PRTR Estimation Manual

07. Asbestos Industry

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Japan Asbestos Association

Contents

1. Procedures for Calculating Releases and Transfers

This chapter describes procedures for calculating quantities of asbestos released and transferred.

1.1 Procedures for calculating releases and transfers

1.1.1 Major manufacturing processes for asbestos-containing products

The main asbestos-containing products include building materials produced through sheet making process, industrial asbestos products such as compressed asbestos sheets, friction materials for such as brake linings (dry-type). The details including the flows of manufacturing processes are described below:

Asbestos-containing building materials

Asbestos-containing building materials include asbestos slate sheet, ECP (extruded products), and roofing products. Fig.1-1 shows the flow chart of manufacturing process for these products. The releases during the processing steps are as follows:

1) Releases to the air

Potential sources of asbestos released during the operations are the processes of bag opening, fiberization, measuring, mixing or kneading, cutting, and milling. All the generated asbestos dust is collected by local filtering gas devices and released from dust collectors to the air.

2) Release to water bodies

Water is used in the processes of mixing, kneading and sheet making. Some plants recycle the water used in these processes, while others release it off-site after a specified treatment. Although production of asbestos-containing building materials requires no water, it was used to wash equipment to which asbestos is adhering. In this case too, some plants may use the water as circulating water and others may release it offsite after a prescribed treatment.

3) Wastes

Wastes are considered to be generated from waste containers of raw asbestos in the bag opening process, debris from the cutting process, off-specification products from the inspection process, sludge from the wastewater treatment process, collected dust from dust collectors, and filter cloths.

Some plants may recycle these wastes generated through these processes.

Compressed asbestos sheets

Figure 1-2 shows the flow chart of manufacturing process for compressed asbestos sheets. Releases during the process are shown below. The raw materials for manufacturing compressed asbestos sheets include, besides asbestos, solvents (mainly toluene, which is Cabinet Order No. 227 under the (1999) Law for PRTR and Promotion of Chemical Management), and chemicals (vulcanizing agents, vulcanization accelerating agents, antioxidant, and auxiliary vulcanization accelerating agents, which vary depending on companies). For raw materials other than asbestos, it is necessary to confirm whether they fall under the Class I Designated Chemical Substances (referred to as PRTR chemicals)

with reference to the attached table. If they are determined to be the PRTR chemicals, make sure to identify the amounts used, etc. and calculate the releases and transfers using related PRTR estimation manuals.

1) Release to the air

The dust sources are in the processes of bag opening, measuring, and mixing or kneading. All of the generated asbestos dust is collected by local exhaust gas filtering equipment and released from dust collectors to the air.

2) Release to water bodies

Since no water is used, there is no release of asbestos off-site.

3) Wastes

Wastes are considered to be generated from waste bags from the bag opening process, waste raw materials from the mixing or kneading process, debris from the cutting process, off-specification products from the inspection process, collected dust from dust collectors, and filter cloths.

Brake linings (dry type)

Figure 1-3 shows the flow chart of manufacturing process for brake linings (dry type). Releases during the process are described below.

The raw materials for brake linings (dry type) are asbestos, powdery resin (mainly phenol resin), chemicals (mainly barium sulfate and calcium carbonate). For the raw materials other than asbestos, it is necessary to confirm whether or not they fall under the PRTR chemicals with reference to the attached table. If they do, make sure to identify the amounts used, etc. and calculate the releases and transfers with reference to other related manuals for release calculations.

1) Release to the air

The dust sources are in the processes of the bag opening, measuring, mixing or kneading, preform making, finishing, drilling, and shoe grinding. All the generated asbestos dust is collected by local exhaust gas filtering equipment to be sent to dust collectors before discharged from the outlet to the air.

2) Release to water bodies

Since no water is used, there is no release of asbestos off-site.

3) Wastes

Wastes are considered to be generated from waste containers of raw asbestos in the bag opening process, debris and grinding powder from the processes of finishing, drilling, and shoe grinding, off-specification products from the inspection process, dust collected by dust collectors, and filter cloths.

1.1.2 Procedures for calculating releases and transfers

Figure 1-1 to 1-4 show the procedures for calculating releases and transfers of asbestos

