

Optional: [Save and Mark as Completed](#) [Click here to delete this emission source and associated data.](#)

AQMD web site Home | AER Web Site | Submit question/comment | Ecotek Web Site | Report a Bug

- Click on P1 for the first process.

Process, in printing operation represent materials used in the printing operation. For each material type (Inks, Varnish, Coatings, Fountain Solution, Metering Roller wash, Roller wash, Blanket wash, etc.), there will be a new process number P1, P2, P3, ...Pn and will be generated by clicking on material type from “Other Use Of Organic” drop-down menu below “Add Process” command, after clicking on “**Back to Emission Source Process Reference**” command for the same permit or emission source from top or bottom left of the data-entry screen for P1. The drop-down menu is generated by clicking on “Add Process” command.

A/N	Permit NO	Permit Device ID	Permit Device Description	AER Device ID	ES Name	Source Group	Emissions?	Equipment	ES Status
111111	D55555			ES1		Other Use of Organics	Y	Printing	Work in progress

Process ID	Source Group	Process Name	Process Status	Operation Type
P1	Other Use of Organics		Work in progress	routine

- Under Process click Open

Facility ID: 999115

Build Reporting Structure

- Combustion Fuels
- Emission Sources (ES)
- Report Process/Emissions**
- Combustion
  - External Combustion
  - Internal Combustion
- Use of organics
  - Spray Coating/Spray Booth
  - Other Use of Organics**
  - Storage Tanks
  - Fugitive Components
  - Other Processes
  - Process Upset
- Summaries
- Data Validation
- Print Facility Report
- Report Submission

Process

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
ES1	11111		P1			

Optional: Mark as Completed

Click here to [delete](#) this process.

Throughput

Annual Throughput

Criteria Emissions (lbs)

Pollutant	EF	Unit	EF Data Source	Emissions
<a href="#">Add New</a>				

Toxic (TAC/ODC) Emissions (lbs)

TAC/ODC Group	CAS #	EF	Unit	EF Data Source	Emissions
<a href="#">Add New</a>					

[Back to Emission Source Process Reference](#)

- The following screen will appear. Fill out and select appropriate data: **Process Name, Major Group, Type of Operation, Application Method, Material Description, and Additional Rule** by clicking the drop-down arrow for each field.
- Click **Save**.

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
ES1		111111	P1			

AER Device ID: ES1  
 PERMITTED  
 AN: 111111  
 Process ID: P1  
 Process Comment:   
 Equipment: Printing  
 Material / Activity: Printing  
 Major Group: Printing  
 Type of Operation: Graphic Arts  
 Application Method: Lithography  
 Type of Material: Web Fed Heatset - Inks  
 Material Description: Black Ink \*  
 Additional Rules: 1130 Remove Add Rule

Save Cancel

At this point, add the other two processes that emit VOCs (Fountain Solution and Blanket/Roller Wash), to complete the individual process associated with this example for Emission Source ES1.

- Click “**Back to Emission Source Process Reference**”.



- Click **Add Process**; select ‘**Other use of Organics**’ from the down arrow pick list. Call the process name **Fountain Solution** and click on **OK**.

A/N	Permit NO	Permit Device ID	Permit Device Description	AER Device ID	ES Name	Source Group	Emissions?	Equipment	ES Status
111111	D55555			ES1		Other Use of Organics	Y	Printing	Work in progress

Process ID: P1  
 Source Group: Other Use of Organics  
 Process Name:   
 Process Status: Work in progress  
 Operation Type: routine

Add Process

Other Use of Organics Process name: Fountain Solution OK

OK

- Click on **Open**

Facility ID: 999115

Facility Information  
Build Reporting Structure  
Combustion Fuels  
Emission Sources (ES)  
Report Process/Emissions

Combustion  
External Combustion  
Internal Combustion  
Use of organics  
Spray Coating/Spray Booth

Facility ID: 999115 · ABC · Reporting period: 2013

« Back to Emission Source Process Reference

### Other Use of Organics

Please provide specific information for every process associated with the other use of organics (except in spray coating/spray booth) including usage, emission factor, and control efficiency (if any). You must select Material/Activity Code and throughput units before reporting emissions. Detailed instructions are available by clicking on Help icon in the tool bar.

