PRTR Estimation Manual

18. Aircraft Maintenance Industry

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Scheduled Airlines Association of Japan

Contents

1. Class I Designated Chemical Substances handled in aircraft maintenance

Cabinet Order No.	CAS No.	Name of chemical substance	Content	Heavy metal conversion factor	Specified Class I Designated Chemical Substance	Product/type	Use
24	68411-30-3	N-alkyl benzene sulfonic acid and its salt	1〜3%	-		Detergent	Aircraft body exterior cleaning (water washing)
43	107-21-1	Ethylene glycol	100%	-		Detergent	Aircraft body exterior cleaning (water washing)
47	60-00-04	Ethylenediaminetetraacetic acid	45%	-		Detergent	Component cleaning (engine, etc.)
60	1306-19-0	Cadmium oxide	99%	0.875	○	Cadmium compounds	Component plating
63	1330-20-7	Xylene	0〜7%	-		Paint (top coat)	Painting
			4%			Paint (primer)	Painting
69		Hexa-valent chromium compounds	1.4%			Kerosene	Aircraft body exterior cleaning (water washing)
			1%		○	Paint remover	Paint removing
	13423-61-5	Magnesium Chromate	4%	0.371		Sealant	Aircraft body outer plate gap sealing
	1333-82-0	Chrome trioxide	30%	0.520		Chromic anhydride	Component plating
	1333-82	Chrome acid	65%		○	Allodine treatment solution	Allodine plating treatment
101	111-15-9	2-methoxy ethyl acetate	45%	-		Thinner	Painting, cleaning
108	143-33-9	Sodium cyanide	97%	0.531		Alkaline degreasing detergent	Alkaline degreasing cleaning
145	27-63-9	Dichloromethane	53〜60%	-		Paint remover	Peeling of coating
211	79-01-6	Trichloroethylene	100%	-		Detergent	Degreasing cleaning
227	108-88-3	Toluene	50%	-		Thinner	Painting, cleaning
			40〜45%			Rubber adhesive	Bonding
			12〜18%			Sealant	Fuel tank seal
			4%			Sealant	Aircraft body outer plate gap sealing
			20%			Paint (top coat)	Painting
232	13770-89-3	Nickel sulfamate	60%	0.182	○	Nickel compounds	Component plating
266	108-95-2	Phenol	15〜20%	-		Paint remover	Paint removing
308	9036-19-5	Poly (oxy-ethylene) octyl phenyl ether	14%	-		Detergent	Maintenance operation cleaning
			0.5〜8%			Detergent	Aircraft body exterior cleaning (water washing)
309	9016-45-9	Poly (oxy-ethylene) nonyl phenyl ether	3〜4%	-		Detergent	Aircraft body exterior cleaning (water washing)
311	1313-13-9	Manganese dioxide	6%	0.632		Sealant	Aircraft body outer plate gap sealing
354	126-73-8	Tri-n-butyl phosphate	20〜58%	-		Hydraulic fluid (skydrol)	Hydraulic fluid

Notes

1. Since the content depend on the product or the maker, MSDS of the product actually used should be referenced as a check. (The contents written in the table are representative examples.)
2. When the sealing compounds are used as two liquid mixtures, the content has already taken the mixture ratios into account.
3. Other than the substances described above, fumigant (methyl bromide) etc. are used in freight facilities. However, the amount is thought to be small.

2. Fuel tank interior sealing process

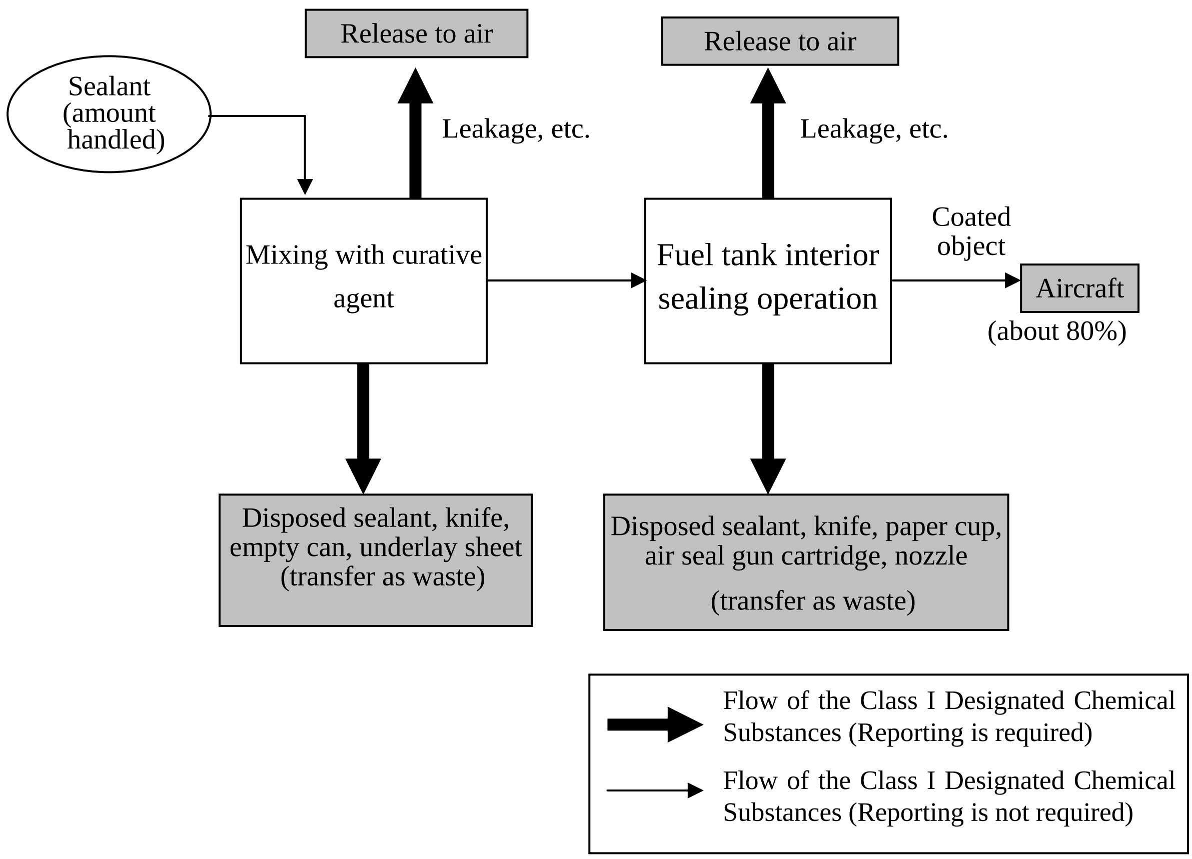
This process is to repair the spots of deteriorated sealant, which keeps the airtightness of the fuel tank in the main wing of an aircraft, by using new sealant.

As a release to the environment, some of the Class I Designated Chemical Substances contained in the sealant volatilize to the environment from the coated surface of an aircraft. The sealant that adheres to the empty cans, knives, seal guns, etc. and the deteriorated sealant removed from the aircraft are regarded as a transfer as waste.

[Class I Designated Chemical Substances]

Manganese compounds and toluene

[Example of process]



Note: Sealant in an opened can is to be disposed when it is not used within a specified period of time.

[Estimation procedure]

1. Solvent

The procedure for estimating the amount of the solvent released and transferred during fuel tank interior sealing process is shown in the following flow:

(1) Estimation of the handled amount of the Class I Designated Chemical Substances contained in the sealant ⇐ Amount of the sealant handled × Content of the substance in the sealant

↓

(2) Estimation of the transferred amount in disposed sealant and sealant existing in empty cans, etc. ⇐ Amount handled × Ratio of disposed sealant

↓

(3) Estimation of the maximum potential amount released to environment ⇐ (Amount handled - amount transferred)

↓

(4) Estimation of the amount released to the air ⇐ Maximum potential amount released to environment

Figure: Estimation procedure for the releases and transfers of solvent during fuel tank interior sealing process

(Work sheet for fuel tank interior sealing process (solvent))

2. Additives

The procedure for estimating the amounts of additives released and transferred during fuel tank interior sealing process is shown in the following flow:

(1) Estimation of the handled amount of the Class I Designated Chemical Substances contained in the sealant ⇐ Amount of the sealant handled × Content of the substance in the sealant

↓

(2) Estimation of the amount shipped out as products ⇐ Amount handled × Content of sealant in products

↓

(3) Estimation of the transferred amount in disposed sealant and sealant existing in empty cans, etc. ⇐ Amount of disposed sealant, etc. produced × Content of substances in disposed sealant

↓

(4) Estimation of the maximum potential amount released to environment ⇐ (Amount handled - Amount shipped out – Amount transferred)

Figure: Estimation procedure for the releases and transfers of additives during fuel tank interior sealing process

(Work sheet for fuel tank interior sealing process (additives))

[Estimation example]

Example of the estimation of the amounts released and transferred for the following facility and its condition is shown below:

(Summary of the facilities)

Process	Sealing inside the fuel tank
Facilities used	None
Exhaust gas/waste water treatment facilities	None
Sealant used	Type B made by Product Research Co., Ltd. (Toluene content 1.8%, manganese dioxide content 4.3%)
Annual amount of sealant used	1.57t/year
Coating efficiency of sealant	80%

1. Estimations of the releases and transfers of toluene

(1) Estimation of the annual amount handled

The annual amount of toluene handled is calculated from the amount of sealant used and the content of toluene in it.