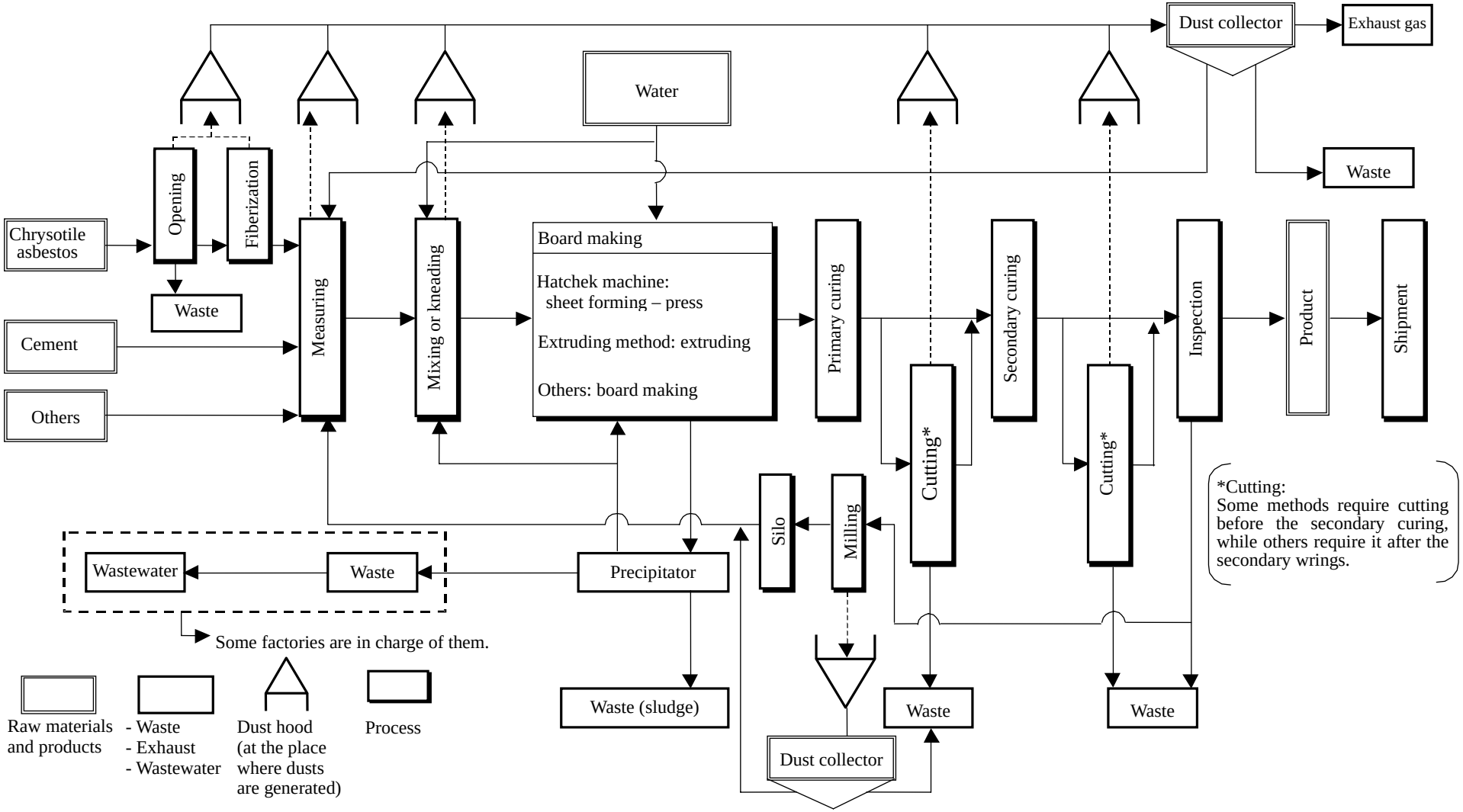
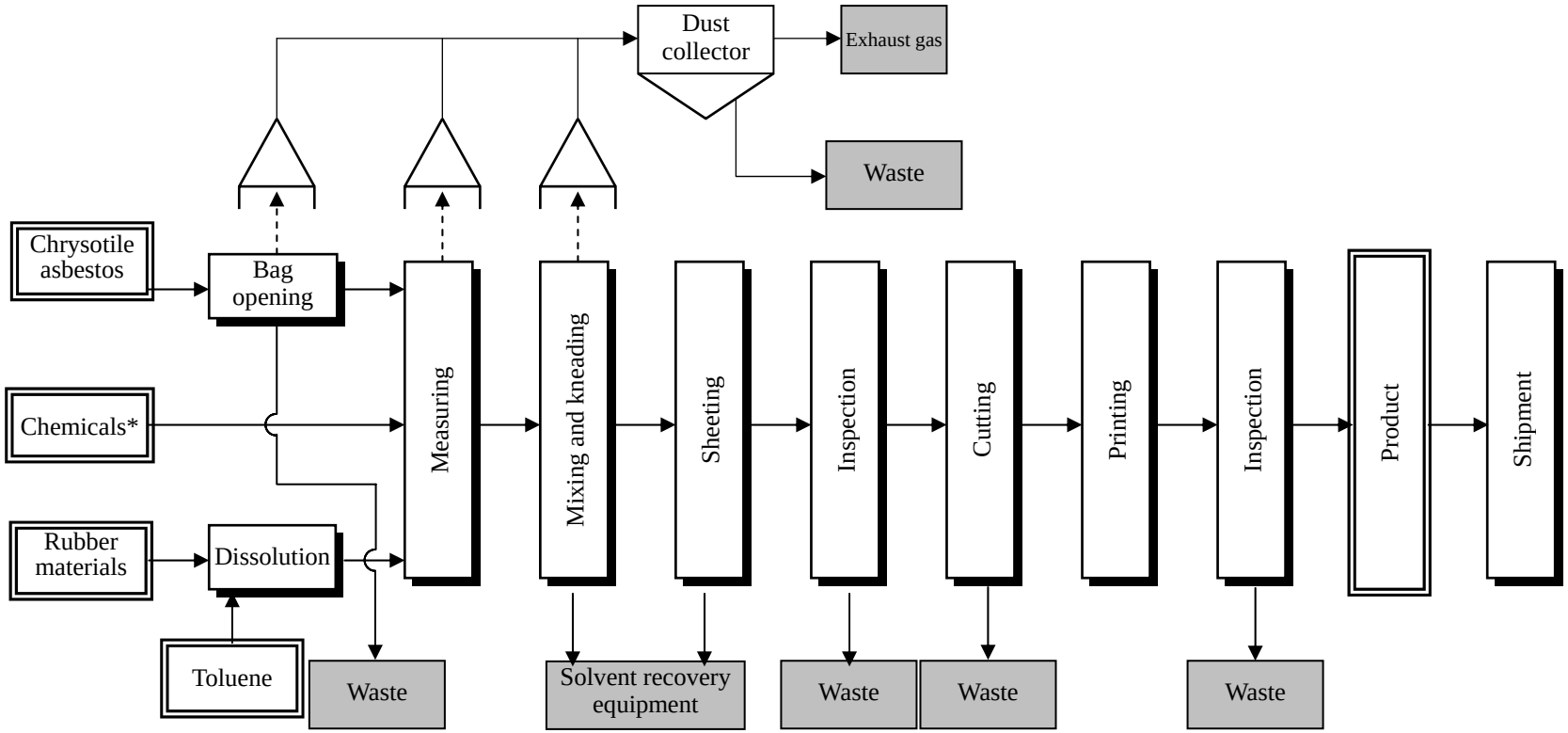
