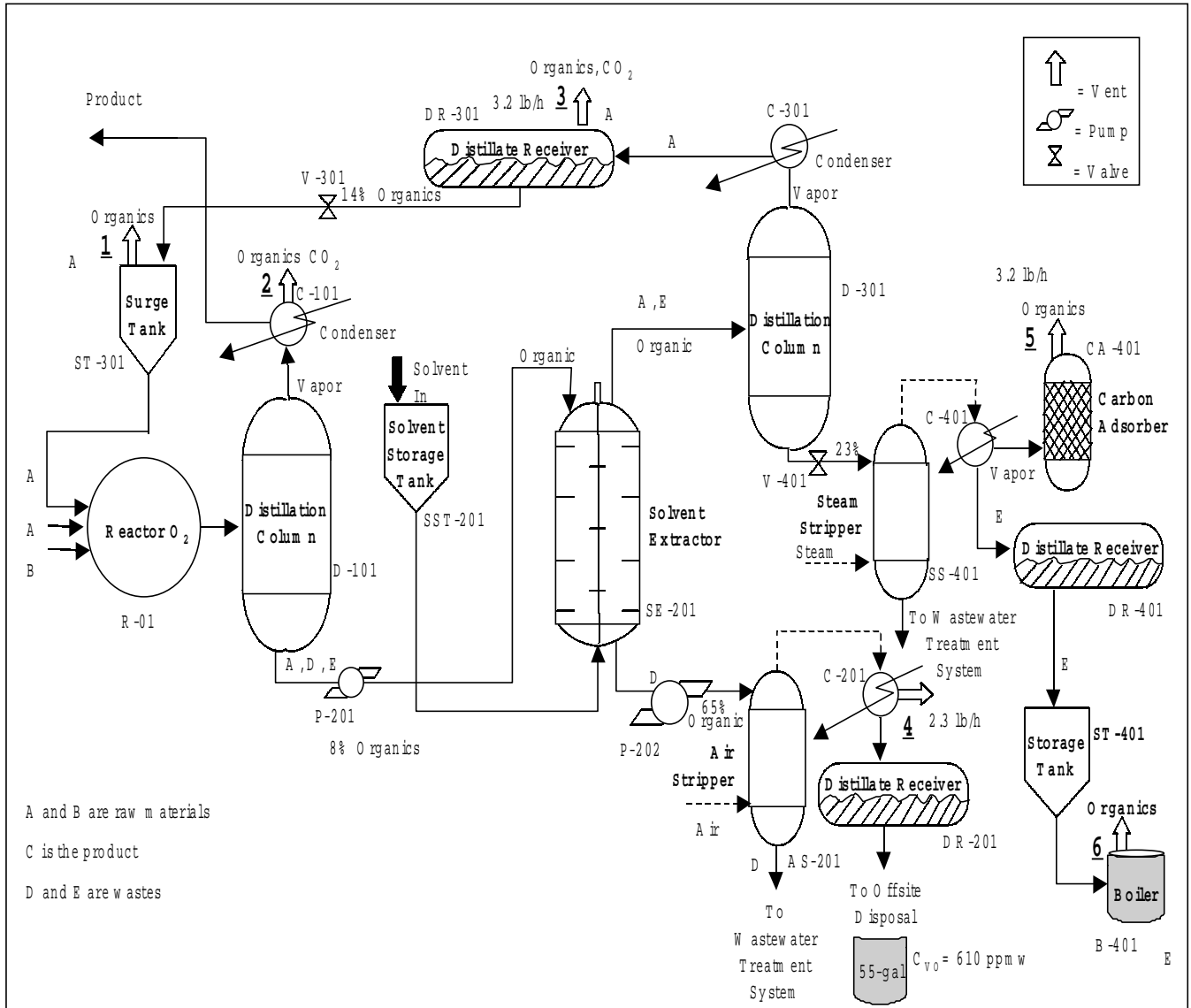


APPENDIX C

Case Studies and Answers

CASE STUDY - APPLICABILITY SUBPARTS AA, BB, AND CC Appendix C

Schematic of XYZ Chemical Corporation Manufacturing Process



**CASE STUDY - APPLICABILITY
SUBPARTS AA, BB, AND CC
Appendix C**

Manufacturing Process Description

XYZ Chemical Company is a permitted RCRA facility which manufactures 50,000 tons/yr of product. Approximately 1,800 tons of hazardous waste is produced per year. During the manufacturing process the unreacted manufacturing constituent is recycled to the main reactor. All waste managed have organic concentrations greater than 10 ppmw.

Questions

Using the schematic provided for XYZ Chemical, answer the following questions:

1. Six process vents are identified in the schematic. The emission rate associated with each vent is provided next to the vent. For each vent, determine the applicability of the Subpart AA regulations and provide the basis for your determination. Note: for the first part of this case study ignore the carbon adsorber associated with the steam stripper. The process vent is from the condenser at a rate of 3.2 lb/h.
2. A carbon adsorber was added after the condenser associated with Vent #5. After installing the carbon adsorber, XYZ monitored emissions at Vent #5 and have reported results of 0.05 lb/h. Make a determination as to the compliance status of XYZ considering the addition of the carbon adsorption system.
3. What additional actions should XYZ Chemical Company take in order to comply with Subpart AA regulations?
4. There are many pieces of equipment associated with the XYZ manufacturing process, however, for the purposes of this case study, only four pieces of equipment are identified on the schematic. Make a determination on the applicability of Subpart BB for the two valves and two pumps identified. The organic composition of the flow through the equipment is identified on the schematic
5. There are two tanks associated with this manufacturing process. Method 25D was used by XYZ to determine the volatile organic concentrations in the tank. Determine the applicability of Subpart CC for the surge tank and the storage tank. Provide the basis for your determination.
6. The waste leaving the distillate receiver is collected in 55-gallon containers. XYZ determined the volatile organic concentration of the waste at the point of origination to equal 610 ppmw. Are these containers subject to Subpart CC? Provide your justification for your determination.
7. What would be required of the facility if the containers meet DOT regulations?

**CASE STUDY - APPLICABILITY
SUBPARTS AA, BB, AND CC
Appendix C**

ANSWERS

1. The following vents are subject to Subpart AA regulations:

Vent #4: The exhaust gases from the condenser serving the air stripper are considered a process vent. Emission from the control device are directly related to the air stripping operations.

Vent #5: The exhaust gases from the condenser serving the steam stripper are considered a process vent. Emission from the control device are directly related to the steam stripping operations.

The following vents are **not** subject to Subpart AA regulations:

Vent #1: The vent on the surge tank is not subject to Subpart AA regulations since it does not meet the definition of a process vent as specified in the rule. The tank emissions are not process related.

Vent #2: This unit is a part of the manufacturing operations, therefore, under 40 CFR 261.4(c) a hazardous waste that is regulated in a manufacturing process unit is not subject to regulations under Parts 262 through 265 until it exits the unit in which it was generated, unless the hazardous waste remains in the unit more than 90 days after the unit ceases to be operated for manufacturing. Therefore, because the unit is not subject to RCRA permitting, the vent on this unit is not subject to the Subpart AA process vent regulations.

Vent #3: The vent on the distillate receiver is not subject to Subpart AA. Under 40 CFR 261.3(c)(2)(1), the definition of hazardous waste materials that are reclaimed from solid waste and that are used beneficially are not solid wastes and hence are not hazardous waste unless reclaimed material is burned for energy recovery or used in a manner constituting disposal.

Vent #6: The vent from the boiler used to burn the hazardous waste is not subject to Subpart AA because the boiler is not one of the unit operations specified in the rule.

2. Prior to the installation of the carbon adsorption system, the total organic emissions from the process vents was:

$$\text{Total Emission Rate} = ER_4 + ER_5$$

$$\text{Total Emission Rate} = 2.3 \text{ lb/h} + 0.05 \text{ lb/h} = 2.35 \text{ lb/h}$$

The total organic emission rate from the process vents is below 3 lb/h, therefore, the facility is now in compliance with Subpart AA. The total organic emissions from process vent #4 was also reduced by over 95%.

**CASE STUDY - APPLICABILITY
SUBPARTS AA, BB, AND CC
Appendix C**

ANSWERS

3. The facility is in compliance with Subpart AA regulations with the installation of the carbon adsorber. No further action is required.

4. The following equipment is subject to Subpart BB:

Pump (P-202): This pump is associated with a waste stream that contacts hazardous waste with organic concentrations of at least 10 percent by weight.

Valve (V-401): This valve is associated with a waste stream that contact hazardous waste with organic concentrations of at least 10 percent by weight.

The following equipment is **not** subject to Subpart BB:

Pump (P-201): The pump contacts a stream which contains mostly compound A, which will be reclaimed. Under 40 CFR 261.3(c)(2)(1), the definition of hazardous waste materials that are reclaimed from solid waste and that are used beneficially are not solid wastes and hence, are not hazardous waste unless reclaimed material is burned for energy recovery or used in a manner constituting disposal.

Valve (V-301): The valve contacts a stream primarily composed of compound A, which will be reclaimed. Under 40 CFR 261.3(c)(2)(1), the definition of hazardous waste materials that are reclaimed from solid waste and that are used beneficially are not solid wastes and hence, are not hazardous waste unless reclaimed material is burned for energy recovery or used in a manner constituting disposal.

5. The surge tank is **not subject to Subpart CC regulations because it contains compound A, which will be reclaimed. Under 40 CFR 261.3(c)(2)(1), the definition of hazardous waste materials that are reclaimed from solid waste and that are used beneficially are not solid wastes and hence, are not hazardous waste unless reclaimed material is burned for energy recovery or used in a manner constituting disposal.**

The storage tank is subject to Subpart CC regulations because it contains hazardous waste with a volatile organic concentration greater than 500 ppmw.

6. The containers are subject to Subpart CC regulations because they contain hazardous waste with volatile organic concentration greater than 500 ppmw.

The facility would be required to keep covers on all openings and closure devices. Transferring of waste should be done as quickly as possible and if batch operation cover should be in place when no more waste will be added within 15 minutes.

