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Komatsu is making a constant effort to pursue environmental conservation through the introduction of energy-saving facilities such as cogeneration systems and rotary hearth furnaces, as well as on more common levels such as air-conditioning and the improvement of lighting.

Energy Conservation: The Goal and Current Conditions

At the 1997 Kyoto Conference (COP3), Japan promised the public that from 2008 to 2012 the emission of greenhouse gases (mainly CO₂) would be reduced 6 percent from the 1990 level.

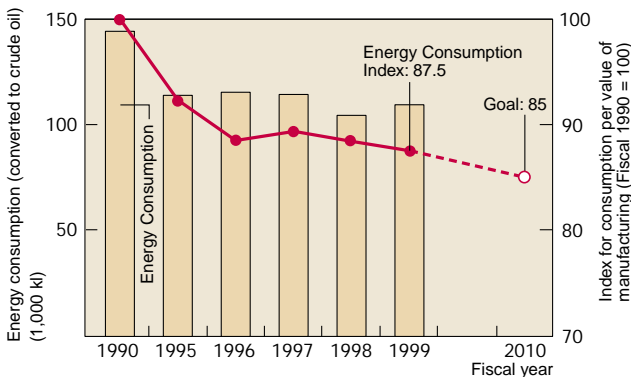
For such a commitment to be kept, Komatsu set the goal that by fiscal 2010 the amount of energy consumption converted to crude oil per value of manufacturing (manufacturing cost excluding material and parts costs) will be reduced 15 percent from that of the fiscal 1990 level.

Examples of Energy-conservation Activities

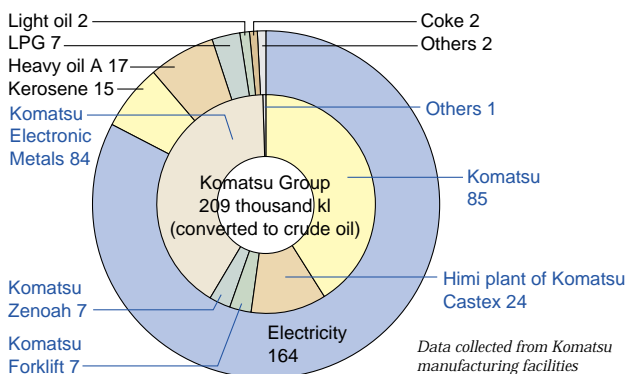
Introduction of Cogeneration Systems

In 1990, our plants at Awazu, Osaka, and Oyama began introducing cogeneration systems driven by Komatsu's own diesel engines. The combined generating capacity of these systems now accounts for 12 percent of the total contract demand by all our plants.

Energy Consumption



Energy Consumption by Komatsu Manufacturing Facilities During Fiscal 1999



Cogeneration System

Introduction of the Rotary Hearth-type Flexible Carburizing Furnace

The carburizing furnace introduced at Komatsu's Awazu plant in 1998 has the advantage that parts subject to different conditions can be continuously treated in the rotating carburizing room. This results in an energy savings of 50 percent compared to a conventional furnace.



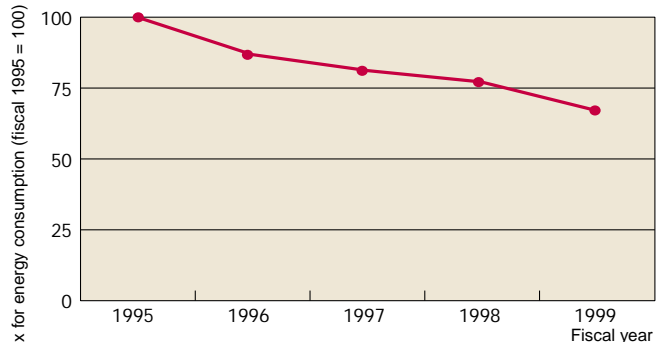
Rotary Hearth-type Flexible Carburizing Furnace

Energy Conservation at Komatsu Electronic Metals*

Komatsu Electronics Metals is actively moving forward with measures to conserve energy and resources. The Nagasaki plant has consistently endeavored to reduce energy consumption through various activities, including a reduction in energy use through improved yield rates, the adoption of inverter controls in the motors of pumps and fans, and the installation of condensers for power-factor improvement. As a result, in fiscal 1999, the plant achieved a 33-percent reduction in index for energy consumption per manufacturing volume from the fiscal 1995 level.

Regarding resource conservation, Komatsu Electronics Metals is working to utilize silicon materials more effectively. Portions of ingots that were not used in products were once simply disposed of, but now, technologies for crushing, washing, and separating them have been improved, and they are increasingly being recycled.

Changes in index for energy consumption



The amount of energy consumption is converted to index for energy consumption per manufacturing volume of wafers.

Komatsu Electronic Metals Co., Ltd., manufactures and sells silicon wafers used as semiconductor materials.