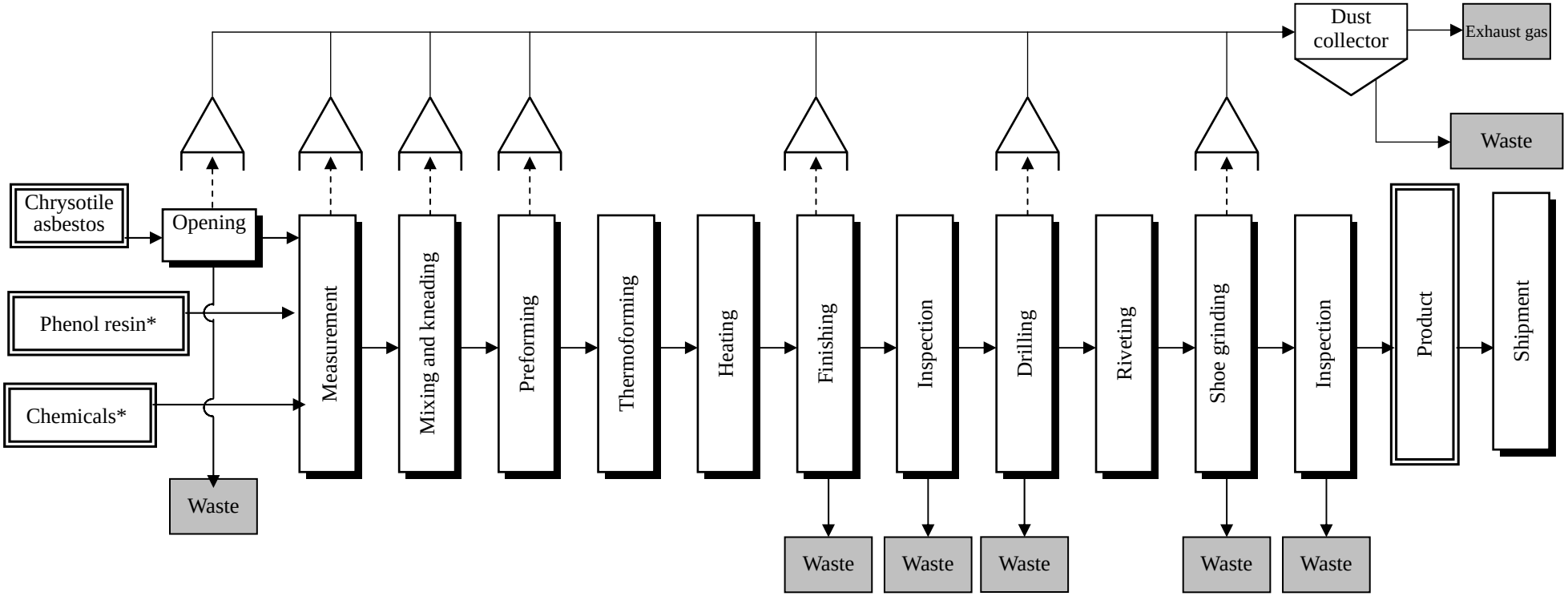