(annual amount of toluene handled)

= (amount of sealant used) × (content% in the sealant)

= 1.57t/year × 1,000kg/t × 1.8%/ 100 = 28kg/year

*Since no solvent is contained in products, the amount shipped out is zero. Therefore, it is omitted from the estimation procedures.

(2) Estimation of the amount transferred being contained in waste

In this process, all of the sealant that has not been used for coating the aircraft will be disposed, thus the calculation is made assuming the amount of sealant corresponding to the coating efficiency adhere to the aircraft and the remaining amount of sealant is transferred as waste.

(amount transferred being contained in waste)

= (annual amount of toluene handled) × [1 - (coating efficiency)]

= 28kg/year × [1 - (80%/ 100)] = 5.6kg/year

(3) Estimation of the maximum potential amount released

The maximum potential amount released is calculated as the difference between the annual amount of toluene handled and the amount transferred being contained in waste.

(maximum potential amount released)
= (annual amount of toluene handled)
- (amount transferred being contained in waste)
= 28kg/year - 5.6kg/year = 22.4kg/year

(4) Estimation of the amount released to the air

Toluene once adhering to an aircraft will be released to the air due to its volatility, thus the amount released is equal to the maximum potential amount released.

(amount released to air) = (maximum potential amount released)
= 22.4kg/year

2. Estimations of the releases and transfers of manganese compounds (manganese dioxide)

(1) Estimation of the annual amount of manganese compounds handled

Note: In the case where the Class I Designated Chemical Substances to be estimated is a metal compound, the amount of the element metal is calculated by using a conversion factor.

The annual amount of the manganese compounds handled is calculated from the amount of the sealant used, the content of manganese dioxide contained in it, and the conversion factor of manganese dioxide into manganese.

(annual amount of manganese compounds handled)
= (amount of the used sealant) × (content% in the sealant)
× (conversion factor)
= (annual handled amount of manganese contained in manganese dioxide)]
= 1.57t/year × 1,000kg/t × 4.3%/ 100 × 0.632 = 43kg/year

(2) Estimation of the amount shipped out as products

The amount shipped out as products can be calculated by multiplying the annual amount of manganese compounds handled by the coating efficiency, since the amount of manganese compounds corresponding to the sealant coating efficiency amount portion is considered to be coated to the aircraft.

(amount shipped out as products)
= (annual amount of manganese compounds handled) × (coating efficiency)
= 43kg/year × 80%/ 100 = 34kg/year.

(3) Estimation of the amount transferred being contained in waste

In this process, all of the sealant that has not been used for coating the aircraft will be disposed, thus the calculation is made assuming the amount of sealant corresponding to the coating efficiency adhere to the aircraft and the remaining amount of sealant is transferred as waste. In this regard, since the sealant that has deteriorated and been removed from the aircraft is also disposed, the same amount of the sealant that was coated on aircrafts should be added as the amount removed.

(amount transferred being contained in waste)
= (annual amount of manganese compounds handled)
- (amount shipped out as products) + (amount shipped out as products)
= 43kg/year - 34kg/year + 34kg/year = 43kg/year

(4) Estimation of the maximum potential amount released

Since all of the manganese compounds used in this process is considered either to have been coated on the aircraft or transferred in waste, the maximum potential amount released is zero.

(maximum potential amount released) = 0kg/year

3. Outer plate joint sealing process during aircraft outer plate painting

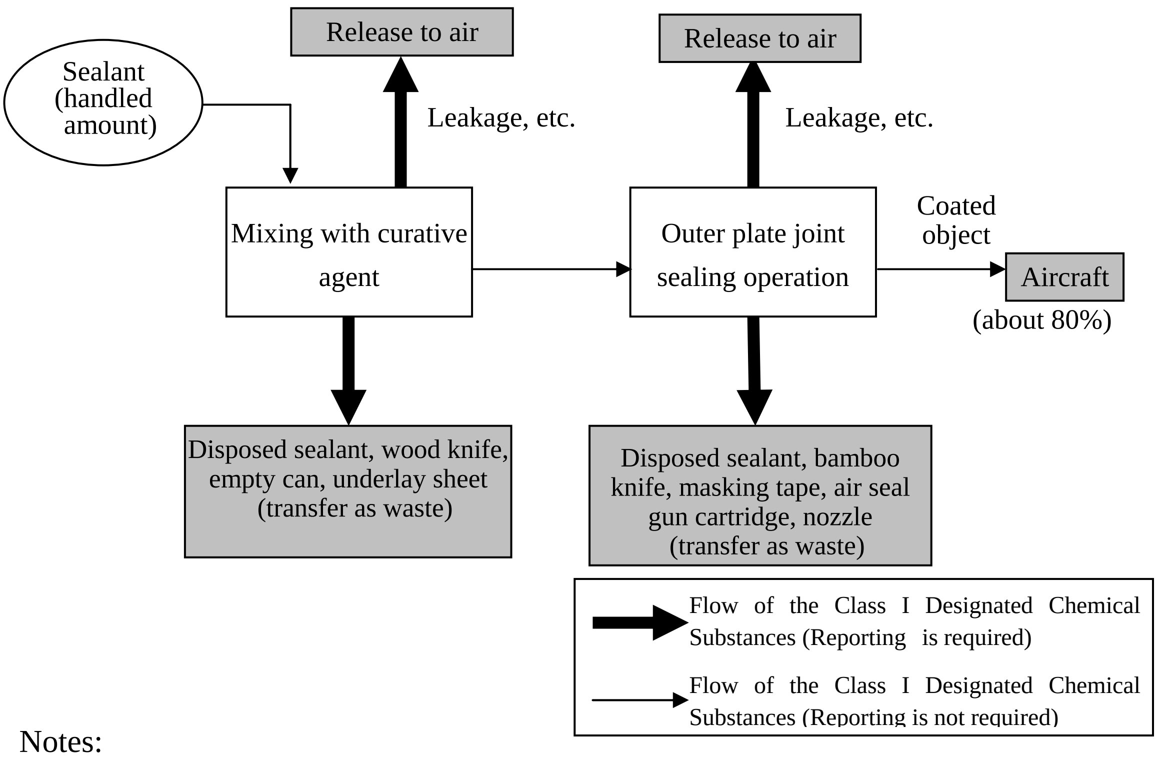
This process is to freshly reseal the sealant on the outer plate joint portions which has deteriorated due to the paint stripping operation during the recoating process of the outer plates wherein the coating including the undercoating of the outer plate of the aircraft is stripped for repainting.

As a release to the environment, some of the Class I Designated Chemical Substances contained in the sealant volatilize to the environment from the coated surface of an aircraft. The sealant that adheres to the empty cans, knives, seal guns, etc. and the deteriorated sealant removed from the aircraft are regarded as a transfer as waste.

[Class I Designated Chemical Substances]

Hexavalent chrome compounds, manganese compounds and toluene

[Example of process]



Notes:

1. This operation is performed only at the time of a major maintenance, in which the paint is completely stripped off with a paint remover. (One in every two major maintenances, about every 12 years)
2. This operation is performed after corrosion control and before allodine treatment (chromate treatment) during the painting process.
3. The sealant coated on the aircraft is removed at the next paint removal as long as the aircraft is in use, and become a transfer as waste.

[Estimation procedure]

1. Solvent

The procedure for estimating the amounts of the solvent released and transferred during outer plate joint sealing process during aircraft outer plate painting is shown below.

(1) Estimation of handled amount of the Class I Designated Chemical Substances contained in sealant	Amount of the sealant handled × Content of the substance in the sealant
↓	
(2) Estimation of the amount transferred in disposed sealant and sealant existing in empty cans, etc	Amount handled × Ratio of disposed sealant
↓	
(3) Estimation of the maximum potential amount released to environment	(Amount handled - Amount transferred)
↓	
(4) Estimation of the amount released to the air	Maximum potential amount released to the environment

Figure: Estimation procedure for the releases and transfers of solvent during outer plate joint sealing process of aircraft outer plate painting

(Work sheet for outer plate joint sealing process of aircraft outer plate painting (solvent))

2. Additives

The procedure for estimating the amounts of additives released and transferred during the sealing process of outer plate joint sealing process of aircraft outer plate painting is shown below.

