Reducing Environmental Impact in Production Activities

Action POINT

Due to changes in the forms of and increases in the scale of our business, the results of our efforts for energy saving, global warming prevention, waste reduction and chemical substances reduction have become difficult to evaluate. From this year, we will analyze the effects of our activities using a basic unit per net sales as a typical index in order to promote effective measures based on these results.

Energy Saving Activities

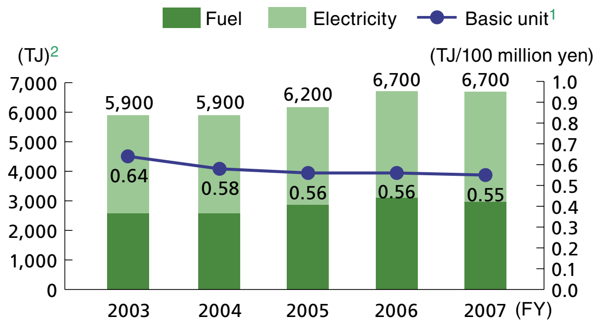
In order to reduce the amounts of greenhouse gas emissions, we are implementing energy saving measures that contribute to reducing electricity and fuel consumption according to the characteristics of each plant. Moreover, we are also undertaking shared measures at every plant.

Examples of Energy Saving Activities

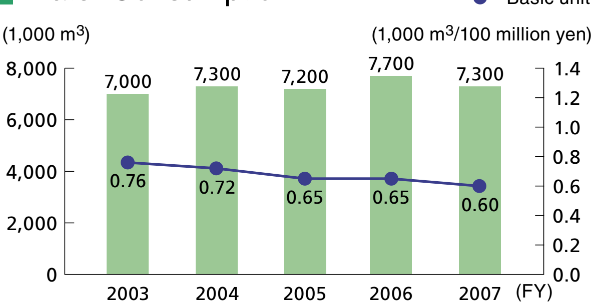
- Efficient operation and renewal of compressed air equipment and other utility facilities
- Replacement with new facilities that have lower CO_2 emissions (through conversion of fuel type, for example)
- Reduction of standby power in electricity receiving facilities and production facilities

We were able to keep the total energy consumption at about the same level as the last fiscal year. Moreover, we were able to reduce the water consumption compared to the last fiscal year by, for example, implementing thorough measures to conserve water and prevent water leaks from pipes and by recirculating and reusing water in industrial processes.

Total Energy Consumption



Water Consumption

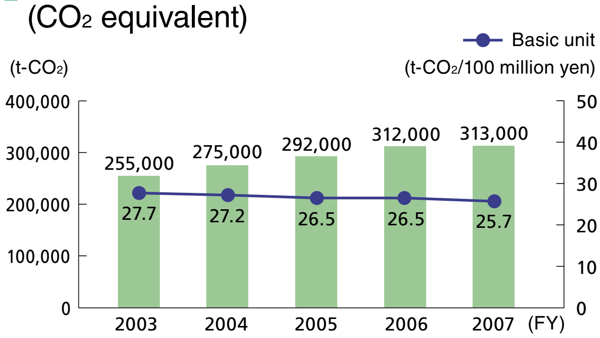


[1] Basic unit: Divided the total energy consumption, water consumption, greenhouse gas emissions, and amount of produced waste by net sales, respectively.
[2] TJ: terajoules (10^{12} J)

Activities to Prevent Global Warming

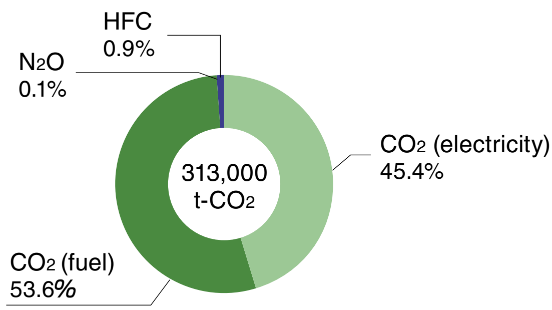
We were able to keep the total greenhouse gas emissions at about the same level as in the last fiscal year. Moreover, as for a basic unit per net sales, which is an evaluation measure that considers our increased business scale, we achieved a 2.9% improvement.

Amounts of Greenhouse Gas Emissions (CO_2 equivalent)



- Electricity conversion factors used herein were specified by power utility companies.
(Electricity conversion factor for FY2006 were used to compute those of FY2007.)

