Enforcement of (1999)Law for PRTR (Pollutant Release and Transfer Register) and Promotion of Chemical Management

Japanese industrial sectors treating chemical substances have taken various steps to smoothly introduce the PRTR system in compliance with the PRTR Law for PRTR and Promotion of Chemical Management. Particularly, the Ministry of Economy, Trade and Industry held meetings to explain estimation methods to quantify the release and transfer of chemical substances and gathered information through questionnaires as part of the PRTR system and for environmental improvements. At the same time, each industrial sector participated in a working group to help prepare “manuals for estimating quantities of released and transferred chemical substances” and “outlines of industrial sector PRTR activities” in 1999 and 2000. Materials for these efforts were drawn from the various sectors’ comprehensive surveys of all processes and treated substances in their respective facilities and offices with the aim of preparing manuals that are “easy to understand and use.” Each sector is lending its particular expertise to the PRTR system to be implemented.

The following manuals have been prepared:

Under the Japan Chemical Industry Association working group:

(1) Automobile chemical manufacturing industry
(2) Adhesive tape manufacturing industry
(3) Fiber-reinforced plastic manufacturing industry
(4) Painting processes

Under the Society of Chemical Engineers, Japan working group:

(1) Paper industry
(2) Light metal product industry
(3) Metal heat treatment industry
(4) Automobile maintenance industry
(5) Hot-dip industry
(6) Electroplating industry
(7) Asbestos industry
(8) Cement fiberboard industry
(9) Iron casting industry
(10) Die casting industry
(11) Aluminum alloy manufacturing industry
(12) Can manufacturing industry
(13) Valve manufacturing industry
(14) Laundry & dry cleaning industry
(15) Industrial cleaning industry
(16) House manufacturing industry
(17) Non-ferrous metal foundry industry
(18) Aircraft maintenance industry

These manuals and other existing manuals will constitute PRTR materials that are as important as the overseas manuals. We hope they will be utilized when industrial sectors address the issue, and that understanding of chemical substances and estimation of quantities of released and transferred chemical substances will improve. We also hope that chemical substance management in Japan will provide an exemplary model for other

countries.

Finally, we sincerely appreciate the assistance of the many people involved in the preparation of these manuals.

March 2001
The Society of Chemical Engineers, Japan

Summary of “Manuals for Estimating Quantities of Released and Transferred Chemical Substances” (Compiled by Type of Industry and Process)

Having been consigned with the task by the Japan Small and Medium Enterprise Corporation, the Society of Chemical Engineers, Japan promoted support of “manuals for estimating quantities of released and transferred chemical substances” prepared by industrial sectors other than the chemical industry in accordance with the “Pollutant Release and Transfer Register (PRTR) Law” to be enforced on April 1, 2001. The aim has been to ensure a smooth introduction of the system whereby individual companies themselves estimate quantities of released chemical substances and register them with government agencies.

In consideration of the fundamentals of chemical material release management, manuals on estimating quantities of released and transferred chemical substances voluntarily prepared by each industrial sector and easy to understand and use had long been awaited. The Japan Chemical Industry Association promoted the preparation of such manuals for the chemical industry and the Society of Chemical Engineers, Japan for other industries. Working groups were organized in which individual industrial sectors participating in preparing manuals. Their activities can be summarized as follows:

(1) Surveys on the need for estimation manuals, such as PRTR pilot business manuals, were conducted by holding explanatory meetings and gathering information using questionnaires.
(2) Business sectors that provided opinions, proposals or questions in their responses to the questionnaires or sectors that had various requirements with respect to other existing estimation manuals were asked to prepare the manuals.
(3) A manual preparation working group (WG) committee was established in each sector that expressed intention to participate in a working group, consisting of technical specialists and experts in each business field.
(4) Experts from the Society of Chemical Engineers, Japan and industrial sectors promoted preparation of manuals with respect to chemical material management in industrial sectors that did not have sufficient expertise of chemical substances and their characteristics and behavior. These manuals were prepared by referring to estimation manuals of quantities of released chemical substances in Japan and overseas, and also by taking into consideration various options and requirements.

