Eco-creative Activities

Green Design and Green Manufacturing Lines

Summary : The Yokogawa Group has expanded the scope of environmentally friendly design rules year by year. In fiscal year 2002, the Group enacted the "Guidelines for Designing Energy-conservation Products." The Group also implemented the "Green Manufacturing Line Improvement Rules," which was enacted last fiscal year, at the Kofu plant on a trial basis and obtained excellent results in energy saving, resource efficiency, toxic substance reduction, and waste reduction. With two new models registered as Eco-labeled products, we now have a total of ten such product models.

1. Guidelines for Designing Energy-conservation Products

Since 1997, the Yokogawa Group has progressively enacted guidelines and standards for designing environmentally friendly products. In fiscal year 2002, we enacted the "Guidelines for Designing Energy-conservation Products" which prescribes items to be observed for energy efficient designs.

Our LCA analysis of Yokogawa Group products revealed that the biggest environmental burden was the power consumed when used. In addition, some products consumed much power during manufacture, even though power consumption during usage was relatively small. Thus, we enacted the "Guidelines for Designing Energy-conservation Products" to reduce environmental burdens both when products are manufactured and when they are used. This guideline will apply to all newly developed products, and is summarized below.

(1) Energy efficient design technologies for products

a. Low power designs
Low power designs focus on using efficient switching power supplies or inverters and reducing power consumption during standby. The guideline also suggests reducing the voltage of circuits, using products that consume little power, increasing the integration of circuits, and using low power elements.

b. Energy efficient controls
The guideline encourages the use of standby mode, in which products are turned off when not in use, and intermittent operation provided it does not affect their functionality.

c. Mechanisms and constructions
The guideline gives examples such as thermal designs including heat insulation designs and local emissions, rotating equipment with less friction, pneumatic equipment that reduce air consumption, and optical equipment that prevents optical losses.

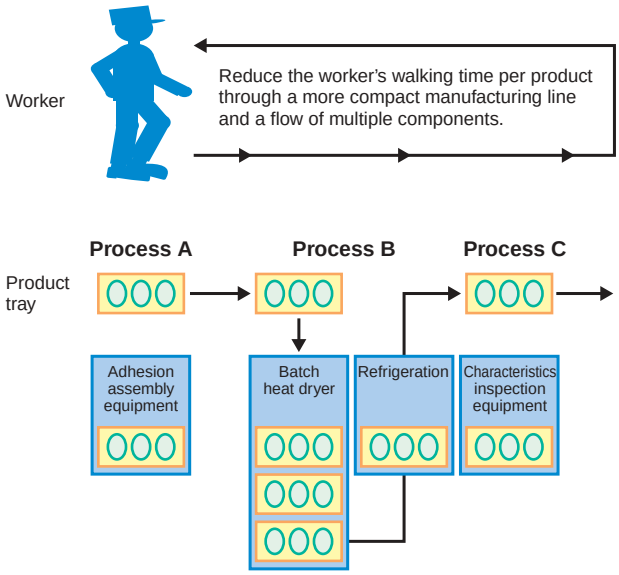
(2) Energy efficient design technologies for manufacturing

These technologies focus on the following:

a. Use less energy for machining and other purposes.
b. Reduce machining energy, heat emission energy, and operation energy by using smaller parts.
c. Use more automatic machines that assemble multiple components.
d. Consider manufacturing facilities, process flows, and the working environment.
e. Work closely with manufacturing personnel, manufacturing engineers, and product design engineers.

Based on the above, the guideline shows how to increase energy efficiency during the manufacturing design stage with respect to automation, product weight/volume/size, working environment, quality accuracy, facility maintenance, lead time, etc., according to manufacturing processes such as parts machining, assembly inspections, surface processing, heat processing, molding, arrangement and storage.

An example of energy-efficient manufacturing lines is shown below. The worker is responsible for processes A to C, moves to these processes one by one while setting products to respective facilities, then goes back to the original process to meet the cycle time.