Figure 1-1: Flow chart of manufacturing process for asbestos-containing construction materials



*For the PRTR Chemicals in the chemicals used, see the attached table.

Figure 1-2: Flow chart of manufacturing process for compressed asbestos joint sheets



* For the PRTR Chemicals in the chemicals used, see the attached table.

Figure1-3: Flow chart of manufacturing process for brake linings (dry type)

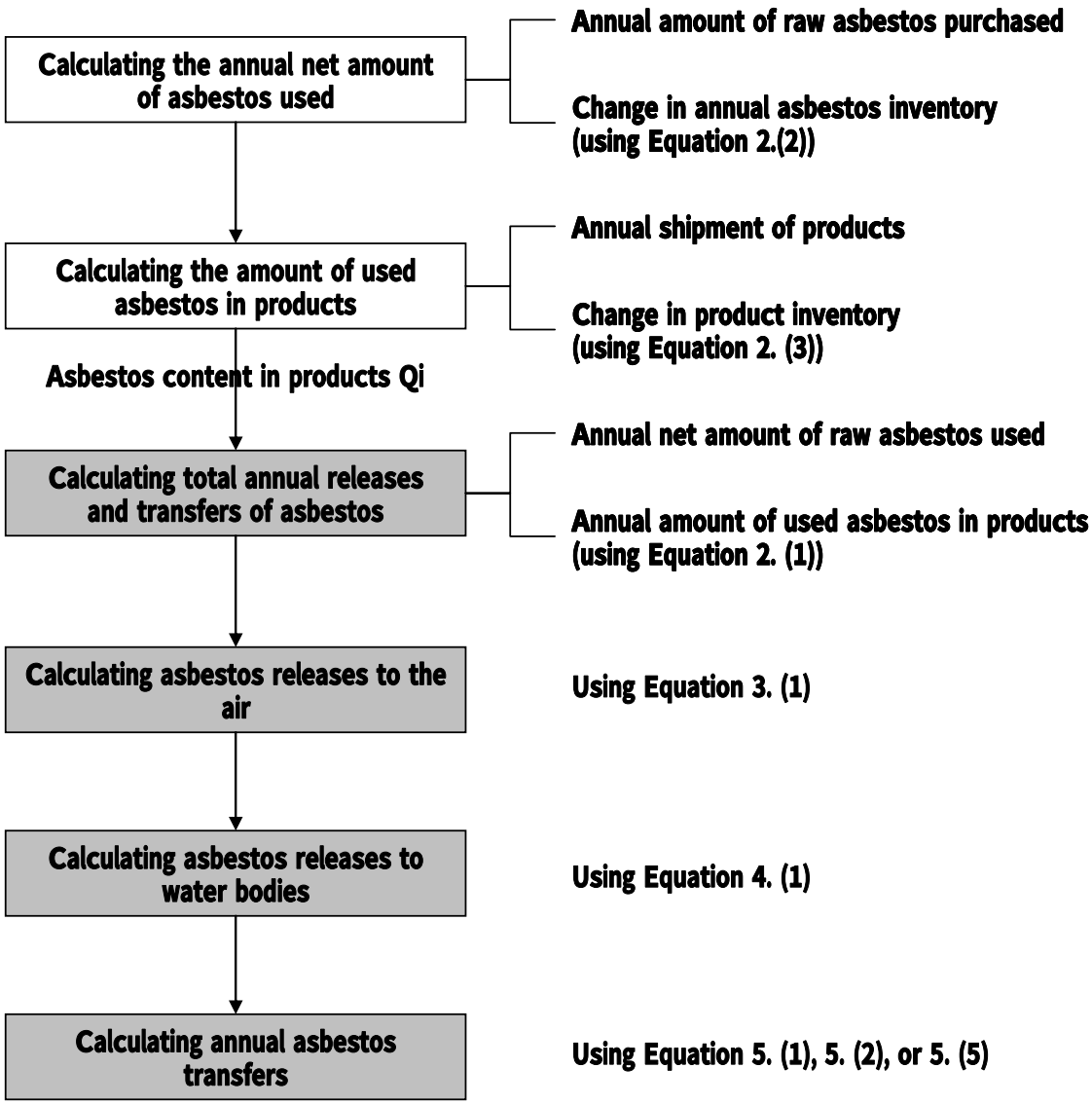


Figure 1-4: Flow chart of calculating procedures for releases and transfers of asbestos

1.2 Procedures for calculating the total releases and transfers

The total annual releases and transfers of asbestos - As (kg) - are calculated using Equation 2. (1) from data on raw materials purchase and inventory as well as on product shipment and inventory.

The total annual releases and transfers of asbestos (As)

= annual net amount of raw asbestos used – annual amount of asbestos contained in products --- Equation 2. (1)

The annual net amount of raw asbestos used is calculated using Equation 2. (2) from the amount of raw asbestos purchased, and the increase/decrease of the inventory of raw asbestos.

Annual net amount of raw asbestos materials used (kg)

= A + B – C ---------- Equation 2. (2)

A: Annual amount of raw asbestos purchased (from April 1 of the preceding year through the end of March of current year.)

B: Amount of inventory of raw asbestos as of the end of March of the preceding year

C: Amount of inventory of raw asbestos as of the end of March of current year

The annual amount of asbestos used being contained in products is calculated using Equation 2. (3) from the amount of annual shipment of asbestos-containing products and the changes in the inventory of asbestos-containing products.

Annual amount of asbestos used being contained in products (kg)

= Σ (Ai + Ci – Bi) x Qi ---------- Equation 2.(3)

Ai: Amount of annual shipment of type i products (from April 1 of the preceding year through the end of March of current year)

Bi: Amount of inventory of type i products as of April 1 of the preceding year

Ci: Amount of inventory of type i products as of the end of March of current year

Qi: Content of asbestos in type i products

Asbestos-containing building materials: the asbestos content calculated by taking the product water content and the amount of crystallization water generated by the reaction into consideration on the basis of measured values or compounding ratio.

Asbestos-containing products other than asbestos-containing building materials: the asbestos content according to the compounding ratio is to be used.

1.3 Calculating the asbestos releases to the air

The asbestos releases to the air (Paa) are calculated using Equation 3. (1).