(5) The Japan Chemical Industry Association promoted the preparation of such manuals for the chemical industry and the Society of Chemical Engineers, Japan for other industries.

As shown in the table attached to this report, two working groups representing twenty-two industrial sectors were established to promote the preparation of estimation manuals concerning quantities of released and transferred chemical substances.

Expert committees developed drafts and committee members examined and discussed them with the participation of individuals from universities and businesses as well as relevant staff from the Ministry of Economy, Trade and Industry (as observers).

In consideration of the actual means of estimation, the working groups promoted preparation of the manuals as follows:

(1) Preparation of process diagrams clearly showing environmental release points (chemical substance release points)
(2) Creation of a list of used Class I designated chemical substances and examination of used quantities
(3) Confirmation and standardization of released and transferred quantities and estimation methods
(4) Provision of calculation examples

Establishing appropriate estimation as the central focus, the working groups aimed to avoid complicated work and to make the manuals as easy to use as possible for small- and medium-sized companies. Using the manuals compiled by these working groups, individual industrial sectors are disseminating the PRTR system to companies under their control targeting the end of March 2001. As for industrial sectors that were preparing their own estimation manuals without forming a working group in concert with the Society of Chemical Engineers, Japan, which have significant influence on their related peripheral industrial sectors, we asked them to provide explanations to the working group committee of quantities of released and transferred chemical substances and discussed their estimation manuals when they accepted our requests.

We believe that knowledge focusing on the processes of the various sectors and more quantitative approaches with respect to the chemical industry enabled us to compile manuals that are easy to use and understand. Continuous efforts are expected to be made to further improve the manuals.

The “manuals for estimating quantities of released and transferred chemical substances” for twenty-two industrial sectors and processes are summarized below.

Main Points of Manuals by Business Type and Process

1. Paper Industry

Paper pulp is made from woodchips and recycled wastepaper through chemical and mechanical treatment. Acrylamide is used as a pulp coagulating agent, NN-dimethylformamide as an antiseptic agent, ethanolamine and glyoxal for specialty papers, and toluene as a solvent.

The estimation method uses calculation in which the identified quantities of designated chemical substances are subtracted from the used quantities, and the difference is considered as the released and transferred amounts to water or air.

2. Light Metal Product Industry

The manual was prepared focusing on coloring through the process of aluminum surface treatment. Nickel compounds and boron are released and transferred through the processes of anodic oxide coating and composite coating. Hexavalent chromium is released and transferred through the process of chromate treatment.

Released quantities are estimated based on concentration analysis values and material balances.

3. Metal Heat Treatment Industry

Degreased and washed products and components undergo salt bathing and heat treatment. Dichloromethane, tetrachloroethylene, and trichloroethylene are released through the processes of degreasing and washing. Inorganic cyanide or barium and its water-soluble compounds are released through the salt bath and heat treatment processes.

Released quantities are estimated based on concentration analysis values and material balances. The concentration of chlorinated organic solvent contained in waste was fixed by using an emission factor based on measurements.

4. Automobile Maintenance Industry

The main processes are recovery of coolants (LLC), filling, and maintenance of air conditioner refrigerant (CFC-12). For LLC recovery and filling processes, ethylene glycol is regarded as a regulated waste (transfer). For maintenance of air conditioner refrigerant, dichlorodifluoromethane is regarded as a regulated waste (released to air).

Basically, emission factors based on empirically obtained values of the industrial

sector are used to estimate the released quantities.

5. Hot-Dip Industry

Materials to be galvanized undergo degreasing and pickling (oxide is removed from their surfaces), fluxing, and dipping in a molten zinc bath after drying. Zinc chloride, zinc sulfate, etc. are released through the processes of pickling and fluxing treatment. Hexavalent chromium compounds are released through the chromate treatment process. Lead is released through hot-dip galvanizing.

