26.Cemented Carbide Tool Industry

1. Calculation Procedures for Quantities Handled, Released and Transferred

1.1 Calculation Procedures for Class I Designated Chemical Substances Handled

(1) Class I Designated Chemical Substances Subject to Reporting (referred to as designated chemical substances hereafter)

The quantities of designated chemical substances that are subject to reporting are calculated using worksheet 1 and 2.

(2) Calculation for Quantities Handled (Worksheet)

The example below illustrates how to calculate designated chemical substances handled for manufacturing cutting tool. The quantities of designated chemical substances handled in manufacturing other products, such as holders, wear resistant tools and engineering tools, should be calculated similarly based on this worksheet.

Refer to the attached Table 1, for the designated chemical substances handled in the cemented carbide tools industry.

① On worksheet 1, list all of the factory materials purchased that contain 1% (0.1% for Specified Class I Designated Chemical Substances) or more of designated chemical substances, then fill out the sheet with the names of the chemical compound and their content.

Note 1: In order to obtain the names and content of chemical compound in the materials purchased, refer to the material safety data sheet (referred to as MSDS hereafter). If this information is unknown, please contact the manufacturer.

Note 2: Purchased materials that contain less than 1.0% of designated chemical substances (less than 0.1% for Specified Class I Designated Chemical Substances) are not subject to reporting.

② Obtain the figures for the annual quantities of the above materials purchased, enter them into the worksheet, then calculate the annual quantities of designated chemical substances handled.

(Worksheet 1 Example of Calculations)

Worksheet 1 (Calculations for Total Quantities Handled)

	① Names of Raw Materials and Other Materials	Calculation of Annual Quantity Handled				Designated Chemical Substance		
		Annual Quantity Purchased kg/year	Inventory at End of FY kg/year	Inventory at Beginning of FY kg/year	②Annual Quantity Handled kg/year	③Name of Designated Chemical Substance	④ Content wt%	⑤Annual Quantity Handled kg/year
1	Cobalt (Co)	1000	500	200	700	Cobalt	100	700
2	Chromium carbide(Cr_3C_2)*	100	50	50	100	Chromium	86.7	86.7
3	Carbonic molybdenum (Mo_2C)	220	50	30	200	Molybdenum	94.1	188.2

* Chromium carbide (Cr_3C_2)
As chromium carbide is neither trivalent nor hexavalent, it is not deemed to be a designated chemical substance. Since the quantity of chromium carbide added to cemented carbide material is usually within the solubility limits for solid chromium as a binder, the chromium carbide present in the binder after sintering is considered to be chromium (a Class I Designated Chemical Substance). Chromium carbide is released / transferred as chromium carbide during the blending, mixing / granulating and forming processes. Therefore, the emission factor is deemed to be "0". However, during the grinding and coating processes, the releases / transfers are considered to be in the form of chromium, with the emission factor determined as specified above.

(3) Confirming the Designated Chemical Substances Handled in the Factory and Determining the Requirement for Reporting (Worksheet 2)

① List all the designated chemical substances for each process or work operation, in worksheet 2, with reference to worksheet 1. Then calculate the total quantities of each designated chemical substance.

② Among the designated chemical substances listed above, any such substances for which the annual quantities handled are 1 ton or more (5 tons or more for FYs 2001 and 2002), are subject to reporting. However, any Specified Class I Designated Chemical Substances, for which the annual quantities handled are 0.5 tons or more, are subject to reporting. Refer to the worksheet to determine whether reporting is required.

