

Environmentally Conscious Products

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With our 2010 Environmental Vision goals of "application of Design for Environment to products" and "provision of products that contribute to environmental protection," we intend to contribute to the formation of a sustainable society by offering products and technologies that help protect the environment.

Product Assessment

Every division in the entire Kawasaki Group actively executed product assessment, which is a key technique for Design for Environment.

The Rolling Stock & Construction Machinery Company Decreases Multi Rotor MINI Power Consumption

The Crushing Plant Business Division (now renamed Earth Technica Co., Ltd.) of the Rolling Stock & Construction Machinery Company conducted a product assessment for crushers used for recovering useful resources from waste. We have achieved dramatic energy conservation and resource conservation improvements with our crusher products.

The equipment that underwent the assessments were Multi Rotor products, which are single shaft crushers used for crushing soft materials including plastic, vinyl sheets, fabric, wood and rubber. This assessment led to the development of Multi Rotor MINI products for small-scale crusher plants that do not have material force-feeding systems. Compared with previous crushers, this line of crusher products requires approximately 17% less power.



Multi Rotor MINI

Implementation of Product Assessments in Past Years

FY	2000	2001	2002	2003	2004
Divisions with regulation/ Total divisions	10/14	11/14	10/13*	10/12*	10/12
Cases of product assessment	69	138	123	98	95

*The total has decreased from the previous year due to the integration of two divisions.

Life Cycle Assessment (LCA)

Every division of the Kawasaki Group is attempting to apply LCA as a technique to assess the environmental impacts of its products.

Environmental Control Plant Division Commitment to LCA

The Environmental Control Plant Division is actively involved in LCA research efforts in the environmental business field, taking part in various outside committees that make environmental assessments for waste disposal and perform LCA study activities. In particular, we are involved and cooperating in the development of a software tool that allows efficient implementation of Waste Life Cycle Assessment (WLCA), which we believe will provide an effective means for developing products that are better for the environment.

Examples of Products that Contribute to Environmental Impact Reduction

New Energy-Saving Joining Technique for Aluminum Alloy Components

● Friction Spot Joining (FSJ)

The Corporate Technology Division has been playing a key role in researching the friction stir welding (FSW) technique for joining aluminum alloy components in the manufacture of rolling stock and ships. This technique has already been put into use. Recently, the Consumer Products & Machinery Company has developed and marketed a unique robot that is designed to perform friction spot joining (FSJ), which operates on principles similar to those of FSW. The power consumption of this new technique is at least 95% lower than conventional aluminum welding techniques.

A very common joining technique for light metal used in the bodies and skins of automobiles and rolling stock is resistance spot welding. This technique, however, has several drawbacks including high power consumption because light metal components are joined together using a strong electric current.

With our friction spot joining technique, frictional heat is utilized to soften the joining spots, allowing the components to be joined together. While a cylindrical joining tool having a threaded projection on its end is rotated, the tool is forced into the material, thereby the material is softened with frictional heat and the components are joined together. The only electricity needed is for running the motor that drives the tool. As a result, the electric power needed for our FSJ technique is at least 95% less than conventional resistance spot welding techniques.

Our FSJ system comprising an articulated robot and a special gun has been put in use by some automakers for



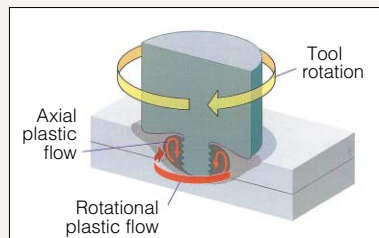
Typical system configuration that combines the special gun and an articulated robot

assembling hoods and doors. Since the ordinary automobile assembly process incorporates scores of industrial robots, adoption of our FSJ system in increasing numbers will lead to decreased power consumption, greatly contributing to CO₂ emissions reduction.

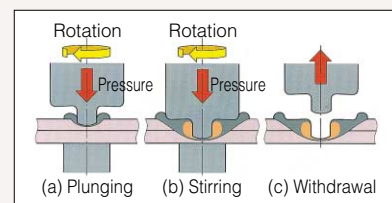
* Suppose that one robot unit performs joining sequences for 1,000,000 joints per year, which is the average for this type of robot, the reduction in CO₂ emissions will amount to approximately 12.3 tons of CO₂ per robot unit every year.

