2-1-5 Judge the medium, air or water, to which larger or smaller quantity is released

Study the following and determine which is larger, the quantity released to air or to water.
a) Material properties of the specified substance (gaseous, liquid, solid) and handling method[*1]
b) Henry's constant of the specified substance[*2]

*1 When it is assumed that either of the quantities released to air or to water is zero depending on the condition where raw materials or materials containing the specified substance are handled, you can enter 0 as the released quantity.
*2 Substance that has a larger Henry constant is more likely to be released to air.

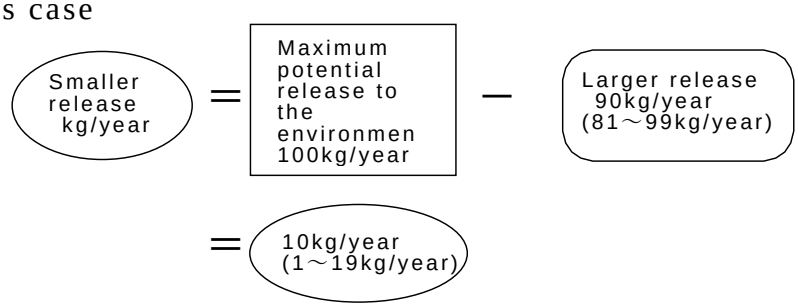
(NOTE)

○ You must calculate the smaller quantity first because if the larger release is calculated first by subtracting the other quantity from the maximum potential release, the error of the smaller release will become larger (reliability will be decreased).

Example: Maximum potential release to the environment = 100 kg/year

① Larger release= 90 kg/year (error 10% → assumed to be 81 to 99 kg/year)

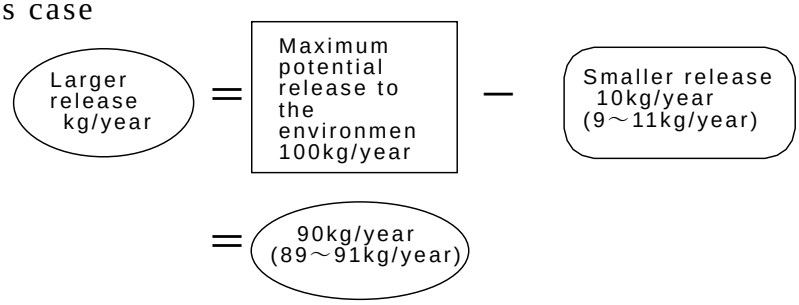
In this case



On the contrary,

② Smaller release= 10 kg/year (error 10% → assumed to be 9 to 11 kg/year)

In this case

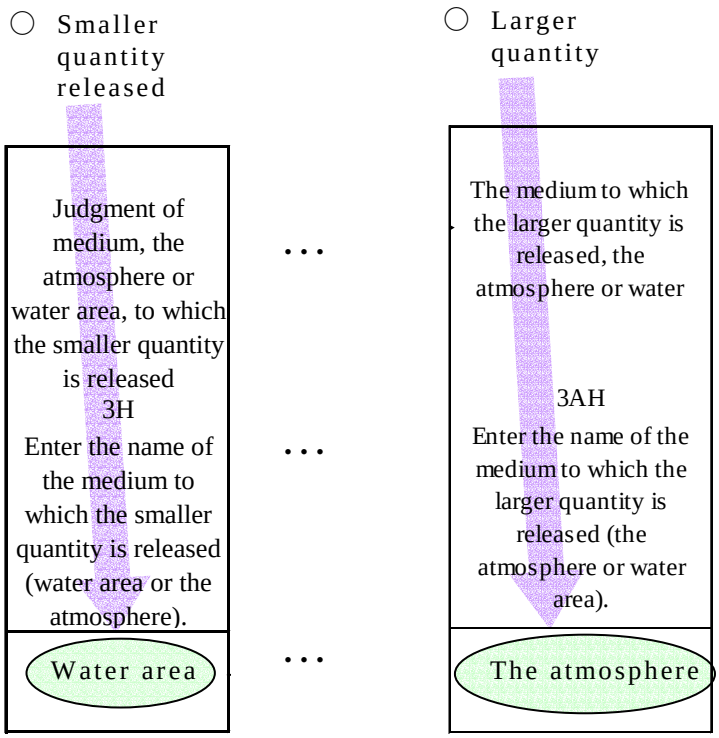


Therefore, in the case of ①, the error of the smaller release is larger than the case of ②. Error in the case of ①: 90%, Error in the case of ②: 10%

Reference page

- Part I 2-2-3 (1) Step1-5 Judge the medium, air or water, to which larger or smaller quantity is released (→ pI-47)
- Part III 4-2-6 Table of physical properties of specified substances (→ pIII-227)
  4-3-7 Guideline to judge to which medium, air or water, larger quantity is released (→ pIII-288)

Filling out the worksheet3



2-1-6 Calculate the quantity released to the medium to which the smaller quantity is released

Calculate the quantity released to the medium to which the smaller quantity is discharged using either of the following methods or other appropriate methods such as values obtained through experience.

a) Direct Measurement (Example of calculation 1–3 → pII-60)
b) Emission Factors (Example of calculation 4, 5 → pII-66)
c) Engineering Calculations (Example of calculation 6–8 → pII-70)

When exhaust gas or effluent treatment is performed, calculate the following values using removal rate and decomposition rate*.

- Discharge after treatment
- Quantity decomposed by treatment
- Quantity in waste generated by treatment

* Removal rate : The rate of removing specified substance in exhaust gas or effluent using a dust remover, purification device, activated carbon adsorption device, etc.

Decomposition rate : The rate of decomposing specified substance in exhaust gas or effluent into another simpler substance (such as carbon dioxide and water) using a combustion device or microbial decomposition device

(NOTE)

① When the measured value is less than the minimum limit of detection (N.D.: not detected) in the calculation based on actual measurement, assume it to be 0. When it is within the range larger than the minimum limit of detection and less than the minimum limit of determination, assume it to be 1/2 of the minimum limit of determination. If the minimum limit of detection or the minimum limit of determination is not known, ask the analysis service who carried out the measurement.

② When exhaust gas/effluent treatment is performed and information on removal rate or decomposition rate based on actual measurement or documents is not available, use "Typical removal rate and decomposition rate of exhaust gas and effluent treatment devices" in Part III (→ pIII-283). If you think the value does not suit the actual situation of the business establishment, adopt a method that you think is more appropriate, such as using values obtained through experience, advice of the equipment manufacturer, etc.

③ When waste such as activated carbon or sludge containing a specified substance is generated by activated carbon adsorption or activated sludge treatment, calculate the quantity in waste from exhaust gas or effluent treatment, on the assumption that the difference between the removed quantity and decomposed quantity is included in the waste. When the volatile specified substance contained in effluent is released to air by aeration during activated sludge treatment, calculate the release to other media by exhaust gas or effluent treatment by using the above formula, on the assumption that the difference between the removed quantity and decomposed quantity is released to other media.

④ When an activated carbon adsorption recovery system is used for exhaust gas/effluent treatment, and a specified substance adsorbed by the activated carbon is recovered and recycled within the same business establishment, do not calculate the “quantity in waste generated by treatment” to prevent the quantity recovered/recycled from being added to the “quantity in waste” or subtracted twice from the released quantity.