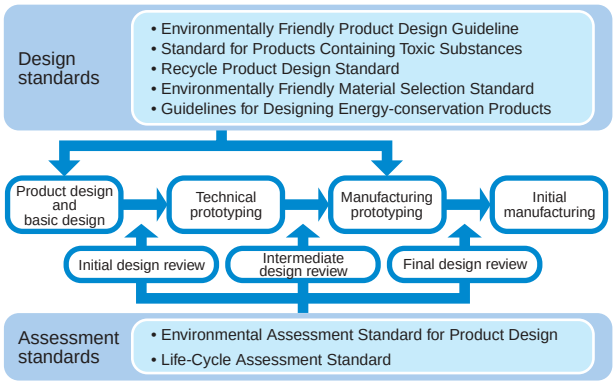


Energy Considerations in Each Process		
Process A	Process B	Process C
• More compact products enable multiple products to flow. • More compact facilities reduce power consumption. • Unified directions of machining and assembly simplify equipment operations.	• More compact products enable multiple products to flow. • More compact heat furnaces reduce lead time and power consumption. • Optimize the number of products for heat processing to achieve a balance between cycle time and heat processing time. • Choose adhesives with less volatile substances to simplify ventilation facilities.	• More compact products enable multiple products to flow. • Unify connectors for use in inspections. • Establish common inspection methods among multiple models.

An Example of Energy-efficient Manufacturing Lines

2. Guidelines and Standards for Environmentally Friendly Design

The Yokogawa Group purchases "green" parts and materials and follows guidelines and standards for providing environmentally friendly products. Guidelines and standards other than the "Guidelines for Designing Energy-conservation Products" are given below.



Environmentally Friendly Design Standards and Assessment Standards

(1) Environmentally Friendly Product Design Guideline

Enacted in 1997. This guideline defines mandatory rules on environmentally friendly product design, and addresses aspects such as the design of long-life products, design of energy-efficient products, design of resource-efficient products, selection of materials and parts, and selection of machining and assembly methods that take recycling and disposal into account. This guideline not only aims to reduce environmental burdens at the initial stage of design but also considers recycling and disposal.

(2) Environmental Assessment Standard for Product Design

Enacted in 1997. This standard specifies eight aspects for assessment: (a) ease of recycling and processing, (b) resource efficiency, (c) energy efficiency, (d) long-term use, (e) ease of collection and transportation, (f) safety and environmental protection, (g) disclosure of information, and (h) packing. Each aspect contains detailed assessment items (29 items in total), which are assessed at the stages of initial design, intermediate design, and final design. Assessment criteria and pass/failure judgment criteria are shown below.

(1) Timing	Initial design review/intermediate design review/final design review
(2) Assessment item	29 items such as ease of recycling and processing, resource efficiency, energy efficiency, long-term use, ease of collection and transportation, safety and environmental protection, disclosure of information, and packing.
(3) Assessment criteria	Zero point if a product design does not comply with laws and regulations. Four points if a product design complies with laws and regulations and also exhibits an improvement of 30% or more. Three points for an improvement of 15% or more. Two points for an improvement of 5% or more. One point for an improvement of less than 5%.
(4) Pass/fail judgment criteria	Pass means that a product design does not have 0 point in any of the evaluation items and that its total evaluation score exceeds those of existing models. Fail means that a product design has 0 point in at least one of the evaluation items or that its total assessment score is equal to or less than those of existing models. A guideline sets a target for improvement of 25% or more and encourages the reduction of environmental burdens in product design.

Environmental Assessment Standard for Product Design

(3) Standard for Products Containing Toxic Substances

Enacted in 1998. This standard encourages the selection of environmentally friendly parts and materials at the design stage. Design engineers are required to use this standard to check through the "Product Design Assessment Review Document" to ensure that selected parts or materials do not contain prohibited substances (nine substances such as designated bromic flame retardants or trichloroethane).

(4) Life-cycle Assessment Standard

Enacted in 1999. This standard concerns the assessment of energy used, amount of carbon dioxide emissions, amount of NOx emissions, amount of SOx emissions, and other aspects in advance in the lifecycle of materials, parts, machining/assembly, distribution, usage, and disposal. If the values for a new product are lower than those of existing products, the product passes and can be commercialized. This LCA analysis is done during the review at the initial, intermediate, and final design stage. Design departments are required to create "LCA calculation sheets" which record the LCA analyses, and to obtain approval from development representatives.

(5) Recyclable Product Design Standard

Enacted in 2000. This standard focuses on improving product recycling for building a recycling-based society. It contains classifications of material level, part level, product level, and packing level. It defines mandatory rules for product design in line with the 3Rs: to "reduce" the waste from used products or parts, and to "reuse" and "recycle" used products.