Case Study - Waste Determination
Appendix C
Controls For Tanks, Surface Impoundments and Containers
Method 25D

Facility Information: The XYZ Chemical Company has one fixed-roof tank (T-201) that contains mixed waste. XYZ will collect four samples to be analyzed by **Method 25D** to calculate the average volatile organic concentration of this waste. The waste is generated from the bottoms portion of a distillation column (D-202) in the solvent reclamation area of the facility. The waste samples will also be collected from valve (V-204). This valve opens the line leading from the distillation column to tank (T-201).

The four samples will be collected on four different dates. The first date occurring in early December, the next collected in April, the third in July and the final in November. For each sample collected, 10 grams of waste will be collected in wide mouth glass vials preserved with 30-ml of polyethylene glycol. The containers will be kept on ice until the samples are collected. Once the sample has been collected the sample will be returned to the ice as soon as practicable, in order to prevent volatilization. One trip blank will be collected each time a sample is collected. Two sets of duplicate samples and two sets of MS/MSD samples will also be collected. A duplicate or matrix spike sample/matrix spike duplicate set will accompany each sample to the laboratory. ABC Laboratories in Chemistry, New Mexico will analyze the samples.

Review the data to insure that the XYZ Chemical Company does not have to place Subpart CC controls on the fixed-roof tank. The discrete mass quantities for each sampling period are as follows:

$Q_j = 750$ kg/hr (for period when XYZ-01-SS was collected)

$Q_j = 725$ kg/hr (for period when XYZ-02-SS was collected)

$Q_j = 640$ kg/hr (for period when XYZ-03-SS was collected)

$Q_j = 715$ kg/hr (for period when XYZ-04-SS was collected)

FORM 1 VOA
METHOD 25D ORGANICS ANALYSIS DATA SHEET

Lab Name: ABC Labs

Lab Code: 11143

Matrix (soil/water): waste

Sample wt/vol: 10 (g/mL) g

Level: (low/med) LOW

XYZ-01-SS

SDG No.: XY-9345

Lab Sample ID: XY-9345-1

Date Received: 13-Dec-96

Date Analyzed: 16-Dec-96

Compounds

Concentration (ppmw)

Total Chlorine as Chloride

298

Total Carbon as Methane

158

Case Study - Waste Determination
Appendix C
Controls For Tanks, Surface Impoundments and Containers
Method 25D

FORM 1 VOA
METHOD 25D ORGANICS ANALYSIS DATA SHEET

Lab Name: ABC Labs	XYZ-02-SS
Lab Code: 11143	SDG No.: XY-9442
Matrix (soil/water): waste	Lab Sample ID: XY-9442-2
Sample wt/vol: 10 (g/mL) g	Date Received: 10-Apr-97
Level: (low/med) LOW	Date Analyzed: 15-Apr-97

Compounds**Concentration (ppmw)**

Total Chlorine as Chloride	253
Total Carbon as Methane	158

FORM 1 VOA
METHOD 25D ORGANICS ANALYSIS DATA SHEET

Lab Name: ABC Labs	XYZ-03-SS
Lab Code: 11143	SDG No.: XY-9533
Matrix (soil/water): waste	Lab Sample ID: XY-9533-1
Sample wt/vol: 10 (g/mL) g	Date Received: 18-Jul-97
Level: (low/med) LOW	Date Analyzed: 25-Jul-97

Compounds**Concentration (ppmw)**

Total Chlorine as Chloride	310
Total Carbon as Methane	168

Case Study - Waste Determination
Appendix C

FORM 1 VOA
METHOD 25D ORGANICS ANALYSIS DATA SHEET

Lab Name: ABC Labs	XYZ-04-SS
Lab Code: 11143	SDG No.: XY-9677
Matrix (soil/water): waste	Lab Sample ID: XY-9677-1
Sample wt/vol: 10 (g/mL) g	Date Received: 20-Nov-97
Level: (low/med) LOW	Date Analyzed: 22-Nov-97

Compounds
Concentration (ppmw)

Total Chlorine as Chloride	285
Total Carbon as Methane	155

Case Study - Waste Determination
Appendix C
Controls For Tanks, Surface Impoundments and Containers
SW-846 Method 8260
Appendix C

Facility Information: The XYZ Chemical Company has one fixed-roof tank (T-201) that contains mixed waste. XYZ will collect four samples to be analyzed by **SW-846 Method 8260** to calculate the average volatile organic concentration of this waste. The waste is generated from the bottoms portion of a distillation column (D-202) in the solvent reclamation area of the facility. The waste samples will also be collected from valve (V-204). This valve opens the line leading from the distillation column to tank (T-201).

The four samples will be collected on four different dates. The first date occurring in early December, the next collected in April, the third in July and the final in November. For each sample collected, 10 grams of waste be collected in unpreserved wide mouth glass vials. Once the sample has been collected it will be placed on ice as soon as practicable, in order to prevent volatilization. One trip blank will be collected each time a sample is collected. Two sets of duplicate samples and two sets of MS/MSD samples will also be collected. A duplicate or matrix spike sample/matrix spike duplicate set will accompany each sample to the laboratory. ABC Laboratories in Chemistry, New Mexico will analyze the samples.

Review the data to insure that the XYZ Chemical Company does not have to place Subpart CC controls on the fixed-roof tank. The discrete mass quantities for each sampling period are as follows:

$Q_j = 750$ kg/hr (for period when XYZ-01-SS was collected)

$Q_j = 725$ kg/hr (for period when XYZ-02-SS was collected)

$Q_j = 640$ kg/hr (for period when XYZ-03-SS was collected)

$Q_j = 715$ kg/hr (for period when XYZ-04-SS was collected)

(Hint: Remeber to include half the value of all nondetects in the concentration calculation)

Case Study - Waste Determination (Cont'd)**Appendix C**

FORM 1 VOA

EPA 8260 ORGANICS ANALYSIS DATA SHEET

Lab Name: ABC Labs	XYZ-01-SS
Lab Code: 11143	SDG No.: XY-9345
Matrix (soil/water): waste	Lab Sample ID: XY-9345-1
Sample wt/vol: 10 (g/mL) g	Date Received: 13-Dec-96
Level: (low/med) LOW	Date Analyzed: 16-Dec-96
% Moisture: 20	Dilution Factor: 1
GC Column:	ID: 0.53(mm)

CAS No.	Compound	Concentration Units mg/l Q
67-64-1	Acetone	20.0 U
107-13-1	Acrylonitrile	115 -
71-43-2	Benzene	5.00 U
108-86-1	Bromochloromethane	5.00 U
74-97-5	Bromodichloromethane	5.00 U
75-27-4	Bromoform	5.00 U
75-15-0	Carbon disulfide	5.00 U
56-23-5	Carbon tetrachloride	5.00 U
108-90-7	Chlorobenzene	5.00 U
75-00-3	Chloroform	5.00 U
67-66-3	2-Chlorotoluene	5.00 U
95-49-8	4-Chlorotoluene	5.00 U
106-43-4	Dibromochloromethane	5.00 U
110-75-8	1,2-Dibromo-3-chloropropane	5.00 U
75-34-3	1,2-Dibromomethane	5.00 U
156-59-2	1,2-Dichlorobenzene	5.00 U
540-59-0	1,3-Dichlorobenzene	5.00 U
78-87-5	trans-1,2-Dichloroethene	5.00 U
594-20-7	1,2-Dichloropropane	5.00 U
563-58-6	2,2-Dichloropropane	5.00 U
142-28-9	1,1-Dichloropropene	5.00 U
10061-01-5	cis-1,3-Dichloropropane	5.00 U
10061-02-6	trans-1,2-Dichloropropane	5.00 U
100-41-4	Ethylbenzene	5.00 U
591-78-6	2-Hexanone	5.00 U
74-83-9	Bromomethane	20.00-
74-87-3	Chloromethane	5.00 U
74-95-3	Dibromomethane	75.00-
78-93-3	2-Butanone	135.00
74-88-4	Iodomethane	5.00 U
75-09-2	Methylene chloride	90.00-
108-10-1	4-Methyl-2-pentanone	100 U
87-61-6	Styrene	5.00 U
630-20-6	1,1,1,2-Tetrachloroethane	5.00 U
79-34-5	1,1,2,2-Tetrachloroethane	5.00 U
127-18-4	Tetrachloroethene	5.00 U
108-10-1	Toluene	5.00 U

Case Study - Waste Determination (Cont'd)

Appendix C

FORM 1 VOA

EPA 8260 ORGANICS ANALYSIS DATA SHEET

Lab Name: ABC Labs
Lab Code: 11143
Matrix (soil/water): waste
Sample wt/vol: 10 (g/mL) g
Level: (low/med) LOW
% Moisture: 20
GC Column:

XYZ-01-SS
SDG No.: XY-9345
Lab Sample ID: XY-9345-1
Date Received: 13-Dec-96
Date Analyzed: 16-Dec-96
Dilution Factor: 1
ID: 0.53(mm)

CAS No.	Compound	Concentration Units mg/l Q
87-61-6	1,2,3-Trichlorobenzene	5.00 U
120-82-1	1,2,4-Trichlorobenzene	5.00 U
71-55-6	1,1,1-Trichloroethane	5.00 U
79-00-5	1,1,2-Trichloroethane	5.00 U
79-01-6	Trichloroethene	5.00 U
75-69-4	Trichlorofluoromethane	5.00 U
96-18-4	1,2,3-Trichloropropane	5.00 U
108-05-4	1,3,5-Trimethylbenzene	5.00 U
95-63-6	1,2,4-Trimethylbenzene	5.00 U
108-05-4	Vinyl acetate	50.0 U
75-01-4	Vinyl chloride	2.00 U
108-38-3	m,p-Xylene	5.00 U
95-47-6	o-Xylene	5.00 U

Case Study - Waste Determination (Cont'd)

Appendix C

FORM 1 VOA

EPA 8260 ORGANICS ANALYSIS DATA SHEET

Lab Name: ABC Labs	XYZ-02-SS
Lab Code: 11143	SDG No.: XY-9422
Matrix (soil/water): waste	Lab Sample ID: XY-9422-2
Sample wt/vol: 10 (g/mL) g	Date Received: 10-Apr-97
Level: (low/med) LOW	Date Analyzed: 15-Apr-97
% Moisture: 20	Dilution Factor: 1
GC Column:	ID: 0.53(mm)