Reference page

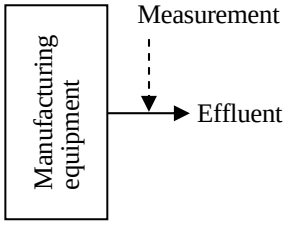
- Part I 2-2-2 Concept of calculating released/transferred quantities (→ pI-35)
  2-2-3 (1) Step1-6 Calculate the quantity released to the medium to which the smaller quantity is released (→ pI-48)
- Part III 2. Q&A Q88–Q90 (→ pIII-147–148), Q94 (→ pIII-149), Q104–Q105 (→ pIII-152),
  4-2-6 Table of physical properties of specified substances (→ pIII-227),
  4-3-1 Examples of emission factors of specified substances into the atmosphere (→ pIII-246),
  4-3-2 Examples of emission factors of the gasoline in a storage tank into the atmosphere (→ pIII-247),
  4-3-3 Emission factors listed in manuals of each industry (→ pIII-249),
  4-3-6 Rejection rate and decomposition rate in representative exhaust gas device and wastewater treatment device (→ pIII-283)

(Example of calculation 1) Method by actual measurement (when effluent treatment is not performed)

○ When acetaldehyde mixed in effluent during the solvent manufacturing process is released

- Quantity of effluent and acetaldehyde concentration in effluent

	Acetaldehyde concentration ($\mu g/L = mg/m^3$)	Quantity of effluent (m^3/month)
Apr.	86	2,500
May	-	3,200
Jun.	120	4,400
Jul.	-	2,800
Aug.	-	2,900
Sep.	98	4,500
Oct.	N.D.(Not Detected)	3,600
Nov.	-	3,300
Dec.	-	2,700
Jan.	65	2,600
Feb.	-	2,800
Mar.	-	3,100
	Mean value (86+120+98+0+65)/5 =73.8	Total 38,400

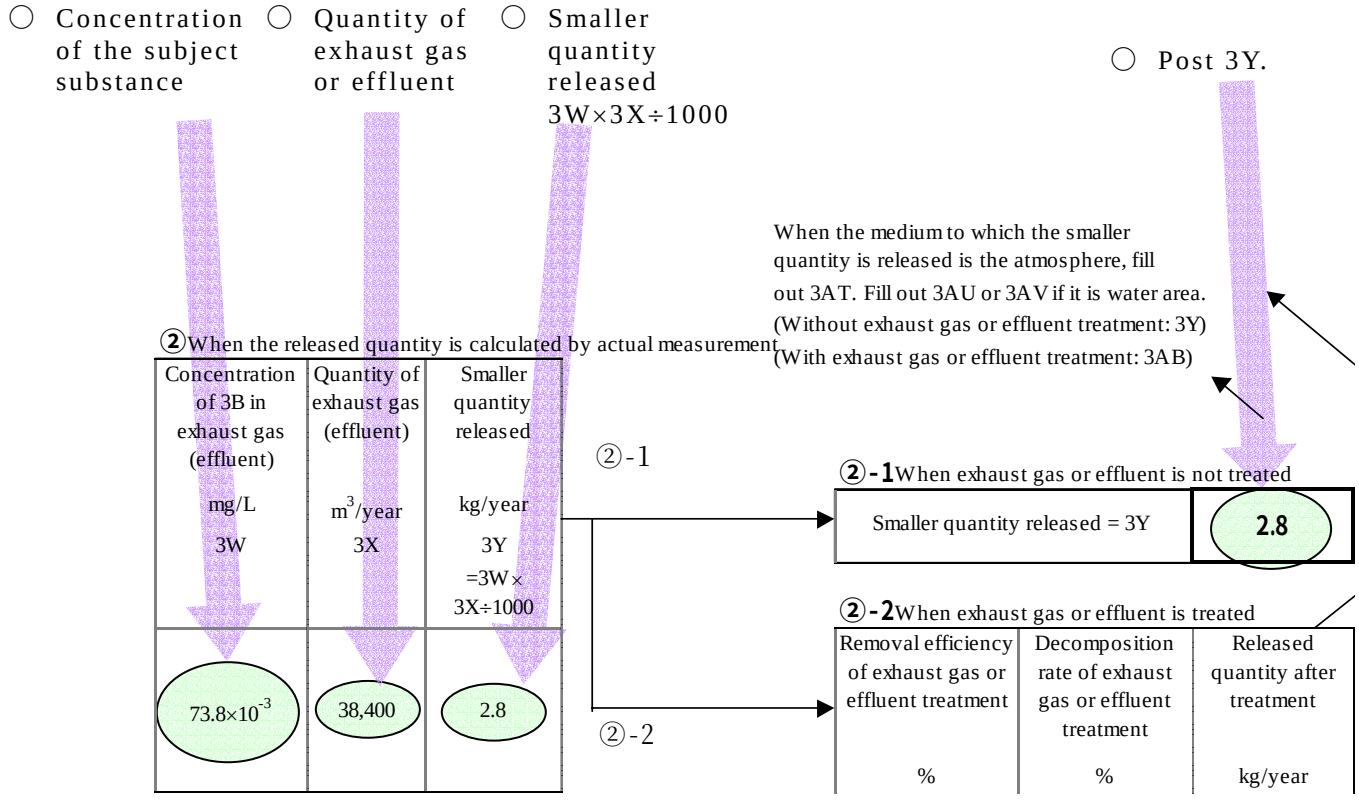


- Calculation of the quantity of acetaldehyde released to water

Quantity of acetaldehyde released to water (kg/year) = Annual quantity of effluent (38,400 m^3/year) × Average acetaldehyde content in effluent (73.8 mg/m^3) ÷ 1,000,000 mg/kg

= 2.8 kg/year

Filling out the worksheet3

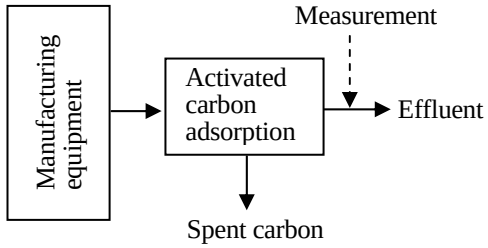


(Example of calculation 2) Method by actual measurement (when waste is generated as a result of effluent treatment)

○ When acetaldehyde mixed in effluent during the solvent manufacturing process is released after activated carbon adsorption treatment

- Quantity of effluent and acetaldehyde concentration after effluent treatment

  → Table in pII-60



- Removal rate/decomposition rate of activated carbon adsorption treatment

Removal rate of activated carbon adsorption treatment	80%
Decomposition rate of activated carbon adsorption treatment	0%

- Calculation of the quantity of acetaldehyde released to water

Quantity of acetaldehyde released to water (kg/year) = Annual quantity of effluent (38,400 m^3/year) × Average acetaldehyde concentration after effluent treatment (73.8 mg/m^3) ÷ 1,000,000 mg/kg

= 2.8 kg/year

- Calculation of the quantity of acetaldehyde decomposed by activated carbon adsorption treatment

Quantity of acetaldehyde decomposed by activated carbon adsorption treatment (kg/year) = Quantity released to water (after effluent treatment) (2.8 kg/year) × Decomposition rate of activated carbon adsorption treatment (0%) ÷ (100 - Removal rate of activated carbon adsorption treatment (80%))