FSJ system: approx. 0.7 t-CO₂/year/system

Resistance spot welding system: approx. 13 t-CO₂/year/system



Friction spot joining overview



Joining process

Green Procurement

To increase our ratio of green products, green procurement should be regarded as one part of Design for Environment practice. Given this, the Kawasaki Group is promoting green procurement in accordance with our Basic Policy of Green Procurement.

The Consumer Products & Machinery Company developed Green Procurement Guidelines that define practices for procuring products and materials and has already begun application of managing, checking and restricting the materials used, beginning with new motorcycle models. It is also verifying the environmental management system of its subcontractors and suppliers.

The degree of progress in conversion to green products varies depending on the type of business of each industry and specific product requirements, but positive efforts are increasingly apparent throughout the Kawasaki Group. Organizations that are actively committed to developing Green Procurement Guidelines include the Aerospace Company, the Rolling

Basic Policy of Green Procurement Implemented in 1999

- ① Environmental impact must be considered across the entire lifecycle of all products from resource mining to waste.
- ② In the selection of a supplier, if multiple suppliers are equal in terms of quality, price and delivery, a supplier who is most seriously committed in environmental conservation is given priority over other suppliers.
- ③ Environmental product information must be obtained from suppliers.

Stock & Construction Machinery Company, and Kawasaki Precision Machinery Ltd.

To rationalize procurement of indirect materials including office equipment, we are introducing an electronic procurement system called "e-bazar" that displays the environmental considerations for each product. This system will allow the Kawasaki Group to realize better management and expansion of green procurement efforts.

注文コード	カタログ名	品名	カタログメーカー名	色	
303935	11.634	BEオリジナル車検受 バイブファイナル100mmブルー-20P	ブルー	ブルー	
		Binet Vel12	275	BEオリジナル	BE2のバイブE2013100
303774	639	BEオリジナル車検受 バイブファイナル100mmブルー	ブルー	ブルー	
		Binet Vel12	275	BEオリジナル	BE2のバイブE2013100
303926	3.642	BEオリジナル車検受 バイブファイナル30mmブルー-10P	ブルー	ブルー	
		Binet Vel12	275	BEオリジナル	BE2のバイブE2013130
303770	385	BEオリジナル車検受 バイブファイナル30mmブルー	ブルー	ブルー	
		Binet Vel12	275	BEオリジナル	BE2のバイブE2013130
303931	13.656	BEオリジナル車検受 バイブファイナル30mmブルー-40P	ブルー	ブルー	
		Binet Vel12	275	BEオリジナル	BE2のバイブE2013130
303932	14.484	BEオリジナル車検受 バイブファイナル50mmブルー-40P	ブルー	ブルー	
		Binet Vel12	275	BEオリジナル	BE2のバイブE2013150
303927	3.858	BEオリジナル車検受 バイブファイナル50mmブルー-10P	ブルー	ブルー	
		Binet Vel12	275	BEオリジナル	BE2のバイブE2013150

Screen from e-bazar

Commitment to Decreasing the Use of Environmentally Hazardous Substances in Motorcycles

● Efforts to Decrease the Use of Four Environmentally Hazardous Substances

In accordance with our Green Procurement Guidelines, the Consumer Products & Machinery Company is committed to decreasing the use of four environmentally hazardous substances (lead, mercury, hexavalent chromium, cadmium).

All newly developed motorcycle models produced from FY2004 onwards are equipped with lead-free wheel balancers. An increasing number of lead-free components are also being incorporated into previous models that are still in production. Furthermore, lead-free coatings are now used on all motorcycles currently being manufactured.

We have virtually completed eliminating the use of mercury except for minute amounts used in components that are absolutely necessary for ensuring traffic safety. In cooperation with component manufacturers, we are also committed to decreasing the amounts of cadmium and hexavalent chromium used in products and developing alternative technologies that enable the production of cadmium-free electronic and electrical components.



Lead-free wheel balancer

Hexavalent chromium has been used in rustproofing for metal components and parts including bolts and nuts. We have been developing an alternative technology for critical motorcycle components and parts such as brakes and engines. For other components and parts, we have been switching to those whose surfaces are treated without hexavalent chromium and will continue to expand our use of hexavalent chromium-free elements. Furthermore, we are developing a new technology to phase out the use of hexavalent chromium for rustproofing aluminum components and parts and for surface preparation before coating aluminum components and parts.