CAS No.	Compound	Concentration Units mg/l Q
67-64-1	Acetone	20.0 U
107-13-1	Acrylonitrile	110.00-
71-43-2	Benzene	5.00 U
108-86-1	Bromochloromethane	5.00 U
74-97-5	Bromodichloromethane	5.00 U
75-27-4	Bromoform	5.00 U
75-15-0	Carbon disulfide	5.00 U
56-23-5	Carbon tetrachloride	5.00 U
108-90-7	Chlorobenzene	5.00 U
75-00-3	Chloroform	5.00 U
67-66-3	2-Chlorotoluene	5.00 U
95-49-8	4-Chlorotoluene	5.00 U
106-43-4	Dibromochloromethane	5.00 U
110-75-8	1,2-Dibromo-3-chloropropane	5.00 U
75-34-3	1,2-Dibromomethane	5.00 U
156-59-2	1,2-Dichlorobenzene	5.00 U
540-59-0	1,3-Dichlorobenzene	5.00 U
78-87-5	trans-1,2-Dichloroethene	5.00 U
594-20-7	1,2-Dichloropropane	5.00 U
563-58-6	2,2-Dichloropropane	5.00 U
142-28-9	1,1-Dichloropropene	5.00 U
10061-01-5	cis-1,3-Dichloropropane	5.00 U
10061-02-6	trans-1,2-Dichloropropane	5.00 U
100-41-4	Ethylbenzene	5.00 U
591-78-6	2-Hexanone	5.00 U
74-83-9	Bromomethane	25.00 -
74-87-3	Chloromethane	5.00 U
74-95-3	Dibromomethane	60.00 -
78-93-3	2-Butanone	95.00 -
74-88-4	Iodomethane	5.00 U
75-09-2	Methylene chloride	105.00
108-10-1	4-Methyl-2-pentanone	100 U
87-61-6	Styrene	5.00 U
630-20-6	1,1,1,2-Tetrachloroethane	5.00 U
79-34-5	1,1,2,2-Tetrachloroethane	5.00 U
127-18-4	Tetrachloroethene	5.00 U
108-10-1	Toluene	5.00 U

Case Study - Waste Determination (Cont'd)
Appendix C

FORM 1 VOA

EPA 8260 ORGANICS ANALYSIS DATA SHEET

Lab Name: ABC Labs	XYZ-02-SS
Lab Code: 11143	SDG No.: XY-9422
Matrix (soil/water): waste	Lab Sample ID: XY-9422-2
Sample wt/vol: 10 (g/mL) g	Date Received: 10-Apr-97
Level: (low/med) LOW	Date Analyzed: 15-Apr-97
% Moisture: 20	Dilution Factor: 1
GC Column:	ID: 0.53(mm)

CAS No.	Compound	Concentration Units mg/l Q
87-61-6	1,2,3-Trichlorobenzene	5.00 U
120-82-1	1,2,4-Trichlorobenzene	5.00 U
71-55-6	1,1,1-Trichloroethane	5.00 U
79-00-5	1,1,2-Trichloroethane	5.00 U
79-01-6	Trichloroethene	5.00 U
75-69-4	Trichlorofluoromethane	5.00 U
96-18-4	1,2,3-Trichloropropane	5.00 U
108-05-4	1,3,5-Trimethylbenzene	5.00 U
95-63-6	1,2,4-Trimethylbenzene	5.00 U
108-05-4	Vinyl acetate	50.0 U
75-01-4	Vinyl chloride	2.00 U
108-38-3	m,p-Xylene	5.00 U
95-47-6	o-Xylene	5.00 U

Case Study - Waste Determination (Cont'd)

Appendix C

FORM 1 VOA

EPA 8260 ORGANICS ANALYSIS DATA SHEET

Lab Name: ABC Labs	XYZ-03-SS
Lab Code: 11143	SDG No.: XY-9533
Matrix (soil/water): waste	Lab Sample ID: XY-9533-1
Sample wt/vol: 10 (g/mL) g	Date Received: 18-Jul-97
Level: (low/med) LOW	Date Analyzed: 25-Jul-97
% Moisture: 20	Dilution Factor: 1
GC Column:	ID: 0.53(mm)

CAS No.	Compound	Concentration Units mg/l Q
67-64-1	Acetone	20.0 U
107-13-1	Acrylonitrile	105.00-
71-43-2	Benzene	5.00 U
108-86-1	Bromochloromethane	5.00 U
74-97-5	Bromodichloromethane	5.00 U
75-27-4	Bromoform	5.00 U
75-15-0	Carbon disulfide	5.00 U
56-23-5	Carbon tetrachloride	5.00 U
108-90-7	Chlorobenzene	5.00 U
75-00-3	Chloroform	5.00 U
67-66-3	2-Chlorotoluene	5.00 U
95-49-8	4-Chlorotoluene	5.00 U
106-43-4	Dibromochloromethane	5.00 U
110-75-8	1,2-Dibromo-3-chloropropane	5.00 U
75-34-3	1,2-Dibromomethane	5.00 U
156-59-2	1,2-Dichlorobenzene	5.00 U
540-59-0	1,3-Dichlorobenzene	5.00 U
78-87-5	trans-1,2-Dichloroethene	5.00 U
594-20-7	1,2-Dichloropropane	5.00 U
563-58-6	2,2-Dichloropropane	5.00 U
142-28-9	1,1-Dichloropropene	5.00 U
10061-01-5	cis-1,3-Dichloropropane	5.00 U
10061-02-6	trans-1,2-Dichloropropane	5.00 U
100-41-4	Ethylbenzene	5.00 U
591-78-6	2-Hexanone	5.00 U
74-83-9	Bromomethane	30.00-
74-87-3	Chloromethane	5.00 U
74-95-3	Dibromomethane	65.00-
78-93-3	2-Butanone	120.00
74-88-4	Iodomethane	5.00 U
75-09-2	Methylene chloride	85.00 -
108-10-1	4-Methyl-2-pentanone	100 U
87-61-6	Styrene	5.00 U
630-20-6	1,1,1,2-Tetrachloroethane	5.00 U
79-34-5	1,1,2,2-Tetrachloroethane	5.00 U
127-18-4	Tetrachloroethene	5.00 U
108-10-1	Toluene	5.00 U

Case Study - Waste Determination (Cont'd)
Appendix C

FORM 1 VOA

EPA 8260 ORGANICS ANALYSIS DATA SHEET

Lab Name: ABC Labs	XYZ-03-SS
Lab Code: 11143	SDG No.: XY-9533
Matrix (soil/water): waste	Lab Sample ID: XY-9533-1
Sample wt/vol: 10 (g/mL) g	Date Received: 18-Jul-97
Level: (low/med) LOW	Date Analyzed: 25-Jul-97
% Moisture: 20	Dilution Factor: 1
GC Column:	ID: 0.53(mm)

CAS No.	Compound	Concentration Units mg/l	Q
87-61-6	1,2,3-Trichlorobenzene	5.00	U
120-82-1	1,2,4-Trichlorobenzene	5.00	U
71-55-6	1,1,1-Trichloroethane	5.00	U
79-00-5	1,1,2-Trichloroethane	5.00	U
79-01-6	Trichloroethene	5.00	U
75-69-4	Trichlorofluoromethane	5.00	U
96-18-4	1,2,3-Trichloropropane	5.00	U
108-05-4	1,3,5-Trimethylbenzene	5.00	U
95-63-6	1,2,4-Trimethylbenzene	5.00	U
108-05-4	Vinyl acetate	50.0	U
75-01-4	Vinyl chloride	2.00	U
108-38-3	m,p-Xylene	5.00	U
95-47-6	o-Xylene	5.00	U

Case Study - Waste Determination (Cont'd)

Appendix C

FORM 1 VOA

EPA 8260 ORGANICS ANALYSIS DATA SHEET

Lab Name: ABC Labs	XYZ-04-SS
Lab Code: 11143	SDG No.: XY-9677
Matrix (soil/water): waste	Lab Sample ID: XY-9677-1
Sample wt/vol: 10 (g/mL) g	Date Received: 20-Nov-97
Level: (low/med) LOW	Date Analyzed: 22-Nov-97
% Moisture: 20	Dilution Factor: 1
GC Column:	ID: 0.53(mm)

CAS No.	Compound	Concentration Units mg/l Q
67-64-1	Acetone	20.0 U
107-13-1	Acrylonitrile	105.00
71-43-2	Benzene	5.00 U
108-86-1	Bromochloromethane	5.00 U
74-97-5	Bromodichloromethane	5.00 U
75-27-4	Bromoform	5.00 U
75-15-0	Carbon disulfide	5.00 U
56-23-5	Carbon tetrachloride	5.00 U
108-90-7	Chlorobenzene	5.00 U
75-00-3	Chloroform	5.00 U
67-66-3	2-Chlorotoluene	5.00 U
95-49-8	4-Chlorotoluene	5.00 U
106-43-4	Dibromochloromethane	5.00 U
110-75-8	1,2-Dibromo-3-chloropropane	5.00 U
75-34-3	1,2-Dibromomethane	5.00 U
156-59-2	1,2-Dichlorobenzene	5.00 U
540-59-0	1,3-Dichlorobenzene	5.00 U
78-87-5	trans-1,2-Dichloroethene	5.00 U
594-20-7	1,2-Dichloropropane	5.00 U
563-58-6	2,2-Dichloropropane	5.00 U
142-28-9	1,1-Dichloropropene	5.00 U
10061-01-5	cis-1,3-Dichloropropane	5.00 U
10061-02-6	trans-1,2-Dichloropropane	5.00 U
100-41-4	Ethylbenzene	5.00 U
591-78-6	2-Hexanone	5.00 U
74-83-9	Bromomethane	20.00-
74-87-3	Chloromethane	5.00 U
74-95-3	Dibromomethane	75.00 -
78-93-3	2-Butanone	125.00
74-88-4	Iodomethane	5.00 U
75-09-2	Methylene chloride	90.00
108-10-1	4-Methyl-2-pentanone	100 U
87-61-6	Styrene	5.00 U
630-20-6	1,1,1,2-Tetrachloroethane	5.00 U
79-34-5	1,1,2,2-Tetrachloroethane	5.00 U
127-18-4	Tetrachloroethene	5.00 U
108-10-1	Toluene	5.00 U

Case Study - Waste Determination (Cont'd)
Appendix C

FORM 1 VOA

EPA 8260 ORGANICS ANALYSIS DATA SHEET

Lab Name: ABC Labs	XYZ-04-SS
Lab Code: 11143	SDG No.: XY-9677
Matrix (soil/water): waste	Lab Sample ID: XY-9677-1
Sample wt/vol: 10 (g/mL) g	Date Received: 20-Nov-97
Level: (low/med) LOW	Date Analyzed: 22-Nov-97
% Moisture: 20	Dilution Factor: 1
GC Column:	ID: 0.53(mm)

CAS No.	Compound	Concentration Units mg/l Q
87-61-6	1,2,3-Trichlorobenzene	5.00 U
120-82-1	1,2,4-Trichlorobenzene	5.00 U
71-55-6	1,1,1-Trichloroethane	5.00 U
79-00-5	1,1,2-Trichloroethane	5.00 U
79-01-6	Trichloroethene	5.00 U
75-69-4	Trichlorofluoromethane	5.00 U
96-18-4	1,2,3-Trichloropropane	5.00 U
108-05-4	1,3,5-Trimethylbenzene	5.00 U
95-63-6	1,2,4-Trimethylbenzene	5.00 U
108-05-4	Vinyl acetate	50.0 U
75-01-4	Vinyl chloride	2.00 U
108-38-3	m,p-Xylene	5.00 U
9-54-76	o=Xylene	5.00 U

Case Study - Waste Determination (Cont'd)
Appendix C
Answers

25D DATA:

Check the data sheets to insure that all samples were collected and analyzed within a one year time period.