Breakdown of Greenhouse Gas Emissions (FY2007)



In addition to continuing to reduce the total greenhouse gas emissions, we will analyze the effect of our activities using a basic unit per net sales for evaluating improvements and continue to investigate effective measures.

We are also focusing on promoting energy saving efforts through follow-up with our business plan.

Waste Reduction Activities

As an effort to reduce waste, we are continuously promoting "zero emissions" efforts in which we seek to achieve a recycling rate of 100%. In addition to efforts suited to the characteristics of each plant, we are also undertaking the "zero emissions" efforts as shared measures at every plant.

Examples of 3R Activities

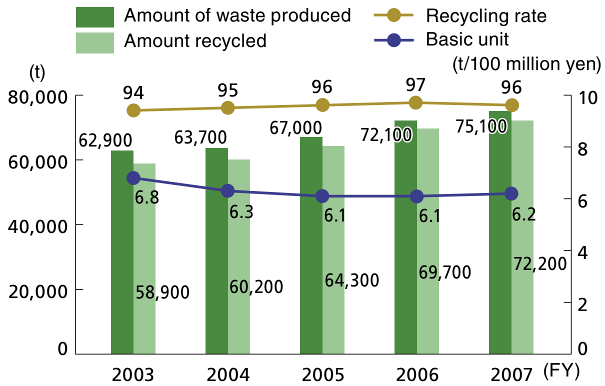
- Suppressed generation of metal scraps, waste oil, wood scraps and other waste
- Expansion of reuse by, for example, using reusable containers instead of pallets and wooden boxes
- Purchase of recycled goods, increase of their use rate and related efforts

As a result of these activities, our recycling rate reached 96% in FY2007.

Due to increases in the scale of our business, however, the total amount of waste that we produced increased about 3,000 tons (4.2%) from the previous fiscal year. For example, at some of our plants, we constructed new buildings and renewed facilities as part of business reorganization, resulting in a significant increase in our total amount of waste output.

We will analyze the effect of our activities using a basic unit per net sales as an important index for evaluating improvements, and we will continue to investigate effective measures to reduce waste.

Amount of Produced and Recycled Waste



Efforts for Reducing Chemical Substances

As part of our shared efforts for reducing chemical substances, we are working to realize reduction targets set at every site for harmful substances, including cadmium, lead, hexavalent chromium, dichloromethane and other VOCs.

We are steadily moving toward our reduction targets for cadmium, which is only used at certain sites and is also handled in small quantities, and for dichloromethane, for which recovery equipment has been installed and other reduction measures have been advanced. Starting with our Consumer Products & Machinery Company, which has achieved the complete elimination of lead from mass-produced goods, we are advancing the reduction of lead, which has increased slightly in use recently, by not using new jigs that contain it and switching to alternative paints that contain low levels of it.

Amounts of Chemicals Subject to Reduction Handled and Emitted

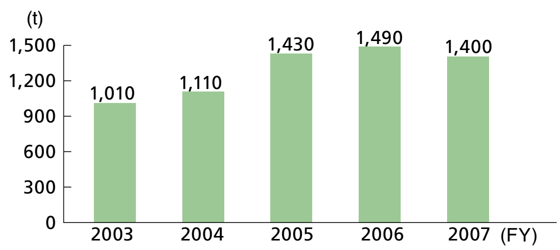
Substance		FY2007
Major VOC	Toluene (t/year)	304
	Xylene (t/year)	812
	Ethylbenzene (t/year)	286
Dichloromethane (t/year)		61
Heavy metals	Lead (t/year)	6.3
	Hexavalent chromium (t/year)	19
	Cadmium (t/year)	0.13

- Amount of major VOC and dichloromethane is the amount emitted, while that of heavy metals the amount handled

Major VOC

We are conducting thorough coating thickness control for paints, which are the main cause of VOC emissions, and switching to solvents with low volatility and adopting water-based paints, for example. As a result of these measures, we achieved a 5.9% reduction in the amount emitted compared to the previous fiscal year.

Change in the Amount of Major VOC Emissions



Hexavalent Chromium

At sites that handle mass-produced goods, we are steadily reducing the quantity of this substance handled by switching to substitutes in surface treatment processes. Moreover, our plan is to reduce the quantity handled in the future by switching the use of surface treatment fluid to a treatment that does not use chromium.