(6) Environmentally Friendly Material Selection Standard

Enacted in 2001. This standard defines criteria to be met when selecting environmentally friendly materials. The "environmentally friendly materials" in this standard are materials that contain no toxic substances and/or that are easy to recycle. The standard requires design engineers to select materials so as to minimize risks to the environment or human health at all stages from manufacturing to disposal of products. Particularly, the standard clearly requires that hexahydric chromium and halide flame retardants, which are highly poisonous, must not be used. The standard also introduces concrete, recommended goods and provides precautions for use so that engineers can preferentially select chromium-free steel plates, chromium-free film processing, halogen-free plastics, halogen-free printed boards, etc.

3. Green Manufacturing Line Improvement Rules

Enacted in March 2002. The objectives are to improve the environment by building environmentally friendly manufacturing lines, raising productivity with fewer resources, reducing the environmental burden, avoiding environmental risks, and decreasing the manufacturing cost. Evaluations after improvements are as follows: For each item in the "energy efficiency" objective category, the evaluation rating is "AAA" if the item was improved by 6% or more, "AA" if improved by 3% or more, and "A" if improved by 1% or more. For resource efficiency, toxic substances, and waste, the evaluation ratings are "AAA" if the item was improved by 20% or more, "AA" if improved by 10% or more, and "A" if improved by 5% or more. In fiscal 2002, we applied these rules to the manufacturing lines at the Kofu plant. We used the Green Manufacturing Assessment Sheet to analyze and evaluate each line, and identified areas for improvement.

The Kofu Manufacturing Department #1 worked on raising the energy efficiency in clean rooms. It defined and strictly observed seasonal criteria for the temperature settings of machines in air-conditioning rooms at 16 locations and periodically cleaned the filters. As a result, it reduced energy usage from 1,610 MWh/year to 1,315 MWh/year and was rated as AAA. The Kofu Manufacturing Department #2 focused on reducing ethanol which is used for cleaning products before packing. It successfully reduced the amount used from 144 L/year to 96 L/year by cleaning the exteriors with water instead of ethanol, and was rated as AAA.

The Kofu Manufacturing Department #3 worked on reducing cyanogen waste which is generated in the plating process. It used to subcontract a waste service company to process cyanogen waste once a month, and was able to reduce the subcontracted amount from 14.5 tons/year to 3 tons/year by performing detoxification internally, and was rated as AAA. Since 2001 it has also strived to reduce the amount of cyanogen used, cutting back from 900 kg/year in fiscal 2000 to 450 kg/year in fiscal 2002. The next step is to analyze how cyanogen is used and check the quality of substitute substances, eventually aiming to eliminate the use of cyanogen entirely.

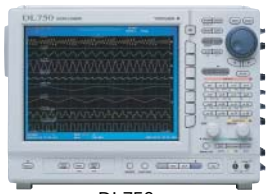
The Kofu Manufacturing Department #4 focused on raising the energy efficiency of manufacturing lines. It set the time of turning on the cleaning equipment and soldering dip tanks to the exact work start time so that unnecessary residual heating was eliminated. As a result, the Department reduced energy usage from 199 MWh/year to 192 MWh/year and was rated as AA.

The Printed Board Manufacturing Line selected the theme of raising resource efficiency and reducing toxic substances. For resource efficiency, this department successfully reduced the filters of filter presses used for sludge processing by 83%. For toxic substances, it reduced the amount of caustic soda (neutralizer) by 29.7%, hydrochloric acid (ion exchange resign regenerant) by 60.8%, and ferric chloride (flocculant) by 29.4%. This section was rated as AAA for all of the improvements.

Although these improvements based on the Green Manufacturing Line Improvement Rules are not revolutionary, steady improvements in manufacturing have produced excellent results. The Kofu plant will continue these activities in new areas, and the Yokogawa Group will apply these rules to all of the Group firms.

4. Eco-labeling

In 1999, the Yokogawa Group adopted ISO14021-stipulated Eco-label Type II, an environmental labeling based on self-declarations without independent third-party certification, the first measuring instrument manufacturer to do so. Eco-labels are displayed on those products that were designed according to the Environmental Assessment Standard for Product Design on page 25, exhibit superior environmental performance to respective earlier models or similar products of other suppliers, and aid customers in their environmental protection activities. The label of a green leaf features a meter, symbolizing our business, as a motif and displays environmental information such as particular refinements and features of the corresponding product beneath the meter symbol. Five models were registered as Eco-labeled products in 1999, one model was added in 2000, two in 2001, and two in 2002, totaling ten Eco-labeled products to date. The two models in fiscal 2002 are the Digital Oscilloscopes DL1640/DL1640L (see page 27 for details) and the ScopeCorder DL750. The DL750 model is far more resource efficient because it is half the volume of the existing DL716 model, and yet it has four times more memory and three times the accuracy/bandwidth.