Released quantities are estimated based on concentration analysis values and material balances.

6. Electroplating Industry

Materials to be plated undergo processes of degreasing, washing in water, pickling, electrolytic cleaning, acid activation, plating, washing in water, and chromate treatment. Trichloroethylene, dichloromethane, tetrachloroethylene, inorganic cyanide, hydrogen fluoride and its water-soluble chlorine, boron and its compound are released through pretreatment processes. Water-soluble compounds of zinc, copper water-soluble chlorine, hexavalent chromium compounds, nickel compounds, chromium and trivalent chromium compounds, lead and its compounds, and silver and its water-soluble compounds are released through plating processes.

Estimation of released quantities are based on measurements.

7. Asbestos Industry

There are processes for sheet forming extrusion for construction material products, asbestos joint sheets, and brake linings. The quantity of asbestos released to air was calculated. In the case of bag opening and mixing dust collectors, it was 0.001 mg/m^3. In the case of dust collectors other than bag opening and mixing ones, it was 0.002 mg/m^3.

Emission factors based on empirical values of the industrial sector are used to estimate released quantities.

8. Cement Fiberboard Industry

As part of the sheet forming process in the production of slag gypsum boards and pulp cement boards, polyoxyethylene alkylether is used as an antifoaming agent, polyoxyethylene nonyl phenyl ether as a mold releasing agent, and acrylamide as a high molecular coagulant.

The quantity of asbestos released into the air is calculated in accordance with manuals compiled by the Asbestos Association. Quantities of released antifoaming agents and mold releasing agents are estimated based on actual measurements using waste

management data.

9. Iron Casting Industry

The process involves melting and casting pig iron to produce casting products. Mn, Cr, Ba, Ni, and Mo are released through the melting process. Phenol, and 1, 3, and 5 trimethylbenzene are released through the casting process. Baking of molding sand causes the release of organic substances, but they are excluded from this quantity estimation.

Emission factors are used to estimate released and transferred quantities.

10.Die Casting Industry

Zinc alloy and aluminum alloy are melted and cast (using die casting machines). Zinc chloride, and hydrogen fluoride are released through the melting process. Mold releasing agents containing alkylbenzene sulfonate, 1, 2 epoxypropane, poly(oxyethylene) alkylether, poly(oxyethylene) octylphenyl ether, and poly(oxyethylene) nonyl phenyl ether are used during the casting process.

Emission factors are used to estimate the released quantity.

11. Aluminum Base Alloy Manufacturing Industry

Aluminum alloys (Mn, Be, Ni, and Cr) are melted and refined. Mn and Be are released through the melting process.

Emission factors are used to estimate released quantities.

12. Can Manufacturing Industry

For cans of a capacity of 18 liters or less, mainly 3-piece cans and 2-piece cans for beverages, are manufactured. Paints containing ethylene glycol monoethyl ether, solvents such as xylene, surface preparation agents such as hydrogen fluoride compounds and polyoxyethylene, and zinc chloride for soldering are used.

Estimation methods are mainly based on actual measurements, and the difference from the used quantity is considered as the quantity released to water or air.

13. Valve Manufacturing Industry

Material alloys are melted and poured into molds to manufacture valves of various types. Pb, Se, Mn, Cr, Mo, and Ni contained in materials, aldehyde phenol in the casting process, dichloromethane for degreasing and washing xylene, chrome for plating, and B, Ni, and Cu, contained in solvents for paints are released.

Emission factors based on measurement are mainly used for the estimations.

14. Laundry & Dry Cleaning Industry

Cleaning processes consist of dry cleaning and laundry. Dry cleaning equipment is sealed and equipped with solvent recovery devices. Used detergents (surface active agents) such as polyoxyethylene, linear alkylbenzene sulfonate, etc. are released. Chlorinated organic compounds to be used for solvents and xylene are released, including those adhering to products.

It is difficult to determine the rate of wastewater treatment because the transferred quantity is larger than the released quantity, but the emission factor is fixed based on reports, literature, etc.