In order to prevent the depletion of the earth's ozone layer—a global environmental problem Komatsu has abolished since fiscal 1995, to abolish the use of specified CFCs, 1.1.1-trichloroethane, and carbon tetrachloride. In the future, we will continue reducing the use of halons as extinguishing agents in fire-extinguishing systems in Oyama computer center and HCFC.

Specified CFCs and Other Substances Abolished Since Fiscal 1995

The ozone layer near the stratosphere has the ability to absorb ultraviolet rays, which are harmful to the human body. However, specific substances used in manufacturing processes and discharged into the air have damaged the ozone layer, resulting in increased ultraviolet radiation at the earth's surface. In response, a global framework for protection of the ozone layer—the Montreal Protocol—was ratified, and in Japan, the Ozone Layer Protection Law was approved in 1988. The production of specified CFCs, 1.1.1-trichloroethane, and several other substances was discontinued in 1996.

The Regulation Schedule based on the Montreal Protocol

Substance	Regulation schedule
Specified CFCs	Use abolished by end of 1996
Halons	Use abolished by end of 1994
Carbon tetrachloride	Use abolished by end of 1996
1.1.1-trichloroethane	Use abolished by end of 1996
HCFC	Use abolished by end of 2020
HBFC	Use abolished by end of 1996
Methyl bromide	Use abolished by end of 2005

Materials used at Komatsu Group manufacturing facilities

Komatsu, a leader in the observance of this law, carried on the development of alternative technologies, and by the end of fiscal 1995 had completely abandoned the use of specified CFCs, 1.1.1-trichloroethane, and carbon tetrachloride in manufacturing. In the future, we will continue reducing the use of halons as extinguishing agents in fire-extinguishing systems in Oyama computer center and HCFC.

Example: 1.1.1-trichloroethane

The nonflammable compound known as 1.1.1-trichloroethane possesses strong degreasing and penetrative powers. It has therefore been used in a wide range of industries for the cleaning of metal parts.

Komatsu's parts manufacturing facilities had also been using it as a degreasing and cleaning agent but substituted it with water or alcohol-based agents in order to protect the ozone layer and prevent contamination of the groundwater and soil. In fact, these facilities had completely discontinued its use by the end of fiscal 1993.



Gear-cleaning Unit at the Osaka Plant (Washing: water-based alkaline cleaner)

Komatsu promotes *Zero Emission* activities in which we make ongoing efforts to reduce manufacturing waste, as well as to utilize the waste generated as raw materials in other fields. For example, the slag from electric furnaces, which was traditionally treated as waste, is now being prepared for reuse on the market as a grading material.

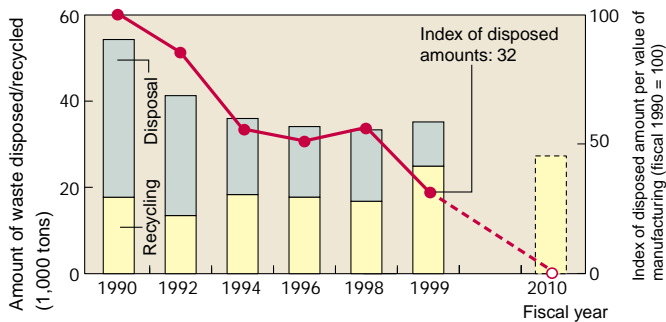
Promotion of Zero Emission Activities

In 1994, the United Nations University presented the concept of utilizing industrial waste products as raw materials for other fields. This idea was called “zero emission,” and in support of it, various attempts have been made in Japan as part of its effort to become an industrial society oriented toward resource recycling.

Komatsu has taken part in these activities through its engagement in *Zero Emission* projects. We are promoting a plan for the reduction of bury-or-burn waste to the zero level by fiscal 2003, starting with our model facility, the Oyama plant. Moreover, we seek to reduce the waste to zero level by fiscal 2010 on a company-wide scale, and are promoting the reduction and recycling of waste generated through manufacturing.

Resource Conservation: Objectives and Current Conditions

Amount of Waste Generated/Recycled/Disposed in Komatsu

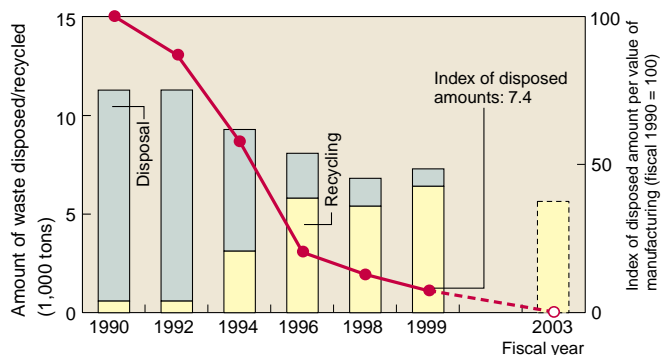


Data was collected from Komatsu manufacturing facilities and the Himi plant of Komatsu Castex Ltd.