DL750

DL1640L

Volume is half that of DL716.

Power consumption is one-third that of DL1540C/DL1540CL.

Green Products

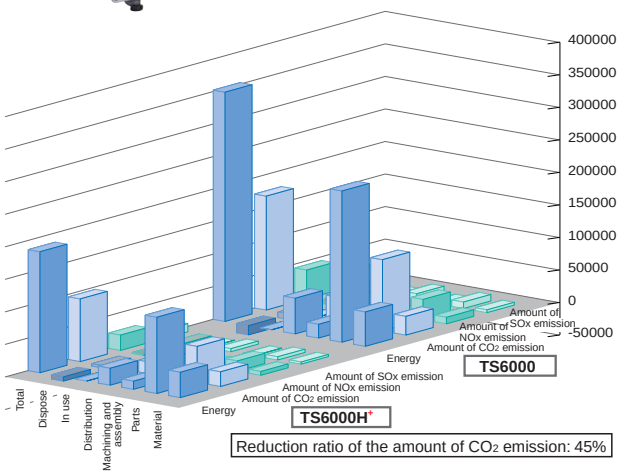
Summary : The Yokogawa Group develops new products according to the Environmental Assessment Standard and the Life-Cycle Assessment Standard. Two typical examples of products developed in fiscal year 2002 are introduced below. The LSI Test System achieved higher integration of parts, reduction in number of parts, and more compact design, while the Digital Oscilloscope realized improved circuits, reduction in number of parts, more compact design, and lighter weight. These improvements greatly reduced emissions of carbon dioxide and NOx and consumption of energy.

1. TS6000H+ LSI Test System

SoC (System on Chip) testers are used to test the logic of system LSI and high-performance IC. Specifically, SoC testers are used to test whether system LSI, which are highly integrated semiconductors, function properly and whether they can perform correct logical operations or not. The conventional model is the TS6000. We developed a new product, the TS6000H+, which offers outstanding functionality and performance and takes account of environmental friendliness.

Compared to the conventional model, the new product uses fewer parts through increased integration and has a more compact design: the printed boards that contain parts are 60% of the conventional size. In terms of functionality, the new product offers more test frequencies and test pins, and also incorporates a new test solution called "V-R TestPlanner®" for test debugging before completion of devices, thereby reducing the period from LSI design till testing. As a result, the emission of CO_2 is reduced by 45%, NOx by 46.7%, SOx by 45.3%, and energy consumption by 45%.

TS6000H+



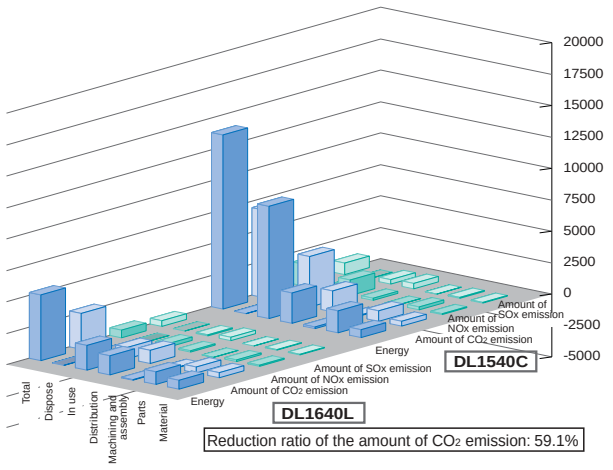
Inventory Comparison between Target Product (TS6000H+) and Conventional Product (TS6000)

2. DL1640/DL1640L Digital Oscilloscope

(See page 26 for photo of DL1640L.)