(Worksheet 2 Example of Calculations)

Worksheet 2
(Calculations for Total Quantities of Designated Chemical Substances Handled)

	CAS No.	Name of Designated Chemical Substance	Manufacturering Process	Annual Quantity Handled kg/year	Total Kg/year	Reporting
1	7440-02-0	Nickel	Blending	100	110	□ Required □ Not Required
			Coating	10		
2	7440-48-4	Cobalt	Coating	60,000	61,000	□ Required □ Not Required
			Coating	1,000		

1.2 Estimation Procedures for Quantities Released / Transferred

There are 5 basic calculation methods available for calculating the quantities of designated chemical substances released from each release point, to either the atmosphere or bodies of water (soil), or for estimating the quantities of such substances transferred in waste, as follows:

(1) Estimation method based on materials balance
(2) Estimation method based on emission factors
(3) Estimation method based on physical properties
(4) Estimation method based on actual measured values
(5) Other estimation methods considered to be appropriate

In the cemented carbide tool industry, it is recommended that “(2) Estimation method based on emission factors”, above, be utilized as the basic concept underlying the estimation of quantities released / transferred. Tables 3-2, 3-4, 3-6, 3-8 and 3-10 show examples of emission factors. However, in the event that emission factors do not apply to a particular business premises, then calculations should be based upon actual measured values obtained by the specific business premises.

For the emission factors shown in Tables 3-2, 3-4, 3-6, 3-8 and 3-10, the quantities released/

transferred are estimated using the following formula:

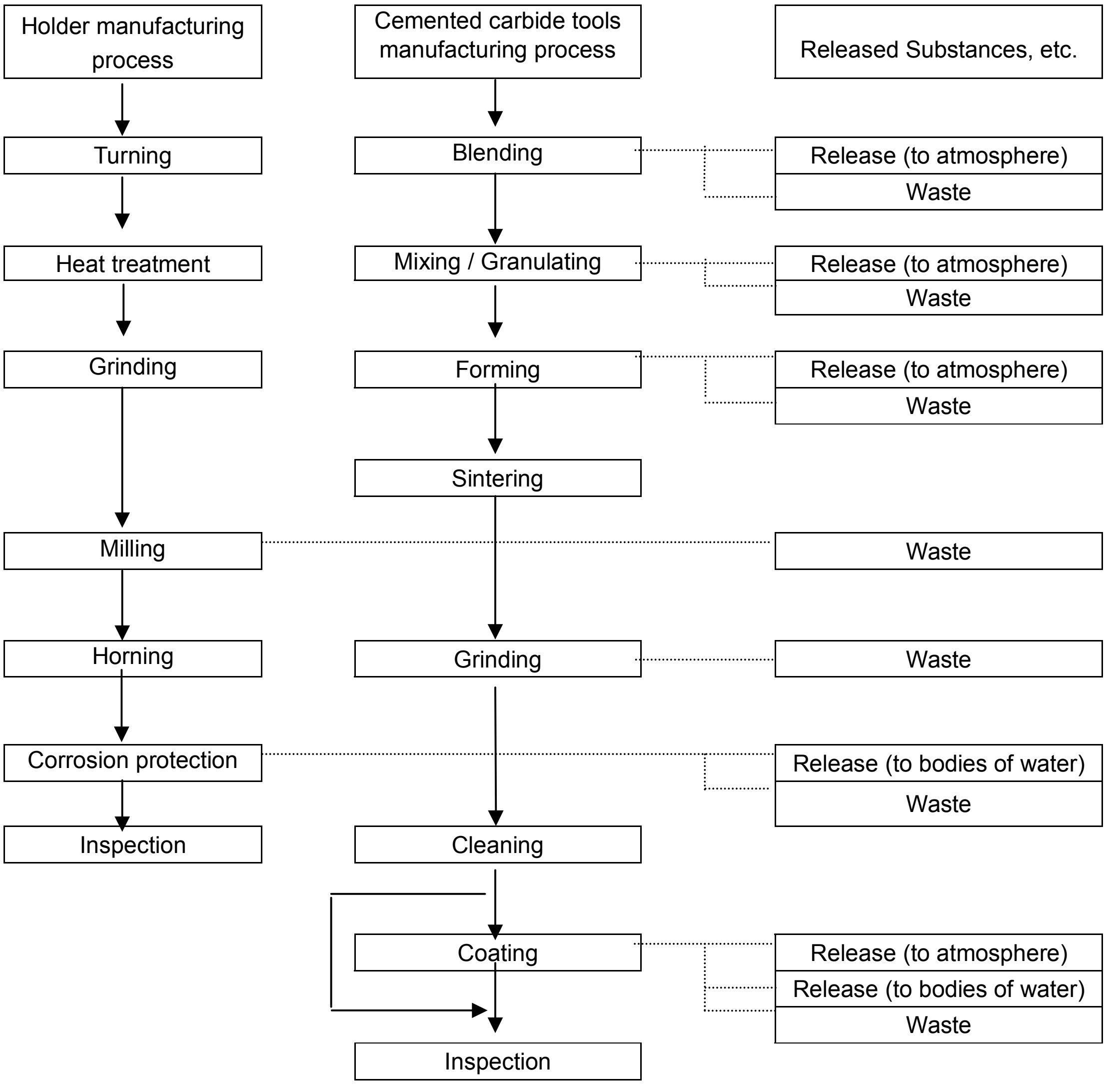
(Quantity released / transferred) = (annual quantity of designated chemical substance handled)×(emission factor)