The four samples were collected and analyzed within one calendar year.

Check the data to insure that the proper number of samples were collected to correct high fluctuations in the data due to seasonal variability.

The four samples were sufficient since the results are very similar. There were no seasonal fluctuations.

Calculate the volatile organic concentration of this waste stream

$$C_{ave} = (1/Q_T) * (Q_j * C_j)$$

$Q_T =$ discrete mass quantity₁ + discrete mass quantity₂ + discrete mass quantity₃ + discrete mass quantity₄

$$Q_T = 750 \text{ kg/hr} + 725 \text{ kg/hr} + 640 \text{ kg/hr} + 715 \text{ kg/hr} = 2830 \text{ kg/hr}$$

$$C_{ave} = (1/2830) * \{[(750)*(298+158)] + [(725)*(253+158)] + [(640)*(310*168)] + [(715)*(285+155)]\} = 445.40 \text{ ppmw}$$

Therefore, no Subpart CC controls are required.

8260 DATA

Check the data sheets to insure that all samples were collected and analyzed within a one year time period.

The four samples were collected and analyzed within one calendar year.

Check the data to insure that the proper number of samples were collected to correct high fluctuations in the data due to seasonal variability.

The four samples were sufficient since the results are very similar. There were no seasonal fluctuations

Case Study - Waste Determination (Cont'd)

Appendix C

Answers

8260 DATA

Locate the fraction measure f_m correction values for all constituents with results above the reporting limits

From Table 34, in 40 CFR 63, Subpart G, Appendix:

Constituent	f_m value
Acrylonitrile	1.00
Bromomethane	1.00
Dibromomethane	1.00
2-Butanone	0.99
Methylene Chloride	1.00

Sum all the detected values with the f_m correction

$$XYZ-01-SS: (115+20+75+133.65+90) = 433.65$$

$$XYZ-02-SS: (110+25+60+94.05+105) = 394.05$$

$$XYZ-03-SS: (105+30+65+118.8+85) = 403.8$$

$$XYZ-04-SS: (105+20+75+123.75+90) = 413.75$$

Sum all the nondetected values for each sample

$$XYZ-01-SS: 355 \text{ ppm}$$

$$XYZ-02-SS: 355 \text{ ppm}$$

$$XYZ-03-SS: 355 \text{ ppm}$$

$$XYZ-04-SS: 355 \text{ ppm}$$

divide the sum by 2 ---> 177.5 and add this value into the sum for the C_j calculation

$$XYZ-01-SS: 433.65 + 177.5 = 611.15$$

$$XYZ-02-SS: 394.05 + 177.5 = 571.55$$

$$XYZ-03-SS: 403.8 + 177.5 = 581.3$$

$$XYZ-04-SS: 413.75 + 177.5 = 591.25$$

$$Q_T = (750 \text{ kg/hr} + 725 \text{ kg/hr} + 640 \text{ kg/hr} + 715 \text{ kg/hr}) = 2830 \text{ kg/hr}$$

$$C_{\text{ave}} = (1/Q_T) * (Q_j * C_j)$$

$$C_{\text{ave}} = (1/2830) * [(750)(611.15) + (725)(571.55) + (640)(581.3) + (715)(591.25)] = 590 \text{ ppmw}$$

Therefore, CC controls are required.

Case Study - Treatment Options and Standards

RCRA Air Emissions Standards for Tanks, Surface Impoundments, and Containers

Appendix C

Under the provisions of the Subpart CC rules [40 CFR 265.1083(c)(2)], air emission controls are no longer required for waste management units that receive hazardous waste when the organic content of the waste has been reduced by a treatment process that meets conditions specified in the rules. The following four (4) examples illustrate the determination of acceptable waste treatment through examination of the various alternatives provided in the rules. These examples include calculation of the exit concentration limit (C_T), the organic reduction efficiency (R), the mass removal rate (MR), the required mass removal rate (RMR), the organic mass biodegradation rate (MR_{bio}), and the organic biodegradation efficiency (R_{bio}); the combustion process alternatives are not covered in the examples.

In completing the case study, the participants will follow the same basic strategy for evaluating the performance of each of the example treatment schemes. The basic steps provided in all four of the examples are:

- Characterize the waste streams at point of waste origination
- Determine a volatile organic (VO) concentration (Method 25D equivalent concentration) for the waste at point of waste origination or at point of waste treatment (entering and exiting the treatment system)
- Calculate C_T , R , MR , RMR , MR_{bio} , R_{bio} , as needed for the particular treatment alternative
- Evaluate the performance of the treatment system; determine if performance criteria are met

Example Treatment Scenarios

General Conditions Applicable to All Four Examples.

Four (4) hazardous waste streams are generated by a manufacturing process; the wastes are collected in closed individual drain systems and sent to a common storage tank where the waste streams mix. Both the collection system and the storage tank system comply with the relevant control requirements of the Subpart CC rules. The aggregated hazardous waste stream is hard piped to the treatment unit.

In order to simplify the calculations and presentation of the material in the examples, the determinations that are formatted in terms of mass (e.g. kg/hr) within the regulation are presented in the examples in units of concentration, ppmw. This assumes that the flow rates into and out of the treatment systems and the density of the waste before and after treatment are unchanged.

Case Study - Treatment Options and Standards (Cont'd)

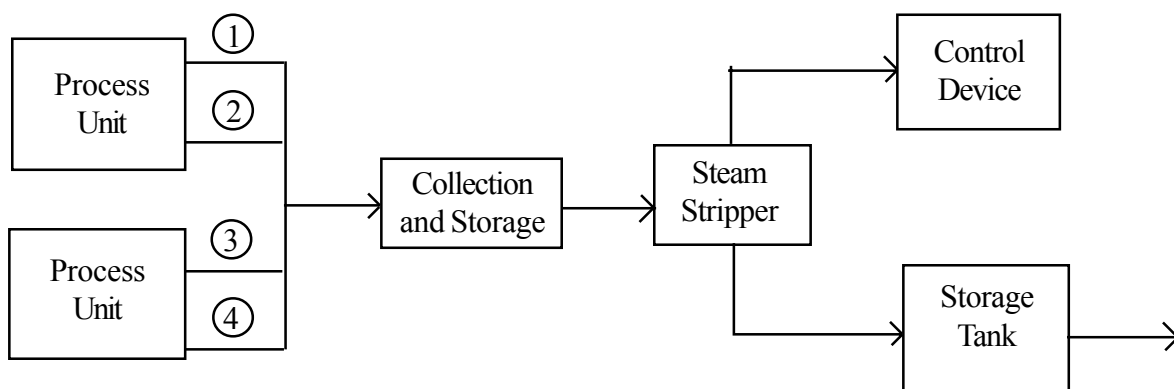
Appendix C

Conditions Specific to Individual Examples.

1. **Steam Stripping.** The aggregated hazardous waste stream is hard piped to a steam stripper. The steam stripper condenser vent is controlled to meet the requirements of Subpart AA provisions for control devices and closed vent systems. The steam stripper effluent is sent to a storage tank.
2. **Biological Treatment.** The aggregated hazardous waste stream is hard piped to a biological treatment unit where the waste is treated in the uncontrolled bio-unit. The bio-unit is considered a surface impoundment for the RCRA permit. Following bio-treatment the waste is piped to a secondary clarifier then to a chlorine basin from which it is discharged. The on-site wastewater treatment system has a National Pollution Discharge Elimination System (NPDES) permit.
3. **Air Stripping followed by Biological Treatment.** The aggregated hazardous waste stream is hard piped to an air stripping unit. The exit gas stream from the air stripper is controlled by a combustion unit that meets the control requirements of Subpart CC. The effluent from the air stripping unit is hard piped to a biodegradation unit; the bio-unit is uncontrolled, i.e., open to the atmosphere. The bio-unit is considered a surface impoundment for the RCRA permit.
4. **Steam Stripping followed by Biological Treatment.** The aggregated hazardous waste stream is hard piped to a steam stripper. The steam stripper condenser vent is controlled to meet the requirements of Subpart AA provisions for control devices and closed vent systems. The steam stripper effluent is sent to a biological treatment unit; the bio-unit is uncontrolled, i.e., open to the atmosphere. The bio-unit is considered a surface impoundment for the RCRA permit.

Example 1: Steam Stripping

Flow Diagram.



Situation.

Four (4) hazardous waste streams are generated by a manufacturing process; the wastes are collected in closed individual drain systems and sent to a common storage tank where the waste streams mix. Both the collection system and the storage tank system comply with the relevant control requirements of the Subpart CC rules. The aggregated hazardous waste stream is hard piped to a steam stripper (Point A). The steam

Case Study - Treatment Options and Standards (Cont'd)

Appendix C

stripper condenser vent is controlled to meet the requirements of Subpart AA provisions for control devices and closed vent systems. The steam stripper effluent is sent to a storage tank (Point B). Assume that the steam stripper inlet flow (Point A) and the outlet flow (Point B) are the same (70 liters per second) and the density of the waste stream does not change as a result of treatment.