= 0 kg/year

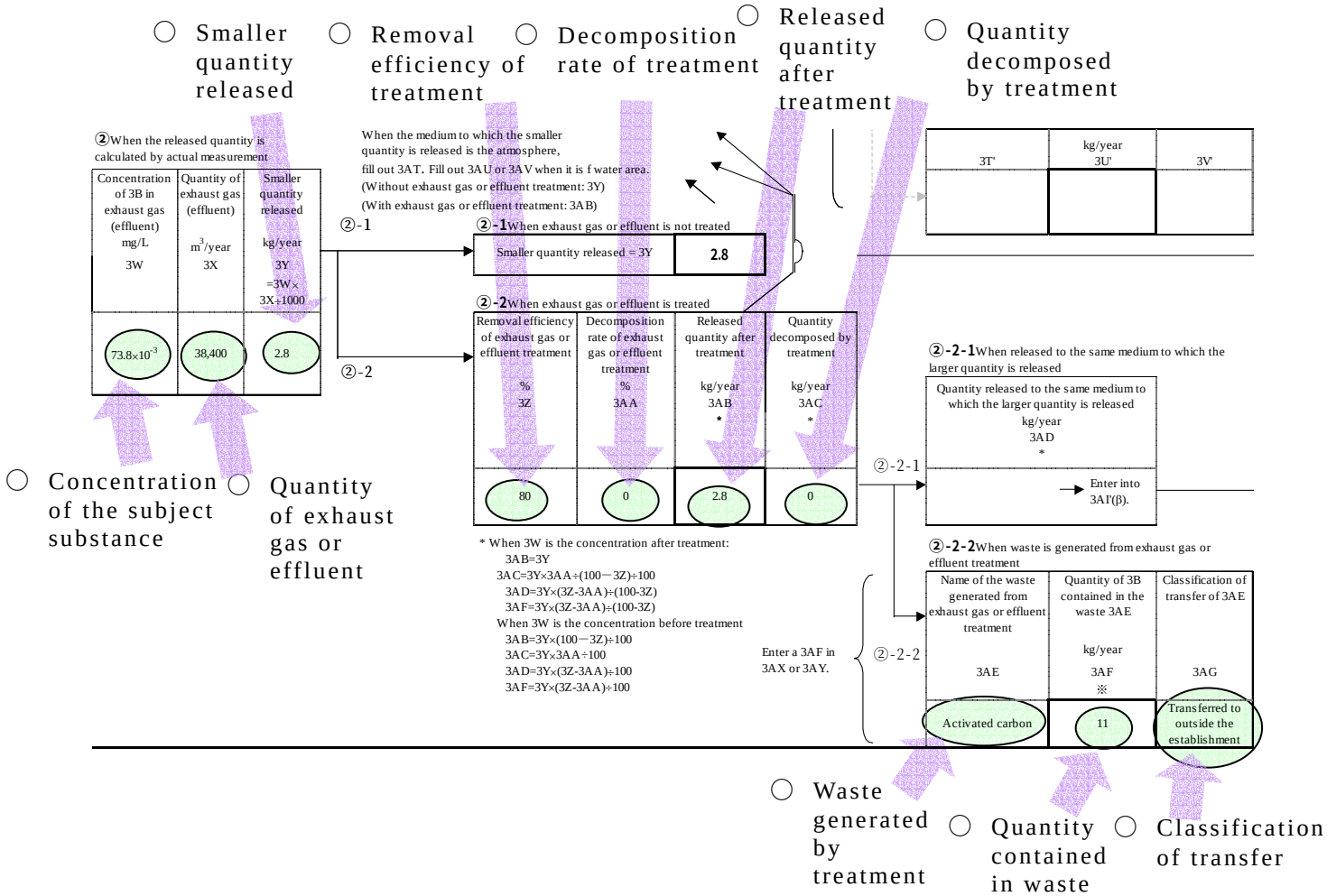
(cont'd)

- Calculation of quantity of acetaldehyde contained in spent carbon

Quantity of acetaldehyde contained in spent carbon (kg/year) = Quantity released to water (after effluent treatment) 2.8 kg/year × (Removal rate of activated carbon adsorption treatment 80% − Decomposition rate of activated carbon adsorption treatment 0%) ÷ (100 − Removal rate of activated carbon adsorption treatment 80%)

= 11 kg/year

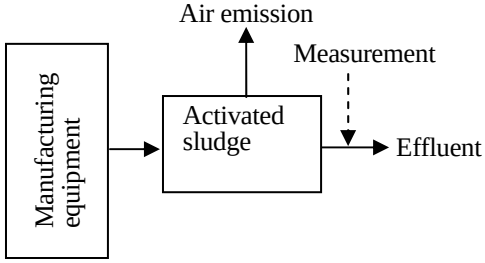
Filling out the worksheet3



(Example of calculation 3) Method by actual measurement (Air emission resulting from effluent treatment)

○ When acetaldehyde mixed in effluent during the solvent manufacturing process is released after activated sludge treatment

→ Table in pII-60



- Removal rate/decomposition rate of activated sludge treatment

Removal rate of activated sludge treatment	60%
Decomposition rate of activated sludge treatment	0%

- Calculation of the quantity of acetaldehyde released to water

Quantity of acetaldehyde released to water (kg/year) = Annual quantity of effluent (38.400 m^3/year) × Average acetaldehyde concentration after effluent treatment (73.8 mg/m^3) ÷ 1,000,000 mg/kg

= 2.8 kg/year

- Calculation of quantity of acetaldehyde decomposed by activated sludge processing

Quantity of acetaldehyde decomposed by activated sludge processing (kg/year) = Quantity released to water (after effluent treatment) (2.8 kg/year) × Decomposition rate of activated sludge processing (0%) ÷ (100 − Removal rate of activated sludge processing (60%))

