PWMI Newsletter

NO 26 2003.9

Plastic Waste Management Institute
JAPAN

Plastic Products, Plastic Waste and Resource Recovery [2001]

Background information and notes on the publication of the Flowchart of Plastic Products, Plastic Waste and Resource Recovery(2001)

The Plastic Waste Management Institute conducts annual surveys on matters related to plastic waste. These include a questionnaire-based survey on amount of recycling, a survey on the amount of plastic waste discharge, a survey directed toward local governments on municipal solid waste management, and a survey on industrial waste management. The results of these surveys are combined and published as the Flowchart of Plastic Products, Plastic Waste and Resource Recovery. This flowchart is published annually and provides quantitative information on the macro flow of plastic production in Japan, its manufacture into products, and its use and disposal, as well as resource recovery and disposal processing of plastic waste.

Please note that the quantities shown in the flowchart are the result of statistical processing performed by the Plastic Waste Management Institute based on statistical data and replies to questionnaires.

Discovered in the 20th century, plastic is a relatively new material. It has been used to develop a wide variety of products in Japan spanning more than 100 registered categories in Japanese Industrial Standards (JIS). Its multifunctionality, processability, moldability, and lightness make it applicable to a wide variety of needs that cannot be met by traditional materials like metal, wood, and glass. Plastic has played an important role in the creation and growth of new industries. Resin production in 2001 came to about 160,000 thousand tons worldwide and 14,000 thousand tons in Japan.

At the same time, there is serious concern that rapid expansion of unrestrained economic activities could destroy natural cycles on a global scale. In response to this problem, plans for achieving sustainable development in modern society were presented at the United Nations Johannesburg Summit 2002.

Important features of plastic such as weather resistance, corrosion resistance, durability, and lightness are actually a major cause of dwindling landfill space when discharging plastic directly. The generation of dioxins when incinerating plastics has also posed a major environmental problem although technical solutions to this problem are close at hand.

The year 2000 saw the drafting and enacting of various laws toward the formation of a recycling-oriented society and 2001 marked significant steps toward their full implementation. A variety of plastic recycling techniques have come to be developed and expanded in the areas of material recycling (MR), chemical recycling (CR), and thermal recycling (TR). There has also been much activity toward the 3R's (reduce, reuse, recycle) at the design stage of plastic products including the streamlining of plastic grades, reduction in weight, and labeling of material type.

The use of plastic can make products smaller and lighter. The pliability of plastic can also reduce energy consumption when manufacturing products, and the long life of plastic products can help preserve resources. There are many cases in

which the use of plastic materials in itself has given rise to highly efficient products using less resources and less energy. Recognizing that plastic can be a vital material in the quest for sustainable development, it should make even more contributions to society in the future.

2001 Highlights

(1) Plastic utilization rate reaches 53%.

(2) Steady expansion of recycling due to the Containers and Packaging Recycling Law and increased capacity for incineration with power generation under local governments results in a year-on-year increase of plastic recycling in the areas of MR (+ 80 thousand tons), CR (+ 110 thousand tons), and TR (+ 230 thousand tons).

(3) Export of scrap plastic expands.

At 13,880 thousand tons, resin production in Japan in 2001 actually decreased by 860 thousand tons from the previous year. Total plastic waste discharge, however, showed an increase of 200 thousand tons from 2000 reaching 10,160 thousand tons. Since total plastic waste discharge includes the discharge of products used in the past, it can be seen that the percentage of total discharge associated with plastic-product consumption in the current year has decreased. Industrial waste in 2001 was about the same as the previous year at 4,890 thousand tons while municipal solid waste increased by 200 thousand tons to 5,280 thousand tons. Most of this increase is attributed to containers and packaging.

Utilized plastic waste increased by 410 thousand tons from the previous year to 5,350 thousand tons or 53% representing a steady year-on-year increase. In material recycling, post-use products accounted for 600 thousand tons, an increase of 900 thousand tons from the previous year, with PET bottles at 178 thousand tons (+ 53 thousand tons), expanded polystyrene (including trays) at 76 thousand tons (+ 2 thousand tons), and pipes and joints at 16 thousand tons (+ 1 thousand tons). These increases reflect the smooth operation of respective recycling systems run by businesses and associations. The export of scrap plastic is increasing jumping 90 thousand tons to 390 thousand tons as international recycling systems continue to form centered on China. In chemical recycling, a variety of systems are expanding steadily including the use of plastic waste as raw material for liquefaction and gasification and as blast furnace raw materials and coke-oven chemical materials. In chemical plants, decomposed gas is applied to the production of ammonia, and in steel plants, plastic waste is used for blast furnace reduction, as coke-oven chemical materials, and for gasification. Finally, in thermal recycling, plastic waste is used as cement kiln fuel in cement plants, and under local governments, incineration with power generation has reached a capacity of 1,180 thousand KW (from last year's 106 KW). Upgrading of incinerators and increasing of generator capacities can be seen in response to stronger dioxin emission standards that began in December 2002.