The results obtained from the above formula for quantities released / transferred, should then be reported.

2. Examples of Methods and Procedures for Estimating the Quantities Released / Transferred

Designated chemical substances are contained in the materials utilized in the following cemented carbide tool manufacturing processes: blending; mixing; grinding; cleaning and coating.

A process flow chart for the cemented carbide tool industry is shown below. For more details, refer to the attached figure.



2.1 Example of Calculations for Each Process Using Emission Factors

2.1.1 Example of Calculations for the Blending Process

The attached Table 1 shows the raw materials used in the blending process.

In the event that any business premises use raw materials and other materials that are different from those listed in the attached Table 1, MSDS for such raw materials and other materials must be obtained, in order to investigate the presence and content of designated chemical substances.

Table 3-1 shows the raw materials and other materials used during each of the processes involved in the cemented carbide tool industry (listed in the attached Table 1) that contain 1% or more of designated chemical substances.

Table 3-1 Class I Designated Chemical Substances in the Blending Process

No.	Name of Material	Cabinet Order Number	Designated Chemical Substance	Content (wt%)
1	Chromium carbide	(68)	Chromium	86.7
2	Carbonic molybdenum	346	Molybdenum	94.1
3	Cobalt	100	Cobalt	100
4	Nickel	231	Nickel	100

Calculate the annual quantities of each designated chemical substance handled by preparing the list for each designated chemical substance, using worksheets 1 and 2, as described in the section entitled "1. Calculation Procedures for Quantities Handled, Released and Transferred".

Any designated chemical substances for which the annual quantities handled are 1 t or more (5 t or more for the 2 years: 2001 and 2002), are subject to reporting. However, any Specified Class I Designated Chemical Substances for which the annual quantities handled are 0.5 tons or more, are subject to reporting (the designated chemical substances that have been circled, in the attached Table 1).

The quantities released / transferred for each manufacturing process can be estimated using the emission factors shown in Tables 3-2 through 3-10.

(The numerical values shown in each table are examples only. Actual emission factors should be determined in accordance with the actual conditions experienced within each company.)

① Calculations for Quantities Shipped Out in Products

Use the formula below to calculate the quantities of designated chemical substances that are shipped out in products:

[Quantity shipped out in products] = [Quantity of designated chemical substances handled] × [Emission factor]

② Estimations for Quantities Released to the Atmosphere

Use the formula below to calculate the quantities of designated chemical substances that are released to the atmosphere:

[Quantity released to atmosphere] = [Quantity of designated chemical substances handled] × [Emission factor]

③ Estimations for Quantities Transferred

Use the formula below to calculate the quantities of designated chemical substances that are transferred as waste:

[Quantity transferred] = [Quantity of designated chemical substances handled] × [Emission factor]