15. Industrial Cleaning Industry

Equipment and machines for electronic-related industrial use are cleaned. Cleaning agents are roughly classified into water, chlorinated compounds, fluorine compounds, quasi-water, and hydrocarbon according to cleaning methods. Chemical compounds consist of polyoxyethylene used as a solvent detergent, 2-aminoethanol and boron used as rust-preventive agents, chlorinated or fluoridated organic compounds, and toluene and xylene used as solvents.

Estimations are based on used quantities after confirming the measured quantities of release and transfer. The working group determined factors based on the industry's data on content and the solubility necessary for an accurate estimation of quantity of release.

16. House Manufacturing Industry

Factories' production processes for components and materials for houses consist of painting, adhesion, coating, welding, and rot proof. Solvents such as toluene and xylene are used for painting, Mn, Ni, and Zn are used for pigments, and dichloromethane and di-n-butyl phthalate are used for adhesion.

The released quantity is estimated by applying the difference between determinate factors and total released quantity to air or water.

17. Nonferrous Metal Foundry Industry

The process is to produce copper alloys (bronze and brass) by melting and casting. Boron and its compounds, phenol, and 1.3.5-trimethylbenzene are released through the melting. Phenol is released through the casting process.

The estimation method is mainly based on emission factors.

18. Aircraft Maintenance Industry

Preparation work for aircraft frames includes painting, washing, and sealing, and degreasing, plating and cleaning for equipment and materials and washing shell plates in

water. Mn and Cr are used as stiffeners; Cr, Cd, Ni, and cyanide as plating materials; toluene as a solvent; and polyoctyl phenyl ether as a detergent.

Material balance estimation is generally used.

19. Automobile Chemical Manufacturing Industry

Chemical products for automobiles refer to chemical products used in automobile manufacture, and comprise various kinds of products with functions related to the running, safety, and maintenance of automobiles. Various methods are used in their manufacture.

We discuss engine antifreeze coolants, motor vehicle brake liquid, and polishing wax for automobiles (including coating agent and polish for washing cars), of which there are three forms (solid, paste, and liquid). These products use large amounts of Class I designated chemical substances. Model manufacturing processes are shown for individual materials. Estimation of the released and transferred quantities of PRTR designated chemical substances in the production process is also shown. A method of estimating the released and transferred quantities of chemical substances involved in daily operation and natural phenomena is used. Released and transferred quantities of chemical substances when opening tanks for periodical checking, and released and transferred quantities caused by problems are also estimated for reference.

Estimation of the released and transferred quantities includes engineering calculations, actual measurements, and the emission factors that can be applied to certain release and transfer spots, and the estimation method is shown. There are also other spots where engineering calculations cannot be applied at present, for example, places where there is no measurements available or emission factors, or, in other words, places where released and transferred quantities cannot be grasped. We will endeavor to establish precise estimation methods for released and transferred quantities–for example, to identify released and transferred quantities by obtaining values measured by individual companies–in cases where there is no effective way to obtain calculated figures. For the time being, we will collect the weights of obtained released and transferred quantities by item, such as air, water, soil, and waste, according to the designated form of reporting. Furthermore, the release and transfer ratios of respective air, water, soil, and waste will be estimated using the collected released and transferred quantities. At the same time, reduced portions obtained from “material balance” will be considered as the total released and transferred quantities, and divided proportionately. The results of these calculations will be reported in a prescribed form.

20. Adhesive Tape Manufacturing Industry

Aiming to prepare a manual for common use focusing on painting processes, eight member companies of the Japan Adhesive Tape Association, which consists of 20

adhesive tape manufacturers, started a WG and compiled the calculation manual after discussion in a WG committee.

The general manufacturing process for adhesive tapes is: (1) to manufacture or purchase adhesives, under-coaters, reverse-side treatment agents, etc.; (2) to use these to coat tape substrate, to dry and remove solvents, and roll them up; and then (3) to cut them to the required width and package them.