Explanation of flowchart items

(1) Resin production, resin processing, and marketing of products

1-1 Resin production

This figure was determined on the basis of chemical-industry statistics from the Ministry of Economy, Trade and Industry (METI).

1-2 Reclaimed products

For convenience sake, the figure used here as input is that of material recycling from the previous year taking figures for export and import of plastic waste into account (Ministry of Finance, trade statistics).

1-3 Domestic plastic products consumption

· (Domestic plastic products consumption) = (Resin production) - (Resin export) + (Resin import) - (Liquid resin, etc.) - (Resin processing waste) + (Reclaimed products) - (Product export) + (Product import)

· Resin export and import figures are based on trade statistics from the Ministry of Finance.

· Figures for liquid resin, synthetic fiber, etc. that fall outside plastic waste discharge are based on chemical-industry statistics from the Ministry of Economy, Trade and Industry.

· Figures for plastic product export and import are based on trade statistics from the Ministry of Finance.

· Figure for processing waste considers discharged waste from the processing step that is not turned into products.

(2) Discharge

2-1 Industrial waste and municipal solid waste

· Industrial waste is waste generated by business activities as defined by the Waste Disposal and Public Cleansing Law, and includes ashes, sludge, waste oil, waste acid, waste alkali, and waste plastic. Its disposal is generally the responsibility of the party that generates the waste. Municipal solid waste is waste other than industrial waste and its disposal is mainly handled by local governments.

2-2 Post-use products discharge

· This figure is determined by an estimation system developed by PWMI based on usage quantities by demand-generating fields and by resin type (usage quantities have been calculated annually for the last 15 years) and on product lifetimes by demand-generating fields (using a PWMI discharge model for the last 15 years).

· Considering that the export/import of new and used automobiles affects the amount of domestic plastic waste, corrections have been made to amounts of reclaimed products and discharge in the transportation field.

· Discharge ratios for municipal solid waste and industrial waste have been estimated using a PWMI discharge model for demand-generating fields.

2-3 Production and processing waste discharge

· Amount of production waste is not included in amount of resin production, and amount of processing waste is extrapolated from the results of questionnaires.

2-4 Total plastic waste discharge

· This figure is the sum total of post-use products discharge and production and processing waste discharge.

2-5 Breakdown of total plastic waste discharge by resin type

· These breakdown figures were estimated from amounts for post-use products discharge, production and processing waste discharge, breakdown of resin production, etc.

(3) Disposal and recovery

3-1 Material recycling

· All material recycling figures and breakdowns are extrapolated from the results of questionnaires sent to recycling companies.

· "Recycled material" indicates pellets, flakes, fluff, blocks, and ingots, while "recycled products" refer to film sheets, stakes, pipes, etc.

3-2 Densified-refuse derived fuel, liquefaction, gasification, blast furnace raw material

· Figures for liquefaction, gasification, and use of plastic waste as blast furnace raw materials and coke-oven chemical materials approved as product recycling procedures by the Containers and Packaging Recycling Law have been determined on the basis of bids announced by the Japan Containers and Packaging Recycling Association and results of questionnaires.

· The figure for densified-refuse derived fuel includes energy recovery as cement kiln fuel and by incineration with power generation.

3-3 Disposal and recovery of municipal solid waste

· Incineration/landfilling ratio

This ratio is determined on the basis of past surveys conducted by PWMI.

· Incineration with power generation

This figure refers to incineration processing by an incinerator equipped with power-generation facilities in waste processing conducted by local governments. The ratio shown is determined by PWMI surveys based on data published by the Ministry of the Environment.

· Incineration with heat utilization facility

This figure refers to incineration processing by an incinerator that, while not equipped with power-generation facilities, has external facilities for utilizing heat. The ratio shown is determined on the basis of PWMI surveys.

3-4 Disposal and recovery of industrial waste

· Disposal and recovery of industrial waste is partially commissioned to local governments as business-related waste. The ratio of such processing by business to that commissioned to local governments is determined on the basis of PWMI surveys. The percentage breakdown of commissioned processing into incineration with power generation, incineration with heat utilization facility, incineration without power generation or heat utilization facility, and landfilling is based on figures for municipal solid waste processing.

· The incineration/landfilling ratio in the processing of industrial waste is based on the results of PWMI surveys.

· The ratios for energy recovery such as power generation in incineration handled by industrial waste management contractors are based on the results of PWMI surveys.