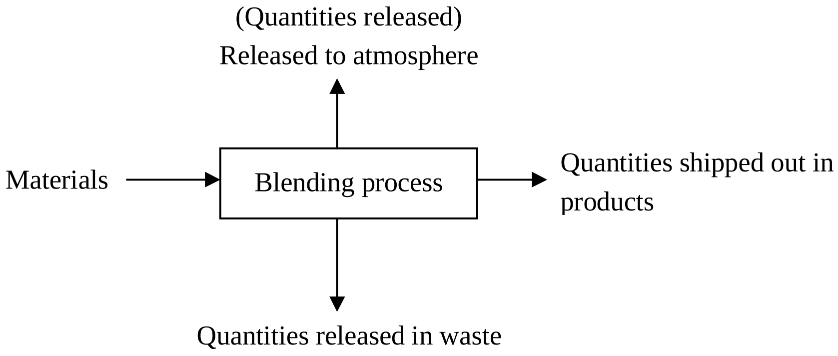


Table 3-2 Examples of Emission Factors for Class I Designated Chemical Substances

Cabinet Order Number	Designated Chemical Substances	Emission Factor for Designated Chemical Substance (wt%)		
		Products	Atmosphere	Waste
68	Chromium (Cr)	100	0	0
346	Molybdenum (Mo)	99～100	0	1.0～0
100	Cobalt (Co)	99～100	0	1.0～0
231	Nickel (Ni)	99～100	0	1.0～0

Notes:

- The emission factors in the above table have been determined based on results of surveys conducted by the member companies of the Japan Cemented Carbide Tool Manufacturers' Association. The emission factors actually used for each particular company should be determined in accordance with the actual material balance conditions.
- Suspended particulates are precipitated into sediment and eventually disposed of as waste. Therefore, the emission factor for suspended particulates released to the atmosphere has been determined as "0".
- In the column with the heading "Products", those contain chemical substances recovered and recycled as valuable materials.

2.1.2 Example of Calculations for Cobalt Used in the Blending Process

① Quantities of Designated Chemical Substances Handled

Calculate the annual quantities of designated chemical substances handled, using worksheet 1 and 2, by following the calculation procedures for the quantities released / transferred, as described in section 2. The example below can also be applied to other chemical substances.

As an example, in a factory that annually uses 60 t of cemented carbide (cobalt content of 8%). Since any quantity handled of 1 t or more (5 t or more for the 2 years: 2001 and 2002) is subject to reporting, the above data must be reported.

(The annual quantity of this designated chemical substance handled is 60 tons × 0.08 (8%) = 4.8 tons.)

② Estimations for Quantities Released / Transferred

Estimate the following quantities for each release route, in accordance with Table 3-2.

a. Quantity shipped out in products

Quantity of designated chemical substance shipped out (during the blending process):

[Quantity shipped out in products] = [Quantity of designated chemical substance handled]×[Emission factor]

[Quantity shipped out in products] = 4.8 tons×0.99 (99%) = 4.75tons

b. Quantity released to the atmosphere

The quantity of designated chemical substance released to the atmosphere is calculated based upon the following formula:

[Quantity released to atmosphere] = [Quantity of designated chemical substance handled]×[Emission factor]

[Quantity released to atmosphere] = 4.8tons×0 (0%) = 0 ton

c. Quantity shipped out (transferred) in waste

Quantity of designated chemical substance shipped out in waste:

[Quantity shipped out in waste] = [Quantity of designated chemical substance handled]×[Emission factor]

[Quantity shipped out as waste] = 4.8tons×0.01 (1%) = 0.05tons

2.1.3 Example of Calculations for the Mixing / Granulating Processes

Table 3-3 indicates the designated chemical substances contained in the chemical compounds used in the mixing / granulating processes. The emission factors for these substances are shown in Table 3-4.