(1) Estimation of the handled amount of the Class I Designated Chemical Substances contained in the sealant	Amount of the sealant handled × Content of the substance in the sealant
↓	
(2) Estimation of the amount shipped out as products	Amount handled × Content of sealant in products
↓	
(3) Estimation of the amount transferred in disposed sealant and sealant existing in empty cans, etc.	Amount of disposed sealant, etc. produced × Content of substances in disposed sealant
↓	
(4) Estimation of the maximum potential amount released to environment	(Amount handled - Amount shipped out – Amount transferred)

Figure: Estimation procedure for the releases and transfers of additives during outer plate joint sealing process of aircraft outer plate painting

(Work sheet for outer plate joint sealing process of aircraft outer plate painting (additives))

[Estimation example]

Example of the estimation of the amounts released and transferred for the following facility and its condition is shown below:

(Summary of the facilities)

Process:	Outer plate joint sealing process of aircraft outer plate painting
Facilities used:	None
Exhaust gas/wastewater treatment facilities:	None
Sealant used:	PS-870B-1/2 (Toluene content 4.3%, manganese dioxide content 7.3%, magnesium chromate content 2.2%)
Annual amount of sealant used:	7.8t/year
Coating efficiency of sealant:	80%

1. Estimations of the releases and transfers of toluene

(1) Estimation of the annual amount handled

The annual amount of toluene handled is calculated from the amount of sealant used and the content of toluene in it.

(annual amount of toluene handled)
= (amount of sealant used) × (content% in the sealant)
= 7.8t/year × 1,000kg/t × 4.3%/ 100 = 335kg/year

*Since no solvent is contained in products, the amount shipped out is zero. Therefore, the corresponding estimation is omitted.

(2) Estimation of the amount transferred being contained in waste

In this process, all of the sealant that has not been used for coating the aircraft will be disposed, thus the calculation is made assuming the amount of sealant corresponding to the coating efficiency adhere to the aircraft and the remaining amount of sealant is transferred as waste.

(amount transferred being contained in waste)
= (annual amount of toluene handled) × [1 - (coating efficiency)]
= 335kg/year × [1 - (80%/ 100)] = 67kg/year

(3) Estimation of the maximum potential amount released

The maximum potential amount released is calculated as the difference between the annual amount of toluene handled and the amount transferred being contained in waste.

(maximum potential amount released)
= (annual amount of toluene handled) - (amount transferred being contained in waste)
= 335kg/year - 67kg/year = 268kg/year

(4) Estimation of the amount released to the air

Toluene once adhering to an aircraft will be released to the air due to its volatility, thus the amount released is equal to the maximum potential amount released.

(amount released to air) = (maximum potential amount released)
= 268kg/year

2. Estimations of the releases and transfers of manganese compounds (manganese dioxide)

(1) Estimation of the annual amount of manganese compounds handled

Note: In the case where the Class I Designated Chemical Substances to be estimated is a metal compound, the amount of the element metal is calculated by using a conversion factor.

The annual amount of the manganese handled is calculated from the amount of the sealant used, the content of manganese dioxide contained in it, and the conversion factor of manganese dioxide into manganese.

(annual amount of manganese handled)
= (amount of the used sealant) × (content% in the sealant)
× (conversion factor)
= [(annual handled amount of manganese contained in manganese dioxide)]
= 7.8t/year × 1,000kg/t × 7.3%/ 100 × 0.632 = 360kg/year

(2) Estimation of the amount shipped out as products

The amount shipped out as products can be calculated by multiplying the annual amount of manganese compounds handled by the coating efficiency, since the amount of manganese compounds corresponding to the sealant coating efficiency amount portion is considered to be coated to the aircraft.

(amount shipped out as products)

= (annual amount of manganese compounds handled) × (coating efficiency)

= 360kg/year × 80%/ 100 = 288kg/year.

(3) Estimation of the amount transferred being contained in waste

In this process, all of the sealant that has not been used for coating the aircraft will be disposed, thus the calculation is made assuming the amount of sealant corresponding to the coating efficiency adhere to the aircraft and the remaining amount of sealant is transferred as waste. In this regard, since the sealant that has deteriorated and been removed from the aircraft is also disposed, the same amount of the sealant that was coated on aircrafts should be added as the amount removed.

(amount transferred being contained in waste)

= (annual amount of manganese compounds handled) - (amount shipped out as products) +(amount shipped out as products)

= 360kg/year - 288kg/year + 288kg/year = 360kg/year

(4) Estimation of the maximum potential amount released

Since all of the manganese compounds used in this process is considered either to have been coated on the aircraft or transferred in waste, the maximum potential amount released is zero.

(maximum potential amount released) = 0kg/year

4. Cleaning process of the painting facility using thinner

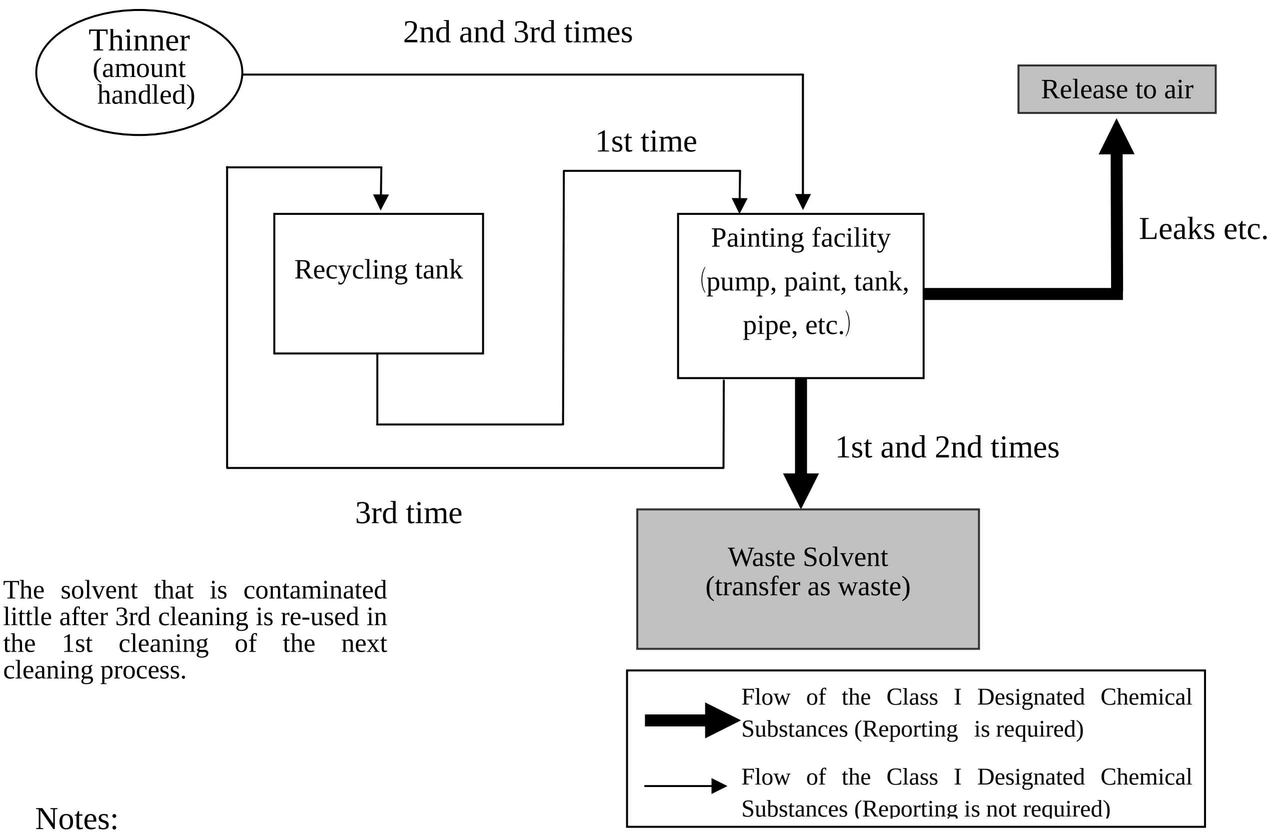
This process is to clean the painting facility using thinner that was used in the painting process of aircraft outer plate.

As a release to environment, some of the Class I Designated Chemical Substances contained in the thinner volatilize into air. The contaminated thinner used in the cleaning process is regarded as a transfer as waste.

[Class I Designated Chemical Substances]

Toluene

[Example of process]



Notes:

1. The cleaning of the painting facility that was used in the painting process of aircraft outer plate is done by pumping thinner into the facility to circulate the thinner within the facility. Since the cleaning is not sufficient with one cleaning, the cleaning is continued 3 times totally with the thinner replaced each time. As the thinner after the 3rd cleaning is little contaminated, it is re-used in the 1st cleaning of the next cleaning process.
2. The amount of the thinner used in one cleaning process is 18L.
3. Thinner is also used during major maintenance to wipe the aircraft outer plate with a rag and a larger amount is used for this, and in such cases thinner is considered to be released to air 100%.