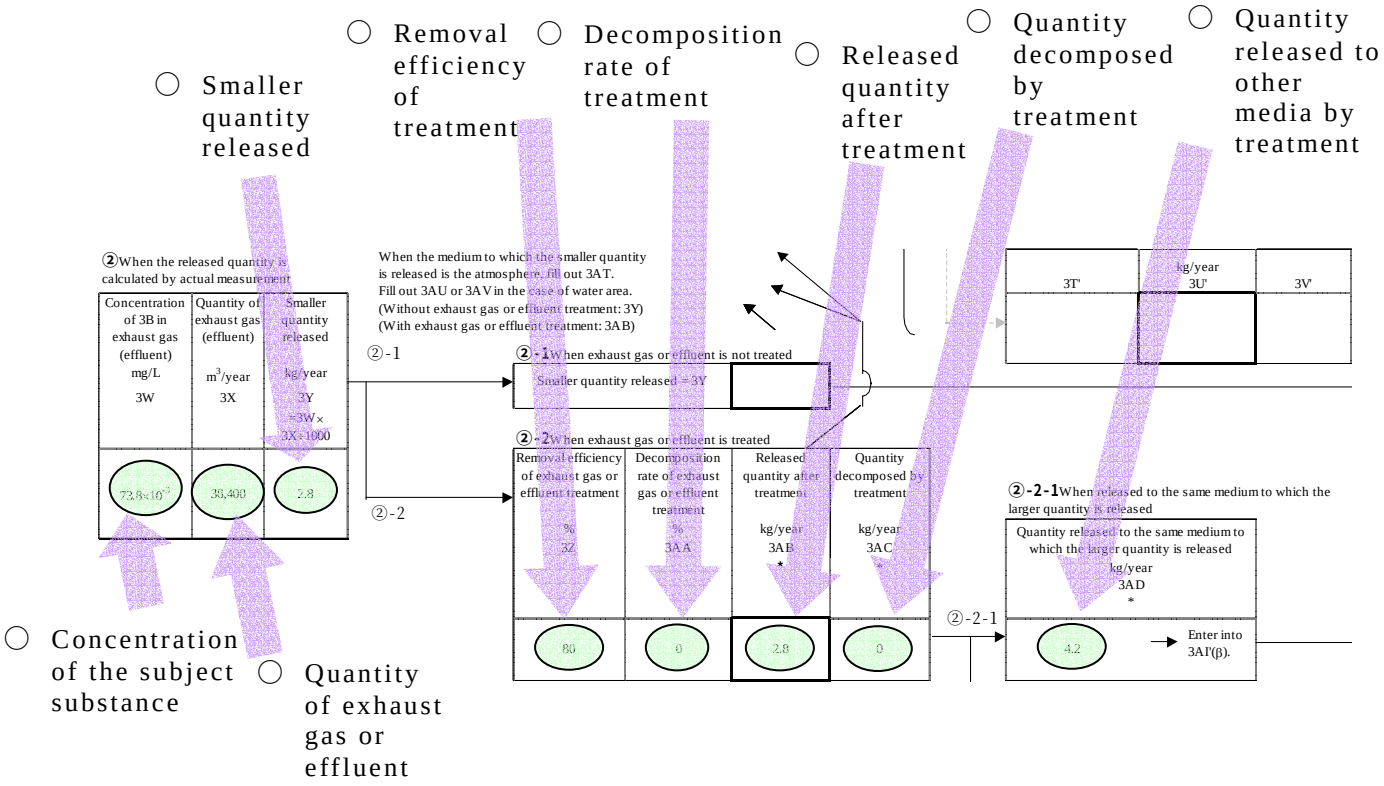
= 0 kg/year

- Air emission of acetaldehyde by activated sludge processing

Air emission of acetaldehyde by activated sludge processing (kg/year) = Quantity released to water (after effluent treatment) 2.8 kg/year × (Removal rate of activate sludge treatment 60% − Decomposition rate of activated sludge processing 0%) ÷ (100 − Removal rate of activate sludge treatment 60%)

= 4.2 kg/year

Filling out the worksheet3

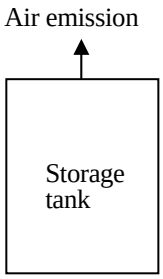


(Example of calculation 4) Method by actual measurement (When exhaust gas treatment is not conducted)

○ When dichloromethane is discharged into air from a storage tank

- Annual quantity of dichloromethane handled and emission factor

Annual quantity of dichloromethane handled	120 t/year
Emission factor of dichloromethane discharged from a storage tank	0.26 kg/t



- Calculation of the quantity of dichloromethane discharged to air

Quantity of dichloromethane discharged to air (kg/year) = Annual quantity of dichloromethane handled (120 t/year) × Emission factor of dichloromethane discharged from the storage tank (0.26 kg/t)

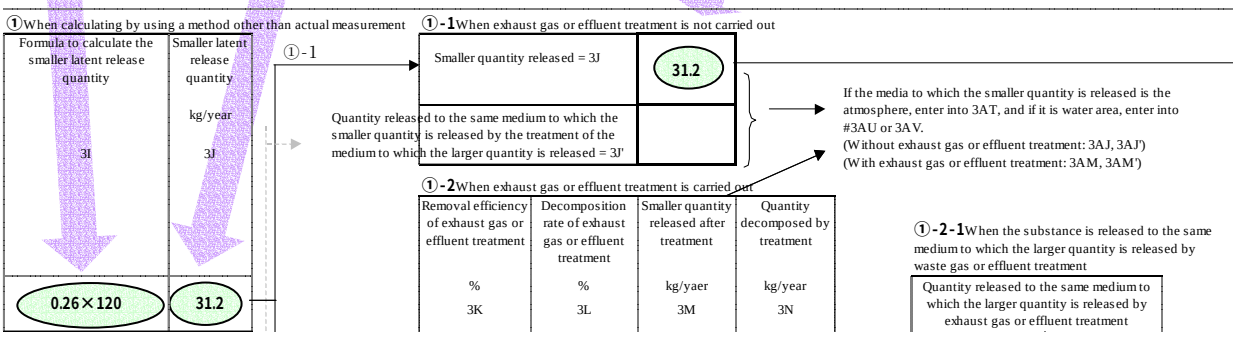
= 31.2 kg/year

Filling out the worksheet3

○ Formula to calculate the smaller quantity released

○ Smaller quantity released

○ Post 3J

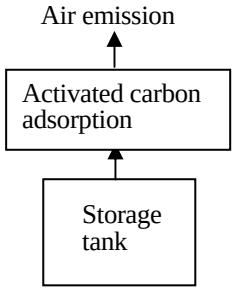


(Example of calculation 5) Method using emission factors (When waste is generated as a result of exhaust gas treatment)

○ When exhaust gas containing dichloromethane in a storage tank is treated by activated carbon adsorption equipment and discharged to air

- Annual quantity of dichloromethane and emission factor

Annual quantity of dichloromethane	120 t/year
Emission factor of dichloromethane from the storage tank	0.26 kg/t



- Removal rate/decomposition rate of activated carbon adsorption treatment

Removal rate of activated carbon adsorption treatment	80%
Decomposition rate of activated carbon adsorption treatment	0%

- Calculation of potential air emission of dichloromethane

Potential air emission of dichloromethane (kg/year) = Annual quantity of dichloromethane handled (120 t/year) × Emission factor of dichloromethane from the storage tank (0.26 kg/t)

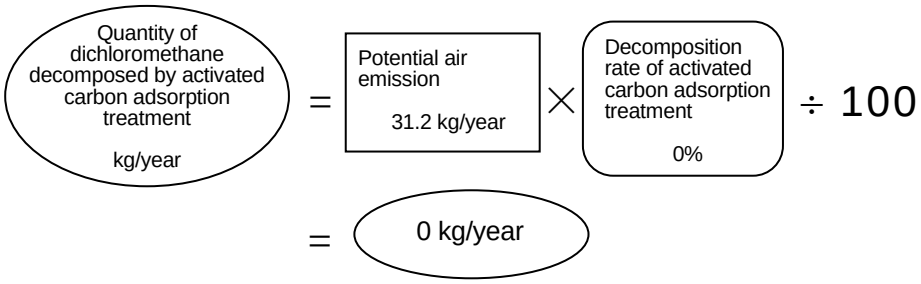
= 31.2 kg/year

- Calculation of air emission of dichloromethane after exhaust gas treatment

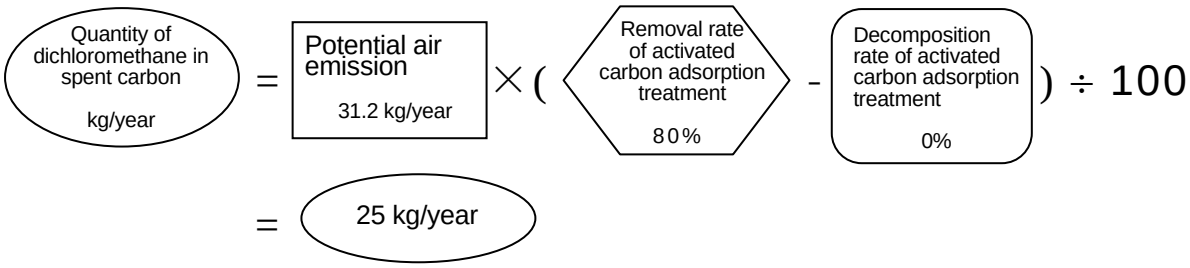
Air emission of dichloromethane (kg/year) = Potential air emission of dichloromethane (31.2 kg/year) × (100 - Removal rate of activated carbon adsorption treatment (80%)) ÷ 100

= 6.2 kg/year

- Calculation of the quantity of dichloromethane decomposed by activated carbon adsorption treatment