Table 3-3 Designated Chemical Substances Present During the Mixing / Granulating Processes

No.	Name of Material	Cabinet Order Number	Designated Chemical Substance	Content (wt%)
1	Chromium carbide	(68)	Chromium	86.7
2	Carbonic molybdenum	346	Molybdenum	94.1
3	Cobalt	100	Cobalt	100
4	Nickel	231	Nickel	100
5	Xylene	63	Xylene	100
6	Toluene	227	Toluene	100

Table 3-4 Emission Factors for Designated Chemical Substances Present During the Mixing / Granulating Processes

Cabinet Order Number	Designated Chemical Substances	Emission Factor for Designated Chemical Substance (wt%)		
		Products	Atmosphere	Waste
68	Chromium (Cr)	100	0	0
346	Molybdenum (Mo)	99～100	0	1.0～0
100	Cobalt (Co)	99～100	0	1.0～0
231	Nickel (Ni)	99～100	0	1.0～0
63	Xylene	0	1.0～0	0
227	Toluene	0	1.0～0	0

Note： Organic solvents (Xylene and Toluene) are used in a distillation recycling, so these are not contained within products.

2.1.4 Example of Calculations for the Forming Process

Table 3-5 indicates the designated chemical substances contained in the chemical compounds used in the forming process. The emission factors for these substances are shown in Table 3-6.

Table 3-5 Designated Chemical Substances Present During the Forming Process

No.	Name of Material	Cabinet Order Number	Designated Chemical Substance	Content (wt%)
1	Chromium carbide	(68)	Chromium	86.7
2	Carbonic molybdenum	346	Molybdenum	94.1
3	Cobalt	100	Cobalt	100
4	Nickel	231	Nickel	100

Table 3-6 Emission Factors for Designated Chemical Substances Present During the Forming Process

Cabinet Order Number	Designated Chemical Substances		Emission Factor for Designated Chemical Substance (wt%)		
			Products	Atmosphere	Waste
68	Chromium (Cr)	B	100	0	0
346	Molybdenum (Mo)	B	99～100	0	1.0～0
100	Cobalt (Co)	B	99～100	0	1.0～0
231	Nickel (Ni)	B	99～100	0	1.0～0

2.1.5 Example of Calculations for the Grinding Process

Table 3-7 indicates the designated chemical substances contained in the chemical compounds used in the grinding process. The emission factors for Designated Chemical Substances Present During the Grinding Process are shown in Table 3-8.

Table 3-7 Designated Chemical Substances Present During the Grinding Process

No.	Name of Material	Cabinet Order Number	Designated Chemical Substance	Content (wt%)
1	Chromium carbide	(68)	Chromium	86.7
2	Carbonic molybdenum	346	Molybdenum	94.1
3	Cobalt	100	Cobalt	100
4	Nickel	231	Nickel	100

Table 3-8 Emission Factors for Designated Chemical Substances Present During the Grinding Process

Cabinet Order Number	Designated Chemical Substances	Emission Factor for Designated Chemical Substance (wt%)		
		Products	Atmosphere	Waste
68	Chromium (Cr)	95～100	0	5.0～0
346	Molybdenum (Mo)	95～100	0	5.0～0
100	Cobalt (Co)	95～100	0	5.0～0
231	Nickel (Ni)	95～100	0	5.0～0

2.1.6 Example of Calculations for the Coating Process

Table 3-9 indicates the designated chemical substances contained in the chemical compounds used in the coating process. The emission factors for these substances are shown in Table 3-10.

Table 3-9 Designated Chemical Substances Present During the Coating Process

No.	Name of Material	Cabinet Order Number	Designated Chemical Substance	Content (wt%)
1	Chromium carbide	(68)	Chromium	86.7
2	Carbonic molybdenum	346	Molybdenum	94.1
3	Cobalt	100	Cobalt	100
4	Nickel	231	Nickel	100
5	Acetonitrile	12	Acetonitrile	100

Table 3-10　Emission Factors for Designated Chemical Substances Present During the Coating Process