The Yokogawa Group produces a huge range of electronic measuring instruments, one of which is digital oscilloscopes. These are used in all areas of design, development, and operation of electronic equipment and so must offer high cost-performance. The Group has addressed itself to the development of environmentally friendly products, not to mention meeting this requirement. In fiscal year 2002, we developed DL1640/DL1640L models featuring 200-MHz bandwidth and 8-M/32-M Word maximum record lengths. By reviewing the circuits and integration of parts, we successfully reduced the number of parts used from 1,800 to 1,550, and so reduced the weight from 4.9 kg for the conventional model to 3.9 kg, and the volume from 16 liters to 11 liters; the new compact design has only an A4 footprint or smaller. Furthermore, the power consumption was reduced by 18% from 93 W to 76 W, thereby reducing the calorific power. As a result, environmental burdens were reduced as shown in the illustration below according to inventory comparisons using life-cycle analyses.

	New Product (DL1640L)	Conventional Product	Reduction Ratio (%)
Energy	5420 MJ	14300 MJ	62.2
CO_2 emission	295 kg	721 kg	59.1
NOx emission	633 g	1780 g	64.5
SOx emission	466 g	947 g	50.8



Inventory Comparison between Target Product (DL1640L) and Conventional Product (DL1540C)

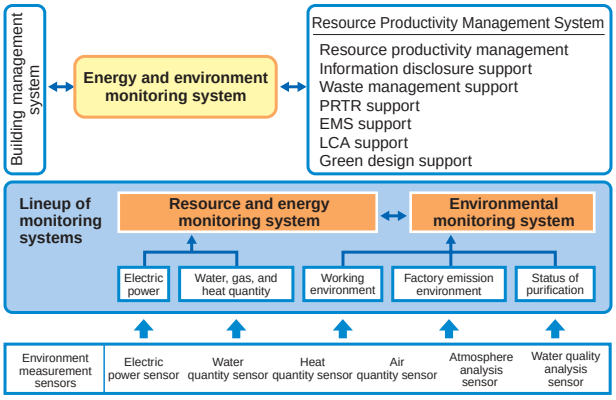
Environmental Solution Proposals

Summary : By applying environmental measurement technologies, the Yokogawa Group has provided corporate customers and society with its technologies and know-how in the form of "solution proposals," thereby reducing environmental burdens and helping to build recycling-based social systems. Typical examples are monitoring systems for energy efficiency measures, measurement systems for soil pollution measures, engineering services for improving boiler operation efficiency, and a method to supply oxygen to bottom layers of lakes, marshes, and dams.

1. Energy and Environment Monitoring Systems and Services

The Yokogawa Group provides energy and environment monitoring systems as tools for energy and resource efficient solutions. Having demonstrated the benefits of these systems at the Kofu plant, the Group is now providing customers with such products. The concept is to provide "industrial solutions to create the ultimate factory with integrated manufacturing and environment controls for realizing a sustainable society." We do more than just provide tools: we also propose energy efficiency and cost savings based on the energy data simulations and customers' data. By "selling results instead of tools," we increase the energy efficiency of our customers.

One example is the application of energy control systems on utility facilities at customer premises, where we implemented the following steps: (1) analysis, (2) proposal, (3) implementation and verification, (4) restraint mechanism (i.e., incorporation into management standards), aiming to recoup the cost of installing the system in about five years. We proposed several improvements including the monitoring and analyses of energy usage by installing systems for monitoring electric power at 50 points, air velocity and pressure at two points, well water velocity at three points, and temperature at eight points, the elimination of unnecessarily processes, and reviewed measures for efficient utilization. As a result, electric power usage was reduced by 765 MWh and water by 2,760 tons annually, yielding an annual cost saving of about 12 million yen.



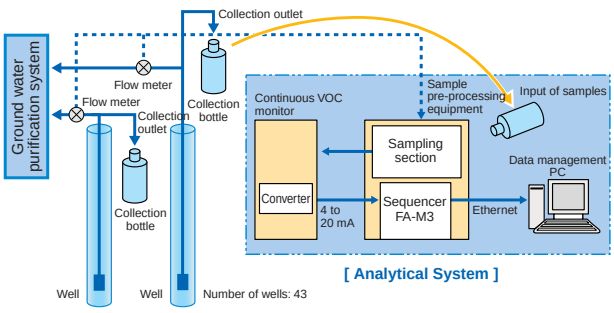
Energy and Environment Monitoring System

2. Continuous VOC Monitor (VM500)

As old factory sites have been redeveloped, contamination of soil and groundwater with heavy metals and/or volatile organic compounds (VOC) has been increasingly revealed. The Soil Contamination Control Law was therefore drawn up and enacted in February 2003. Accordingly, the Yokogawa Group developed the VM500 Continuous VOC Monitor, and offers soil and groundwater VOC measurement solutions using this product. The VM500 monitor measures VOC automatically, and drastically reduces the time and cost in combination with semi-automated sampling systems.