· Incineration with heat utilization facility

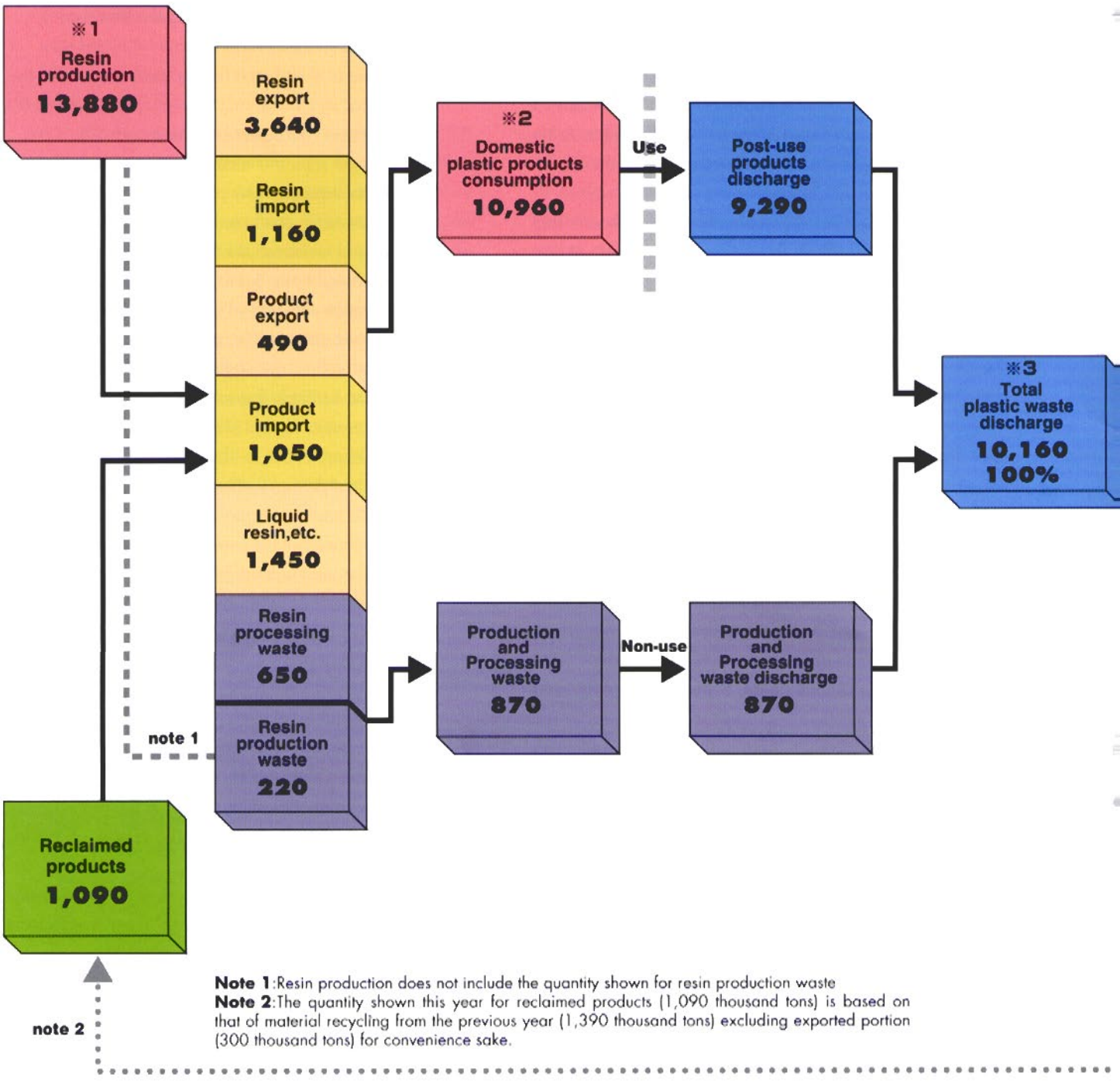
Ratios for heat utilization in industrial-waste incineration processing by local governments and industrial waste management contractors are based on the results of PWMI surveys.