Paa (kg)

= annual operation hours (hr) x amount of exhaust gas (m^3/hr) x Ai x 10^{-6}

----- Equation 3. (1)

Ai: The result of experiments at exhaust gas outlets of dust collectors, which were carried out by the Japan Asbestos Association, shows that all the values were less than the minimum determination limit. The following values (minimum determination limit) are to be used.

In case of dust collectors for bag opening and mixing processes:

0.001 mg/m^3

In case of dust collectors for those other than bag opening and mixing processes:

0.002 mg/m^3

*In case where there are two or more dust collector units, the amount of asbestos from each individual outlet should be calculated using Equation 3. (1) and their aggregate values should be used.

1.4 Calculating the asbestos releases to water bodies

Manufacturing of asbestos-containing products causes little release of asbestos to water bodies. Only some of the facilities manufacturing asbestos-containing building materials release wastewater offsite. For the case where asbestos is released to water bodies, the asbestos releases (Paw) are calculated using Equation 4. (1).

Paw (kg)

= annual amount of wastewater (m^3/year) x annual average amount of SS (mg/liter) x A_j x 10^{-6} x 10^3 ---------- Equation 4. (1)

Annual average amount of SS: the average of SS (suspended substance) values measured twice a year is to be used.

A_j: measured content of asbestos contained in SS (to be measured by individual facilities). Measurements carried out by Japan Asbestos Association show that A_j ranges between 0 and 0.1.

*In cases where there are two or more lines of wastewater outlets, the amount of asbestos from each individual outlet should be calculated using Equation 4. (1) and their total value should be used.

1.5 Calculating the annual transfers of asbestos

The annual transfers of asbestos should be estimated by either method of 1.5.1 or 1.5.2.

1.5.1 Calculating the estimated annual transfers of asbestos

(1) For cases wherein the asbestos releases only to the air:

The estimated annual transfers of asbestos (Aew) are calculated using Equation 5. (1).

Aew (kg) = As – Paa ---------- Equation 5. (1)

As: total annual releases and transfers of asbestos (Equation 2. (1))

Paa: asbestos releases to the air (Equation 3. (1))

(2) For cases wherein the asbestos releases to the air and water bodies:

The estimated annual releases of asbestos (Aew) to the air and water bodies are calculated using Equation 5. (2).

Aew (kg) = As – Paa – Paw -- Equation 5. (2)

As: total annual releases and transfers of asbestos (Equation 2. (1))

Paa: asbestos releases to the air (Equation 3. (1))

Paw: asbestos releases to water bodies (Equation 4. (1))

1.5.2. Calculating the annual transfers of asbestos

When calculating the annual transfers of asbestos (W) using the actual results, etc., carry out calculations by using the methods of (1), (2), and (3) to follow Equation 5. (5) in (4) below.

(1) How to calculate the residual amount of asbestos in waste containers for raw asbestos

In cases where raw asbestos bags are recycled or incinerated at on-site facilities, make the calculation on the assumption that the amount of asbestos is “zero.” In cases where the waste raw asbestos container bags are consigned to industrial waste firms for disposal, use the following values:

“The residual amount of asbestos contained in each waste container bag for raw asbestos of 50 kg: 0.4 g”

(2) How to calculate the amount of asbestos adhering to waste filter cloths and dust respirator filters, which are specified as the “Specially Managed Industrial Waste”.

The amount of asbestos adhering to waste filter cloths and dust respirator filters is regarded as “zero” for the following reasons. While, waste filter cloths and dust respirator filters are controlled and disposed of as the “Specially Managed Industrial Waste”.

1) Waste filter cloths

a. The life of filter cloths, which varies depending on the dropping mechanism of dust collectors (pulse jet system, shaking system, etc.), is 3 to 10 years. Therefore, the annual amount disposed of is extremely small.

b. Filter cloths are disposed of, as a rule, only after removing asbestos-containing dust adhering to them. Therefore the amount of asbestos-containing dust adhering to filter cloths is extremely small.

c. In addition to the reasons of the above a. and b., it is extremely difficult to assess the amount of asbestos adhering to filter cloths.

2) Waste dust-respirator filters

a. The average asbestos dust concentration in working environment, which is measured by the Japan Asbestos Association, is 0.5fibers/cm^3 or less. This shows that the surrounding environment is in an acceptable condition. As a result, the frequency of changing filters of dust respirators is very small.

b. The amount of asbestos adhering to waste dust-respirator filters is extremely small and negligible compared with the overall amount of the waste.

(3) How to calculate the amount of asbestos contained in waste, other than the above (1) and (2)

- The annual amount of asbestos containing waste (Dkg: excluding waste container bags for raw asbestos, waste filter cloths, and waste dust-respirator filters) is calculated based on the Control Manifest (two types: general and special).
- The average content of asbestos in various products (Qw) is calculated using Equation 5. (3).

$$Qw = \Sigma (Ai \times Qi) / \Sigma Ai \quad \text{---------- Equation 5. (3)}$$

Ai: annual production of type i products (from April 1 of the preceding year through the end of March of the current year)

Qi: asbestos content in type i products

Asbestos-containing building materials: the asbestos content calculated by taking the product water content and the amount of crystallization water generated by the reaction into consideration on the basis of measured values or compounding ratio.