When released into the environment, target chemical substances in the solvents contained in the reverse-side treatment agent, under-coats, and adhesives are volatilized (dissipated) in the air, solvents from solvent recovery equipment are mixed into wastewater, and waste fluid generated through the coating process is transferred.

There is also transfer of target chemical substances generated due to losses in the coating, rewinding, and cutting processes (liquid and solid) other than solvents used as substrate, reverse-side treatment agents, under-coats, and adhesives.

Process diagrams of solvent ingredients and solid ingredients are shown to enable calculation with individual calculation sheets.

21. Fiber-Reinforced Plastic Manufacturing Industry

Fiber-reinforced plastic is made of composite materials using glass fiber as reinforcement and radical curing type resins such as unsaturated polyester resin and vinyl ester resin as matrices. The production of fiber-reinforced plastic products requires registration of the released quantity under the PRTR Law.

Seven target materials, which are presumed to be related to composite materials, are included. It seems that there are several FRP manufacturers that will be obligated to register the released quantity in and after April 2002. Manuals were prepared in the hope of being useful to such manufacturers. We devised an estimation formula for transferred and released quantities mainly for styrene (hereinafter called SM), which is an important main raw material as a cross-linking agent for unsaturated polyester resin and vinyl ester resin. We also developed an estimation formula for methyl metacrylate (hereinafter called MMA) and toluene in the same way with the SM method. However, MMA was regarded as being included only in gelcoat.

Classification in 27 types according to molding method and equipment is shown. Emission factors are calculated by using individual conditions and their rates of content of SM or MMA resin or gelcoat.

22. Painting Process

A working group (WG) was established by nine organizations that made proposals or requirements about the “painting process” following questionnaires for a needs survey. After discussion, the WG Committee compiled a manual for common use.

The “painting process” is a unit process that exists in various types of businesses,

although there are a wide variety of methods in this process. We focused on “spray painting,” which is the most common requirement.

We tried to show as many estimation examples as possible, to make the estimation of actual released and transferred quantities effective. Although the purpose of painting is to form a paint film on the surface of painting substrates to protect them and make them attractive, we can also add other special functions. There are various methods of painting, but today spray painting is mainly used for industrial painting.

“Spray painting” consists of painting work and work drying the paint films. Paints used during the painting process are diluted with solvents. A solid portion of paints is sprayed on painting substrates to form a paint film. The quantity of target chemical substances used is calculated based on the composition of paints and thinner, and composite contents are grasped based on MSDS, etc.

The painting method used during painting operation depends on the shape, size, material, and quantity of the painted object. The “painting efficiency” differs according to such operational conditions. Furthermore, the ratio of the quantity of the coating film formed on the painted object to the quantity of the paint sludge generated from overspraying, also differs.

In “spray painting” within a painting booth, most of the solvents of painting films are diffused in the air and the solid portion of oversprayed paints remains in the circulating-fluid tank of the painting booth as paint dross. Dilution solvent is volatilized in the air and a portion of the solvents is released to air due to drying of paint films. Some of them are removed by deodorizing equipment. Overspray causes wastewater released from circulating-fluid tank of painting booths into an aquatic environment or waste fluid at the time of exchange of fluid. Paint sludge becomes industrial waste and a portion is incinerated.

Remaining paints and cleaning solvents are recovered and processed by the companies that use them or by external recovering companies.

The WG made it possible to make estimations with reference to calculation examples because painting work and transfer efficiency vary depending on the industrial sector.

Users of this manual should fully take into consideration the unique situation of their own business type, because the position and background of “painting processes” vary significantly depending on the business type.

The manual provides a basic means of estimating the released and transferred quantities by using 3 sheets: a flow sheet for calculation of released quantities through the painting process, work sheet (1), and work sheet (2).

The numbers described in the work sheet (1), work sheet (2), and estimation examples and examples of entry mentioned later correspond with the line numbers. We have tried to use the same line numbers throughout the materials.