[Estimation procedure]

The procedure for estimating the amount of the solvent released and transferred during cleaning process of the painting facility using thinner is shown in the following flow

(1) Estimation of handled amount of the Class I Designated Chemical Substances contained in thinner	⇐ Amount of thinner handled × Content of the substance in the thinner
↓	
(2) Estimation of amount transferred being contained in waste solvent.	⇐ Amount of waste solvent produced × Content in the waste solvent
↓	
(3) Estimation of the maximum potential amount released to the environment	⇐ (Amount handled – Amount transferred)
↓	
(4) Estimation of amount released to the air	⇐ Maximum potential amount released to the environment

NOTE: The numeral in a parenthesis corresponds to the numeral of the work sheet below.

Figure: Estimation procedure of the releases and transfers of the substance during cleaning process of the painting facility using thinner
(Work sheet for cleaning processes of the painting facility using thinner)

[Estimation example]

Example of the estimation of the amounts released and transferred for the following facility and its use condition is shown below:

(Summary of the facilities)

Process:	Cleaning of the painting facility using thinner
Facilities used:	Painting facility (connected to exhaust duct, no water discharge system)
Exhaust gas treatment facilities:	None
Thinner used:	Thinner for cleaning (50% of toluene content)
Annual amount of thinner used:	46t/year
Contaminated thinner:	30t (content is unknown) is handed over to industrial waste treatment contractors

(1) Estimation of the annual amount of toluene handled

Annual amount of toluene handled is calculated from the amount of thinner used and the content of toluene contained in it.

(annual amount of toluene handled)

= (amount of thinner used) × (content% in thinner)

= 46t/year × 1,000kg/t × 50%/100 = 23,000kg/year

(2) Estimation of amount transferred being contained in waste

Since the content of toluene in contaminated thinner is unknown, the amount transferred of toluene as waste is calculated from the content of toluene in the mother thinner and the amount of contaminated thinner handed over to industrial waste treatment contractors.

(amount transferred being contained in waste)

= (amount handed over to industrial waste treatment contractors) × (content% in the mother thinner)

= 30t/year × 1,000kg/t × 50%/100 = 15,000kg/year

(3) Estimation of the maximum potential amount released

The maximum potential amount released is calculated as the difference between the annual amount of toluene handled and the amount transferred being contained in waste.

(maximum potential amount released)

= (annual amount of toluene handled)

- (amount transferred being contained in waste)

= 23,000kg/year - 15,000kg/year = 8,000kg/year

* Since the wastewater does not exist absolutely, the amount released to water body is zero. Therefore, it is omitted from the estimation procedures.

(4) Estimation of the amount released to the air

Since toluene is very much volatile, thus the amount released is equal to the maximum potential amount released.

(amount released to air) = (maximum potential amount released)

= 8000kg/year

5. Plating Process

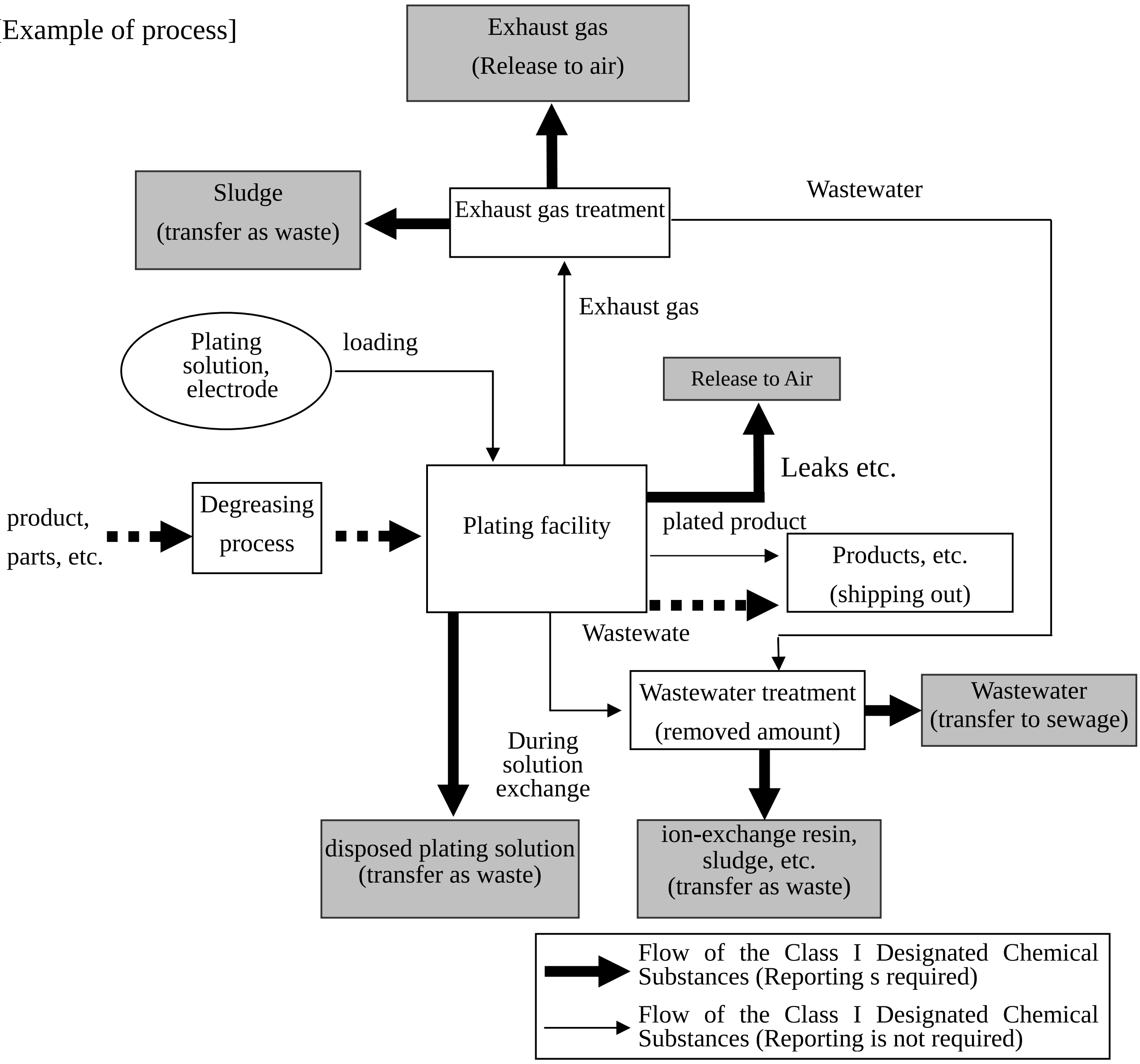
This process is to coat the surfaces of metal or non-metal products with a thin metal layer, whose methods include electroplating and electroless plating.

As a release to environment, some of the plating solution mix into waste water and some transfer as waste plating solution. Also, the platings removed from the plated objects prior to plating process as well as the sludge generated during the treatment in wastewater treatment facilities for neutralization treatment are transferred as waste.

[Class I Designated Chemical Substances]

Chromium compound, cadmium compounds, nickel compounds, and sodium cyanide

[Example of process]



NOTE: There is always a degreasing process using trichloroethylene etc. before plating. This process is the same as the pilot programme manual of the 2000 fiscal year.

[Estimation procedure]

1. Solvent

The procedure for estimating the amounts of the solvent released and transferred during plating process is shown below.