Optional: Mark as Completed

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
<a href="#">Open</a> ES1		111111	P2			

Click here to [delete](#) this process.

- The following screen pops up. Fill out and select appropriate data: **Process Name, Major Group, Type of Operation, Application Method, Material Description, Additional Rule** by clicking the drop-down arrow for each field.
- Click **Save**. This becomes process P2.

### Edit Emission Process - Other Use of Organics

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
ES1		111111	P2			

AER Device ID: ES1      AER Device Name: \_\_\_\_\_

PERMITTED      AN: 111111      Permit Device ID: \_\_\_\_\_

Process ID: P2      Process Name: Fountain Solution

Process Comment: \_\_\_\_\_

Equipment: Printing

Material / Activity \*

Major Group: Printing

Type of Operation: Graphic Arts

Application Method: Lithography

Type of Material: Web Fed Heatset - Fountain Solution

Material Description: Fountain Solution \*

Additional Rules: 1130      Remove Add Rule

Save      Cancel



- Click on the **Back to Emission Source Process Reference** button at the bottom of the subsequent screen.

« Back to Emission Source Process Reference

- The following screen pops up. Select **Add Process**.

Process References ✕

A/N	Permit NO	Permit Device ID	Permit Device Description	AER Device ID	ES Name	Source Group	Emissions?	Equipment	ES Status
111111	D55555			ES1		Other Use of Organics	Y	Printing	Work in progress

Process ID	Source Group	Process Name	Process Status	Operation Type
P1	Other Use of Organics	Black Ink	Work in progress	routine
P2	Other Use of Organics	Fountain Solution	Work in progress	routine

Add Process

OK

- The following screen pops up. Select **Other use of Organics** from the down arrow pick list. Call the process name **Blanket/Roller wash** and click on **OK**.

Process References ✕

A/N	Permit NO	Permit Device ID	Permit Device Description	AER Device ID	ES Name	Source Group	Emissions?	Equipment	ES Status
111111	D55555			ES1		Other Use of Organics	Y	Printing	Work in progress

Process ID	Source Group	Process Name	Process Status	Operation Type
P1	Other Use of Organics	Black Ink	Work in progress	routine
P2	Other Use of Organics	Fountain Solution	Work in progress	routine

Add Process

Other Use of Organics ▾
Process name: 
OK

OK

- Click down arrows and select appropriate group, operation, application method, type of material, material description, and Rule 1171. Click **Save**. **This becomes process P3.**

### Edit Emission Process - Other Use of Organics

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
ES1		111111	P3			

AER Device ID	ES1	AER Device Name	
PERMITTED	AN: 111111	Permit Device ID	
Process ID	P3	Process Name	Blanket/Roller Wash
Process Comment	<input type="text"/>		
Equipment	Printing		
Material / Activity *			
Major Group:	Solvents		
Type of Operation:	Solvent Cleaning Operations		
Application Method:	Wipe Cleaning		
Type of Material:	Application Equipment Cleaning - Inks		
Material Description	Universal Blanket/Roller Wash Solvent *		
Additional Rules	1171	<input type="button" value="Remove"/>	<input type="button" value="Add Rule"/>

- Click on the **Back to Emission Source Process Reference** button at the bottom of the subsequent screen.

[« Back to Emission Source Process Reference](#)

### Process References

A/N	Permit NO	Permit Device ID	Permit Device Description	AER Device ID	ES Name	Source Group	Emissions?	Equipment	ES Status
111111	D55555			ES1		Other Use of Organics	Y	Printing	Work in progress

Process ID	Source Group	Process Name	Process Status	Operation Type
P1	Other Use of Organics	Black Ink	Work in progress	routine
P2	Other Use of Organics	Fountain Solution	Work in progress	routine
P3	Other Use of Organics	Blanket/Roller Wash	Work in progress	routine

- Click on **P1** to begin data entry of throughput (4,000 lb ink as input). Click **Save**.