2005 Model Ninja ZX-6R

Environmentally Conscious Products

When developing and designing new products, we always evaluate them from an environmental perspective. We handle a diverse spectrum of products and the nature of the environmental impacts of these products varies greatly. For every product, however, we intend to find and execute

possible improvements for protecting the environment, beginning with the easiest to achieve.

★...Corporate Technology Division, Head Office ●...Rolling Stock & Construction Machinery Company ●...Aerospace Company ●...Gas Turbines & Machinery Company ●...Consumer Products & Machinery Company
 ●...Environmental Control Plant Division / Steel Structure & Industrial Equipment Division ●...Kawasaki Shipbuilding Corporation ●...Kawasaki Precision Machinery Ltd. ●...Kawasaki Plant Systems, Ltd.

Energy Efficiency Improvement and Control of Greenhouse Gas Emissions

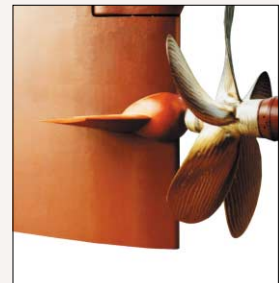
Fuel-Efficient Large Wheel Loader

The new AUTHENT 135ZV model of large wheel loader is our largest product of this kind, boasting a bucket capacity of 9.3 m³ and a vehicle weight of 80 tons. It features better operability and lower fuel consumption due to its three operation modes, unique hydraulic system and tire spin control function. The engine satisfies currently effective exhaust gas regulations and has longer oil replacement intervals, thus contributing to reducing waste emissions. After starting sales in the USA, we released this product in Japan in FY2004.



Energy Saving Rudder Device

The Kawasaki Rudder Bulb System with Fins (RBS-F) is an energy conservation device, consisting of a streamlined bulb and a pair of fins, that is installed on the rudder behind the propeller. By smoothing both the inflow to the propeller and the rotational flow behind the propeller, this system converts otherwise wasted energy into positive propulsion, thereby reducing energy loss and cutting the propulsive horsepower required by 2 to 7%. Capable of improving energy efficiency a great degree, this system has been installed on more than 80 Kawasaki ships during the past 30 years. Since it can be easily retrofitted on already operating ships, we are designing and supplying an RBS-F design for ships constructed by other shipbuilders. The expected results of incorporation of this device, assuming that all vessels with it remain operative for 20 years, are very impressive – a decrease in fuel consumption of 1,000,000 tons and a reduction in CO₂ emissions of 3,000,000 tons.



Energy Efficiency Improvement

Example

● Development of electronically controlled marine diesel engines: realization of low fuel consumption, and reduction in NO_x and dust emissions ● Steam turbine for CCPP: Steam consumption rate has been improved by 2% compared to conventional designs ● Fuel efficiency improvement for motorcycles has been evaluated as a percentage through the product assessment ● Energy-efficient spot joining method for light metal components:

friction spot joining (FSJ) ● A novel bow form "Sharp Entrance Angle bow as an Arrow" (SEA-Arrow) was introduced that, by reducing wave-making resistance, improves the propulsion performance of vessels ● Improved hull form design realizes an efficient LNG carrier able to carry 10,000 m³ (about 7%) more LNG with almost the same fuel consumption as conventional LNG carriers

Control of Greenhouse Gas Emissions

Example

● Wheel loaders: reduced use of air conditioner refrigerant (HFC)
 ● Wheel loaders and road rollers: Instruction manuals and labels specify that recovery of air conditioner refrigerant (HFC) is mandatory

Resource Utilization Efficiency

Lightweight Marine Diesel Engine Designs

Recently, the need for marine diesel engines with higher outputs, compact designs, and improved reliability and maintainability have been increasing. In response to these needs, a new MC-C model based on the conventional MC engine has been proposed. We have completed the world's first machine for one class of this model. We are now expanding production of this and other classes. Compared with the MC model, the MC-C model is approximately 10% lighter while having a 10% greater output. In other words, the MC-C is a compact, resource conserving, environmentally conscious product. Since 1921, we have manufactured 2,500 marine and land diesel engines. We are currently producing marine diesel engines on a licensed production basis, but our Technical Institute and specialists perform design reviews to verify and improve licensor designs.