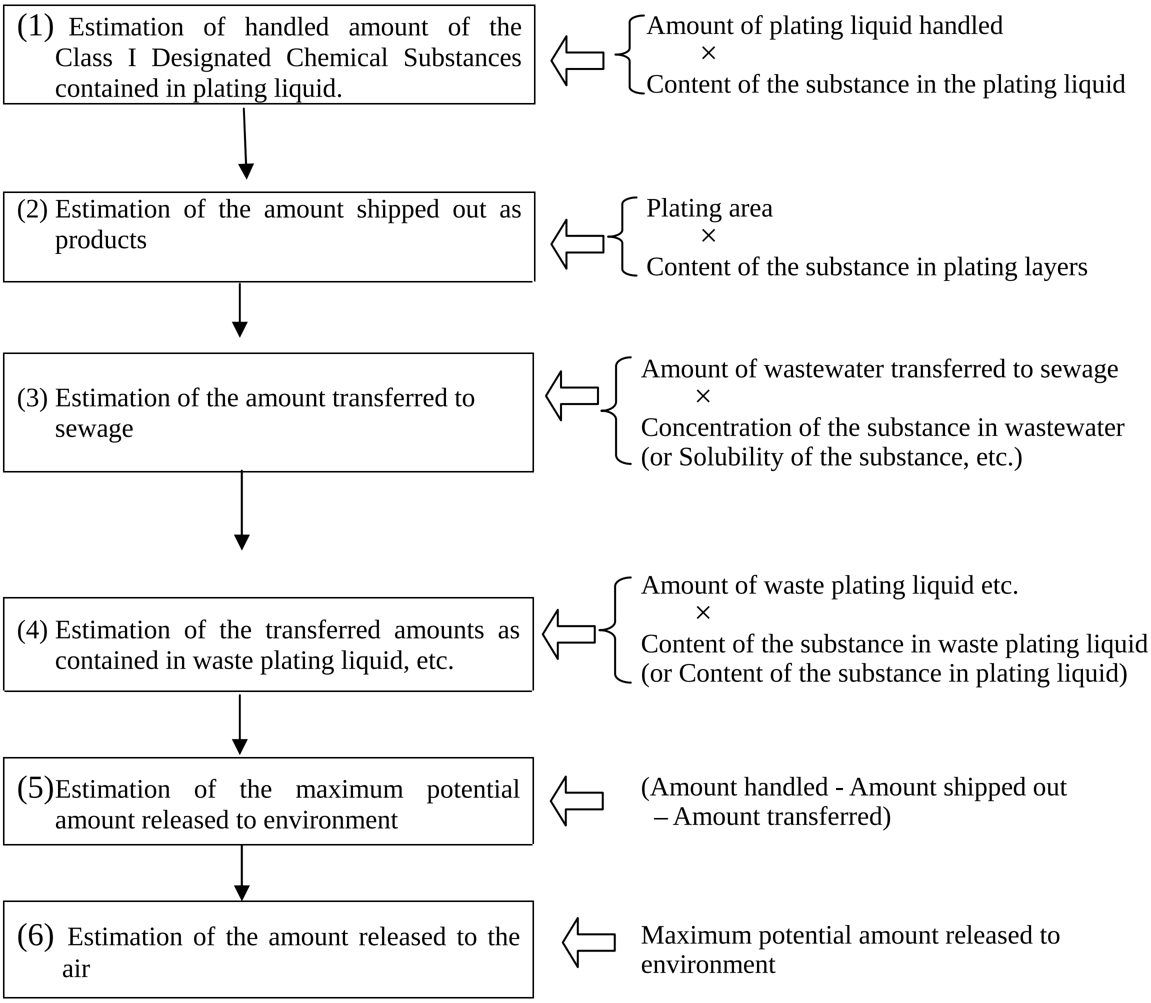


Figure: Estimation procedure for the releases and transfers of solvent during plating process (Work sheet for plating process (solvent))

2. Solutes

The procedure for estimating the amounts of the solutes released and transferred during plating process is shown below.

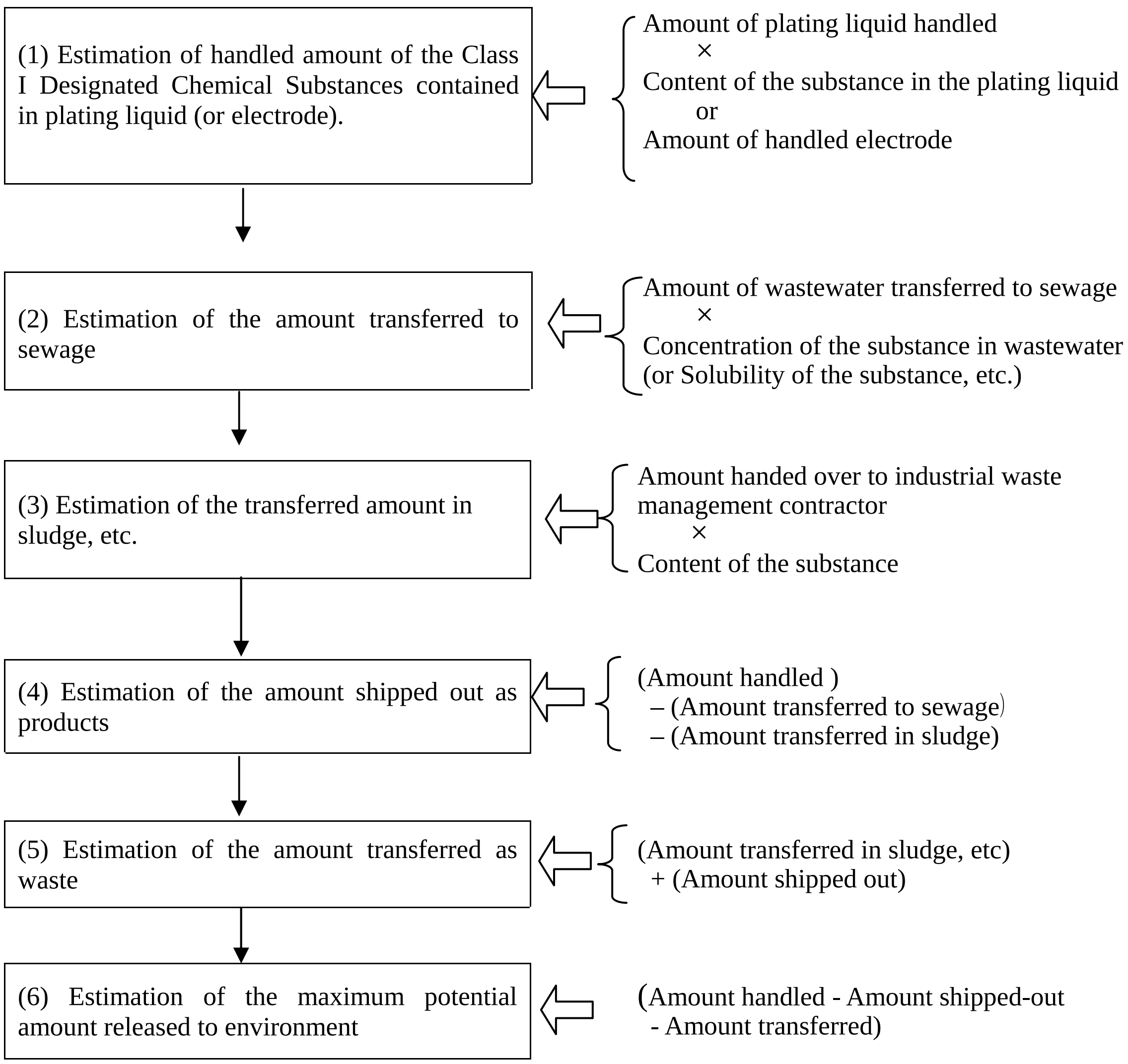


Figure: Estimation procedure for the releases and transfers of solutes during plating process
(Work sheet for plating process (solutes))

[Estimation example] I

Example of the estimation of the amounts released and transferred for the following facility and its condition is shown below:

(Summary of the facilities)

Process	Cadmium plating on metal parts
Wastewater treatment facilities used:	Alkaline chlorination treatment → Coagulation precipitation
Plating liquid used	Sodium cyanide (content = 20%)
Annual amount of plating liquid used	8.5t/year
Amount of wastewater	$2m^3$/day, 200operating days/year (0.5mg/L in wastewater)

1. Estimation of the releases and transfers of cyanides (sodium cyanide)

(1) Estimation of the annual amount of cyanides handled

Note: In the case where the Class I Designated Chemical Substances to be estimated is a cyanide compound, the amount of the cyan is calculated by using a conversion factor.

The annual amount of the cyanides handled is calculated from the amount of plating liquid used, the content of sodium cyanide contained in it and the conversion factor from sodium cyanide to cyan.

(annual amount of cyanides handled)
= (amount of the plating liquid used)
× (content% in the plating liquid)
× (conversion factor)
= [(annual amount of the cyan handled contained in a sodium cyanide)]
= 8.5t/year × 1,000kg/t × 20%/100 × 0.531
= 903kg/year

(2) Estimation of the amount shipped out as a product

Since cyanide is not contained in a product, the amount shipped-out as a product is zero.

(amount shipped out as a product) = 0kg/year

(3) Estimation of the amount transferred to sewage

The amount transferred to sewage after alkaline chlorination process is estimated using the observed value of the wastewater (0.5mg/L=$0.0005kg/m^3$).

(amount transferred to sewage)

= (concentration in wastewater)
× (amount of wastewater)
= $0.0005kg/m^3 \times 2m^3/day \times 200$ day/year
= 0.2kg / year

(4) Estimation of the amount transferred being contained in waste

Since all of the plating liquid is loaded into a plating bath, the transferred amount as waste plating liquid is zero.

The amount after subtracting the transferred amount to public sewerage from the annual amount handled, becomes sludge via wastewater treatment and is counted as a transfer as waste.