**Edit Throughput Information - Other Use of Organics** ✕

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description	SCC
ES3		111111	P1	1130	Printing:Graphic Arts:Lithography:Web Fed Heatset - Inks	Black Ink	
<b>Annual Throughput</b>							
4,000.00000000 lbs							
Usage (Annual Throughput)		<input style="width: 150px;" type="text" value="4,000.00000000"/>		* lbs v *			
Throughput Type		<input style="width: 50px;" type="text" value="Input"/>		*			
Throughput Origin		<input style="width: 150px;" type="text" value="Direct measurement"/>				v *	
Usage Comment		<input style="width: 150px;" type="text" value="Logbook"/>					
<b>Save</b>						<b>Cancel</b>	

- After entering the throughput, click on **Add New** (Criteria Emissions).

**Throughput**

		Annual Throughput
<a href="#">Open</a>		4,000.00 lbs

**Criteria Emissions (lbs)**

	Pollutant	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
<b>Add New</b>							

- Enter the **VOC content** of 0.375 lb/lb, and the **overall control efficiency** of 0.995. The retention factor and the emission factor if applicable will be populated for you. Heat set ink oils are 20% retentive (80% evaporative in the heat set dryer). Click **Save**.

**Open Criteria Emission Information - Other Use of Organics** ✕

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
ES1		111111	P1	1130	Printing:Graphic Arts:Lithography:Web Fed Heatset - Inks	Black Ink
<b>Annual Throughput</b>						
4,000.00 lbs						
Pollutant	VOC <span style="float: right;">*</span>					
VOC Volatile Organic Compounds						
Retention Factor (RF)	0.2					
VOC or Litho Oil Content	0.3750 * lbs/lbs					
Emission Factor (EF)	0.3000 * lbs/lbs					
Overall Control Efficiency	0.99500					
Emission Factor Comment	<input type="text"/>					
Emission Factor Data Source	MSDS <span style="float: right;">*</span>					
Emissions	6.00 lbs					

Save
Cancel

Data entry for the ink, complete as per the next screenshot. The ink SDS shows no standard toxic content.

**Process** Optional: Mark as Completed

	AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
<a href="#">Open</a>	ES1		111111	P1	1130	Printing:Graphic Arts:Lithography:Web Fed Heatset - Inks	Black Ink

Click here to [delete](#) this process.

---

**Throughput**

Annual Throughput	
<a href="#">Open</a>	4,000.00 lbs

---

**Criteria Emissions (lbs)**

	Pollutant	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
<a href="#">Open</a>	VOC	0.3000	lbs / lbs	No	MSDS	0.99500	6.00

Add New

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**Toxic (TAC/ODC) Emissions (lbs)**

	TAC/ODC Group	CAS #	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
Add New								

- Click **Back to Emission Source Process Reference**, and Select process **P2**.

**« Back to Emission Source Process Reference**

**Process References**

A/N	Permit NO	Permit Device ID	Permit Device Description	AER Device ID	ES Name	Source Group	Emissions?	Equipment	ES Status
111111	D55555			ES1		Other Use of Organics	Y	Printing	Work in progress

Process ID	Source Group	Process Name	Process Status	Operation Type
P1	Other Use of Organics	Black Ink	Work in progress	routine
<b>P2</b>	Other Use of Organics	Fountain Solution	Work in progress	routine
P3	Other Use of Organics	Blanket/Roller Wash	Work in progress	routine

**OK**

- Select **Throughput** and enter data (20 gallons fountain solution input). Click **Save**.

**Edit Throughput Information - Other Use of Organics**

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description	SCC
ES3		111111	P2	1130	Printing:Graphic Arts:Lithography:Web Fed Heatset - Fountain Solution	Fountain Solution	

**Annual Throughput**  
20.00000000 gal

Usage (Annual Throughput)  \* gal \*

Throughput Type  \*

Throughput Origin  \*

Usage Comment

**Save** **Cancel**

- After saving throughput data, click on **Add New** (Criteria Emissions).