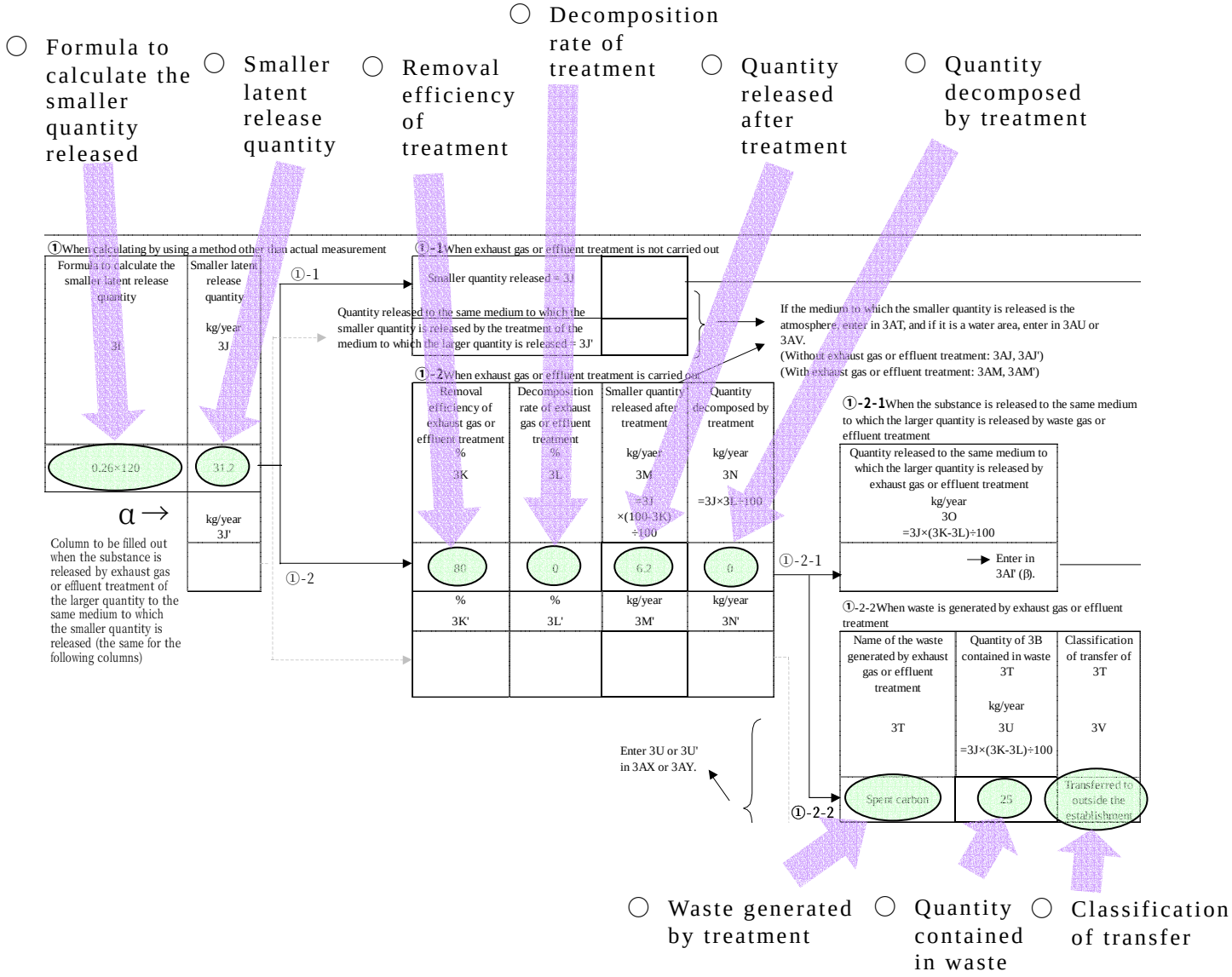


- Calculation of the quantity of dichloromethane contained in spent carbon



NOTE: The above is an example of calculation using the emission factors. Engineering calculations can also be used in the same manner to calculate the release after treatment, the quantity decomposed by treatment, and the quantity contained in waste.

Filling out the worksheet3

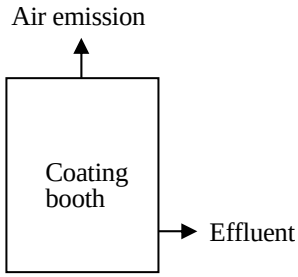


(Example of calculation 6) Engineering Calculations (When effluent treatment is not performed)

○ When toluene in paint splattered in the process of spray coating is recovered by a wet booth (provided with water curtain) and released in effluent

- Quantity of effluent per day, number of days of operation per year, and solubility of toluene to water

Quantity of effluent per day	2 m^3/day
Number of days of operation per year	200 days/year
Solubility of toluene to water	0.58 kg/m^3



- Calculation of the quantity of toluene released to water

Quantity of toluene released to water (kg/year) = Annual quantity of effluent (2 m³/day × 200 days/year) × Solubility of toluene to water (0.58 kg/m^3)

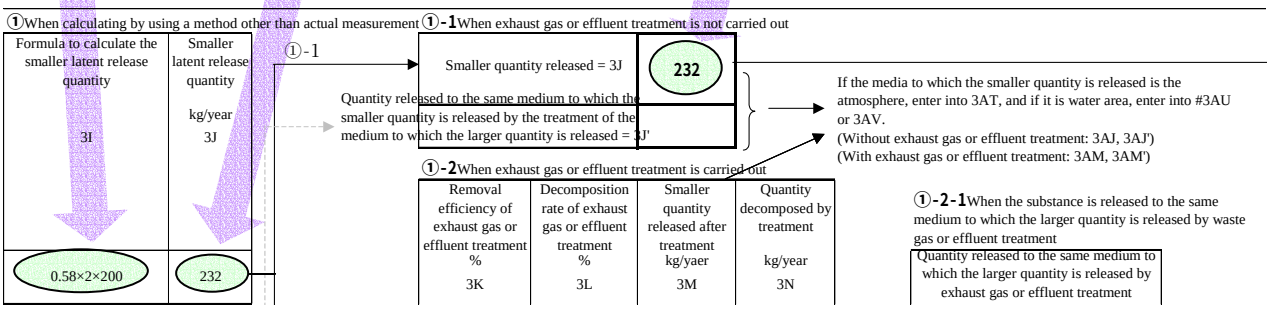
= 232 kg/year

Filling out the worksheet3

○ Formula to calculate the smaller quantity released

○ Smaller quantity released

○ Post 3J

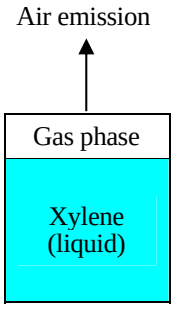


(Example of calculation 7) Engineering Calculations (When exhaust gas treatment is not performed)

○ When xylene is stored in a storage tank and released as exhaust gas

- Tank conditions, vapor pressure of xylene and molecular mass

Quantity of exhaust gas from the tank	0.2 m^3/min. (@ 25 °C)
Days of storage per year	365 days/year
Full pressure inside the tank	101.3 × 10^3 Pa
Vapor pressure of xylene	1.06 × 10^3 Pa
Molecular mass of xylene	106.2 g/mol



- Calculation of air emission of xylene
  Calculate the air emission of xylene using the vapor pressure, etc. as shown below.