Product Weight

Example

● Back-up gas turbine generators: Compact designs with greatly reduced weight have been adopted for all 19 models
 ● Weight reduction percentage for motorcycles is evaluated through product assessment
 ● Industrial robots: decreased robot product weight relative to its load-bearing capacity
 ● Adoption of the hovering stage has enabled designs for unique multi-purpose domes (with baseball fields, soccer fields, etc.) to help promote resource conservation

Containers and Packaging

Example

● The wooden crates for tugboat propellers were replaced with steel racks to eliminate the use of wood materials
 ● The packing of Jet Ski engines for export has been converted to a returnable steel pallet
 ● The packing for hydraulic components for export has been converted to a returnable type

Product Service Life

Example

● Model change intervals for motorcycles have been evaluated through product assessment
 ● Composite slab with a truss-type shear connector has realized a highly durable slab for road bridges

Hazardous Substances and Environmental Pollutants Control

● Environmental Protection Measures for Taiwan's High Speed Railway Trains

The 700T train for Taiwan's High Speed Rail Corporation is a low power consumption, low noise, high speed train design based on the technologies of the JR 700 series shinkansen train. To cope with the customer's need to protect the local environment, the outer surface of the train is painted with a coating that does not contain heavy metal (chromium). In addition, a decorated aluminum panel material and an olefin-based material are used instead of PVC for the interior and floor covering of the train to alleviate possible environmental impacts when the train is eventually decommissioned. Furthermore, the drive system on the train utilizes a flexible plate joint that is free from meshing between gears to improve the quietness in the cars.



● Application of Low-Polluting Paints for Aircraft

Introduction of coatings (paints) with reduced environmental impacts is in progress in various industrial fields. In aircraft painting, use of high-solid coatings containing a low level of organic solvents, which have harmful environmental impacts, is increasing. For the small commercial aircraft that we cooperate in producing, approximately 1/3 of the coating materials used are high-solid coatings. We have developed and acquired certification for a high-solid coating that is produced in Japan according to our specifications and have begun its use on applicable aircraft.



Example

- Cleaner exhaust gas from wheel loaders and road rollers
- Motorcycles: promotion of decrease in use of four environmentally hazardous substances (lead, mercury, hexavalent chromium, cadmium)
- Adoption of oil-free hydraulic actuation system for sluice gates: elimination of environmental pollution including oil leakage
- Development of heat insulating polyurethane foam for cargo tanks of LNG and LPG carriers that uses non-ozone depleting fluorocarbon as a foaming agent
- Adoption of chlorine-free coating instead of chlorinated rubber coating for LNG

- carriers, LPG carriers and oil tankers to reduce use of chlorine-based coating
- Ships: In order to decrease use of thinner, a solvent-free coating has been used on the inner surface of fresh water tanks
- Realization of mono-block design of combination control valves for compressed natural gas vehicles
- Study of possible improvements for hydraulic pumps in order to use bio-degradable hydraulic fluid

Waste Disposal and Recycling

● Motorcycle Recycling System Starts

Prior to the enforcement of the Car Recycling Law in Japan, the four domestic motorcycle manufacturers as well as importers jointly and voluntarily created a recycling system for used motorcycles that was put into operation on October 1, 2004. In this system, recycling costs are included in the prices of motorcycles and thus collected from users when they purchase new ones with motorcycle recycling labels. After a used motorcycle is delivered to the system by a user for disposal, the manufacturer or importer is responsible for recycling the used motorcycle. If a motorcycle lacking a recycling label is brought in for disposal, the user is charged for the recycling costs.

Motorcycle recycling label



Ratio of Use for Reusable and Recyclable Parts

Example

- Shield tunneling machines: Reuse system has been implemented

Recovery of Used Products, Containers & Packaging

Example

- Tire rollers: Engine hood material changed from FRP to sheet metal
- Material type is indicated by a symbol on resin components (● wheel loaders, road rollers ● back-up gas turbine generators ● motorcycles ● hydraulic components)

Disassembly times for products

Example

- Wheel loaders, road rollers: decreased use of FRP components that have embedded metal parts
- Decreased numbers of parts in motorcycles

Vibration and Noise Control

● Soundproof Equipment attached to Noise Barriers (Silent Edge)

We have developed unique soundproof equipment with a hybrid structure composed of resonance and noise absorption devices. This equipment has been adopted as a noise countermeasure at the Komazawa Viaduct in the Tokyo Metropolis and at other locations. When tested in accordance with the performance evaluation method of the Ministry of Land, Infrastructure and Transport, this equipment exhibited noise reduction performance of the highest level compared with other products of the same type. Installation of this equipment allows the use of noise barriers with lower profiles on roads, avoiding influences on the surrounding area such as a sunlight blocking and radio wave interference.