Subject of aggregation: FY 1990—1997, industrial waste only

General waste is also included beginning FY 1998.

Amount of Waste Recycled/Disposed at the Oyama Plant



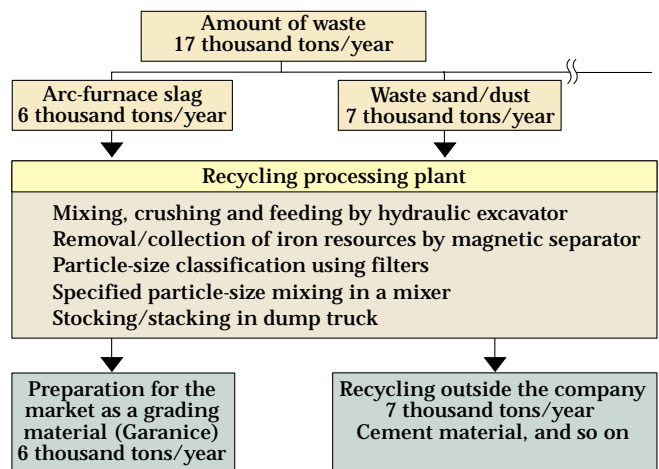
Example: A Project to Utilize Slag of Electric Furnaces as a Grading Material

Waste, such as the slag generated from foundries, accounts for 70 percent of the total waste generated through manufacturing. Therefore, it has been a top-priority issue to develop technologies that make efficient use of such waste.

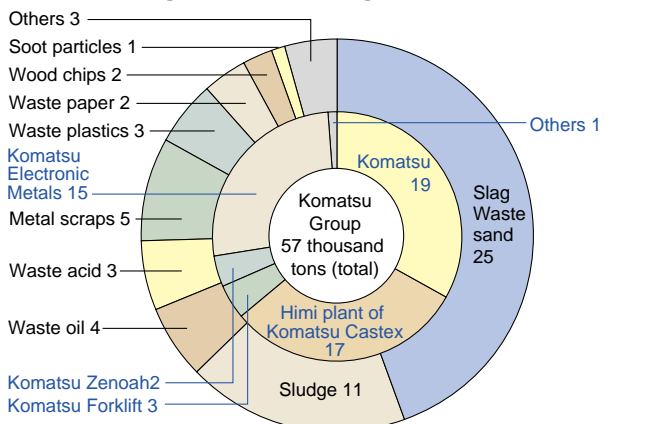
Addressing this issue, Komatsu Castex established a technology to crush the slag from electric furnaces, classify it by size, and utilize it as a grading material. Komatsu Castex set up its processing plant and has begun selling the slag under the product name ‘Garanice.’

The Garanice product has excellent compaction as compared to conventional, crushed concrete materials. Since its prospects as a product are good, it has become possible to recycle all the slag. Moreover, the establishment of such a recycling project has allowed us to close down the waste-disposal site on the premises.

Slag Recycling Processing (Komatsu Castex Fiscal 1999)



Amount of Waste Recycled/Disposed by Komatsu Group Manufacturing Facilities During Fiscal 1999



Data collected from Komatsu Group manufacturing facilities

Komatsu is working on the development of various technologies as part of the environmental conservation activities undertaken in its manufacturing processes, including the "development of one-coat painting" and "dry cutting."

Examples of Environment-friendly Technologies

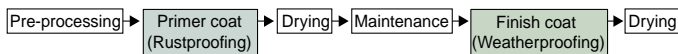
Development of One-coat Technology

The finish applied to the main parts of construction equipment generally consists of two coats—the primer and finish coats—to ensure external quality and high durability.

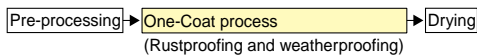
However, through collaboration with paint manufacturers the Komatsu Group's manufacturing facilities have developed a one-coat paint whose quality is equivalent to the two-coat-type, contributing to a dramatically simplified process.

Thanks to this technology, the amount of volatile organic solvents, including toluene and xylene, discharged into the air has declined 66 percent.

[Two-coat Process]



[One-coat Process]



Application of Dry Cutting

Large amounts of cutting oils and fluids are used at machining plants for the purpose of stabilizing dimensional accuracy and lengthening the life of the machine tools.

A key Komatsu goal was to reduce the amount of waste oil produced, so as part of that effort, the company's manufacturing facilities have been promoting activities that extend the application of dry cutting (the use of air injection rather than cutting oil) and semi-dry cutting (employing a slight spray of cutting oil) within a three-year plan beginning in fiscal 1999. We have applied for and obtained four patents and four utility models with regard to the manufacturing technologies developed through this activity.