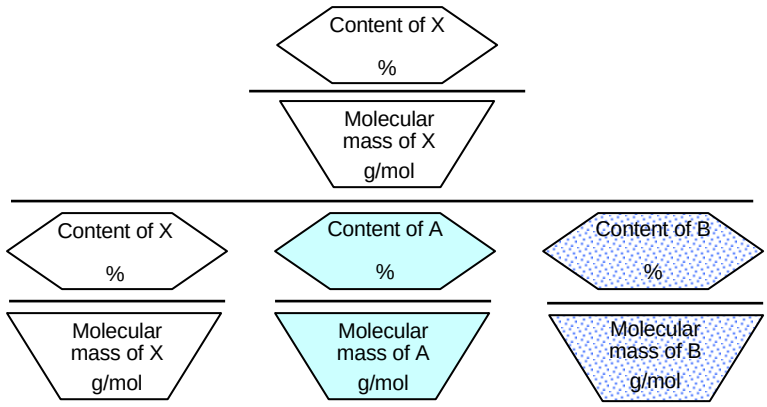
Air emission of xylene (kg/year) = (Vapor pressure of xylene 1.06 × 10^3 Pa / Full pressure inside the tank 101.3 × 10^3 Pa) × (Molecular mass of xylene 106.2 g/mol / Volume of air at 25 °C per 1 mol. 24.45 L/mol) × Quantity of exhaust gas 0.2 m^3/min. × 1440 mins./day × Number of days of storage 365 days

= 4,800 kg/year

* If the exhaust gas temperature is not 25°C, look for the vapor pressure at that temperature in chemistry reference guides, etc. and use that value. To convert to the volume at the given temperature, multiply the above formula by the coefficient obtained using the following formula.

$$\text{Conversion factor for the volume of gas per 1 mol at a given temperature} = \frac{25 + 273.15}{\text{Given temperature (°C)} + 273.15}$$

* If the stored substance is mixed liquor, find the content and the molecular mass of each substance contained in the mixed liquor, and multiply the above formula by them.
(To find the quantity of substance X in the mixed liquor consisting of substances X, A and B)

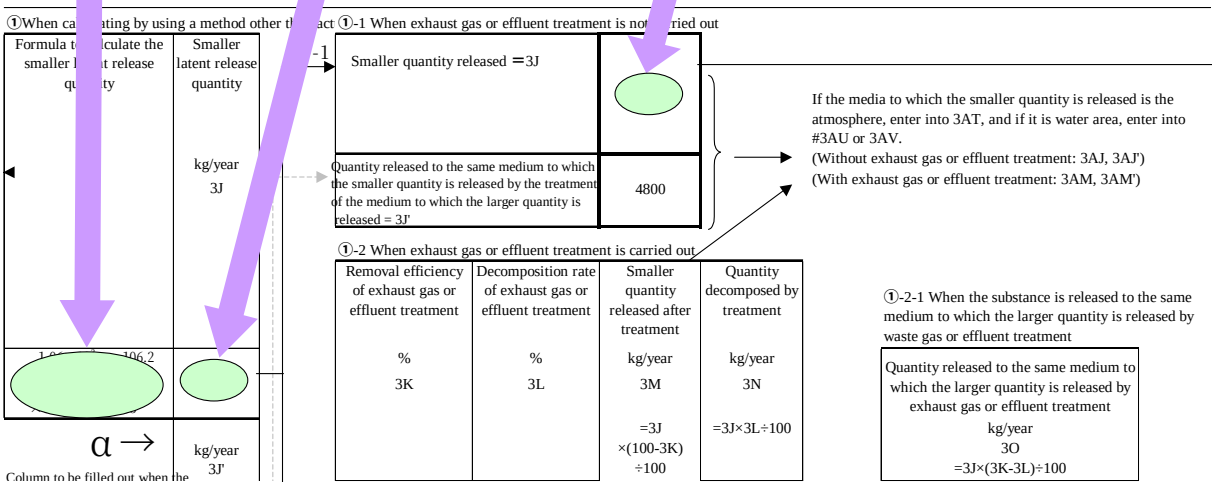


Filling out the worksheet3

○ Formula to calculate the smaller quantity released

○ Smaller quantity released

○ Post 3J

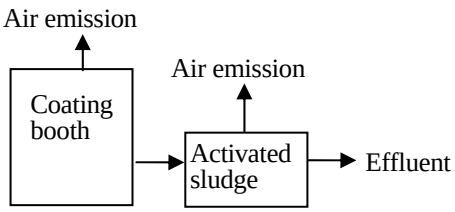


(Example of calculation 8) Engineering calculations (When specified substance is released to air through effluent treatment)

○ When toluene in paint splattered in the process of spray coating is recovered by a wet booth (provided with water curtain) and released in effluent

- Quantity of effluent per day, number of days of operation per year, and solubility of toluene to water

Quantity of effluent per day	2 m^3/day
Number of days of operation per year	200 day/year
Solubility of toluene to water	0.58 kg/m^3



- Removal rate/decomposition rate of activated sludge treatment

Removal rate of activated sludge treatment	60%
Decomposition rate of activated sludge treatment	0%

- Calculation of potential release of toluene to water

Potential release of toluene to water (kg/year) = Annual quantity of effluent (2 m^3/day × 200 days/year) × Solubility of toluene to water (0.58 kg/m^3)

= 232 kg/year

- Calculation of release of toluene to water after effluent treatment

Release of toluene to water (kg/year) = Potential release to water (232 kg/year) × (100 − Removal rate of activated sludge processing (60%)) ÷ 100

= 93 kg/year

- Calculation of decomposition rate of toluene by activated sludge processing

Quantity decomposed by activated sludge processing (kg/year) = Potential release to water (232 kg/year) × Decomposition rate of activated sludge processing (0%) ÷ 100

= 0 kg/year

- Calculation of air emission of toluene by activated sludge processing

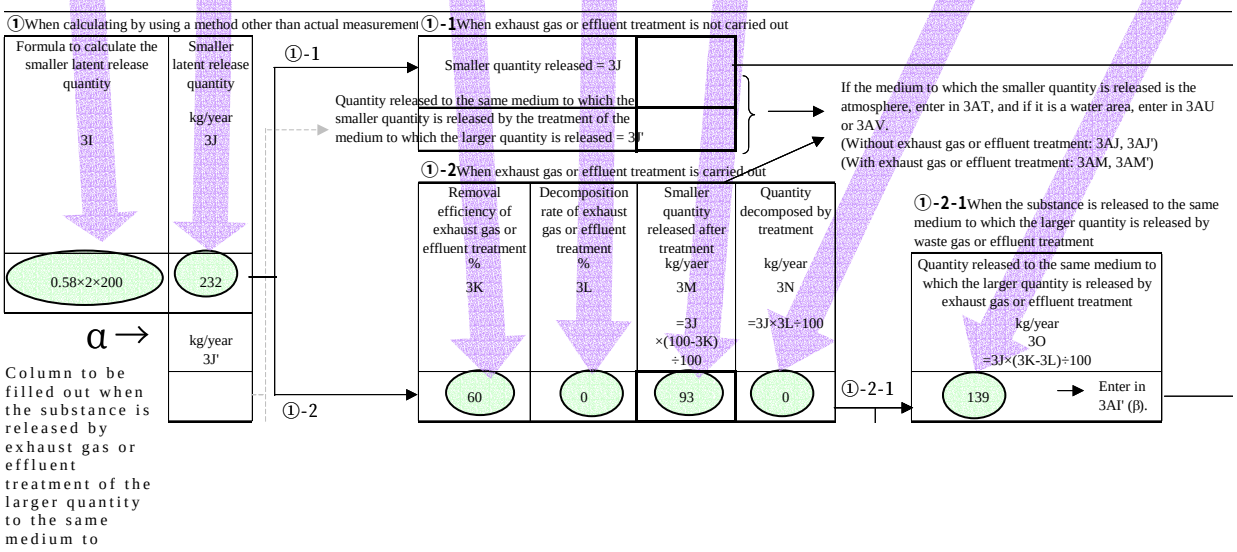
Air emission by activated sludge processing (kg/year) = Potential release to water (232 kg/year) × (Removal rate of activated sludge processing (60%) − Decomposition rate of activated sludge processing (0%)) ÷ 100

= 139 kg/year

NOTE: The above is an example of engineering calculations. Emission Factors can also be used in the same manner to calculate the release after treatment, the quantity decomposed by treatment, and the quantity contained in waste.