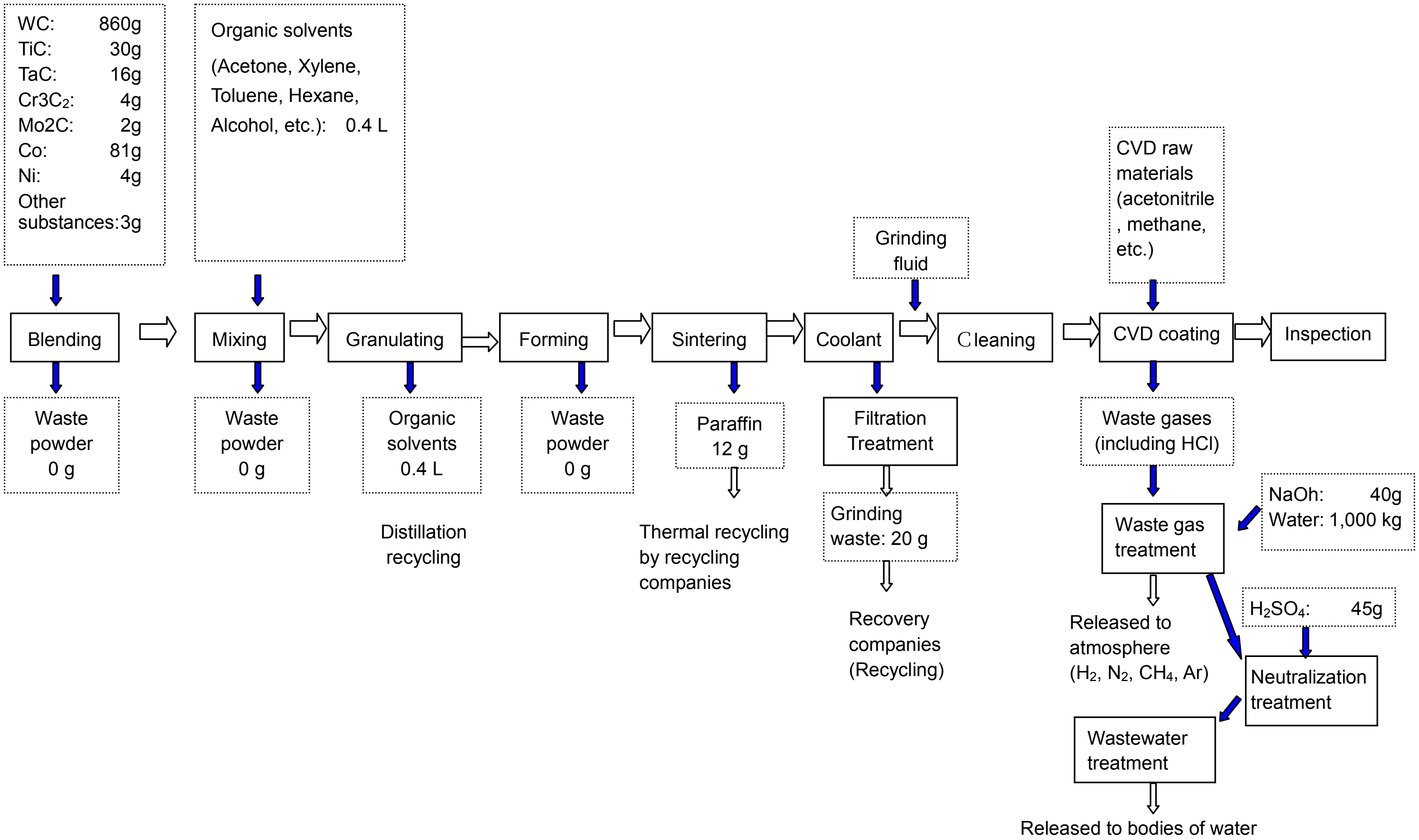
Cabinet Order Number	Designated Chemical Substances	Emission Factor for Designated Chemical Substance (wt%)			
		Products	Atmosphere	Bodies of water	Waste
68	Chromium (Cr)	95～100	0	2.0～0	5.0～0
346	Molybdenum (Mo)	95～100	0	2.0～0	5.0～0
100	Cobalt (Co)	95～100	0	2.0～0	5.0～0
231	Nickel (Ni)	95～100	0	2.0～0	5.0～0
12	Acetonitrile (CH_3CN)	99～100	0.5～0	0.5～0	0

2.1.7　Example of Calculations for the Inspection Process

In the event that any products are returned for reprocessing to a previous process, due to defects discovered during the inspection process or due to product returns, the quantities of designated chemical substances contained in these returned products shall still be subject to estimation and reporting of quantities released and transferred.