The owner/operator has decided to use the treatment process alternative that involves the determination of the organic reduction efficiency (**R**) in §265.1083(c)(2)(ii). Use of this alternative limits the number and location of the waste VO concentrations that must be made to determine if the treatment system meets the criteria in the rule. For example, since the calculation of **R** is based on the actual VO mass (concentration, ppmw, can be used in this example because flow and density do not change) of the waste entering and exiting the treatment process (at Points A and B) no data on VO concentrations are needed for the four individual wastes at their point of waste origination (Points 1 through 4). Under this treatment alternative, if the organic reduction efficiency (**R**) is greater than or equal to 95% and the VO concentration of the treated waste is less than 100 ppmw, then downstream units managing this waste stream no longer require control for air emissions under Subpart CC.

The owner/operator has used direct measurement (using OW Methods 624 and 625) to determine the actual organic concentrations for the three organic constituents present in the aggregated waste stream (i.e., cresol, methanol, and chloroform) entering and exiting the steam stripper. The average constituent concentrations at Point A and Point B are presented below. The owner/operator does not have any waste constituent data at the point of waste origination for the waste streams that comprise the aggregated waste at Point A. In addition, the owner/operator does not wish to conduct a Method 25D analysis for the waste at Point A and Point B; however, the VO concentration of the waste is needed at these two locations in order to determine the total waste volatile organic mass flow entering and exiting the process. Therefore, the owner/operator makes use of the EPA published values of the fraction measured by Method 25D (f_m) that have been determined by EPA for a large range of chemical constituents to estimate the VO concentration as measured by Method 25D. A list of f_m values are in EPA Docket No. F-95-CE3A-FFFFF. To calculate the Method 25D VO concentration for a particular constituent, the actual concentration is multiplied by the f_m value to obtain an estimate of what concentration would be seen by Method 25D.

Measurements and Calculations.

Step 1. Identify the actual composition of the waste streams and waste stream flow rates. If EPA Method 25D is to be run on the waste streams, skip this step.

Waste Compositions:

	Waste Constituents, ppmw			Total
	cresol	methanol	chloroform	
Actual Concentrations (measured at Point A)	227	386	537	1,150
Actual Concentrations (measured at Point B)	115	40	10	165

Case Study - Treatment Options and Standards (Cont'd)

Appendix C

Step 2. Measure the Method 25D VO concentrations, or estimate the VO concentrations from the wastewater analysis. Obtain the f_m value for each compound. Multiply each concentration by the f_m value to obtain the estimated Method 25D VO concentration.

VO Concentration Determination:

	Waste Constituents, ppmw			Total
	cresol	methanol	chloroform	
f_m fraction measured by EPA Method 25D	0.0345	0.433	1.03	
VO(25D) Concentrations (estimated at Point A)	8	167	553	728
VO(25D) Concentration (estimated at Point B)	4	17	11	32

Step 3. Calculate the organic reduction efficiency (**R**) for the treatment unit. **R** is calculated by subtracting the organic mass exiting the treatment unit from the organic mass entering the treatment unit and the dividing the remainder by the organic mass entering the treatment unit and multiplying by a hundred to get a percent.

Organic Reduction Efficiency:

	Waste Constituents, ppmw			Total
	cresol	methanol	chloroform	
VO(25D) Concentrations (estimated at Point A)	8	167	553	728
VO(25D) Concentration (estimated at Point B)	4	17	11	32
VO mass removal (ppmw) (Calculated: A - B)	4	150	542	696
Organic Reduction Efficiency, R(%) (Calculated: [A-B]/A)	50%	90%	98%	96%

Questions.

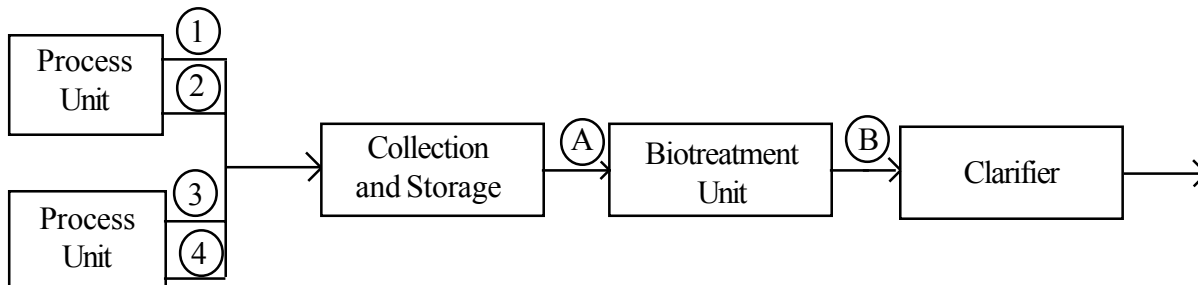
**Do the waste management units following the steam stripper require control under the Subpart CC rules?
Why?**

Case Study - Treatment Options and Standards (Cont'd)

Appendix C

Example 2: Biological Treatment

Flow Diagram.



Situation.

Four (4) hazardous waste streams are generated by a manufacturing process; the wastes are collected in closed individual drain systems and sent to a common storage tank where the waste streams mix. Both the collection systems and the storage tank system comply with the relevant control requirements of the Subpart CC rules. The aggregated hazardous waste stream is hard piped to a biological treatment unit where the waste is treated in the uncontrolled bio-unit. The bio-unit is considered a surface impoundment for the RCRA permit. Following bio-treatment the waste is piped to a secondary clarifier then to a chlorine basin from which it is discharged. The on-site wastewater treatment system has a National Pollution Discharge Elimination System (NPDES) permit.

The owner/operator has decided to use the treatment process alternative that involves the determination of the organic mass biodegradation rate (MR_{bio}) and the required mass removal rate (**RMR**) in §265.1083(c)(2)(iv). Use of this alternative is not waste stream specific in that it does not require a 95% reduction for every waste stream; the required mass removal is based on the aggregated organic mass of the untreated waste. This alternative however does require VO concentration data at the point of waste origination (Points 1 through 4) for the four individual wastes that comprise the aggregate waste stream. Under this treatment alternative, if the actual organic mass biodegradation rate (MR_{bio}) is equal to or greater than the required mass removal rate (**RMR**), then downstream units managing this waste stream no longer require control for air emissions under Subpart CC. In addition, bio-units that meet this condition are exempt from the control requirements of the Subpart CC rules; no cover is required for the surface impoundment (i.e., the bio-unit).

The owner/operator has used direct measurement (using methods in SW 846 for volatiles and semi-volatiles) to determine the actual organic concentrations at their point of waste origination for the three organic constituents present in each of the four waste streams (i.e., cresol, methanol, and chloroform) that make up the aggregated waste. The constituent concentrations at Points 1 through 4 are presented below. The owner/operator does not wish to conduct a Method 25D analysis for the wastes streams at their point of waste origination; however, the VO concentration of the waste is needed at these four locations in order to determine the required mass removal rate (**RMR**). Therefore, the owner/operator makes use of the EPA published values of the fraction measured by Method 25D (f_m) that have been determined by EPA for a large range of chemical constituents to estimate the VO concentration as measured by Method 25D. To calculate the Method 25D VO concentration for a particular constituent, the actual concentration is multiplied by the f_m value to obtain an estimate of what concentration would be seen by Method 25D.

Case Study - Treatment Options and Standards (Cont'd)

Appendix C

Measurements and Calculations.

Step 1. Identify the actual composition of the waste streams and waste stream flow rates. If EPA Method 25D is to be run on the waste streams, skip this step.

Waste Compositions:

	Waste Constituents, ppmw			Total	Flow (Q, L/s)
	cresol	methanol	chloroform		
Actual Concentration					
(measured at Point 1)	700	600	387	1,687	10
(measured at Point 2)	300	800	600	1,700	20
(measured at Point 3)	34	12	2	48	250
(measured at Point 4)	0	25	0	25	400

Step 2. Measure the Method 25D VO concentrations, or estimate the VO concentrations from the wastewater analysis. Obtain the f_m value for each compound. Multiply each concentration by the f_m value to obtain the estimated Method 25D VO concentration.

VO Concentration Determination:

	Waste Constituents, ppmw			Total	Flow (Q, L/s)
	cresol	methanol	chloroform		
f_m , fraction measured by EPA method 25D					
0.0345					
0.433					
1.03					
VO Concentration (25D)					
(estimated at Point 1)	24	260	399	683	10
(estimated at Point 2)	10	346	618	975	20
(estimated at Point 3)	1	5	2	8	250
(estimated at Point 4)	0	11	0	11	400

Step 3. Estimate the required organic mass removal rate (**RMR**). The treatment unit's actual organic mass biodegraded (MR_{bio}) must equal or exceed the **RMR** or the bio-unit must be controlled for air emissions and the waste management units following the bio-unit must be controlled for air emissions. The VO concentration that exceeds the action level of 500 ppmw (C_{AL}) is used as the basis for the **RMR** calculation (if $C_{VO} > 500$ ppmw, then $C_{AL} = C_{VO} - 500$; if $C_{VO} < 500$ ppmw, then $C_{AL} = 0$). Within the regulation the **RMR** has units of kg/hr; however, for this example it is assumed that the densities of the hazardous waste streams are equal to that of water. Therefore, for ease of comparison, the **RMR** is expressed in terms of ppmw.

Case Study - Treatment Options and Standards (Cont'd)

Appendix C

Required Mass Removal Rate Calculation:

Waste Stream	Q (L/s)	C _{vo} (ppmw)	Q * C _{vo} (ppmw)	C _{AL}	Q * C _{AL}
Point 1	10	683	6,830	183	1,830
Point 2	20	975	19,500	475	9,500
Point 3	250	8	2,000	0	0
Point 4	400	11	4,400	0	0
Sums	680		32,730		11,330

$$\begin{aligned} \text{VO Concentration at Point A} &= (32,730 \div 680) &= & 48 \text{ ppmw} \\ \text{RMR} &= (11,330 \div 680) &= & 17 \text{ ppmw} \end{aligned}$$

Step 4. The actual waste constituent concentrations and the VO concentrations are calculated on a flow-weighted mass basis for the aggregated waste stream at Point A, the inlet to the biotreatment unit. The results of these calculations are presented below.