Application of Dry Cutting

Process	Dry cutting	Semi-dry cutting
Milling		()
Surface milling		
Gearing		
Screw holes		
Hole punching	Standard	
	Deep holes	
Grinding		

Total number of machine tools: 1,461
 Number of tools subject to dry cutting: 740
 Number of dry cutting installed during FY 1999: 346

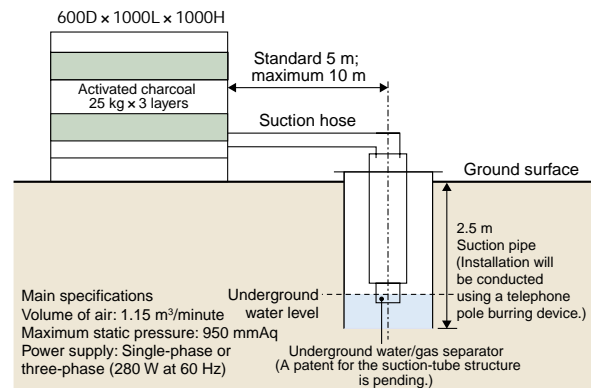
Underground Air Cleaner (Soil-gas Suction Method)

Komatsu is also developing purification devices for soil contamination, and has developed an underground air cleaner employing the soil-gas suction method. In principle, the device sucks up in a vacuum organic chlorine-based solvents present in the soil, whereupon the soil is purified and the gas collected via activated charcoal. The advantage of this device is that it has a structure that allows it to suck up intensively from directly above the groundwater surface (where gas concentrations are the highest). Komatsu has applied for a patent on this device.

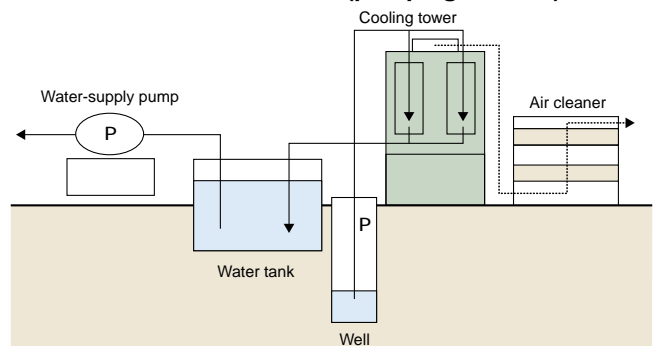
Simplified Purification Device Using Simplified Gasification and Air Cleaner (pumping method)

Komatsu has successfully combined a simplified gasification and air cleaner, allowing them to function as a purification device in the fight against groundwater contamination. The principle is to pump up the groundwater first, gasify the organic chlorine-based solvents, and then collect the gas using the aforementioned underground air cleaner. The system's characteristic component is a cooling tower for the air-conditioning process used in gasification. In this way, large amounts of low-concentration groundwater can be treated efficiently at minimal cost.

Underground Air Cleaner (Soil-gas Suction Method)



Simplified Purification Device Using Simplified Gasification and Air Cleaner (pumping method)



Komatsu observes the regulations imposed by the countries and regions in which it is active, and regularly reports and stores actual measurement results. Moreover, we make a dedicated effort to prevent contamination, including the “zero use of organic chlorine-based cleaning fluids” and “improvement of underground tanks.”

Measures for Preventing Contamination

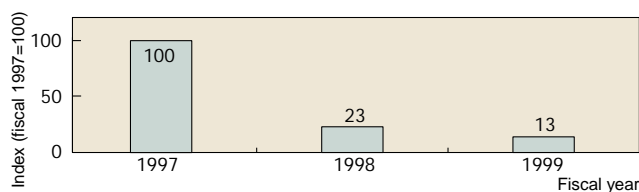
Zero Use of Organic, Chlorine-based Cleaning Fluids

Komatsu’s manufacturing facilities had by the end of fiscal 1998 ceased using organic chlorine-based cleaning fluids such as trichloroethylene and methylene chloride, which are regulated substances with respect to water contamination. Additionally, the company has since fiscal 1998 been involved in group-wide activities to eliminate the use of such compounds by the end of fiscal 2001.

Removal of Incinerators

While carrying out a major reduction of waste through the *Zero Emission* activities, Komatsu is gradually eliminating the use of waste incinerators (either removal or closure), which are a known source of dioxin emission. In fact, Komatsu’s manufacturing facilities abandoned all the incinerators during fiscal 1999. Komatsu Group manufacturing facilities also abandoned eight incinerators and are working toward the abolishment of three remaining incinerators before the end of fiscal 2000.