Flowchart of plastic products, plastic waste and resource recovery

2001

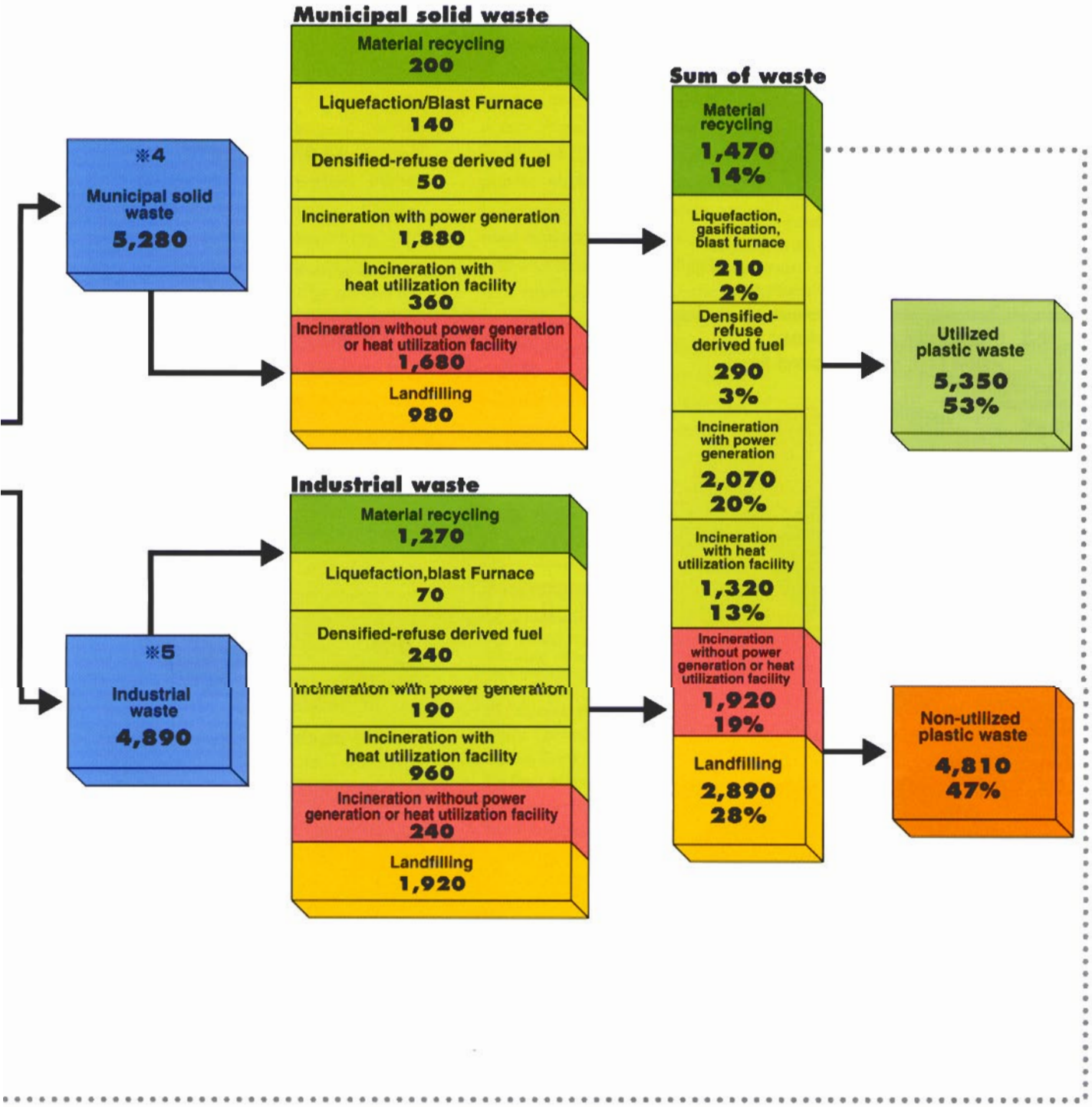
[Unit; thousand tons]

Resin production, resin processing, and marketing of products | **Discharge**



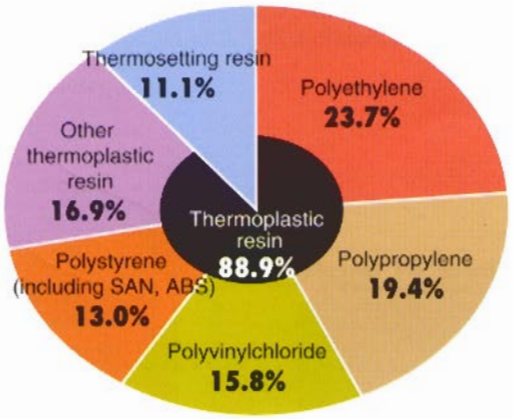
Note 1:Resin production does not include the quantity shown for resin production waste
Note 2:The quantity shown this year for reclaimed products (1,090 thousand tons) is based on that of material recycling from the previous year (1,390 thousand tons) excluding exported portion (300 thousand tons) for convenience sake.