Flow-Weighted Average Concentration:

Point A	Waste Constituent Flow-Weighted Average Concentration, ppmw			
	cresol	methanol	chloroform	Total
Actual Concentration	32	34	30	81
f _m , fraction measured by EPA Method 25D	0.0345	0.433	1.03	
VO (25D) Concentration	1	15	31	47

Step 5. The biological removal effectiveness for the bio-treatment unit, the organic mass biodegradation rate (MR_{bio}) is calculated using the VO concentration at the inlet to the treatment unit, Point A, and the organic fraction biodegraded (f_{bio}). f_{bio} is obtained using the methodology in 40 CFR Part 63, Appendix C, "Determination of the Fraction Biodegraded (f_{bio}) in a Biological Treatment Unit." MR_{bio} equals the organic mass entering the bio-unit multiplied by f_{bio} . The fraction of organics that are lost to the air for the bio-unit, f_e , can also be obtained from Appendix C and EPA's WATER8 air emission model; these values can then be used to estimate air emissions for the bio-unit. The MR_{bio} is formatted in units of kg/hr in the regulation; however, as previously noted this mass value is expressed in terms of ppmw in this example.

Case Study - Treatment Options and Standards (Cont'd)

Appendix C

Organic Mass Biodegraded Calculation:

Point A	Waste Constituent Flow-Weighted Average Concentration ppmw			
	cresol	methanol	chloroform	Total
VO (25D) Concentration (Mass in)	1	15	31	47
f_{bio} , fraction biodegraded	0.999	0.95	0.18	
f_e , fraction emitted to air	0.0001	0.04	0.8	
MR_{bio} , mass biodegraded (f_{bio} x Mass in)	1	14	6	21
Air emissions from bio-unit (f_e x Mass In)	0	1	25	26
Biological removal fraction (f_{bio}) (Overall mass weighted)				0.45
R_{bio} (mass weighted)				45%
Air emissions fraction				0.55

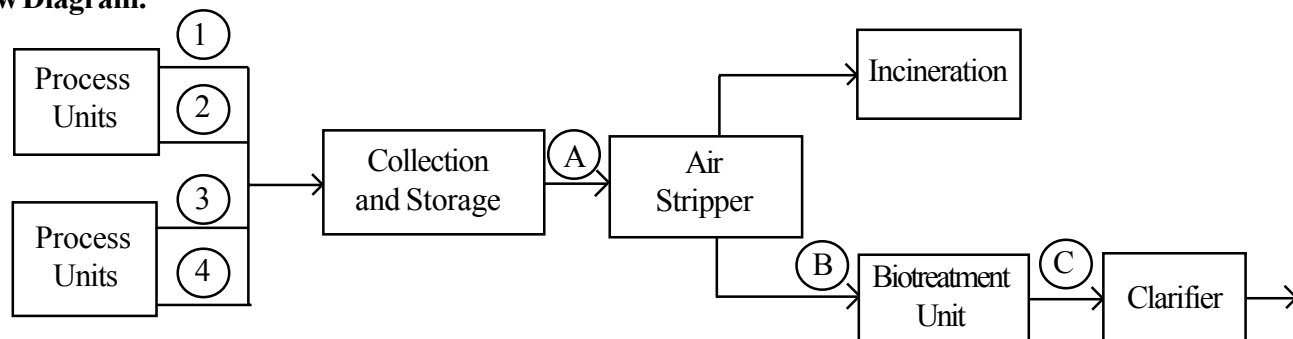
Questions.

Does the bio-treatment unit need to be controlled?

Why?

Example 3: Air Stripping Followed by Biological Treatment

Flow Diagram.



Situation.

Four (4) hazardous waste streams are generated by a manufacturing process; the wastes are collected in closed individual drain systems and sent to a common storage tank where the waste streams mix. Both the collection systems and the storage tank system comply with the relevant control requirements of the Subpart CC rules. The aggregated hazardous waste stream is hard piped to an air stripping unit. The exit gas stream from the air stripper is controlled by a combustion unit that meets the control requirements of Subpart CC. The effluent from the air stripping unit is hard piped to a biodegradation unit; the bio-unit is uncontrolled, i.e., open to the atmosphere. The bio-unit is considered a surface impoundment for the RCRA permit. Following bio-treatment,

Case Study - Treatment Options and Standards (Cont'd)

Appendix C

the waste is piped to a secondary clarifier then to a chlorine basin from which it is recycled to the plant as process water. The on-site wastewater treatment system does not have a National Pollution Discharge Elimination System (NPDES) permit.

The owner/operator has decided to use the treatment process alternative that involves the determination of the exit concentration limit (C_p) in §265.1083(c)(2)(l). Use of this alternative accommodates mixing of waste streams and accounts for dilution of regulated waste with dilute non-regulated waste streams; this alternative, although waste stream specific, does not require a 95% reduction for every waste system. This alternative, in order to calculate C_p , requires VO concentration data at the point of waste origination (Points 1 through 4) for the four individual wastes that comprise the aggregated waste stream. Under this treatment alternative, if the VO concentration of the treated waste is less than the calculated exit concentration limit (C_p), then downstream units managing this waste stream no longer require control for air emissions under Subpart CC.

The owner/operator has used direct measurement (using methods in SW-846 for volatiles and semi-volatiles) to determine the actual organic concentrations at their point of waste origination for the three organic constituents present in each of the four waste streams (i.e., cresol, methanol, and chloroform) that make up the aggregated waste. The constituent concentrations at Points 1 through 4 are presented below. The owner/operator does not wish to conduct a Method 25D analysis for the wastes streams at their point of waste origination; however, the VO concentration of the waste is needed at these four locations in order to determine the exit concentration limit (C_p). Therefore, the owner/operator makes use of the EPA published values of the fraction measured by Method 25D (f_m) that have been determined by EPA for a large range of chemical concentration for a particular constituent, the actual concentration is multiplied by the f_m value to obtain an estimate of what concentration would be seen by Method 25D.

Measurements and Calculations.

Step 1. Identify the actual composition of the waste streams and waste stream flow rates. If EPA Method 25D is to be run on the waste streams, skip this step.

Waste Compositions:

	Waste Constituents, ppmw				Flow (Q, L/s)
	cresol	methanol	chloroform	Total	
Actual Concentration					
(measured at Point 1)	700	400	2,500	3,600	10
(measured at Point 2)	300	200	43	543	20
(measured at Point 3)	800	50	2	852	30
(measured at Point 4)	80	124	7	211	8

Step 2. Measure the Method 25D VO concentrations, or estimate the VO concentrations from the wastewater analysis. Obtain the f_m value for each compound. Multiply each concentration by the f_m value to obtain the estimated Method 25D VO concentration.

Case Study - Treatment Options and Standards (Cont'd)

Appendix C

VO Concentration Determination:

	Waste Constituents, ppmw				Flow (Q, L/s)
	cresol	methanol	chloroform	Total	
f_m , fraction measured by EPA Method 25D	0.0345	0.433	1.03		
VO Concentration (25D)					
(estimated at Point 1)	24	173	2,575	2,772	10
(estimated at Point 2)	10	87	44	141	20
(estimated at Point 3)	28	22	2	51	30
(estimated at Point 4)	3	54	7	64	8

Step 3. Calculate the exit concentration limit (C_T). The treatment unit's exit stream VO concentration must be less than the C_T or the waste management units following the treatment unit/system must be controlled for air emissions. The VO concentration of the original four waste streams (Points 1 through 4) that is less than the action level of 500 ppmw (C_{EX}) is used as the basis for the C_T calculation. (If $C_{VO} > 500$ ppmw, then $C_{EX} = 500$; if $C_{VO} < 500$ ppmw, then $C_{EX} = C_{VO}$.)

Exit concentration Limit Calculation:

Waste Stream	Q (L/s)	C_{VO} (ppmw)	$Q \cdot C_{VO}$ (ppmw)	C_{EX}	$Q \cdot C_{EX}$
Point 1	10	2,772	27,720	500	5,000
Point 2	20	141	2,820	141	2,820
Point 3	30	51	1,530	51	1,530
Point 4	8	64	512	64	512
Sums	68		32,582		9,862

$$\text{VO Concentration at Point A} = (32,582 \div 68) = 479 \text{ ppmw}$$

$$C_T = (9,862 \div 68) = 145 \text{ ppmw}$$

Step 4. The actual waste constituent concentrations and the VO concentrations are calculated on a flow-weighted mass basis for the aggregated waste stream at Point A, the inlet to the air stripper unit. The results of these calculations are presented below.

Case Study - Treatment Options and Standards (Cont'd)

Appendix C

Flow-Weighted Average Concentration:

Point A	Waste Constituent Flow-Weighted Average Concentration, ppmw			
	cresol	methanol	chloroform	Total
Actual Concentration	553	154	382	1089
f_m , fraction measured by EPA				
Method 25D	0.0345	0.433	1.03	
VO (25D) Concentration	19	67	393	479

Step 5. The actual waste constituent concentrations and the VO concentrations are measured/calculated on a flow-weighted mass basis for the aggregated waste stream at Point B, the outlet of the air stripper unit (and inlet to the bio-unit). The results of these calculations are presented below. Note that the VO concentrations are too low to be measured by Method 25D. Other methods were used to obtain individual constituent concentrations and the results were multiplied by the f_m factor for each compound.

Flow-Weighted Average Concentration:

Point B	Waste Constituent Flow-Weighted Average Concentration, ppmw			
	cresol	methanol	chloroform	Total
Actual concentration	435	76	87	598
VO (25D) Concentration	15	33	89	137
VO mass removed by air stripper (calculated: A - B)	4	34	304	342
VO fraction removed in air stripper (Calculated: [A - B]/A)	0.21	0.51	0.77	0.71

Step 6. The actual waste constituent concentrations and the VO concentrations are measured/calculated on a flow-weighted mass basis for the aggregated waste stream at Point C, the outlet of the bio-unit. The results of these calculations are presented below. Note that the VO concentrations are too low to be measured by Method 25D. Other methods were used to obtain individual constituent concentrations and the results were multiplied by the f_m factor for each compound.