Usage of Organic Chlorine-Based Cleaning Fluids (Komatsu Group Manufacturing Facilities)



Improvement of Underground Tanks (Measures)

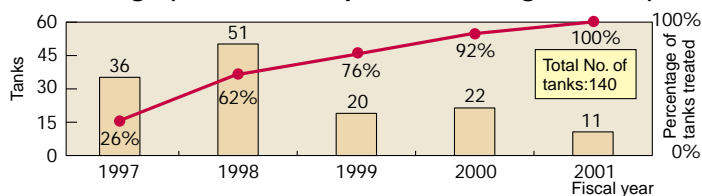
In order to prevent leakage from underground tanks into the surrounding soil, Komatsu regularly promotes the substitution of underground tanks with surface tanks and double-wall underground tanks. At the company’s manufacturing facilities, all underground tanks installed more than 25 years ago were replaced during fiscal 1999. We plan to carry out the same procedure for underground tanks ranging from 20 to 25 years in age during fiscal 2000.

Komatsu’s manufacturing facilities are conducting the same procedures, scheduling completion by the end of fiscal 2001.

Management of Chemical Substances

In 1997, before PRTR was brought into law, Komatsu joined the voluntary PRTR activities advocated by the Federation of Economic Organizations. These activities targeted 174 substances, endeavoring to monitor their amounts of emission and transfer. The result of that research on target environmental contaminants for PRTR by the Federation of Economic Organizations’ Voluntary Activities in Fiscal 1999 is shown in the following table. (The values are totals of Komatsu manufacturing facilities and Komatsu Castex) Additionally, during fiscal 1999, we introduced a management system for chemical substances at the Awazu plant. Through the expanded targeting of chemical substances and trials, we were able to accumulate data and modify our systems. We will begin introducing this system to other facilities in fiscal 2000.

Improvement of Underground Tanks Installed More Than 20 Years Ago (Komatsu Group Manufacturing Facilities)



Survey on Emissions and Transfers of Environmental Contaminants by Komatsu during Fiscal 1999

Unit: tons

Material number	Material name	Toxicity ranking	Amount handled	Emission			Amount consumed (products)	Amount processed for removal (chemical change)	Amount transferred (waste)
				Air	Water	Soil			
107	Manganese compounds	Regulations, et al: B	531.7	0.0	0.0	0.0	509.1	0.0	22.6
21	Xylenes	Regulations, et al: D or lower	370.1	301.6	0.0	0.0	0.0	54.0	14.5
25	Chromium compounds (excluding hexavalent chromium)	Regulations, et al: A	232.4	0.0	0.0	0.0	228.2	0.0	4.2
79	Toluene	Regulations, et al: D or lower	86.6	72.0	0.0	0.0	0.0	10.3	4.5
55	4,4-diphenylmethane diisocyanate	B	70.4	56.3	0.0	0.0	0.0	14.1	0.0
	Ten other materials, including molybdenum		62.6	5.2	0.0	0.0	54.7	0.0	2.6
Total of 15 materials			1,353.7	435.1	0.0	0.0	792.0	78.4	48.4
Composition ratio (%)			100%	32%	0%	0%	59%	6%	4%

*1: The survey was conducted in compliance with the Federation of Economic Organizations’ Voluntary Activities.

*2: Of the fifteen materials subject to reporting, the five most frequently used materials are listed.

*3: The survey was conducted with the cooperation of Komatsu manufacturing facilities and Komatsu Castex Ltd.

To cooperate with suppliers in activities dedicated to environmental conservation, we created our *Guidelines for Environment-Conscious Procurement* in December 1999 and defined a Green Index based on the company's constitution and products. Moreover, Komatsu now provides examples of activities at work throughout the company, as well as the expertise in environmental management to support systems of environmental promotion.

Environment-friendly Manufacturing and Procurement

In order to actively pursue a manufacturing strategy that puts less stress on the environment through the aforementioned energy-conservation activities, more efficient use of resources and the reduction/recycling of industrial waste, the materials and parts thus procured should of course be environment-friendly.

Issuing Guidelines and Educating Suppliers

Komatsu created its publication entitled *Guidelines for Environment-Conscious Procurement* in December 1999 and distributed it to our suppliers. The purpose of the guidelines was to clarify the need for manufacturing methods that place primary importance on the environment, and to cooperate with suppliers in such activities. Since then, we have endeavored to convince each supplier of the need for a system of environmental management, taking advantage of situations such as business liaison meetings and mutual workshops held by the Purchasing Department. During purchase transactions, we have made it our philosophy to put top priority on doing business with suppliers who are committed to environmental conservation under the condition that the levels of quality, cost, delivery time, and technology meet—that they should in fact exceed—the given standards.

Definition of Green Index

To cooperate with our suppliers in environmental conservation activities, Komatsu introduced the concept of Green Index. The Green Index consists of six items regarding the company's constitution standard (company philosophy, promotion system, environmental management system, evaluation of environmental influence, training/education, and information disclosure) and two items regarding the product standard (level of technology at which they can adapt to the environment, and packing material). It aims to build the philosophy of "greenness" into the supplier's evaluative system and heighten the level of environmental conservation in manufacturing and procurement.

Providing Environmental Information and Support

Komatsu provides each supplier with case studies of resource savings and energy conservation, along with the expertise of environmental management. Moreover, we support them in building their own systems of environmental promotion so that the conservation activities on the suppliers' side will have an actual, quantifiable effect.