Attachment: Flow Chart for Cemented Carbide Manufacturing Process

Environment-related flow chart for coating indexable insert tools
(Manufacturing of CNMG120408 type inserts: unit in process: kg)



Attached Table 1　Chemical Substances Handled in the Cemented Carbide Tool Industry

Process	Usage	Name of Material Used	Class I Designated Chemical Substances						Remarks (○: subject to reporting) Confirmation via MSDS report
			Chemical Compound	%	Chemical Compound	%	Chemical Compound	%	
Blending	Raw Material	Tungsten carbide, tungsten							
		Titanium carbide (nitride)							
		Tantalum carbide							
		Chromium carbide	Chromium	86.7					○
		Molybdenum carbide	Molybdenum	94.1					○
		Niobium carbide							
		Cobalt	Cobalt	100					○
		Nickel	Nickel	100					○
		Carbon							
		Paraffin							
Turning process	Raw materials	Steel	Chromium	0.9	Manganese	0.6	Molybdenum	0.15	Examination not required (less than 1%)
Mixing	Solvents	Hexane							
		Xylene	Xylene	100					○
		Alcohol							
		Acetone							
		Toluene	Toluene	100					○
		Other organic solvents							
Grinding	Grinding	Coolant	Boron	0.3					Examination not required (less than 1%)
Cleaning	Cleaning	Water							
		Cleaning agent							
		Organic solvent							
Coating	Raw materials	Titanium tetrachloride							
		Aluminum							
		Hydrogen							
		Nitrogen							
		Argon							
		Acetonitrile	Acetonitrile	100					○
Wastewater treatment	Neutralization	Sulfuric acid							
		Sodium hydroxide							
		Calcium hydroxide							
		Sodium hypochlorite							

Reference Information

Definition of Cemented Carbide Tools

- The term “cemented carbide tools” is a collective name for tools that are made of cemented carbide materials. These tools include: cutting tools (accounting for approximately 70% of the entire production output of cemented carbide tools), wear resistant tools (25% of output) and civil engineering and construction tools (5% of output).

  Cutting tools: indexable tools and inserts, bits, cutters, end mills, drills, reamers, etc.
  Wear resistant tools: dies, die plugs, rolls, shearing tools, machine parts, etc.
  Civil engineering and construction tools: bit rods, load planers, concrete drills, etc.

Cemented carbides (cemented carbide tips) are manufactured through the powder metallurgy process using tungsten carbide (WC) as the primary raw material. They also utilize powdered cobalt (Co) that has high toughness, as a binder in this process. Powder metallurgy is a series of processes in which powdered metals (mixed) are formed and then sintered, in order to manufacture useful finished products.

Certain metals with high melting points, such as titanium carbide (TiC) and tantalum carbide (TaC), are added to the alloys for eventual usage in cutting applications, in order to increase the hardness of tips at high temperatures.

In recent years, it has become increasingly popular to apply various single or multiple coatings to indexable insert tips. These tip coatings may contain titanium carbide (TiC), titanium nitride (TiN), titanium carbide / nitride (TiCN) and special ceramic materials.

- The methods used to manufacture cemented carbide tools from cemented carbides, include the following:

  - Solid Tools: Tools that utilize cemented carbides for both the tip part and the main tool body (holder part)

  - Indexable inserts: Tools in which the insert tip can be mechanically mounted to the tool body. Whenever a tip wears out, it is replaced with another corner or the tip itself is changed, thus enabling continued tool operation.

- Brazed Tools: Tools in which the cemented carbide tip part is affixed to the steel body part with a brazed filler, such as silver solder or copper solder

- Shrinkage Fit Tools: Tools in which the case is first heated, in order to increase the inside diameter of the tip holder. Then the cemented carbide tip is inserted and becomes firmly fixed due to the differential shrinkage between the tip and the case, as the temperature returns to normal.