Flow-Weighted Average Concentration:

Point C	Waste Constituent Flow-Weighted Average Concentration, ppmw			
	cresol	methanol	chloroform	Total
Actual Concentration	0.30	0.80	0.07	1.2
f_m , fraction measured by EPA				
Method 25D	.0345	0.433	1.03	
VO (25D) Concentration	0.01	0.35	0.07	0.43

Step 7. The biological removal effectiveness for the bio-treatment unit [the organic biodegradation efficiency (R_{bio}) and the organic mass biodegradation rate (MR_{bio})] are calculated using the VO concentration at the inlet

Case Study - Treatment Options and Standards (Cont'd)

Appendix C

to the biotreatment unit, Point B, and the organic fraction biodegraded (f_{bio}). f_{bio} is obtained using the methodology in 40 CFR Part 63, Appendix C, "Determination of the Fraction Biodegraded (f_{bio}) in a Biological Treatment Unit." R_{bio} is equal to f_{bio} multiplied by 100. MR_{bio} equals the organic mass entering the bio-unit multiplied by f_{bio} . The fraction of organics that are lost to the air from the bio-unit, f_e , can also be obtained from Appendix C and the EPA's WATER8 air emission model; these values can then be used to estimate air emissions for the bio-unit.

The MR_{bio} is formatted in units of kg/hr in the regulation; however, as previously noted, this mass value is expressed in terms of ppmw in this example. The organic reduction efficiency (R) for the bio-unit is calculated on a mass in and mass out basis. This value however does not reflect the actual control efficiency or performance of the unit because air emissions from the bio-unit are not taken into consideration in the calculation that uses only the VO mass of the waste entering and exiting the treatment unit.

Organic Mass Biodegraded Calculation:

	Waste Constituent Flow-Weighted Average Concentration, ppmw			
	cresol	methanol	chloroform	Total
VO (25D) Concentration (Point B, Mass in)	15	33	89	137
f_{bio} , fraction biodegraded	0.999	0.95	0.18	
f_e , fraction emitted to air	0.0001	0.04	0.8	
MR_{bio} , mass biodegraded (f_{bio} x Mass in)	15	31	16	62
Air emissions from bio-unit (f_e x Mass In)	0	1	72	73
Biological removal fraction (f_{bio}) (Overall mass weighted)				0.45
R_{bio} (mass weighted)				45%
Air emissions fraction				0.53
VO (25D) Concentration (Point C)	0.01	0.35	0.07	0.43
Organic reduction Efficiency (R) [Mass in - Mass out) / Mass in]	99%	99%	98%	99%

Step 8. The overall treatment effectiveness, i.e., organic reduction efficiency, for the two unit system is calculated using the total VO mass into the two unit system (i.e., air stripper and bio-unit) and the mass removed by the air stripper plus the amount biodegraded in the bio-unit. Mass removed through air emissions from the air stripper and the bio-unit are not considered in the overall reduction efficiency.

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Treatment System Reduction Efficiency:

	Waste Constituent Flow-Weighted Average Concentration, ppmw			
	cresol	methanol	chloroform	Total
Total VO mass in (Point A), ppmw	19	67	393	479
Total VO mass removed, ppmw	19	65	320	404
Organic Reduction efficiency (%)	99%	98%	81%	84%

Questions.

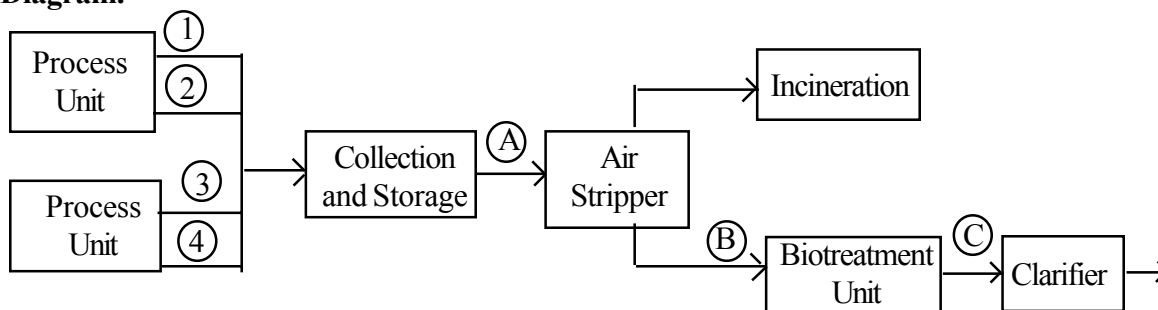
Do the waste management units following the biotreatment unit need to be controlled?

Does the bio-unit meet the requirements for organic reduction efficiency?

Does the biotreatment unit need to be controlled under Subpart CC requirements? Why?

Example 4: Steam Stripping Followed by Biological Treatment

Flow Diagram.



Situation.

Four (4) hazardous waste streams are generated by a manufacturing process; the wastes are collected in closed individual drain systems and sent to a common storage tank where the waste streams mix. Both the collection systems and the storage tank system comply with the relevant control requirements of the Subpart CC rules. The aggregated hazardous waste stream is hard piped to a steam stripper. The steam stripper condenser vent is controlled to meet the requirements of Subpart AA provisions for control devices and closed vent systems. The steam stripper effluent is sent to a biological treatment unit; the bio-unit is uncontrolled, i.e., open to the atmosphere. The bio-unit is considered a surface impoundment for the RCRA permit. Following bio-treatment the waste is piped to a secondary clarifier then to a chlorine basin from which it is discharged. The on-site wastewater treatment system has a National Pollution Discharge Elimination System (NPDES) permit.

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The owner/operator is uncertain if the facility's hazardous waste treatment system meets any of the available treatment alternatives and therefore would like to examine the alternatives to determine if and at what point in the treatment scheme the facility treatment of the waste meets any of the criteria in §265.1083(c)(2).

The owner/operator has used direct measurement using EPA Method 25D to determine the volatile organic (VO) concentrations at their point of waste origination for each of the four waste streams that make up the aggregated waste. The VO concentrations at Points 1 through 4 are presented below. The VO concentration of the wastes is needed at these four locations in order to determine the exit concentration limit (C_T) and the required mass removal rate (RMR).

Measurements and Calculations.

Step 1. Identify the actual composition of the waste streams and waste stream flow rates. If EPA Method 25D is to be run on the waste streams, skip this step.

Waste Compositions:

Actual waste compositions (i.e., constituent concentrations) were not determined for the four waste streams at the point of waste origination; the owner operator used direct measurement with Method 25D to determine the VO concentrations of the waste streams.

Step 2. Measure the Method 25D VO concentrations, or estimate the VO concentrations from the wastewater analysis.

VO Concentration Determination:

VO Concentration (Measured using EPA Method 25D)	Total VO (ppmw)	Flow (Q, L/s)
Point 1	3,898	10
Point 2	3,994	20
Point 3	1,175	30
Point 4	103	8

Step 3. Calculate the exit concentration limit (C_T). A treatment unit's exit stream VO concentration must be less than C_T , at the point waste treatment, in order for the waste management units following the treatment unit/system to be exempt from the air emission control requirements. The VO concentration of the original four waste streams (Points 1 through 4) that is less than the action level of 500 ppmw is used as the basis for the C_T calculation. Using the procedure outlined in Step 3 of Example 3, the exit concentration limit is calculated.

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Exit Concentration Limit:

$$C_T = 453 \text{ ppmw}$$

Step 4. Calculate the required organic mass removal rate (**RMR**). The treatment unit's actual organic mass removal rate (**MR**) must exceed the **RMR** or the waste management units following the treatment unit must be controlled for air emissions. The VO concentration that exceeds the action level of 500 ppmw ($C_{AL} = C_{VO} - 500$) is used as the basis for the **RMR** calculation. Within the regulation, the **RMR** has units of kg/hr; however, for this example it is assumed that the densities of the hazardous waste streams are equal to that of water. Therefore, for ease of comparison, the **RMR** is expressed in terms of ppmw.

Required Mass Removal Rate Calculation:

Waste Stream	Q (L/s)	C_{VO} (ppmw)	$Q * C_{VO}$	C_{AL} (ppmw)	$Q * C_{AL}$
Point 1	10	3,898	38,980	3398	33,980
Point 2	20	3,994	79,880	3494	69,880
Point 3	30	1,175	35,250	675	20,250
Point 4	8	103	824	0	0
Sums	68		154,934		124,110

VO Concentration, flow weighted average, at Point A = $(154,934 \div 68) = 2,279$ ppmw

RMR = $(124,110 \div 68) = 1,825$ ppmw

Step 5. The actual waste constituent concentrations and the VO concentrations are measured/calculated on a flow-weighted mass basis for the aggregate waste stream at Point B, the outlet of the steam stripper unit (and inlet to the bio-unit). The results of these calculations are presented below. Note that the VO concentrations are too low to be measured by Method 25D. Other methods were used to obtain individual constituent concentrations and the results were multiplied by the f_m factor for each compound.

Flow-Weighted Average Concentration:

Point B	Waste Constituent Flow-Weighted Average Concentration, ppmw			
	cresol	methanol	chloroform	Total
Actual Concentration (measured)	320	792	173	1,285
f_m , fraction measured by EPA Method 25D	0.0345	0.433	1.03	
VO (25D) Concentration (estimated)	11	343	179	533
VO mass removed by stripper (Calculated: A-B)				1,746
VO fraction removed in stripper (Calculated: [A-B]/A)			0.77	
Organic reduction efficiency (R) of the steam stripper		=		77%
Exit concentration, C_{VO} , for the steam stripper		=		533

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Step 6. The actual waste constituent concentrations and the VO concentrations are measured/calculated on a flow-weighted mass basis for the aggregate waste stream at Point C, the outlet of the bio-unit. The results of these calculations are presented below. Note that the VO concentrations are too low to be measured by Method 25D. Other methods were used to obtain individual constituent concentrations and the results were multiplied by the f_m factor for each compound.