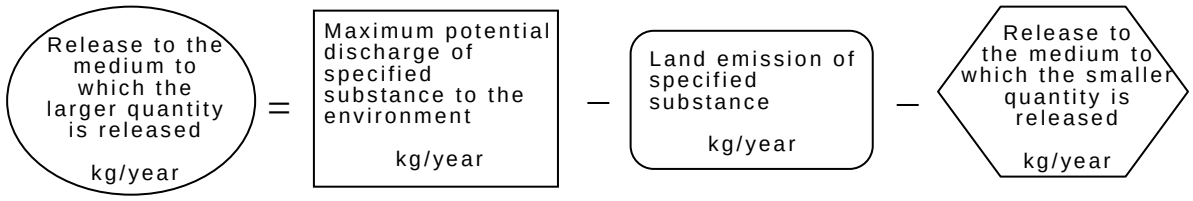
Filling out the worksheet3

○ Formula to calculate the smaller quantity released
○ Smaller latent release quantity
○ Removal efficiency of treatment
○ Decomposition rate of treatment
○ Quantity released after treatment
○ Quantity decomposed by treatment
○ Quantity released to other media by treatment



2-1-7 Calculate the quantity released to the medium to which the larger quantity is released

Calculate the quantity released to the medium to which the larger quantity is released using the following formula.



When exhaust gas or effluent treatment is performed, calculate the following values using removal rate and decomposition rate*.

- Discharge after treatment
- Quantity in waste generated by treatment

(NOTE)

○ When exhaust gas or effluent treatment is performed in a "medium to which a smaller quantity is released," subtract the "potential release to the medium to which a smaller quantity is released."

Reference page

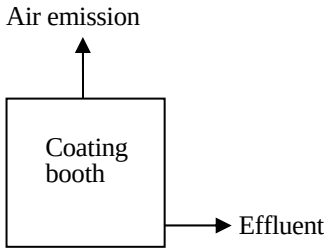
- Part I 2-2-3 (1) Step1-7 Calculate the quantity released to the medium to which the larger quantity is released (→ pI-50)
- Part III 2.Q&A Q88 (→ pIII-147), Q94 (→ pIII-149), 4-3-6 Rejection rate and decomposition rate in representative exhaust gas device and wastewater treatment device (→ pIII-283)

(Example of calculation 1) When exhaust gas treatment is not performed

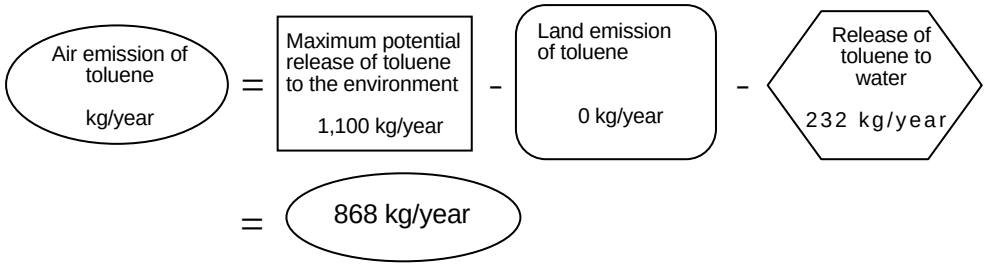
○ When toluene in paint splattered in the process of spray coating is recovered by a wet booth (provided with water curtain), some of which is released contained in effluent, and the rest is released to air.

- Annual handled quantity of toluene in paint manufactured

Maximum potential release of toluene to the environment	1,100 kg/year
Land emission of toluene	0 kg/year
Release of toluene to water	232 kg/year



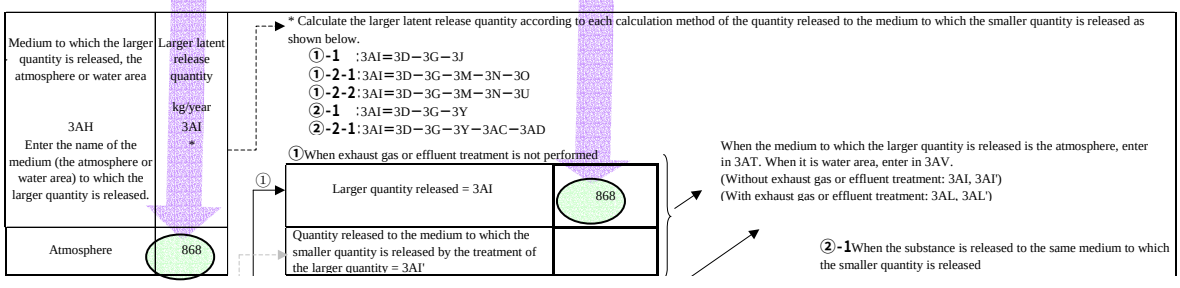
- Calculation of air emission of toluene



Filling out the worksheet3

○ Larger quantity released 3D-3J

○ Post "3AI"

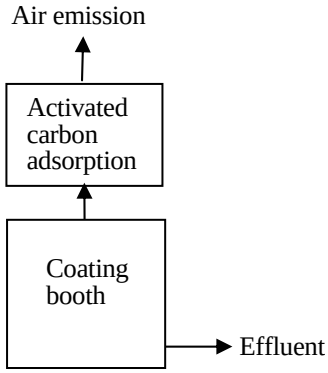


(Example of calculation 2) When exhaust gas treatment is performed

○ When toluene in paint splattered in the process of spray coating is recovered by a wet booth (provided with water curtain), some of which is released contained in effluent, and the rest undergoes activated carbon adsorption treatment and then released to air.

- Annual handled quantity of toluene in paint manufactured

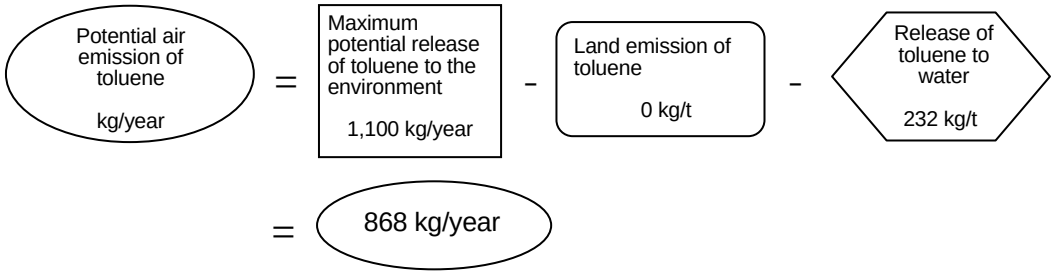
Maximum potential release of toluene to the environment	1.100 kg/year
Land emission of toluene	0 kg/year
Release of toluene to water	232 kg/year