The Future of Environment-conscious Procurement

We will in future promote more fruitful, environmental conscious procurement by working in cooperation with our R&D engineers, who determine the specifications of parts and materials, as well as the manufacturing engineers at each plant with regard to the regulation of environmentally burdensome substances. We will do this with full consideration for the benefit of incentives, such as ratings and awards for suppliers. We are planning to raise the consciousness of our suppliers during fiscal 2000, through questionnaires regarding environmental conservation.



Guidelines for Environment-Conscious Procurement

Komatsu promotes its environmental conservation activities through transportation and packing, which affect the environment the most in terms of logistics, by adopting two-way transportation with other companies in the same industry and employing steel packing materials.

For More Advanced Environmental Conservation in Logistics

Of the four functions in logistics—transportation, packing, storage, and loading/unloading—the following two processes have the greatest effect on the environment:

1. Transportation: Affects air pollution and resources
2. Packing: Relates to resources and waste

With regard to the improvement of transportation, Komatsu has since 1994 been developing more efficient methods of transportation, including two-way transportation in tandem with other companies in the same industry. As for the issue of packing, we are making an effort on behalf of returnable packages. To promote environmental conservation activities even more vigorously, Komatsu has since fiscal 1997 worked toward the improvement of logistics as one of its most important management issues, and consequently has established midterm goals for these issues. Through the establishment of a framework for such improvements, we are advancing by way of the various activities introduced below. It is not Komatsu alone that is engaged in such activities; indeed, we are working globally in cooperation with group companies and other collaborating organizations. Komatsu will extend its environmental conservation activities even further in the future, as well.

Development of a Comprehensive, Domestic Transportation System

Despite the increasing seriousness of environmental problems such as increased CO₂ emissions, the realization of cooperation/collaboration in transportation beyond the framework of individual companies has been delayed in the transport of heavy loads. Especially, trailer transportation of 15 tons or more is mostly carried out through one-way transportation, and that inefficiency has become an issue in search of a solution. In order to address such issues, Komatsu

has applied to the Advanced Logistics System Development Project sponsored by the Ministry of International Trade and Industry, and has decided to work on the development of a socially efficient system of transportation.

The transportation system is characterized by the deployment of the following information technologies:

1. Shortest-route simulations using digital mapping
2. Calculation of optimal car allocation based on the simulated annealing method
3. Simple, easy access to information/databases through WEB technology
4. Providing load/vehicle information utilizing GPS

For real-world logistics, all information pertaining to loads and vehicles—ranging from the procurement of parts, deliveries of supply parts, and collaborative transportation with other companies—is transferred to the Information Clearing House (ICH) with the aim of achieving two-way transportation and the improvement of load rates through consolidation.

Improvements in Global Transportation

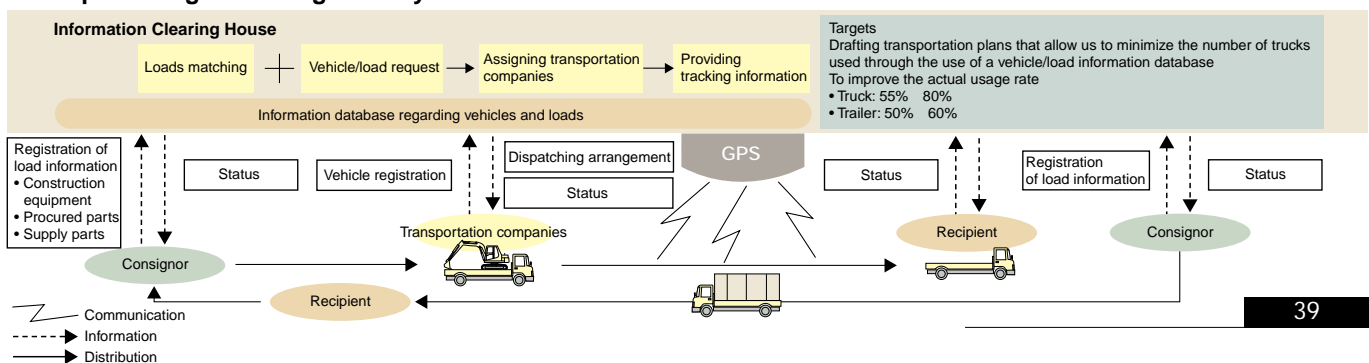
Komatsu is pursuing the reduction of transport distances and congestion through use of the nearest available, local ports. Moreover, we are making an effort to achieve more efficient international transportation by cooperating with trading companies and logistics companies across a worldwide network.

Improvements in Packing

In terms of packing materials, Komatsu is facilitating the two-way use of corrugated cardboard boxes and repeated use of folding steel pallets under the theme of “returnability.” We have already begun the two-way use of corrugated cardboard boxes with affiliated companies in Thailand, and are promoting the repeated use of steel pallets with affiliated companies in the U.S., UK, and China.