Disposal and recovery



Details of flowchart elements

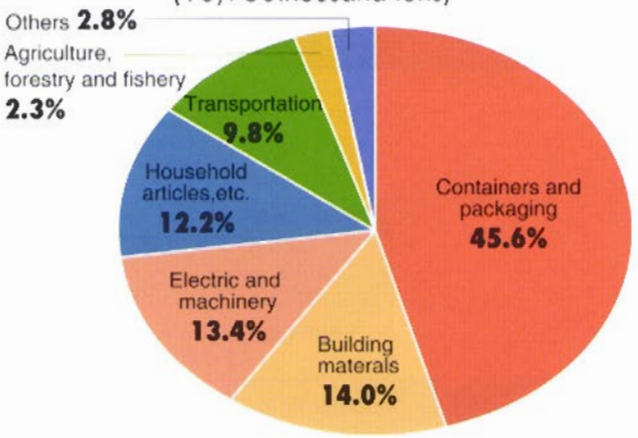
※1 Breakdown of resin production (13,880 thousand tons) by resin type



(Source: METI chemical-industry statistics)

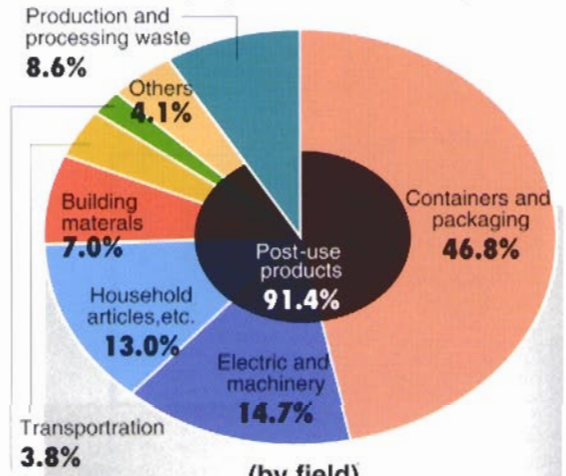
For convenience sake, the other 1.4% of resins not categorized as thermosetting resin or thermoplastic resin is included in "other thermoplastic resin."

※2 Breakdown of resin products by field (10,960thousand tons)

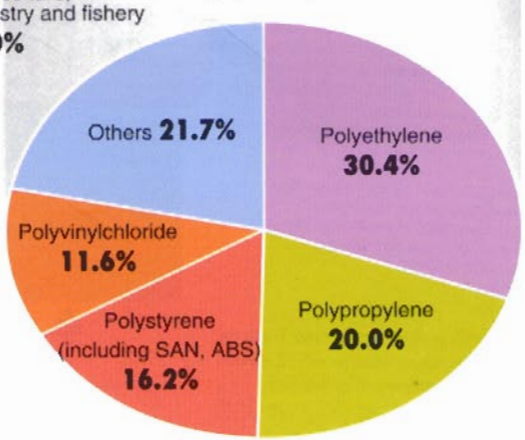


(Source : Estimations by related organizations.)

※3 Breakdown of total plastic waste (10,160 thousand tons)



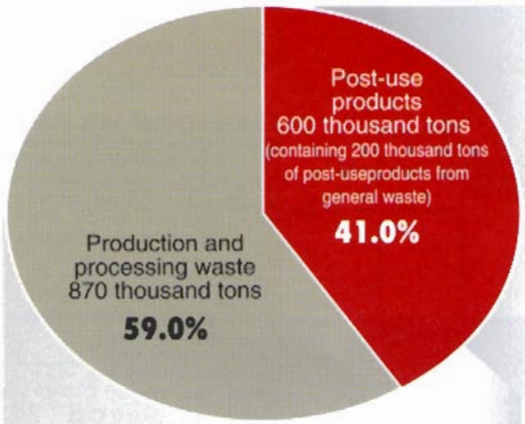
(by field)



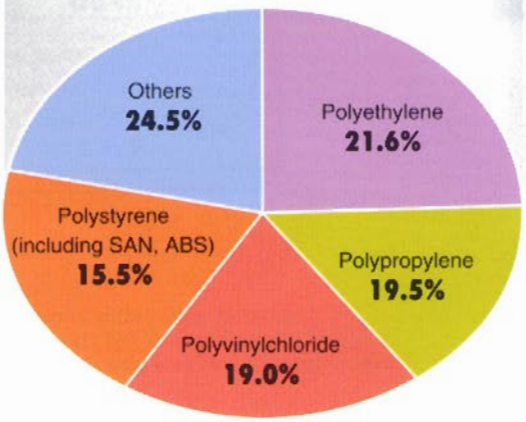
(by resin type)

※6 Breakdown of material recycling (1,470 thousand tons)

● Breakdown of material recycling resources

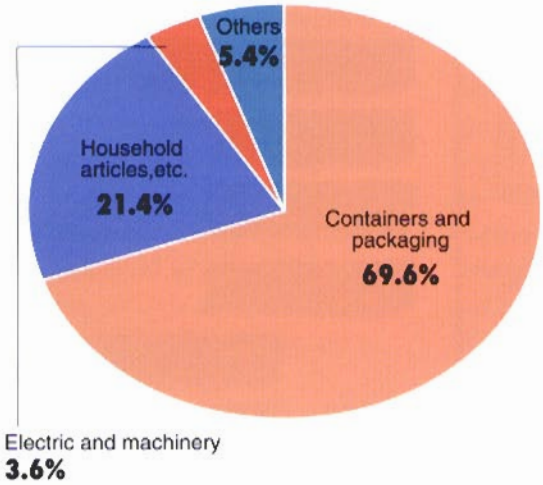


(by discharge type)