Energy Saving Activities at Our Plants

Action POINT

In response to the increasingly urgent need to reduce CO_2 emissions, we believe that making production processes considerate of the environment is an urgent business matter. In this section, we will introduce representative efforts of the Machinery Division, which is seeking to curtail CO_2 emissions by 1,500 t/year through energy saving activities and of Kawasaki Precision Machinery Ltd., which is actively promoting its own advanced measures.

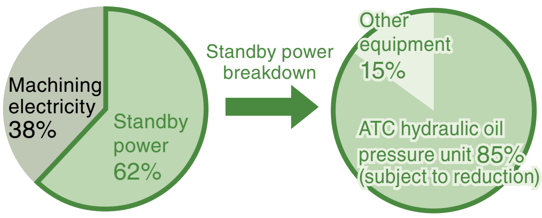
Efforts at the Kobe Works of the Machinery Division

Curtailment of Standby Power Consumed by Machine Tools

FY2007 achievement
Reduction of
120 t-CO_2/year

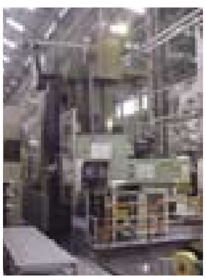
As a result of investigating the machinery plant, which consumes about 50% of the electricity used by the Kobe Works, we found that about 62% of the electricity consumed by the machining centers,* which are representative of the facilities, was standby power. Furthermore, 85% of that standby power was used for operation of the hydraulic oil pressure unit of the automatic tool changer (ATC). Even though the ATCs are not in use when the machining centers are conducting machining, their hydraulic oil pressure units are designed to continue to operate at full power. For our plant, which changes tools infrequently, running this equipment constantly day and night was the cause of an extremely large amount of wasteful electricity consumption.

Electricity Consumption by a Typical Machining Center and Breakdown of the Power Used in Standby



As a countermeasure, we switched to inverter-controlled motors for ATC hydraulic oil pressure units and now only raise motor output to its rated level when changing tools. At all other times when the equipment is in standby, they now operate with minimum output. As a result, we have been able to curtail electricity use by 3,653 kWh/month, which is equivalent to 15 t-CO_2/year.

So far, we have applied inverter-controlled motors to the ATC hydraulic oil pressure units of 8 machining centers, realizing an energy saving effect of 120 t-CO_2/year. By FY2010, we are seeking to reduce the total amount of CO_2 emissions from our machinery plant by 6%, which is equivalent to 200 t-CO_2/year.


Machining center

* Machining center: automatic tool changer machine tools

Energy Saving Effect of Using Inverter Control for ATC Hydraulic Oil Pressure Units (per unit)

Quantity of electricity consumption	Before use	7,314 kWh/month
	After use	3,661 kWh/month
Electricity conserved		3,653 kWh/month
CO_2 emissions reduction		15 t-CO_2/year

Reduction of Fuel Consumption by Heat Treatment Furnace

FY2007 achievement
Reduction of
270 t-CO_2/year

● **Energy Saving Through Improved Heat Treatment Furnace Efficiency**

At our plant, as heat treatment furnaces for large-scale structures, we have a 150-ton truck furnace and a 120-ton truck furnace that burn city gas. These heat treatment furnaces consume about 430,000 m^{3}N of city gas as fuel annually, so we sought to curtail this consumption.

In large-scale furnaces, if there are gaps between the product input portal or input truck and the furnace walls, negative pressure occurs inside the furnace, and excess air enters causing increased exhaust gas and greater heat loss (exhaust gas loss). At the same time, a suitable air-fuel ratio cannot be achieved and combustion efficiency is reduced. From this perspective, we measured the internal pressure of the furnace during operation and found that in the 120-ton truck furnace the pressure is always negative, showing that there are gaps and that air is flowing in. In response to this, we adjusted the gaps between the input portal or input truck and the furnace walls to increase airtightness and realize a fuel consumption reduction of at least 20%.

Moreover, an air-fuel ratio of about 1.2 is considered to be optimal for efficient combustion of city gas, but investigating our 150-ton truck furnace, we found that when the temperature was rising the air-fuel ratio was 1.75 (exhaust gas oxygen concentration of about 10%, equivalent to an exhaust gas loss of 45%). By adjusting the combustion to realize an air-fuel ratio of 1.3 (exhaust gas oxygen concentration of about 5%, equivalent to exhaust gas loss of 35%), we were able to reduce fuel consumption by about 10%.