Along with our continued effort to simplify packing, we are promoting resource conservation from a different perspective by accommodating the relaxation of container-weight regulations in order to promote full loading. Komatsu is also making the process more efficient through bulk transportation in response to the upsizing of trucks.

Conceptual Diagram of Logistics System



Komatsu is stepping up the environmental effort at its overseas manufacturing facilities, as well. One such initiative is to acquire ISO 14001 certification for quality in environmental management. As of fiscal 1999, six of our overseas subsidiaries have already received certification, and all subsidiaries will be certified under ISO 14001 by the end of fiscal 2001.

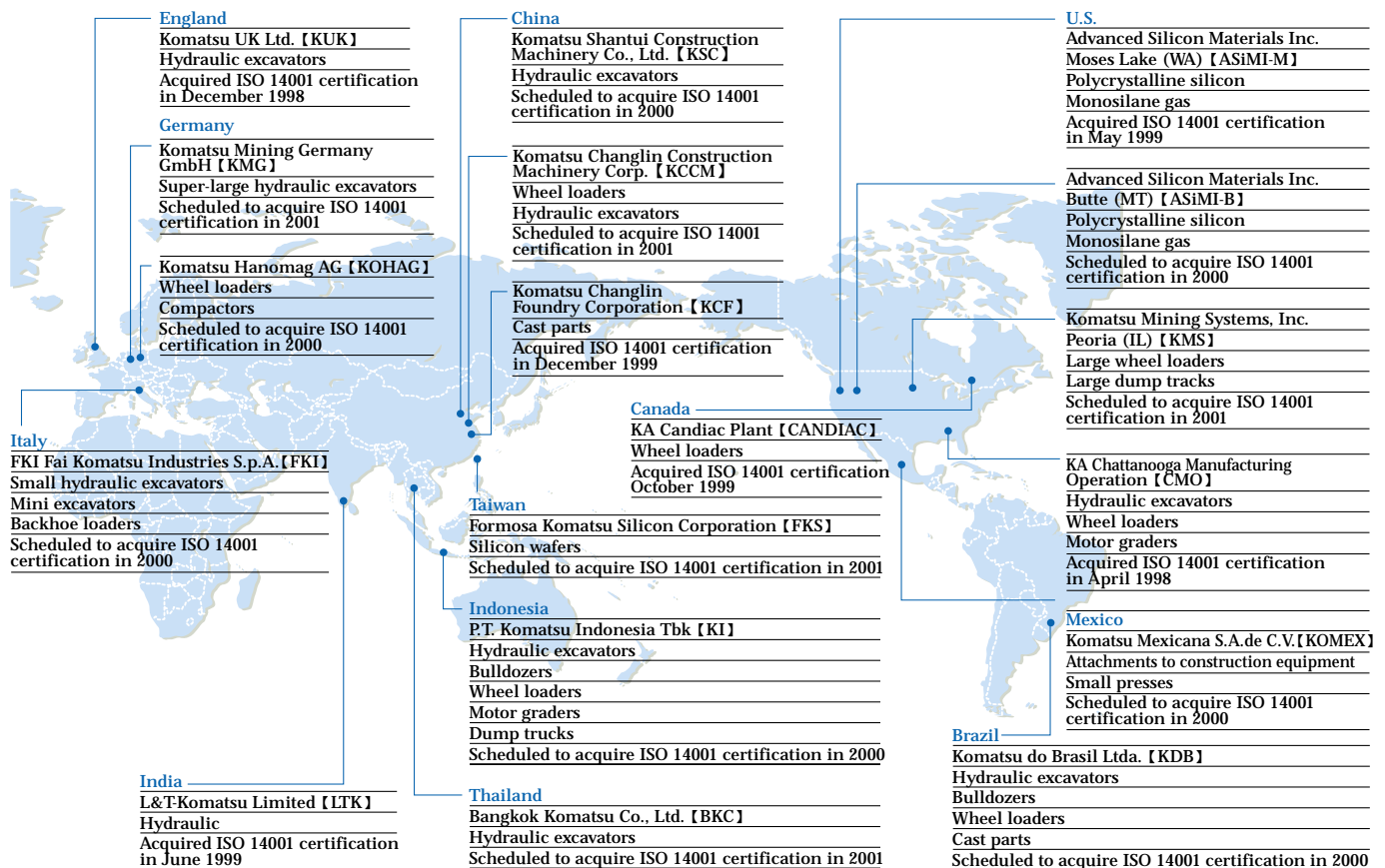
Environmental Conservation at Overseas Manufacturing Facilities

Komatsu's overseas manufacturing facilities, as members of our global network, actively undertake environmental conservation measures according to the Komatsu Earth Environment Charter. In addition, each facility is implementing its own environmental measures as a means of complying with the regulations of that country.

