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

Biological Treatment Unit Case Study:

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 example illustrates the determination of acceptable waste treatment through examination of the various alternatives provided in the rules. This example includes calculation of 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}**).

In completing the case study, the participants will follow the same basic strategy for evaluating the performance of any of the eight treatment schemes provided in the rule. The basic steps provided in all caes 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}, or R_{bio}, as needed for the particular treatment alternative
- Evaluate the performance of the treatment system; determine if performance criteria are met

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Example Treatment Scenario

General Conditions Applicable to the Example Treatment Scenario.

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 example, the determinations that are formatted in terms of mass (e.g., kg/hr) within the regulation are presented in the example 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.

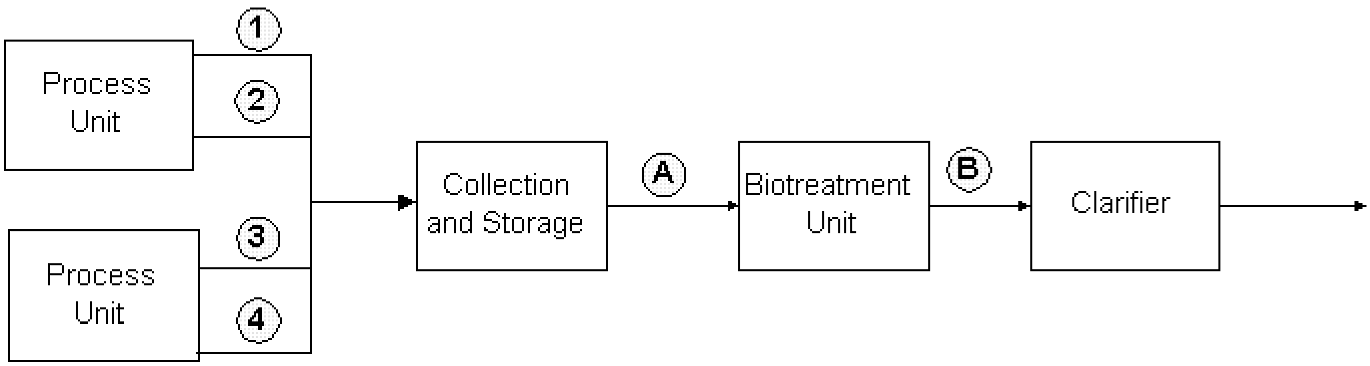
Conditions Specific to the Biological Treatment Unit.

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.

Example : Biological Treatment Unit

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.

Example : Biological Treatment
(continued)

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				
	cresol	**methanol**	**chloroform**	**Total**	**Flow** (Q, L/s)
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

Example : Biological Treatment
(continued)

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. Examine the Henry's law constants to determine if any of the organic compounds present inthe hazardous waste streams may be excluded from the VO concentration determination for compliance with subpart CC.

VO Concentration Determination:

	Waste Constituents , ppmw				
	cresol	**methanol**	**chloroform**	**Total** (ppmw)	**Flow** (Q, L/s)
f_m, fraction measured by EPA Method 25D	0.0345	0.433	1.03		
Method 25D Concentration					
(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
Henry's law constant (Y/X)	0.0394	0.2885	221.331		

VO concentration for compliance with subpart CC	**VO*** (ppmw)
(at Point 1)	659
(at Point 2)	965
(at Point 3)	7
(at Point 4)	11

* – Note: The definition of volatile organic concentration in subpart CC states that the VO concentration of a hazardous waste must include organic compounds with a Henry's law constant value of 0.1 Y/X or greate. Cresol has a Henry's law constant value of less than 0.034 Y/X; therefore it need not be included in the VO concentration for purposes of complying with subpart CC.

Example : Biological Treatment
(continued)

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 $C_{VO} \geq 500$ 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**.

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	659	6,590	159	1,590
Point 2	20	965	19,300	465	9,300
Point 3	250	7	1,750	0	0
Point 4	400	11	4,400	0	0
Sums	680		32,040		10,890

VO Concentration at Point A = (32,040 ÷ 680) = 47 ppmw

RMR = (10,890 ÷ 680) = 16 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 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	
Method 25D Concentration	1	15	31	**47**
VO concentration				**46**

Example : Biological Treatment
(continued)

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 Biodegrated (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.

Organic Mass Biodegraded Calculation:

Point A	Waste Constituent Flow-weighted Average Concentration, ppmw			
	cresol	**methanol**	**chloroform**	**Total**
VO (25D) Concentration (Mass in)	*	15	31	**46***
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)	*	14	6	**20**
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
Organic reduction efficiency (**R**) [(Mass in – Mass out)/ Mass in]				99.9 %

* – Note: Cresol has a Henry's law constant value less than 0.1 Y/X and therefore is not included in the determination of the VO concentration used for compliance with subpart CC.

Example : Biological Treatment
(continued)

Questions.

Does the bio-treatment unit need to be controlled? Why?