Flow-Weighted Average Concentration:

Point C	Waste Constituent Flow-Weighted Average Concentration, ppmw			
	cresol	methanol	chloroform	Total
Actual Concentration (measured)	0.30	6.93	3.40	10.63
f_m , fraction measured by EPA Method 25D	0.0345	0.433	1.03	
VO (25D) Concentration (estimated)	0.01	3.00	3.50	6.51

Step 7. The biological removal effectiveness for the bio-treatment unit [the organic biodegradation efficiency (R_{bio}) and the organic mass biodegradation rate (MR_{bio})] are calculated using the VO concentration at the inlet to the biotreatment unit, Point B, and the organic fraction biodegraded (f_{bio}). f_{bio} is obtained using the methodology in 40 CFR Part 63, Appendix C, "Determination of the Fraction Biodegraded (f_{bio}) in a Biological Treatment Unit." R_{bio} is equal to f_{bio} multiplied by 100. MR_{bio} equals the organic mass entering the bio-unit multiplied by f_{bio} . The fraction of organics that are lost to the air from the bio-unit, f_e , can also be obtained from Appendix C and the EPA's WATER8 air emission model; these values can then be used to estimate air emissions for the bio-unit. The MR_{bio} is formatted in units of kg/hr in the regulation; however, as previously noted, this mass value is expressed in terms of ppmw in this example. The organic reduction efficiency (R) for the bio-unit is calculated on a mass in and mass out basis. This value however does not reflect the actual control efficiency or performance of the unit because air emissions from the bio-unit are taken into consideration in the calculation that uses only the VO mass of the waste entering and exiting the treatment unit.

Organic Mass Biodegraded Calculation:

	Waste Constituent Flow-Weighted Average Concentration, ppmw			
	cresol	methanol	chloroform	Total
VO (25D) Concentration (Point B, Mass in)	11	343	179	533
f_{bio} , fraction biodegraded	0.999	0.95	0.18	
f_e , fraction emitted to air	0.0001	0.04	0.8	
MR_{bio} , mass biodegraded (f_{bio} x Mass in)	11	326	32	369
Air emissions from bio-unit	0	14	143	157
Biological removal fraction (f_{bio}) (Overall mass weighted)				0.69
R_{bio} (mass weighted)				69%
Air emissions fraction				0.29
VO (25D) Concentration (Point C)	0.01	3.00	3.50	6.51
Organic reduction Efficiency (R) [Mass in - Mass out] / Mass in	99+%	99%	98%	99%

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Step 8. The overall treatment effectiveness, i.e., organic reduction efficiency, for the two unit system is calculated using the total VO mass into the two unit system (i.e., steam stripper and bio-unit) and the mass removed by the steam stripper plus the amount biodegraded in the bio-unit. Mass removed through air emissions from the steam stripper and the bio-unit are not considered in the overall reduction efficiency.

Treatment System Reduction Efficiency:

	Waste Constituent Flow-Weighted Average Concentration, ppmw			
	cresol	methanol	chloroform	Total
Total VO mass in (Point A)	19	425	1834	2278
Total VO mass removal rate (MR)	19	408	1688	2115
Organic Reduction efficiency (%)	100	96	92	93

Questions.

Do the waste management units following the biotreatment unit need to be controlled?

Does the bio-unit meet the requirements for organic reduction efficiency?

Does the biotreatment unit need to be controlled under Subpart CC requirements? Why?

Does the two-unit treatment system (i.e., steam stripper and bio-unit) meet the requirements for organic reduction efficiency?

Does the two-unit treatment system (i.e., steam stripper and bio-unit) meet the requirements for organic mass removal rate?

Why is the use of the exit concentration limit treatment alternative inappropriate for systems involving open bio-units?

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Solutions

Under the provisions of the Subpart CC rules (40 CFR 264 and 265, Subpart CC), air emission controls are no longer required for waste management units that receive hazardous waste when the organic content of the waste has been reduced by a treatment process that meets conditions specified in the rules, §265.1083(c)(2).

Example 1: Steam Stripping

The owner/operator has decided to use the treatment process alternative that involves the determination of the organic reduction efficiency (**R**) in §265.1083(c)(2)(ii). Use of this alternative limits the number and location of the waste VO concentrations that must be made to determine if the treatment system meets the criteria in the rule. For example, since the calculation of **R** is based on the actual VO mass of the waste entering and exiting the treatment process (at **Points A & B**), no data on VO concentrations are needed for the four individual wastes at their point of waste origination (**Points 1 through 4**). Under this treatment alternative, if the organic reduction efficiency (**R**) is greater than or equal to 95% and the VO concentration of the treated waste is less than 100 ppmw, then downstream units managing this waste stream no longer require control for air emissions under Subpart CC.

Review of the data for this treatment unit shows that the organic reduction efficiency (**R**) is equal to 96% and the VO concentration at the point of waste treatment is 32 ppmw (at Point B). This meets the criteria established in §265.1083(c)(2)(ii) of the rule; therefore, the waste management units following the steam stripper do not require control. However, it is important to note that the treatment device, i.e., the steam stripper, a tank in this case, must be controlled for air emissions.

Example 2: Biological Treatment

The owner/operator has decided to use the treatment process alternative that involves the determination of the organic mass biodegradation rate (MR_{bio}) and the required mass removal rate (**RMR**) in §265.1083(c)(2)(iv). Use of this alternative is not waste stream specific in that it does not require a 95% reduction for every waste stream; the required mass removal is based on the aggregated organic mass of the untreated waste. This alternative however does require VO concentration data at the point of waste origination (**Points 1 through 4**) for the four individual wastes that comprise the aggregate waste stream in order to calculate the required mass removal rate (**RMR**). Under this treatment alternative, if the actual organic mass biodegradation rate (MR_{bio}) is equal to or greater than the required mass removal rate (**RMR**), then downstream units managing this waste stream no longer require control for air emissions under Subpart CC. In addition, bio-units that meet this condition are exempt from the control requirements of the Subpart CC rules; no cover is required for the surface impoundment (i.e., the bio-unit).

Review of the data for this treatment unit shows that the fraction biodegraded for the overall waste stream (f_{bio}) is equal to 0.45 and the total mass entering the unit is 47 ppmw; this results in a MR_{bio} of 21 ppmw ($f_{bio} \times \text{Mass in}$). The required organic mass removal rate (**RMR**) as calculated from the VO concentration at the point of waste origination is equal to 17 ppmw. This meets the criteria established in §265.1083(c)(2)(iv) of the rule; therefore, the waste management units following the bio-unit do not require control. In addition, it is important

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to note that the bio-treatment unit, a surface impoundment in this case, also does not require controls for air emissions because the exemption criteria in §265.1086(a)(2) are met.

Example 3: Air Stripping Followed by Biological Treatment

The owner/operator has decided to use the treatment process alternative that involves the determination of the exit concentration limit (C_T) in §265.1083(c)(2)(i). Use of this alternative accommodates mixing of waste streams and accounts for dilution of regulated waste with dilute non-regulated waste streams; this alternative, although waste stream specific, does not require a 95% reduction for every waste stream. This alternative, in order to calculate C_T , requires VO concentration data at the point of waste origination for the four individual wastes (**Points 1 through 4**) that comprise the aggregated waste stream. Under this treatment alternative, if the VO concentration of the treated waste is less than the calculated exit concentration limit (C_T), then downstream units managing this waste stream no longer require control for air emissions under Subpart CC.

Based on the VO concentration of the wastes at their point of waste origination, the exit concentration limit (C_T) is calculated to be 145 ppmw. The VO concentration of the waste stream at the exit of the air stripper (Point B) is 137 ppmw which is less than the required C_T ; therefore, the waste stream exiting the air stripper no longer requires management in units that meet the Subpart CC control requirements. However, it is important to note that the treatment device, i.e., the air stripper, a tank in this case, must be controlled for air emissions.

The organic reduction efficiency of the bio-unit is only 45 percent based on the mass entering the unit. This does not comply with the 95 percent requirement in §265.1083(c)(2)(iv); however, because the air stripper meets the treatment requirements, the bio-unit is exempt from the control requirements regardless of the efficiency of the biodegradation process.

Example 4: Steam Stripping Followed by Biological Treatment

The owner/operator is uncertain if the facility's hazardous waste treatment system meets any of the available treatment alternatives and therefore would like to examine the alternatives to determine if and at what point the treatment scheme the facility treatment of the waste meets any of the criteria in §265.1083(c)(2).

Could the owner/operator use the exit concentration limit (C_T) as a treatment performance criteria?

This would be acceptable if the owner/operator were examining only the performance of the steam stripper as a treatment device. In this example, however, the C_T is 453 ppmw and the exit concentration of the steam stripper is 533 ppmw. The performance of the steam stripper is not adequate to meet the performance criteria of §265.1083(c)(2). The steam stripper, a tank in this case, would require control under Subpart CC.

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Use of the exit concentration limit is not appropriate in the case where the bio-unit is considered a part of the overall treatment system. This is because the exit VO concentration does not reflect the actual control efficiency or performance of the treatment system because the air emissions from the bio-unit are not taken into consideration in the calculation of the exit concentration. If the bio-unit were covered and vented to a control device that complied with the Subpart CC requirements then it would be acceptable to use the exit concentration limit criteria.

Does the treatment system meet the required organic mass removal rate (RMR) criteria?

The **RMR** in this example is 1825 ppmw; the VO mass removed by the steam stripper is 1746 ppmw based on the exit VO concentration of the steam stripper. The steam stripper alone is not adequate to meet the treatment criteria of the rule. If the steam stripper and bio-unit are considered together as a treatment system then the mass removed is 2115 ppmw (1746 ppmw for the stripper plus 369 ppmw for the bio-unit). The combined treatment system therefore meets the **RMR** criteria and the waste management units downstream of the bio-unit do not require control.

Does the bio-unit meet the requirements for organic reduction efficiency?

The organic reduction efficiency of the bio-unit is only 69 percent based on the mass entering the unit. This does not comply with the 95 percent requirement in §265.1083(c)(2)(iv); however, because the steam stripper and bio-unit are considered as a combined treatment system and that treatment system meets the mass removal treatment requirements of the rule, the bio-unit is exempt from the control requirements regardless of the low efficiency of the biodegradation process. This exemption only applies in situations where the bio-unit is the unit that ultimately achieves the treatment targets (i.e., the **R** of 95% or the site-specific **RMR** value). In other words, an open bio-unit can not be the first in a series of units within a treatment system that is used to meet the treatment requirements of the Subpart CC rules.