(amount transferred being contained in waste)

= (annual amount of cyanides handled)
- (amount transferred to sewage)
= 903kg/ year - 0.2kg/year = 903kg/year

(5) Estimation of the maximum amount of the potential release

Since sodium cyanide is not volatile and all of the wastewater is transferred to sewerage, the maximum potential amount released is zero.

(maximum potential release) = 0kg/year

* Since all of the wastewater is transferred to sewerage, the amount released to water body is zero. Therefore, it is omitted from the estimation procedures.

(6) Estimation of the amount released to air

Since sodium cyanide is not volatile, the amount released to air is zero.

(amount released to air) = 0kg/year

[Estimation example] II

Example of the estimation of the amounts released and transferred for the following facility and its condition is shown below:

(Summary of the facilities)

Process	Chrome plating on metal parts
Facilities used:	Coagulation precipitation
Plating liquid used	Chromic acid anhydride solution

	(content = 30%)
Electrode used	Pb electrode
Annual amount of plating liquid used	8.3t/year
Amount of wastewater	$2m^3$/day, 200operating days/year (20mg/L as chromium in wastewater)
Sludge removed in the water treatment and exhaust-gas-treatment facilities	3t is handed over to industrial waste treatment contractors (content = 10% as chromium)

Estimations of the releases and transfers of chromium compounds

In this estimation procedure, the target chemical substrates are chromic anhydride compounds. Although chromium itself are not released in this process, it is transferred being contained in wastewater as chromic anhydride in the plating bath.

(1) Estimation of the annual amount of chromium compounds handled

Notes: In the case where the chemical substances to be estimated is a metal compound, the amount of the element metal is calculated by using a conversion factor.

The annual amount of chromium compounds handled is equal to the amount of the chromic anhydride used.

(annual amount of chromium handled)

= 8.3t/year × 1,000kg/t × 0.3 × 0.520

= 1,295kg/year

(2) Estimation of the amount transferred to sewage

The amount transferred to sewage after chemical clarification can be estimated using the observed value ($20mg/L=0.02kg/m^3$) of a wastewater.

(amount transferred to sewage after chemical clarification)

= (concentration in wastewater)

× (amount of wastewater)

= $0.02kg/m^3 \times 20m^3$/day × 200 day/year

= 80kg/year

(3) Estimation of the amount transferred being contained in sludge etc.

Since all of the plating liquid is loaded into a plating bath, the amount transferred as waste plating liquid is zero.

The amount transferred being contained in sludge generated by chemical clarification, can be calculated from its content in the sludge which can be obtained from the elemental analysis results.

(amount transferred being contained in sludge etc.)

= (amount handed over to industrial waste treatment contractors) × (content)

= 3,000kg/year × 10%/ 100

= 300kg/year

(4) Estimation of the amount shipped out as products

Since all of the wastewater in the process is transferred to sewerage and chromic anhydride compounds do not have volatility, the annual amount handled minus the amount transferred as waste can be considered as the amount shipped out adhering to the plated products.

(amount shipped out as products)

= (annual amount of chromium compounds handled)
- (amount transferred to sewage)
- (amount transferred being contained in sludge etc.)

= 1,295kg/year - 80kg/year - 300kg/year

= 915kg/year

(5) Estimation of the amount transferred being contained in waste

Since the plating removed, which is generated in the plating removal process prior to plating to repair the plated products, is disposed, the same amount of the chromium compound plated on the product should be added as waste to be transferred.

(amount transferred being contained in waste)

= (amount transferred being contained in sludge etc.)
+ (amount shipped out as products)

= 300kg/year + 915kg/year

= 1,215kg/year

(6) Estimation of the maximum amount of the potential release

Since chromic anhydride is not volatile and all of the wastewater is transferred to sewerage, the maximum potential amount released is zero.

(maximum potential release) = 0kg/year

6. Cleaning process of painted aircraft exterior surface

Cleaning of aircraft exterior surface is a process for the purpose to keep aircraft exterior appearance and to prevent corrosion.

Exterior surface cleaning is performed using suitable cleaning agents and method determined by the type and degree of the soiling, the nature of the area to be cleaned, and the check whether icing is expected due to the outside temperature at the time of cleaning, etc. Usually, the cleaning agent is applied by a sprayer or using a mop, brush, etc., and is washed off with high-pressure water.

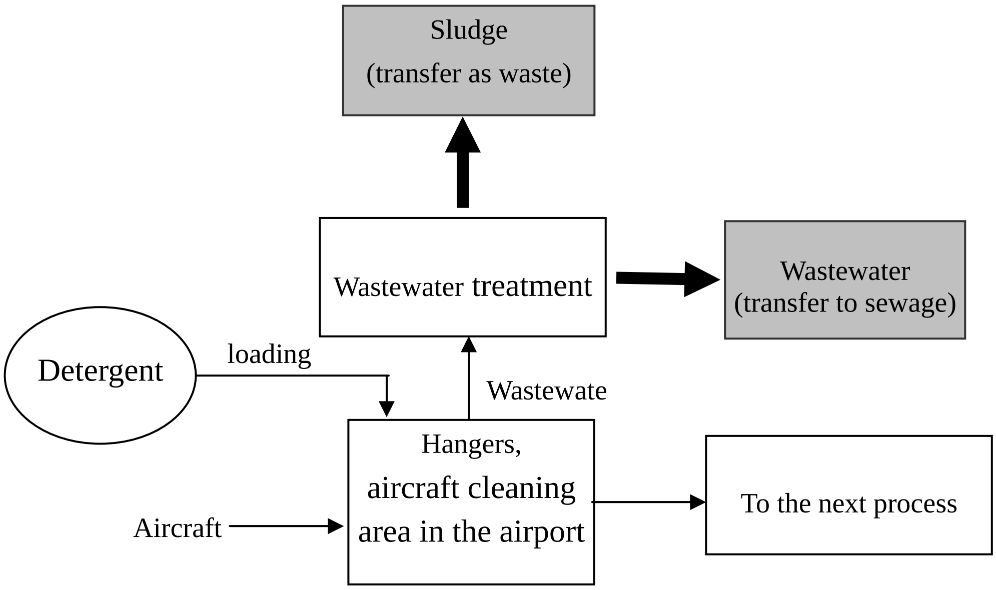
The upper and lower surfaces of the wings, etc., where icing may occur in winter that makes the flight troublesome, is cleaned by rubbing well using mops or pads with detergent, whose freezing temperature has been adjusted by mixing with ethylene glycol, and then the detergent is removed off using clean, dry mops.

Some of the Class I Designated Chemical Substances contained in the detergent are transferred to the wastewater treatment facilities inside the aircraft cleaning area or hangars in the airport.

[Class I Designated Chemical Substances]

Poly(oxyethylene) octylphenylether, linear alkylbenzene sulfonic acid and the salt thereof, poly(oxyethylene) nonylphenylether, ethylene glycol and xylenes

[Example of process]



[Estimation procedure]

The procedure for estimating the amounts released and transferred during cleaning of aircraft exterior surface is shown in the following flow

(1) Estimation of handled amount of the Class I Designated Chemical Substances contained in detergent.	⇐	Amount of detergent handled × Content of the substance in the detergent
↓		
(2) Estimation of the amount transferred being contained in waste	⇐	Amount transferred
↓		
(3) Estimation of the amount transferred to sewage	⇐	Amount transferred

[Estimation example]

Example of the estimation of the amounts released and transferred under the following condition for the facilities of aircraft exterior surface cleaning is shown below:

(Summary of the facilities)

Process	Cleaning process of painted aircraft exterior surface
Facilities used	Outdoor aircraft cleaning area or hangar
Detergent use	Detergent A [poly(oxyethylene) octylphenylether, content = 10%]
Annual amount of detergent used	10t/year

(1) Estimation of annual amount of poly(oxyethylene) octylphenylether handled

Annual amount of the poly(oxyethylene) octylphenylether handled is calculated from the amount of detergent used and contents of poly(oxyethylene) octylphenylether in it.

(annual amount of the poly(oxyethylene) octylphenylether handled)

= (the amount of detergent used)

× (content in detergent)

= 10t/year × 1,000kg/t × 10%/ 100 = 1,000kg/year

(2) Estimation of the amount transferred being contained in waste

Almost all amount of poly(oxyethylene) octylphenylether undergoes wastewater treatment together with the cleaning water, and then transferred as waste.

Also, since pads, brushes, mops, etc. used in the cleaning process are washed and re-used, the adhering substances are also washed out and sent to wastewater treatment, and then transferred as waste.

Therefore, the transferred amount as contained in waste is same to the amount of the annual amount of poly(oxyethylene) octylphenylether handled.

= 1,000kg/year

(3) Estimation of the amount transferred to sewage

Since all poly(oxyethylene) octylphenylether is transferred as waste as mentioned above (2), none is transferred to sewage.