Of the eighteen manufacturing facilities Komatsu operates abroad, six have already acquired ISO 14001 certification, including Komatsu UK (KUK) and the Chattanooga Manufacturing Operation (CMO) of Komatsu America International Company. According to our plan, all facilities will become ISO-14001 certified by the end of fiscal 2001.

The following describes some of the representative initiatives being implemented by our overseas operations.

Komatsu's Overseas Manufacturing Facilities



Komatsu UK Ltd. (KUK)

KUK, which was established in 1985, has become the Komatsu Group's largest European manufacturing base. It is complete with design and sales departments, and now employs approximately 500 people. KUK's production figure for 1999 so far comes to 2,500 machines, including medium-sized hydraulic excavators, to be sold in the UK and other EU countries.

Having acquired ISO 14001 certification in 1998, KUK's factory at Birtley has been successful in the implementation of various environmental measures, including those that are legally required. A particular area of emphasis is the reduction of emissions. Here the company has worked with a paint manufacturer to develop a low-VOC paint in order to meet British environmental regulations (EPA) requiring a reduction of VOC emissions from the painting process. Additionally, KUK introduced enclosed paint booths. Today,



Introduction of Enclosed Paint Booths

Komatsu UK is one of a select group of companies in north-eastern England that are in complete compliance with all environmental regulations.

KUK is working to reduce landfill waste, too. The company has implemented programs to raise employees awareness regarding recycling and the environment, and has introduced a system of classification and collection that is both practical and effective. In 1999 the volume of landfill waste has decreased 32 percent over the preceding year, and the company is continuing its effort to meet the new target for the year 2000. In the area of water usage, KUK has already



System of Classification and Collection at Each Operation

reduced its water consumption by 14,000 tons annually through the improvement of process control in the pre-painting treatment facility.

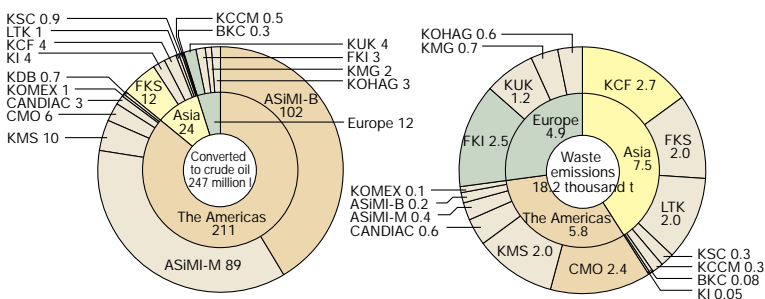
KUK is also encouraging its subcontractors and suppliers to acquire ISO 14001 certification, and several of their partners have already become ISO-certified. KUK is currently setting new goals for environmental management, and is redoubling its efforts in order to achieve them.

Chattanooga Manufacturing Operation (CMO) of Komatsu America International Company

CMO, which now employs approximately 440 people, was established in 1985 in the U.S. state of Tennessee. As the Komatsu Group's largest U.S. manufacturing facility, CMO has produced nearly 2,400 machines, including midsize and large excavators, in 1999.

Already an ISO 14001-certified operation, CMO is motivating environmentally friendly operations and effective resource use under the goal of "90-percent reduction of landfill waste by 2005 and complete elimination by 2010."

Energy Consumption (in Liters of Crude Oil) and Waste Emission Recycled/Disposed at Komatsu's Overseas Manufacturing Facilities (during fiscal 1999)



Such efforts have yielded remarkable results. For example, to reduce industrial waste the company has introduced trailer-loaded distillation equipment and begun the separation of solvent from sludge generated in the painting process. Significant reductions were achieved in both waste and cost by reusing the collected solvent so that only the sludge is forwarded to the treatment process.

Furthermore, a wide variety of other activities, such as greening the grounds by planting trees, are being undertaken with an eye on medium- and long-term goals.



Trailer-loaded distillation equipment

Other Overseas Bases

Advanced Silicon Materials which operates factories in the U.S. states of Washington and Montana, was established in 1984 as the electronics arm of the Komatsu Group. The company supplies monosilane gas and polycrystalline silicon to semiconductor companies around the world. Advanced Silicon's plant in Washington acquired ISO 14001 certification in May 1999, while its Montana plant is expected to receive it by the end of 2000. Both factories are working to reduce the use of alternative CFCs.

India's L&T-Komatsu (LTK) in June 1999 became the first ISO 14001-certified Indian manufacturer of construction equipment. The company is extending its air/waste-water treatment facilities and introducing monitoring equipment in order to address various environmental regulations, including those pertaining to environmental measurement. LTK has succeeded in 2 to 5 percent annual reductions in the use of energy, water and oils. Furthermore, the company is actively promoting tree-planting initiatives. LTK is in fact engaged in a wide range of programs, including a voluntary cleanup effort in which it removes sludge to help clean the local communities using construction equipment.