Silent edge



Example

- Helicopters: Rotor blade geometry and rotor wingtip form have been optimized to decrease helicopter noise in flight
- Back-up gas turbine generator: New package features an equipment noise level of 55 dB
- Noise prediction and reduction of steel viaduct for railway
- Development of an electro-hydraulic hybrid system (inverter motor-driven pump unit) featuring reduced noise and power consumption

Environmental Protection Products

We are dedicated to continuing to make a wide range of products that help protect the environment by realizing efficient energy utilization, pollution control, waste treatment and recycling. In FY2004, we remained committed to environmental protection by keeping pace with the current legal and

regulatory trends in environmental protection and better understanding social needs by providing a diverse variety of new and proven products.

★...Corporate Technology Division, Head Office ●...Rolling Stock & Construction Machinery Company ●...Aerospace Company ●...Gas Turbines & Machinery Company ●...Consumer Products & Machinery Company
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Energy

● Combined Cycle Power Plant (CCPP)

A CCPP system is a combined power generation system in which a gas turbine generates electricity and, using the waste heat from the gas turbine, a steam turbine creates electricity. We use the L20A, one of the world's most efficient gas turbines, as the core of its CCPP system. With this system, we are expanding our power generation plant business to achieve comprehensive energy efficiency improvement and CO₂ emissions reduction. In July 2004, we delivered a CCPP system rated with a total output of 50 MW to the Chiba Mihama Power Generation Project.* This system, designed for total optimization, consists of the L20A and other main equipment produced by Kawasaki.

*Heat-electricity supply project undertaken by Sumitomo Corporation in which heat and electricity are supplied to multiple factories and surplus electric power is sold to consumers.



● Wind Turbine Generation System

We actively participate in the field of wind turbine generation. For example, we are an investor in the Japanese representative of Vestas, the company that boasts the largest share in the global wind turbine generation market, and has already completed a total of 32 wind turbine generation systems throughout Japan. In June 2004, we, together with Penta-Ocean Construction, won a contract to construct a wind turbine generation system for a large-scale wind turbine generation plant. This system boasts six 2,000 kW-class wind turbines, which are among the largest generators of their kind in Japan, with a total output of 12,000 kW. This system will be constructed in FY2005 at the seaside of Setana-cho, Hokkaido, where we have already delivered Japan's first offshore wind turbine generation system.



★ New Type of Battery (Gigacell)

We are developing a new Ni-H battery that does not contain hazardous heavy metals such as lead and cadmium. This new battery features a greater output and higher power storage efficiency since its scale can be increased for larger capacities and higher voltages, but its structure is simple, so it can be disassembled and recycled simply. This battery will find applications in wind power, solar power and other natural energy-based power generation systems where power outputs tend to fluctuate, as well as in factories whose power requirement can vary greatly.



Conservation and Effective Utilization of Energy

Product

- Gas turbine cogeneration system
- Waste heat recovery boiler
- Cement plant waste heat power generation system
- Top-pressure recovery plant for blast furnace
- Stirling engine power generator
- Ice storage cooling system
- District heating and cooling system
- Optimization and diagnosis of industrial energy system

Research & Development

- Ceramic gas turbine
- Fuel cell power system

Renewable Energy System

Product

- Photovoltaic system
- Geothermal generation system
- ★ ● Woody biomass power generation system

Research & Development

- ★ Black liquor gasification technology

New Energy System

Product

- Liquid hydrogen container

Air Pollution Control

■ Reaction Analysis for Flue Gas Desulfurization System

There have been few studies with detailed models for very complex and unique reactions such as those in flue gas desulfurization system where chemical substances are dissociated into ions in aqueous solution. We are aiming to establish a reaction simulation technique that eliminates empirical approximations for these types of electrolyte ion reaction problems. Through research on this technique, we will be able to design and develop optimized flue gas desulfurization system that satisfies varying needs including equipment for the Chinese market where design requirements greatly differ from those of the Japanese market.