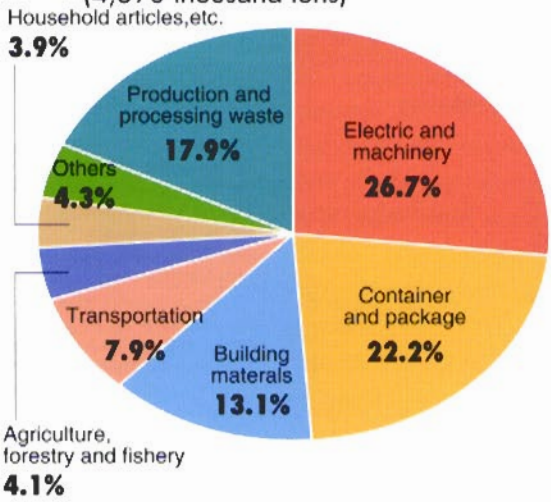


(by resin type)

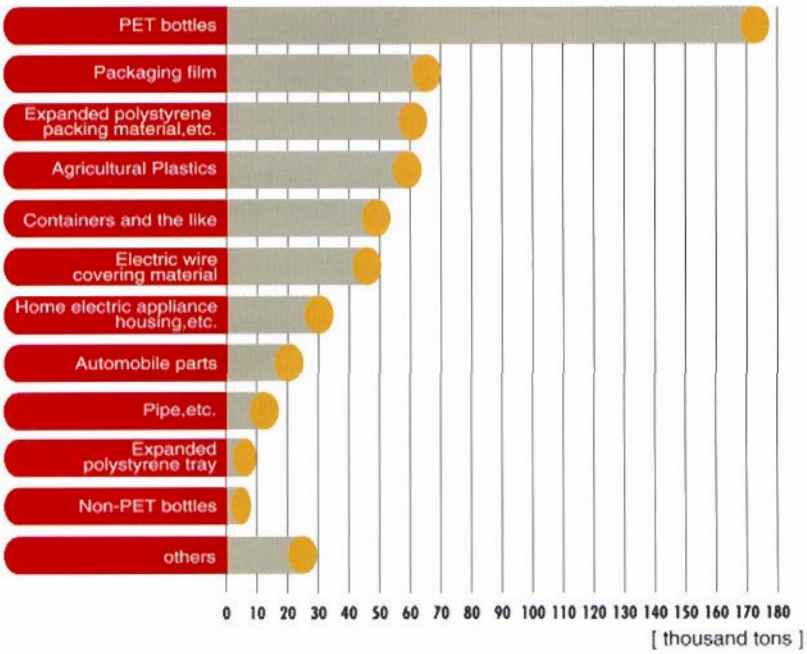
※4 Breakdown of municipal solid waste by field (5,280 thousand tons)

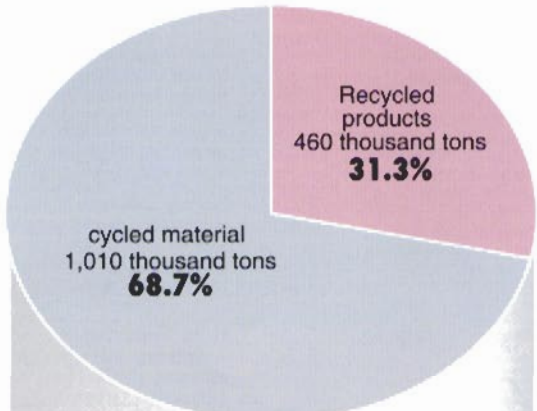


※5 Breakdown of industrial waste by field (4,890 thousand tons)

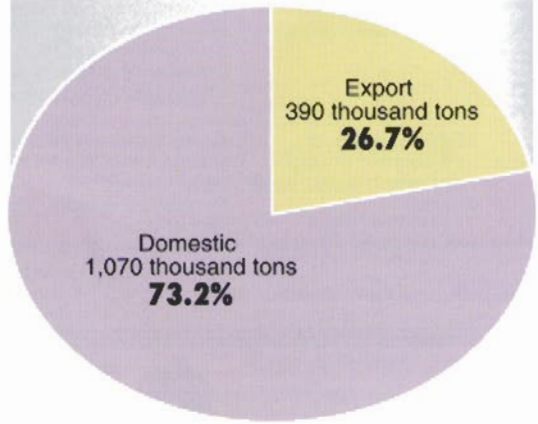


○ Breakdown of post-use products for material recycling (600 thousand tons)