Notes:

Although the xylenes, which is Class I Designated Chemical Substances, is contained in the kerosene (coal oil) which is used as detergent, kerosene is used in emulsion form by mixing with detergent and water, and therefore xylenes are not released to air and the whole-quantity undergoes wastewater treatment, and then transferred as waste.

7. Cleaning process in aircraft maintenance

This process is to clean the particularly dirty areas, like the exterior surface of the landing gear well, the exterior surface of the wing leading and trailing edge storage well, and the lower area of cargo compartment, by coating them with detergent and then washing out with water. The amount of the detergent used increases significantly in the removing process of anti-corrosion agents.

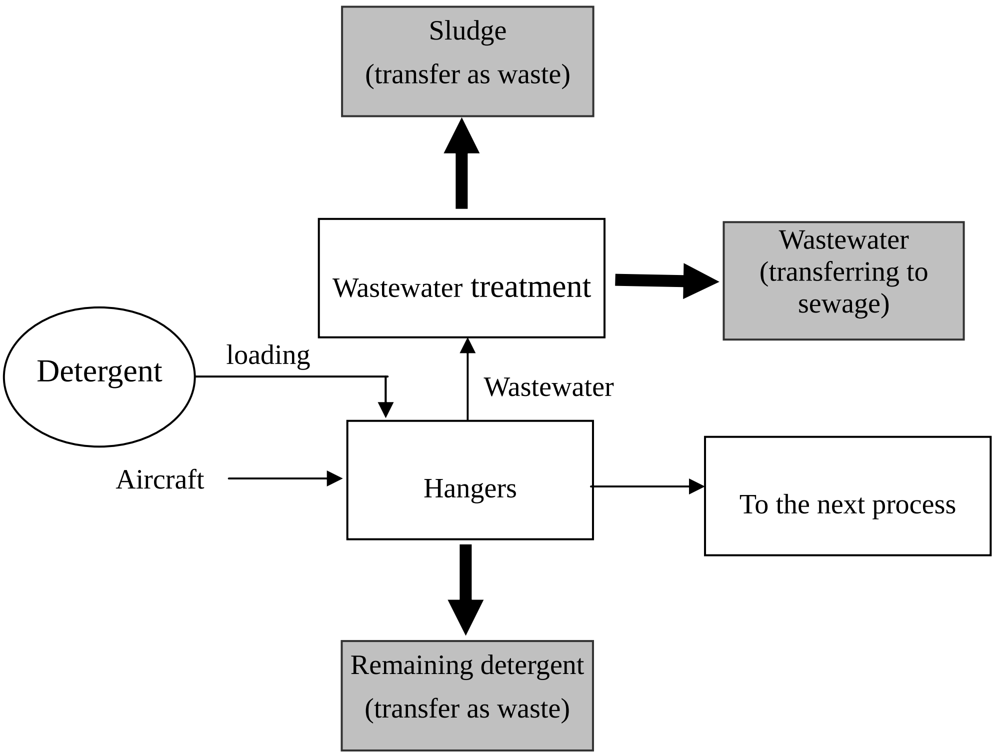
The method of cleaning comprises coating with the detergent using a sprayer or brush and then washing out by high-pressure cleaning with worm water, and the detergent together with the anti-corrosion agents removed from the airframe drain hole are washed out and drained to wastewater treatment facilities, and the water that could not be drained and the detergent still remaining are wiped off with waste cloth and mops.

Some of the Class I Designated Chemical Substances contained in the detergent are transferred to the wastewater treatment facilities inside hangars. The remaining detergent in the cans is transferred as waste together with the waste cans.

[Class I Designated Chemical Substances]

Poly(oxyethylene) octylphenylether

[Example of process]



[Estimation procedure]

The procedure for estimating the amounts released and transferred during cleaning process in aircraft maintenance is shown in the following flow

(1) Estimation of handled amount of the Class I Designated Chemical Substances contained in detergent. ⇦ Amount of detergent handled × Content of the substance in the detergent

↓

(2) Estimation of the amount transferred being contained in waste ⇦ Amount transferred

↓

(3) Estimation of the amount transferred to sewage ⇦ Amount transferred

[Estimation example]

Example of the estimation of the amounts released and transferred under the following condition for the facilities of aircraft exterior surface cleaning is shown below:

(Summary of the facilities)

Process	Cleaning process of painted aircraft exterior surface
Facilities used	Outdoor aircraft cleaning area or hangar
Detergent used	Detergent B [poly(oxyethylene) octylphenylether, content = 15%]
Annual amount of detergent used	19t/year

(1) Estimation of annual amount of poly(oxyethylene) octylphenylether handled

Annual amount of the poly(oxyethylene) octylphenylether handled is calculated from the amount of detergent used and contents of poly(oxyethylene) octylphenylether in it.

(annual amount of the poly(oxyethylene) octylphenylether handled)
= (the amount of detergent used)
× (content in detergent)
= 19t/year × 1,000kg/t × 15%/100 = 2,850kg/year

(2) Estimation of the amount transferred being contained in waste

Almost all amount of poly(oxyethylene) octylphenylether undergoes wastewater treatment together with the cleaning water, and then transferred as waste.

Also, since pads, brushes, mops, etc. used in the cleaning process are washed and re-used, the adhering substances are also washed out and sent to wastewater treatment, and then transferred as waste.

Therefore, the transferred amount as contained in waste is same to the amount of the annual amount of poly(oxyethylene) octylphenylether handled.

= 2,850kg/year

(3) Estimation of the amount transferred to sewage

Since all poly(oxyethylene)octylphenylether is transferred as waste as mentioned above (2), none is transferred to sewage.

8. Hydraulic fluid changing process

The hydraulic fluid of an aircraft is used as a power source for controlling flight wing, landing gear, brakes, etc. Changing process of hydraulic fluid occurs in the following cases:

(1) Aircraft maintenance factory

[1] Change due to deterioration of hydraulic fluid itself

[2] Change during filter checkup of hydraulic system

[3] Change during hydraulic system component maintenance

(2) Component overhaul factory

[4] Leaks during receiving TEST of removed components

[5] Leaks from piping of the TEST device

[6] Flushing of equipment before TEST

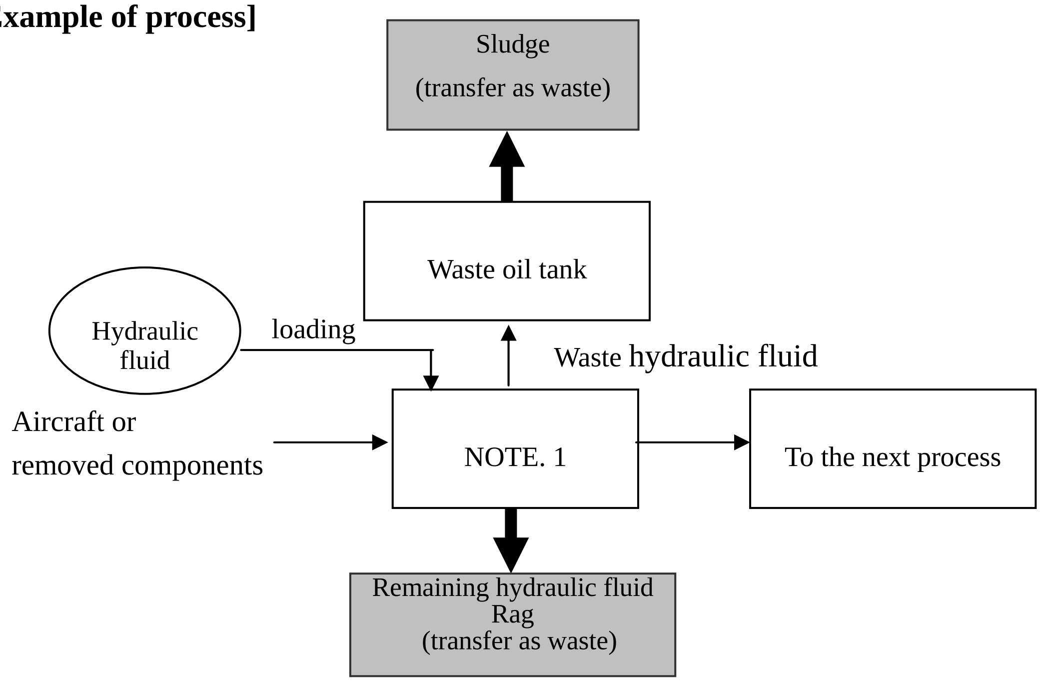
[7] Change of hydraulic fluid itself in TEST tank due to deterioration

As for releases to the environment, the Class I Substances contained in the hydraulic fluid are collected into the waste oil tank installed in the aircraft maintenance factory or component overhaul factory, and then are transferred as waste. Waste cans, used rags, etc. are also transferred as waste.

[Class I Designated Chemical Substances]

Tri-n-butyl phosphate

[Example of process]



NOTE. 1: Hydraulic fluid tank of aircraft system for the case of aircraft.
Hydraulic fluid tank in component overhaul factory for the case of removed components.