Asbestos-containing products other than asbestos-containing building materials: the asbestos content according to the compounding ratio is to be used.

- The amount of asbestos in asbestos-containing waste (Wa (kg)) is calculated using Equation 5. (4).

$$Wa\ (kg) = D \times Qw \quad \text{---------- Equation 5. (4)}$$

(4) How to calculate the annual transfers of asbestos

For the reasons of above (1), (2), and (3), the annual transfers of asbestos (W) can be calculated using Equation 5. (5).

$$W\ (kg) = 0.4\ g \times 10^{-3} \times \text{annual net amount of raw asbestos used (kg)}/50\ kg + Wa \quad \text{------ Equation 5. (5)}$$

Annual net amount of raw asbestos used (kg): the value calculated in accordance with the above Equation 2. (2)

Wa: the value calculated using the above Equation 5. (4)

2. Concerning the Materials other than the Asbestos used as the raw materials of Asbestos-containing Products that are Considered to come under the subject of PRTR law

2.1 Asbestos-containing building materials

Boards are mainly manufactured as the asbestos-containing building materials, and among the main raw materials there is none other than the asbestos that are PRTR chemicals. However, coating is required if boards need to be decorated when used as interiors. This coating, however, is mainly dealt by off-site coating firms. When coating on-site, however, the materials that are used in the coating process and that are the PRTR chemicals are the following substances. The coating process is shown in Figure 2.

1. Toluene
2. Xylene
3. Ethyl acetate
4. Butyl acetate
5. Cyclohexanone

2.2 Compressed asbestos sheets/Asbestos-cement sheets (Asbestos joint sheet)

The chemical substances which are used as raw materials for manufacturing compressed asbestos sheets and which are considered to be the PRTR chemicals are as follows;

1. Hexamethylenetetramine
2. Tetramethylthiuramdisulfide (thiuram)
3. N-cyclohexyl-2-benzothiazolesulfonamide
4. Phthalic acid anhydride
5. Toluene

2.3 Brake linings (dry-type)

The chemical substances which are used as raw materials for manufacturing brake linings (dry-type) and which are considered to be the PRTR chemicals are as follows:

1. Molybdenum
2. Phenol
3. Formaldehyde

<The data to be covered>

The annual total quantities of asbestos released and transferred, releases to the air and to water bodies and transfers contained in waste are to be covered.