(by type of reclaimed products)



(by destination of recycling use)

Plastics production and waste discharge

Year	Resin production	Domestic plastic products consumption	Total plastic waste discharge	Municipal solid waste		Industrial waste	
	1,000 t / year	1,000 t / year	1,000 t / year	1,000 t / year	%	1,000 t / year	%
1975	5,170	3,150	2,610	1,470	56	1,140	44
1980	7,520	5,520	3,250	1,780	55	1,470	45
1985	9,230	6,990	4,190	2,320	55	1,870	45
1986	9,370	7,300	4,530	2,500	55	2,030	45
1987	10,030	7,920	4,650	2,600	56	2,050	44
1988	11,020	8,610	4,880	2,760	57	2,120	43
1989	11,910	9,570	5,060	2,910	58	2,150	42
1990	12,630	9,990	5,570	3,130	56	2,440	44
1991	12,800	10,070	6,220	3,450	55	2,770	45
1992	12,580	9,280	6,920	3,910	56	3,010	44
1993	12,250	9,020	7,560	4,190	55	3,370	45
1994	13,040	9,660	8,460	4,230	50	*4,230	50
1995	14,030	9,790	8,840	4,430	50	4,410	50
1996	14,660	10,810	9,090	4,550	50	4,540	50
1997	15,210	11,360	9,490	4,780	50	4,710	50
1998	13,910	10,200	9,840	4,990	51	4,850	49
1999	14,570	10,810	9,760	4,860	50	4,900	50
2000	14,740	1,0980	9,970	5,080	51	4,890	49
2001	13,880	1,0960	10,160	5,280	52	4,890	48

* The method for making estimations was changed in 1994 so that non-use resin production and processing waste would be added to the figure for industrial waste.

Change in Utilized Plastic Waste by Amount and Rate Over Time

Year	1990	1995	1996	1997	1998	1999	2000	2001
Utilization amount (thousand tons)	1,440	2,210	3,580	3,990	4,350	4,520	4,940	5,350
Utilization rate(%)	26	25	39	42	44	46	50	53

Please see the PWMI Web site for detailed data on the production, discharge, reuse, and disposal of plastic products.

Introduction To PWMI

Goals and Tasks

The Plastic Waste Management Institute (PWMI) originally began as the Plastic Management Research Association in November 1971, and received its current name in July 1972 as a result of expanded operations.

The goals of PWMI are to research and develop systems for optimal processing of plastic waste and effective use of processed waste as a resource, and to promote the use of these systems.

To accomplish these goals, PWMI performs a wide variety of tasks. These include researching and developing technologies for using plastic waste effectively, performing model experiments, disseminating technologies, conducting research surveys, publicizing the work of PWMI, and providing loan guarantees to recycling ventures.

Activities

Ongoing R&D, Surveys, and Public Relations

Since its founding, PWMI has been engaged in various activities related to plastic waste. These range from the development of processing and recycling technologies to the surveying of discharge amounts and waste-processing conditions and publicity work to raise the level of consciousness regarding the processing and recycling of plastic waste. PWMI has also implemented a loan guarantee system to promote the growth of the plastic-waste recycling business. The main activities at PWMI are presented below in the section titled "Operations (1971-2002)." For the future, PWMI plans to continue its work on plastic waste through activities of this nature.

Responding to New Challenges

Over the last 10 years, waste problems have become increasingly severe and social concern for dealing with these problems through recycling has been growing. Against this background, PWMI has placed much importance on the smooth enactment and implementation of the Containers and Packaging Recycling Law in Japan, and has undertaken the development of recycling technologies indispensable to this end. These include the use of plastic waste as raw material for liquefaction and gasification and as blast furnace fuel. Social conditions with regard to waste handling have, in fact, been changing dramatically in recent years. For example, the movement toward a recycling-oriented society characterized by the 3R's (reduce, reuse, recycle) has gained momentum, and laws related to the recycling of home appliances, construction materials, and automobile such as the Basic Law for the Promotion of a Recycle-based Society have been enacted one after another.

To respond to these changing conditions, PWMI will promote activities that contribute to the formation of a recycling-oriented society through the use of plastic. These activities will include the development of recycling technologies in relation to plastic waste discharged from home appliances and automobiles, the survey of plastic waste generated when dismantling houses, and the provision of plastic-recycling educational materials for elementary and middle school students. PWMI will also expend efforts on proposing systems that include thermal recycling to promote the smooth reuse of resources and energy.