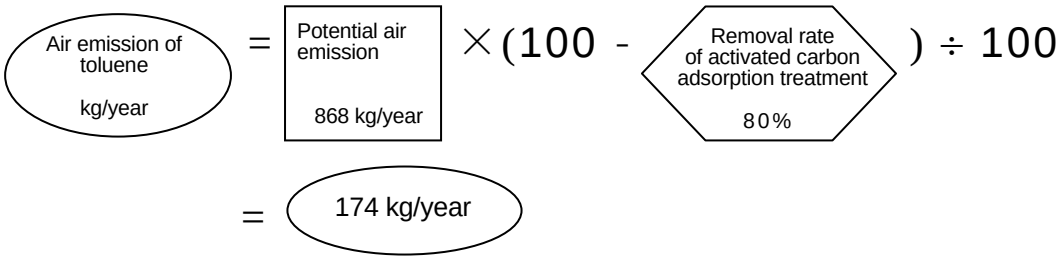
- Removal rate/decomposition rate of activated carbon adsorption treatment

Removal rate of activated carbon adsorption treatment	80%
Decomposition rate of activated carbon adsorption treatment	0%

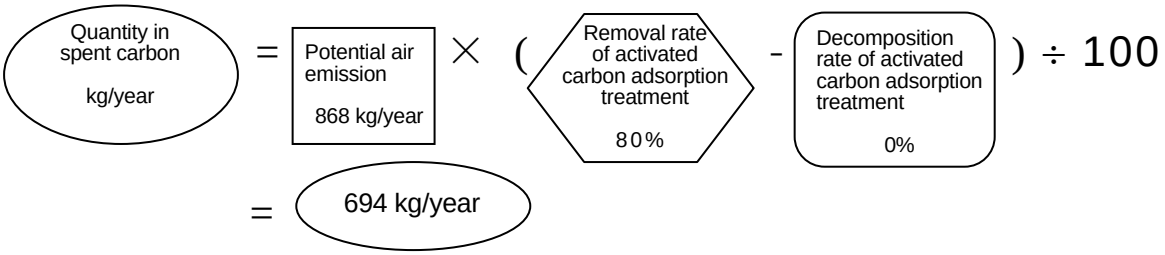
- Calculation of potential air emission of toluene



- Calculation of air emission of toluene after exhaust gas treatment



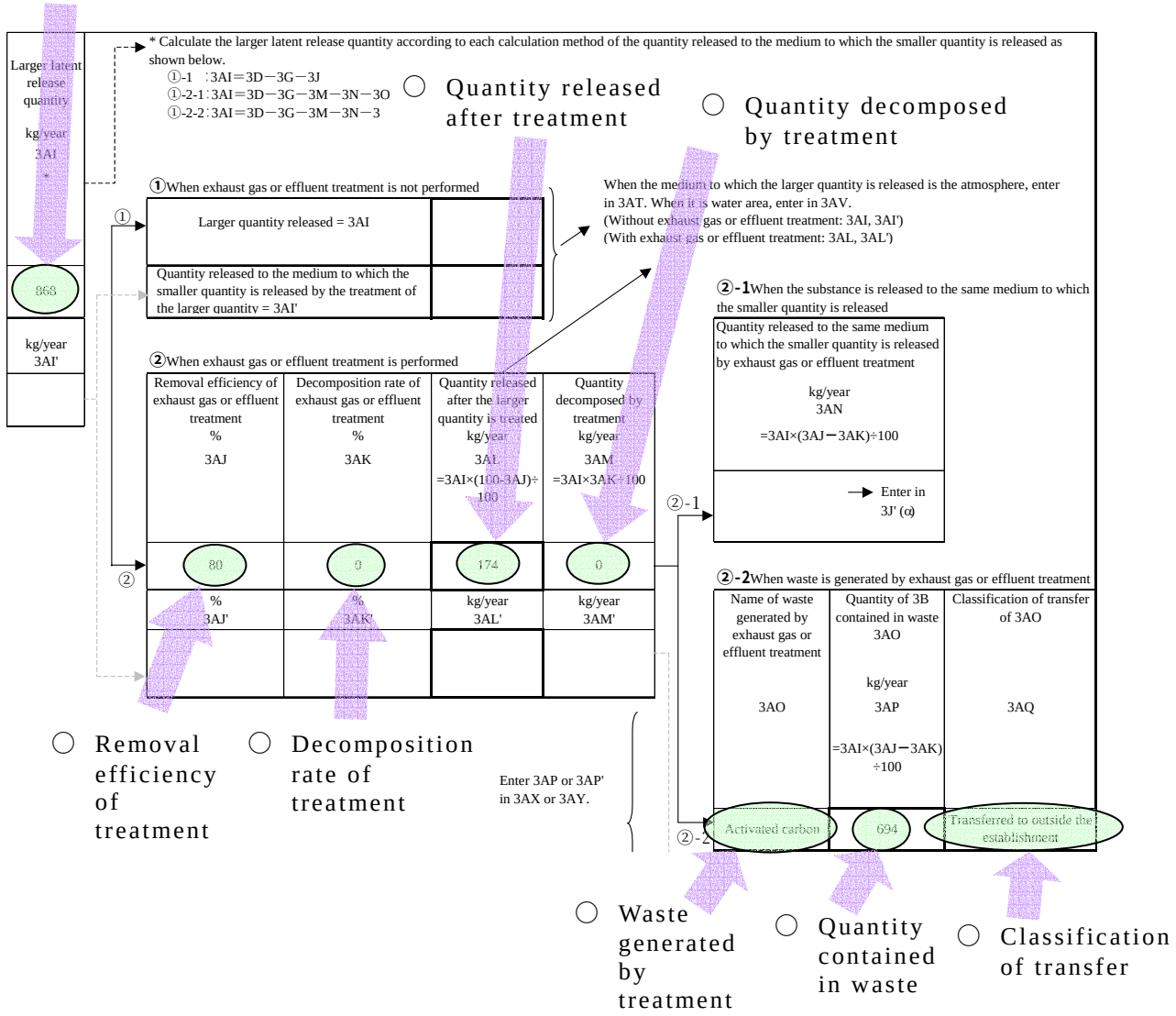
- Calculation of the quantity of toluene in spent carbon



* When exhaust gas or effluent treatment is performed in the medium to which the smaller release, subtract not only the release to water but also the quantity decomposed by exhaust gas or effluent treatment and the transfer by being contained in waste from the treatment (or the release to another medium by the treatment).

Filling out the worksheet3

○ Larger latent release quantity



2-1-8 Compilation of quantities released/transferred

Add up all the released/transferred quantities calculated according to the classification of notification.

(NOTE)

① Sum up the releases to a medium to which the larger quantity is released and the one to which the smaller quantity is released by the air emission and the release to water. Sum up the releases to water depending on the release conditions as shown below.

- When released to public water area such as rivers, lakes, agricultural waterways..... Surface water discharge
- When released to sewage works ..... Transfer to sewage

② Sum up the quantities contained in waste according to treatment methods as shown below.

- When waste is handed over to an industrial waste treatment service and it is handed over to a recycling service at no charge ..... Off-site Transfer in waste
- When waste is disposed of in a landfill inside the pertinent establishment..... Landfills in the business establishment

When waste is sold to a recycling service, it need not be included in the summation, since it is considered to be a transfer of products.

③ When waste liquid generated in business establishment A is transferred directly to the effluent treatment plant of business establishment B where treatment is performed, and then discharged to surface water, the following classification applies.

a) If effluent generated in business establishment A is transferred directly to the effluent treatment plant of business establishment B through a pipeline, etc. and then released from there, report it as “surface water discharge” from business establishment A. In this case, business establishment B need not submit notifications.

b) If effluent is not transferred directly through a pipeline, etc., report it as “off-site transfer in waste.” In this case, business establishment B must submit a notification of quantities released/transferred from specific requirement facilities if it has a waste treatment plant.

Reference page
・ Part I 2-2-3 (1) Step1-8 Sum-up the released/transferred quantities (→ pI-52)