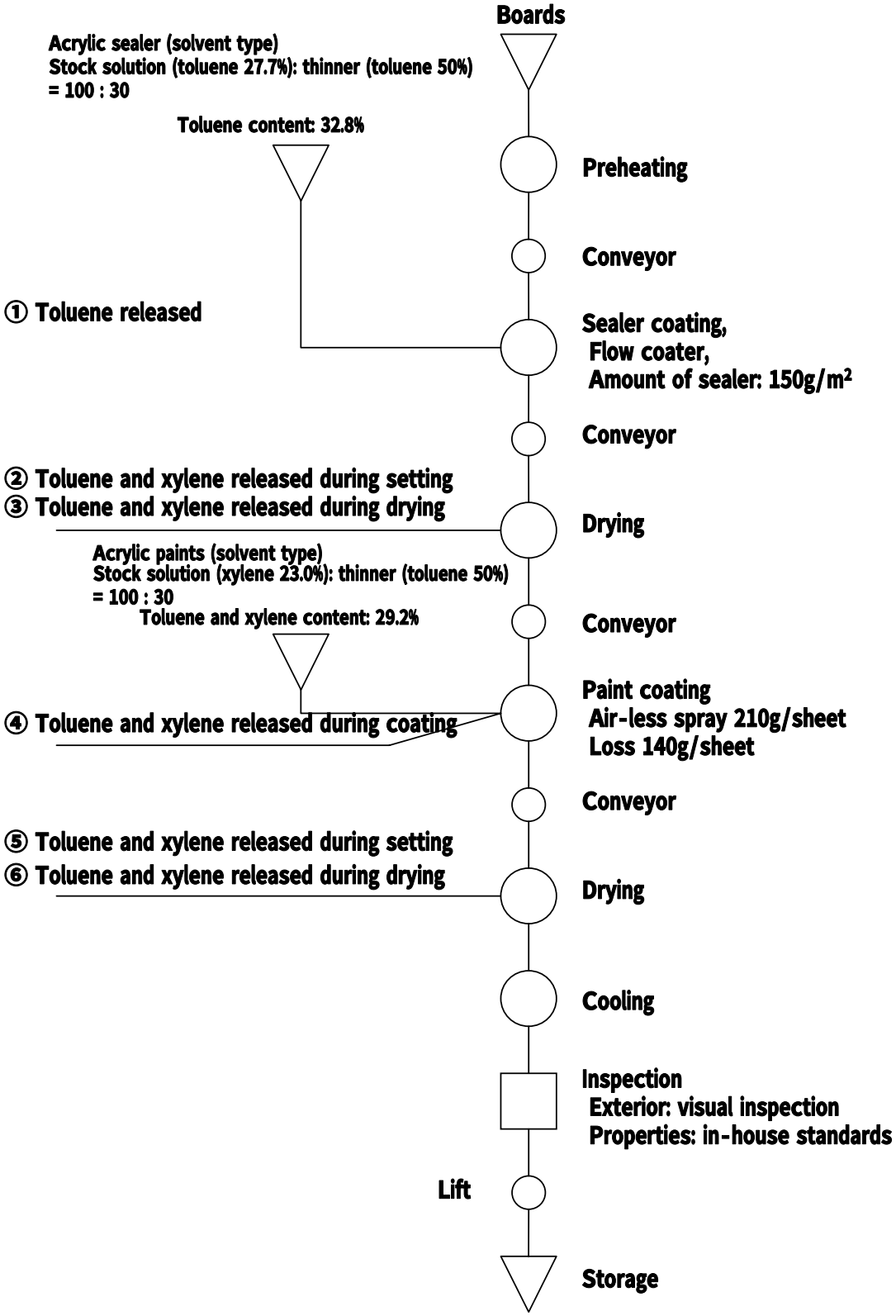


Figure 2: Flow chart of coating process

Appendix 1

Methods for Calculating Releases and Transfers of Asbestos

[Methods for calculating the total annual releases and transfers of asbestos (As)]

Total annual releases/transfers of asbestos As (kg)

= Annual net amount of raw asbestos used (kg) – Annual amount of asbestos in products (kg)

●Annual net amount of raw asbestos used (kg) = A + B – C

A: Annual amount of raw asbestos purchased (from April 1 of the preceding year through the end of March of current year)

B: Amount of inventory of raw asbestos as of the end of March of the preceding year

C: Amount of inventory of raw asbestos as of the end of March of current year

● Annual amount of asbestos used in products (kg) = Σ (Ai + Ci – Bi) x Qi

Ai: Annual amount of shipment of type i products (from April 1 of the preceding year through the end of March of current year)

Bi: Amount of inventory of type i products as of April 1 of the preceding year

Ci: Amount of inventory of type i products as of the end of March of current year

Qi: Asbestos content of type i products

Asbestos-containing building materials: the asbestos content calculated by taking the product water content and the amount of crystallization water generated by the reaction into consideration on the basis of measured values or compounding ratio.

Asbestos-containing products other than asbestos-containing building materials: the asbestos content according to the compounding ratio is to be used.

[Calculating the asbestos releases to the air (Paa)]

Paa (kg)

= Annual operation hours (hr) x amount of exhaust gas (m^3/hr) x Ai x 10^{-6}

Ai: The result of experiment at exhaust gas outlets of dust collectors, which was carried out by the Japan Asbestos Association, shows that all the values were less than the minimum determination limit. However, the following values (the minimum determination limit) are to used.

In case of dust collectors during bag opening and mixing processes:

0.001 mg/m^3

In case of dust collectors during processes other than bag opening and mixing processes: 0.002 mg/m^3

* In cases where there are two or more dust collector units, the amount of asbestos from each individual collector should be calculated using the above Equation and their aggregate values should be used.

[Calculating the asbestos releases for cases where there is a release to water bodies]

Paw (kg)

= annual amount of wastewater generated (m^3/year) x annual average amount of SS (mg/L) x A_j x 10^{-6} x 10^3

Annual average amount of SS: the average value of suspended substances (SS) measured twice a year is to be used.

A_j: measured content of asbestos contained in the suspended substances (SS) (to be measured by individual facilities). Measurements carried out by the Japan Asbestos Association show that A_j ranges between 0 and 0.1%.

*In cases where there are two or more lines of wastewater outlets, the amount of wastewater from individual outlet should be calculated using the above Equation and their aggregate values should be used.

[Calculating the annual transfers of asbestos (W)]

1. Calculating the estimated annual transfers of asbestos

(1) Transfers only to the air

Aew (kg) = As – Paa

As: total annual releases/transfers of asbestos (Equation 2. (1))

Paa: asbestos releases to the air (Equation 3. (1))

(2) Transfers to the air and water bodies

Aew (kg) = As – Paa - Paw

As: total annual releases/transfers of asbestos (Equation 2. (1))

Paa: asbestos releases to the air (Equation 3. (1))

2. Calculating the annual transfers of asbestos

If the above step (1.) is not applicable, calculations may be made using the following equation.

W (kg)

= 0.4 g x 10^{-3} x net annual quantity of raw asbestos used (kg)/50 kg + Wa

● Wa = D x Qw

D: Quantity of asbestos-containing waste calculated based on the Manifesto (excluding waste raw asbestos container bags, waste filter cloth and waste anti-dust filters)

Qw: Σ (Ai x Qi)/ Σ Ai

Ai: Annual production amount of type i product (from April 1 preceding year through March current year)

Qi: Content of asbestos in type i products

Asbestos-containing building materials: the asbestos content calculated by taking the product water content and the amount of crystallization water generated by the reaction into consideration on the basis of measured values or compounding ratio.

Asbestos-containing products other than asbestos-containing building materials: the asbestos content according to the compounding ratio is to be used.