Finally, in response to rapidly growing concern for people's health and safety, PWMI will continue to inform the general public that plastic is a highly safe material even during waste processing

Members

The current members consist of the following 19 corporations, 3 organizations and 6 supporting members(as of June 2003)

●Regular members

Asahi Chemical Industry Co., Ltd.
Chisso Corporation
Du Pont-Mitsui Polychemicals Co., Ltd.
Idemitsu Petrochemical Co., Ltd.
Japan Polyolefines Co., Ltd.
Japan Polychem Corporation
Kaneka Corporation
Maruzen Polymer Co., Ltd.
Mitsui Chemicals Inc.
Nippon Unicar Co., Ltd.
Shin Dai-Ichi Vinyl Corporation
Shin-Etsu Chemical Co., Ltd.
Sumitomo Chemical Co., Ltd.
SunAllomer Ltd.
Taiyo Vinyl Corporation
Tosoh Corp.
Tokuyama Sekisui Co., Ltd.
Ube Industries, Ltd.
V-Tech Corporation

●Trade Organizations

Japan Petrochemical Industry Association
Japan Plastics Industry Federation
Vinyl Environmental Council

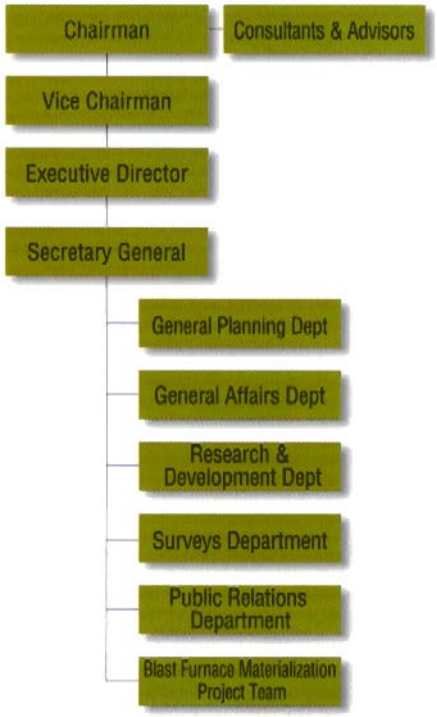
●Supporting Members

Japan PET Bottle Association
Japan Expanded Polystyrene Recycling Association
Japan PVC Environmental Affairs Council
Japan Urethane Industries Institute
Comference on Hygiene of Vinylidene Chloride Products , Japan
Tokuyama Corp.

Operations(1971-2002)

	Target Field	Recent Projects
Technology development	Sorting,volume reduction	Research of PET-bottle recovery system. Development of automatic sorting/separation technology using near-infrared radiation (spectroscopic analysis). Development of volume-reduction technology for raising waste-transport efficiency.
	Recycling promotion	Research and develop material-recycling system for plastic waste. Survey current state of material recycling/processing industry.
	Chemical recycling	Develop technologies for using plastic waste as raw material for liquefaction and gasification through thermal breakdown techniques. Develop technology for using plastic waste as a blast-furnace reducing agent in steel production.
	Incineration, energy recovery	Investigate conditions for suppressing generation of toxic substances and technologies for removing them when incinerating plastic waste. Develop energy-recovery technologies through densified-refuse derived fuel.
	Technology development support	Make extensive calls for new technology-development themes in relation to recycling technologies, reclaimed products, and combustion techniques,and fund R&D expenses.
Surveys	Municipal solid wastes ystems	Survey local-government activities to determine amount of plastic waste occupied by municipal solid waste.Survey progress in constructing PET-bottle recycling systems.Obtain basic data for performing life cycle assessment (LCA).
	Industrial waste systems	Survey discharge, processing, and reuse of industrial plastic waste.Perform a basic survey on the reuse of plastic waste generated in construction.
	Production to processing/ disposal flow	Survey current state of plastic production,discharge, reuse, and processing/disposal in Japan, quantify its macro flow, and publish an annual report.
	Overseas surveys	Survey overseas trends in plastic recycling and processing.Participate in international conferences and exchange information in conjunction with European and U.S. organizations(APME/APC) and Far East Asian countries (Korea, Taiwan, etc.).
Public relations	Exhibits,etc	Hold "Recycled Products Exhibition" as a cosponsor with the Ministry of Economy,Trade and Industry (METI) and the Japan Plastics Effective Utilization Union.Support recycling exhibits held by local governments and recycling organizations.
	Dissemination of information through print media	Gather materials at recycling sites and local governments and disseminatere cycling-related information through periodical publications. Announce and publicize results of PWMI activities and current state of plastic recycling in newspapers, mass media,etc.
	Dissemination of information through digital and audio/visual media	Disseminate explanatory material on PWMI activities and plastic recycling to local governments, general public, and students through pamphlets, movies,videos, CD-ROMs, and Web sites.

Organization



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