Through these types of improvements, we achieved a total fuel consumption reduction of at least 30% (which is equivalent to 270 t-CO_2/year emissions) or more.

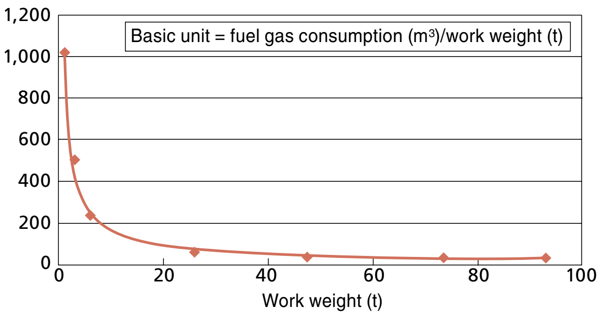

150-ton heat treatment furnace that burns city gas

● Energy Saving Through Treatment of Suitable Work Weight

In large-scale furnaces, the fuel gas consumption increases dramatically when work weight of six tons or less is treated. Treatment of small weight can be avoided by handling multiple products together, but differences in heat treatment conditions, production process downsides and numerous other limitations make actual application of this practice difficult.

In consideration of this, we decided to convert a 25-ton heavy oil-burning furnace that had been taken out of service into a 10-ton city-gas-burning furnace for the heat treatment of smaller parts. By using this equipment, which we plan to complete in FY2008, for the treatment of small weight of less than 10 tons, we expect to reduce city gas consumption by about 25% compared to using the large-scale furnaces.

Relation Between Fuel Gas Consumption and Work Weight of 150-Ton Heat Treatment Furnace



Heat Insulating Paint on Plant Buildings

At our plant, the building roofs and walls are mostly covered with zinc-plated steel sheets and the ceilings are also high, so they are not suited to being completely air-conditioned. For this reason, we are reliant on spot coolers and heaters to deal with hot and cold conditions.

In recent years, we have incorporated air-cooling systems that use gas absorption chiller/heater in some areas with low ceilings in order to improve the work environment, but solar heat radiating from roofs and walls prevented it from having sufficient effect. In response to this, we added heat insulating paint to the roofs and exterior walls of the plant buildings, realizing an average temperature reduction effect of 15.2°C on the exterior walls and 2.2°C (maximum of 3.2°C) on the internal walls. Hypothetically, if we were to incorporate air-conditioning systems into a plant building as a whole, to maintain an indoor temperature of 28°C with an outside temperature of 33.5°C and eight medium-sized machining centers that emit 50 kW of heat inside, the load of the required air-conditioning would be 196.9 kW. With the heat insulating paint, the load would be reduced to 160.8 kW (18% reduction) according to our trial calculations. This effect is equivalent to eliminating the waste heat of six of our machining centers.

Plant Building with Heat Insulating Paint

At our plant, we plan to investigate the effects of this as a model case and expand the application of this coating method when recoating plant buildings in the future.

Efforts at Kawasaki Precision Machinery Ltd.

Installation of a Large-Scale Photovoltaic System

FY2007 achievement
Reduction of
110 t-CO_2/year

At our new core parts plant built in April 2007, we are incorporating features that are considerate of the environment, including energy saving air-conditioning and lighting. In March 2008, we installed and began operation of a 300-kW photovoltaic system (manufactured by Kawasaki Plant Systems, Ltd.) that has an annual power generation capacity of 300 MWh/year, which equals a reduction of 110 t-CO_2/year. Furthermore, during this fiscal year we also plan to install a large-scale nickel-metal hydride battery Gigacell® to control power generation output fluctuations and increase energy use efficiency.

Photovoltaic system at core parts plant

Incorporation of a Power Regeneration Stand and Energy Recovery

FY2007 achievement
Reduction of
54 t-CO_2/year

We have incorporated a power regeneration stand that transforms, recovers and reuses energy that had previously been wasted during hydraulic pump endurance tests and hydraulic motor pre-delivery tests. We will work to install more of these and further reduce CO_2 emissions.

Function/Performance	Pump endurance stand	Hydraulic motor pre-delivery tests stand
Main electric motor electricity consumption	253 kW/2,000 min^{-1}	303 kW/unit (number of motor units)
Recovered electricity	109 kW (43% recovery rate)	
Recovered electricity amount (result)	About 110 MWh (FY2007)	About 40 MWh (FY2007)
CO_2 reduction	About 40 tons	About 14 tons

Power Regeneration Stand for Pump Endurance Tests