SOx/NOx Reduction, Dust Collection

Product

- De-NOx plant and dust collector for flue gas
- Low-NOx gas turbine generation system
- Low NOx coal burning boiler
- Low NOx heavy oil burning boiler
- NO₂ removal system for road tunnel
- Ventilation filter for road tunnel
- Electrostatic precipitator for road tunnel

Research & Development

- ★ Motorcycle exhaust gas purifying catalyst

Air Pollution Control

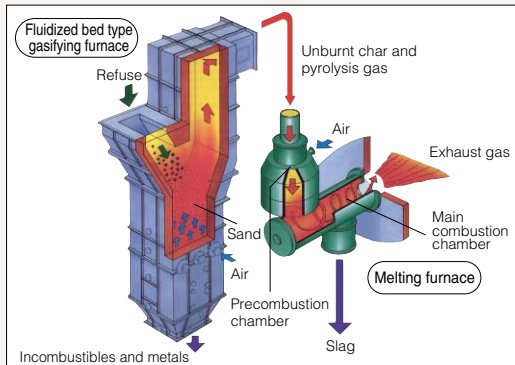
Product

- ★ Photocatalyst

Waste Treatment and Recycling

● Fluidized Bed Type Gasifying-Melting Furnace

This system, which gasifies refuse in a fluidized bed type gasifying furnace and then melts ash in the melting furnace, has the advantage of melting ash by using the energy of the refuse itself and is intended to reduce the impact on the environment and operate economically. In FY2004, we won a contract for constructing a gasifying-melting furnace with a daily capacity of 300 tons, which is the first of its kind in the Tokyo Metropolis.



■ Melt State Polymerization System for Chemical Recycling of PET Bottles

The PET bottle recycle process consists of the units including crushing, foreign material removal, rinsing, depolymerization to monomer, purification (so-called thin-film evaporation), and repolymerization of PET material via Melt State and Solid State Polymerization System, and so on. We provided the Melt State Polymerization System for the recycle plant constructed in Kawasaki City, Japan, in 2004. This plant can first regenerate PET resin from recycled bottles with the same quality of PET resin from virgin raw material. We will remain committed to recycling efforts to conserve precious resources with our accumulated expertise.



Waste Incineration

Product

- High-performance refuse incineration system (Stoker-type furnace, Internal circulation fluidized bed type furnace)
- Refuse gasifying-melting system (Shaft-type gasifying-melting furnace)
- High-efficiency refuse power generation system (Power generation from refuse combined with gas turbine)
- Waste-to-energy system (RDF power generation, Kraft recovery boiler, etc.)
- Flue gas treatment system for dioxin removal
- Dioxin thermal decomposition system for fly ash

Research & Development

- Monitoring technology for dioxin surrogates

Crushing and Sorting

Product

- Bulky waste crushing and recycling system
- Waste automobile/electrical appliance crushing and recycling system
- Construction waste crushing and recycling system

Recycling, Pollution Control

Product

- Refuse incineration ash treatment system (Melting)
- Refuse derived fuel (RDF) production system
- Refuse paper and plastic fuel (RPF) production system
- Refuse melting slag utilization system
- Food waste treatment system (Methane fermentation, Compost, Feed, etc.)
- Livestock waste treatment system (Methane fermentation, Compost, etc.)
- Coal fired boiler's ash recycling system (Road base material, etc.)
- Ultrasonic air filter cleaning system (Reuse of air filter)

Research & Development

- Refuse incineration ash utilization technology
- Organic wastes treatment technology (Gasification, etc.)
- ★ Refuse gasification power generation technology
- PCB decomposition technology

Radioactive Waste Treatment

Product

- Radioactive waste treatment system

Research & Development

- Nuclear reactor decommissioning technology

Water and Soil Pollution Control

● On-Vehicle Sludge Drying System

This unique system accepts sludge from sewage treatment facilities and dries, deodorizes and forms the sludge on site to convert it into useful resources such as fertilizer and solid fuel. This on-vehicle system contributes to cost reduction for sludge disposal at small and medium sewage treatment facilities and decreases the amount of sludge disposed of as landfill.

Drying is achieved with the exhaust gas from the compact gas turbine generator within the system, and the electricity generated by the generator is used to drive the whole system. As a result, greater thermal efficiency is achieved and the CO₂ emissions from the system are decreased.



Sewage/Sludge Treatment

Product

- Sewage/sludge treatment system
- Membrane type water treatment system
- Sewage sludge processing system (Transformation of sludge into activated charcoal, fuel, fertilizer, etc.)

Decontamination of Contaminated Soil

Research & Development

- Cleaning technology for dioxin polluted soil