**Throughput**

Annual Throughput	
<a href="#">Open</a>	20.00 gal

**Criteria Emissions (lbs)**

Pollutant	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
<b>Add New</b>						

- Enter the **VOC content** of 0.8 lb/gal, and the **overall control efficiency** as the product of the capture efficiency and the destruction efficiency ( $0.7 \times 0.995 = 0.6965$ ). Calculation is performed automatically. Click **Save**.

**Open Criteria Emission Information - Other Use of Organics** ✕

AER Device ID	Permit Device ID	A/N	Process ID	Rule #	Material/Activity Code	Material Description
ES1		111111	P2	1130	Printing:Graphic Arts:Lithography:Web Fed Heatset - Fountain Solution	Fountain Solution
<b>Annual Throughput</b>						
20.00 gal						
Pollutant		VOC - Volatile Organic Compounds				
Emission Factor (EF)		0.8000 * lbs/gal				
Overall Control Efficiency		0.69650				
Emission Factor Comment		Control Efficiency = 0.7 x 0.995				
Emission Factor Data Source		AQMD default *				
Emissions		4.86 lbs				

Click here to [delete](#) this Emission.

Save
Cancel

Data entry for the **Fountain Solution** is complete as per the next screenshot. The ink SDS shows no standard toxic content.

- Click **Back to Emission Source Process Reference**, and Select process **P3**.

[« Back to Emission Source Process Reference](#)

**Throughput**

Annual Throughput	
<a href="#">Open</a>	20.00 gal

**Criteria Emissions (lbs)**

	Pollutant	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
<a href="#">Open</a>	VOC	0.8000	lbs / gal	No	AQMD default	0.69650	4.86
<span style="background-color: #ffcc00; padding: 2px 10px; border: 1px solid black;">Add New</span>							

**Toxic (TAC/ODC) Emissions (lbs)**

	TAC/ODC Group	CAS #	EF	Unit	Controlled EF	EF Data Source	Overall CE	Emissions
<span style="background-color: #ffcc00; padding: 2px 10px; border: 1px solid black;">Add New</span>								

A/N	Permit NO	Permit Device ID	Permit Device Description	AER Device ID	ES Name	Source Group	Emissions?	Equipment	ES Status
111111	D55555			ES1		Other Use of Organics	Y	Printing	Work in progress

Process ID	Source Group	Process Name	Process Status	Operation Type
P1	Other Use of Organics	Black Ink	Work in progress	routine
P2	Other Use of Organics	Fountain Solution	Work in progress	routine
P3	Other Use of Organics	Blanket/Roller Wash	Work in progress	routine

[Add Process](#) [OK](#)

- Repeat steps for Process ID P3 as for P1 and P2. *The throughput is 10 gallons and the emission factor for this example is 6.7 lb/gal. The overall efficiency will be  $0.4 \times 0.995 = 0.398$  when entering criteria emission information.* The final screenshot below shows all three processes input into the program, as viewed in **Report Process/Emissions**.

Facility ID: 999115 · ABC · Reporting period: 2013

**Facility ID: 999115**

[Facility Information](#)

[Build Reporting Structure](#)

[Combustion Fuels](#)

[Emission Sources \(ES\)](#)

[Report Process/Emissions](#)

Combustion

- External Combustion
- Internal Combustion

Use of organics

- Spray Coating/Spray Booth
- Other Use of Organics**
- Storage Tanks
- Fugitive Components
- Other Processes
- Process Upset

[Summaries](#)

[Data Validation](#)

[Print Facility Report](#)

[Excel Reports](#)

### Other Use of Organics

Please provide specific information for every process associated with the other use of organics (except in spray coating/spray booth) including usage, emission factor, and control efficiency (if any). You must select Material/Activity Code and throughput units before reporting emissions. Detailed instructions are available by clicking on Help icon in the tool bar.

#### Other Use of Organics Process List Overview

[Add New](#) [Print Preview](#)

Process ID	Status	Material Description	Usage	Units	Em	
					ROG	SPOG
P1	Work in Progress	Black Ink	4,000.00	lbs	6.00	0
P2	Work in Progress	Fountain Solution	20.00	gal	4.86	0
P3	Work in Progress	Universal Blanket/Roller Wash Solvent	10.00	gal	40.33	0