Appendix 2

1. Examples of Calculating Releases/Transfers of PRTR Chemicals Contained in Asbestos-Containing Building Materials

1. Conditions set

(1) Quantities of raw asbestos used

Annual quantity of raw materials purchased (A): 4,000,000 kg
Inventory at the end of March preceding year (B): 400,000 kg
Inventory at the end of March current year (C): 126,250 kg

(2) Production/Inventory

Product A

Shipment: 2,310,000 m^2
Inventory at the end of March preceding year: 49,500 m^2
Inventory at the end of March current year: 33,000 m^2
Weight: 18.18 kg/m^2 (dry weight 17.09 kg/m^2), water content at shipment 6%
Asbestos content: 10% (dry weight)

Product B

Shipment: 330,000 m^2
Inventory at the end of March preceding year: 3,300 m^2
Inventory at the end of March current year: 16,500m^2
Weight: 21.21 kg/m^2 (dry weight19.94 kg/m^2), water content at shipment 6%
Asbestos content: 5% (dry weight)

(3) Asbestos releases to the air

Dust collectors (in bag opening and mixing processes): 3 units (the amount of exhaust gas: 6,000 m^3/hr., operation hours: 3,000 hrs, JAA values: 0.001)

Dust collectors (in other processes): 5 units (the amount of exhaust gas: 30,000 m^3/hr., operation hours: 6,000 hrs, JAA values: 0.002)

(4) Asbestos releases to water bodies

Amount of water discharge:

25,000 m^3/year (about 10 m^3/day), concentrations of suspended substances (SS): 15 mg/liter, asbestos content in SS: 0.5%

(5) Amount of waste

The amount of waste carried out: 117,000 kg (the annual dry weight), asbestos content: average 6.2%

2. Calculation Examples

Calculations of releases/transfers of asbestos may be made based on the conditions described in above 1.

(1) Calculating the total annual releases/transfers of asbestos

Annual net amount of raw asbestos used

= 4,000,000 + 400,000 – 126,250 = 4,273,750 kg

Annual amount of used asbestos contained in products

= 3,921,885 (Product A) + 341,484 (Product B) = 4,261,761.5 kg

*** Product A**

$\underline{17.09\ kg/m^2}$ x $\underline{(2{,}310 + 33 – 49.5) \times 1000\ m^2}$ x $\underline{10\%}$ = 3,919,591.5 kg

(Dry weight/m^2) x (Production amount m^2) x

(Amount of asbestos contained in Product A)

*** Product B**

$\underline{19.94\ kg/m^2}$ x $\underline{(330 + 16.5 – 3.3) \times 1{,}000\ m^2}$ x $\underline{5\%}$ = 342,170 kg

(Dry weight/m^2) x (Production amount m^2) x

(Amount of asbestos contained in Product B)

<u>Annual total releases/transfers of asbestos = 4,273,750 – 4,261,761.5 = 11,988.5 kg</u>

(2) Asbestos releases to the air

Asbestos releases to the air (kg)

$= (3 \times 3{,}000 \times 6{,}000 \times 0.001 + 5 \times 6{,}000 \times 30{,}000 \times 0.002) \times 10^{-6}$

= 1.854

= 1.9

(3) Asbestos releases to water bodies

Asbestos releases to water bodies (kg)

$= 25{,}000 \times 10^3 \times 15 \times 10^{-6} \times 0.005$

= 2 kg

(4) Estimated annual transfers of asbestos

Aew (kg) = 11,988.5 – 1.9 – 2 = 11,984.6

The releases and transfers of asbestos to be reported for this case will be as follows:

Total annual releases and transfers of asbestos = 11,988.5 kg

Annual transfers of asbestos = 11,984.6 kg

Asbestos releases to the air = 1.9 kg

Asbestos releases to water bodies = 2.0 kg

<Comparison>Calculations of annual transfers of asbestos based on actual measurements

1) Transfers of asbestos for waste raw asbestos container bags

Quantity of asbestos in waste raw asbestos container bags (kg)

= 4,273,750/50 x 0.4 x 10^{-3} = 34

2) Transfers of asbestos in asbestos waste

Transfers of asbestos in asbestos waste (kg) = 117,000 x 0.062 =7,254

* Because the amount of product waste was so large, that the average asbestos content was close to that of the product.

Annual transfer of asbestos (kg) = 34 + 7,254 = 7,288

*The amount was roughly equal to that of the annual estimated transfers of asbestos.

2. Examples of checking PRTR for raw materials other than asbestos --- Phenol and formaldehyde in phenol-resin

Certain brake linings (dry type) use phenol resin as a raw material other than chrysotile asbestos. Depending on the manufacturers some phenol resins contain unreacted phenol and formaldehyde, which are designated as the PRTR chemicals.

Therefore it is necessary, by following the steps below, to figure out the releases and transfers according to PRTR and determine to report to the central government through prefectural governments:

(1) You need to obtain MSDSs from the phenol resin manufacturers and to check whether the contents of unreacted phenol and formaldehyde are more than one percent or not. If they are less than one percent, the substances are out of PRTR reporting requirement.

(2) If the contents of phenol and formaldehyde are found to be more than one percent, you need to identify their annual amounts of phenol resin(s) purchased (including changes in inventory), and multiply them by the content ratio of phenol and formaldehyde to obtain the quantities of respective chemicals. If the respective annual quantity is less than one ton (less than 5 tons for FY 2001 and 2002), they are not required to be reported.

(3) If the annual quantity are more than one ton (more than 5 tons for FY 2001 and 2002), you are to calculate the releases and transfers of phenol and formaldehyde. The calculations may be made by referring to the Manual for Estimating Releases/Transfers prepared eleswhere.