[Estimation procedure]

The procedure for estimating the amounts released and transferred during hydraulic fluid changing process is shown in the following flow

(1) Estimation of handled amount of the Class I Designated Chemical Substances contained in hydraulic fluid. ⇦ Amount of hydraulic fluid handled × Content of the substance in hydraulic fluid

↓

(2) Estimation of the amount transferred being contained in waste ⇦ Amount transferred

[Estimation example]

Example of the estimation of the amounts released and transferred for the following facilities is shown herewith:

(Summary of the facilities)

Process	Change of hydraulic fluid
Facilities used	Facility for collecting waste hydraulic fluid, and waste oil tank
Hydraulic fluid used	Hydraulic fluid A (Tri-n-butyl phosphate, contents = 20%)
Annual amount of hydraulic fluid used	36t/year

(1) Estimation of the annual amount handled of tri-n-butyl phosphate

Annual amount of the handled tri-n-butyl phosphate is calculated from the amount of the hydraulic fluid used and the content of tri-n-butyl phosphate in it.

Annual amount of the tri-n-butyl phosphate handled
= (amount of the hydraulic fluid used)
× (content in hydraulic fluid)
= 36t/year × 1,000kg/t × 20%/100 = 7,200kg/year

(2) Estimation of amount transferred being contained in waste

Tri-n-butyl phosphate is collected as waste oil and stored in waste oil tanks, and then handed over to industrial waste treatment contractors.

Remaining hydraulic fluid in waste cans, used rags, etc. are considered as transfer as waste.

Therefore, the amount transferred being contained in waste is same to the annual amount of tri-n-butyl phosphate handled.

= 7,200kg/year

9. Aircraft body painting process

Painting of aircraft is carried out in order to maintain external appearance and to prevent corrosion.

There are two methods of painting process, one is stripping all painted surface before re-painting (strip paint), and the other is sanding off only upper painted layer before painting the painted surface (over paint).

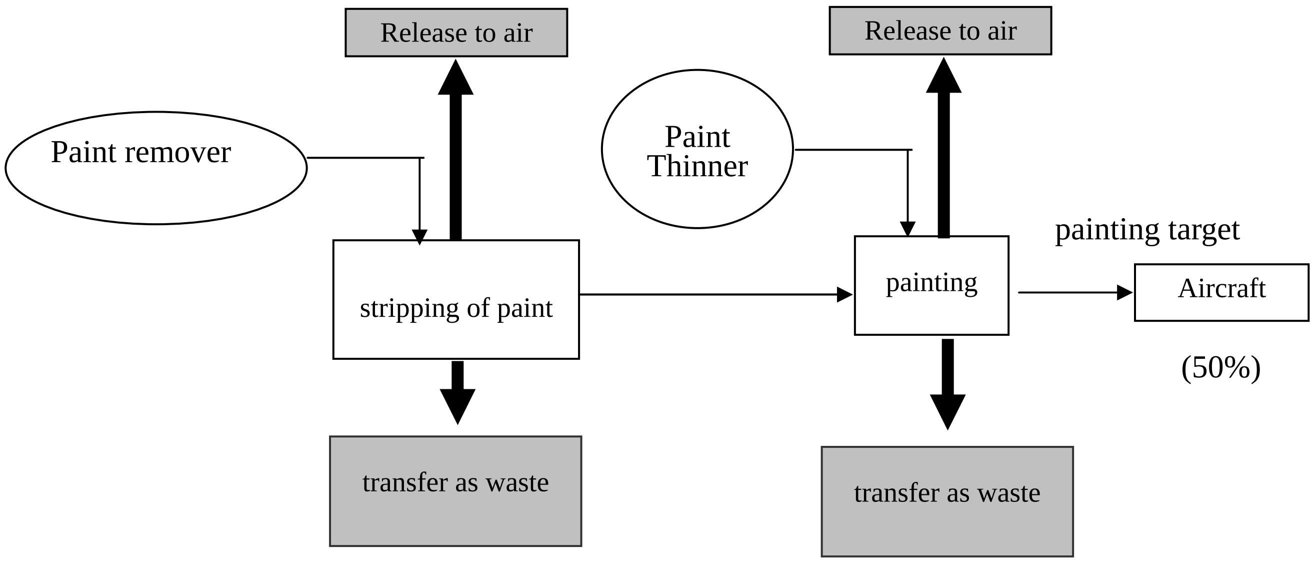
Some of the Class I Designated Chemical Substances contained in the paint remover, paint and thinner volatilize into the air and are considered to be released to environment. Also, remaining used stripping agent and the paint adhering to empty cans, spray guns, rollers, etc., and paint stripped from aircraft are considered to be transferred as waste.

[Example of process]

(Paint stripping process)

[Class I Designated Chemical Substances]

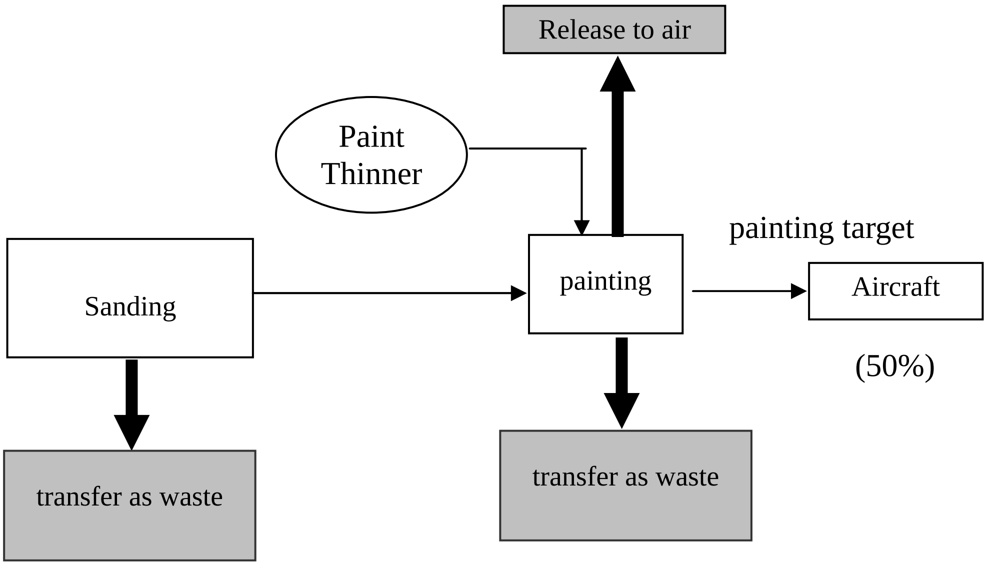
Toluene, dichloromethane, phenol, xylenes, chromic acid, etc.



(over paint process)

[Class I Designated Chemical Substances]

Toluene, xylenes, chromic acid, etc.



NOTE: The deposit ratio of paint is about 90% for electrostatic coating and about 50% for spray painting.

[Example of estimation for painting process]

Example of Class I Designated Chemical Substance: Dichloromethane

Paint remover (dichloromethane content: 60%, specific gravity: 1.3255) Annual purchased amount: 6,800L, Amount abandoned due to expiration: 1,200L

Estimation example

$6,800 \times 0.6 \times 1.3255 = 5,408$kg

$1,200 \times 0.6 \times 1.3255 = 954$kg

Amount used = 5,408 – 954 = 4,454kg

Amount released to air = $4,454 \times 1/1,000 \times 336 = 1,497$ kg

(336/1,000 is the emission factor for dichloromethane [source: Environment Agency]

Amount of waste transferred = 4,454 - 1,497 + 954 = 3,911kg

Example of Class I Designated Chemical Substance: Toluene

Paint (toluene content: 20%) Annual purchased amount: 300L, Amount abandoned due to expiration: 60L. Thinner (toluene content: 50%, specific gravity: 0.8661) Annual purchased amount: 4,000L, Amount of waste thinner: 250L.

Estimation example

[Release]	Paint	$[(300 \times 0.2) - (60 \times 0.2)] \times 0.8661 = 41.6$kg
	Thinner	$[(4,000 \times 0.5) - (250 \times 0.5)] \times 0.8661 = 1,624$kg
[Transfer]	Paint	$60 \times 0.2 \times 0.8661 = 10.4$kg
	Thinner	$250 \times 0.5 \times 0.8661 = 108.3$kg

Amount of release to air = 41.6kg + 1,624kg = 1,665.6kg

Amount of waste transferred = 10.4kg + 108.3kg = 118.7kg

The premise for the estimation

1. Concerning the released and transferred amount during the painting process, all are assumed to be released to the air during the process for toluene.
2. The paint abandoned due to expiration during purchase stock is considered to be transferred as waste.
3. Concerning the paint stripped from aircraft body, the same amount of paint as that of repainted is assumed to be transferred as waste.