Generally, VOC concentration measurements are used to check the existence of contamination and progress of remediation works. In particular, for the latter, many points must be measured simultaneously and over a long time, and it's often also necessary to simultaneously measure the amount of groundwater that has been pumped up. The time, labor and costs involved in all these efforts tend to become immense, so the Yokogawa Group has developed a quick low-cost measuring method; one good example of this concept is contamination purification. In this example, 43 pumping-up wells were used and it was necessary to measure groundwater drawn from pumps installed more than ten meters below ground and then to process the data. This work had to be done every day for at least three months and then every two or three days thereafter. The conventional manual approach would have required many man-hours, but with our VM500 model and automation of pre-measurement works, just one-third of the labor force and processing time were required.

VM500



System Configuration

3. Boiler Operation Efficiency and Improvement Support (Dr. Y.E.S)

Among industrial equipment, boilers which burn fossil fuels must be improved to counter global warming, because many of these facilities do not have sufficient energy efficient controls. Thus, the Yokogawa Group provides an engineering service solution called "Dr. Y.E.S". This is an engineering consultation in which experienced measurement control engineers of the Group and engineers of a boiler manufacturer jointly carry out diagnostics of entire boiler facilities and improvement activities (environmental protection measures and operation cost reduction). The service helps improve boiler efficiency, reduce cost, and lower the environmental burden by controlling oxygen values in exhaust gas, stabilizing drum levels, controlling the rotation speed of feed pumps, etc. We first carry out "simple boiler diagnostics" to identify problems, and then propose "optimum boiler tuning" and provide boiler control training. Some examples of improvements are listed below.

Adoption of oxygen control	Flue gas oxygen control optimally set the air-fuel ratio, reducing the annual fuel bill for heavy oil by approximately 2 million yen. It also reduced the annual emission of carbon dioxide by approximately 260 tons.
Drum level stabilization control	Minimizing the heat loss caused by fluctuations in the drum level reduced the annual fuel bill for heavy oil by approximately 1.3 million yen. It also reduced the annual emission of carbon dioxide by approximately 140 tons.
Tuning of feedwater pump speed control	Proper control of the feedwater pump speed to regulate the discharge pressure to the minimum level reduced the annual power consumption by approximately 6 million yen. It also reduced the annual emission of carbon dioxide by approximately 210 tons.
Stabilization of main steam temperature	Modifying the control circuits of main steam temperature made it possible to limit fluctuations of main steam temperature up to ±2.5°C, reducing the annual fuel bill for heavy oil by approximately 3 million yen. It also reduced the annual emission of carbon dioxide by approximately 420 tons.

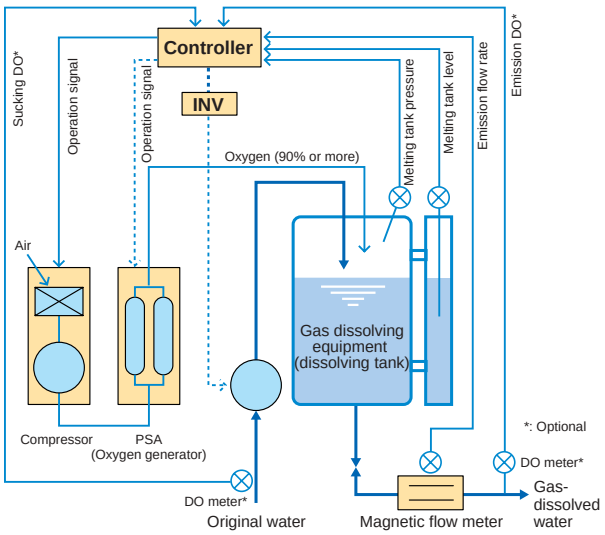
* One ton of carbon dioxide is equivalent to the amount emitted when a car drives 5,263 km.

4. Oxygen Supply Method through Gas Melting Equipment

Domestic wastewater, stock farm wastewater, and industrial wastewater flow into lakes, marshes, dams, and reservoirs, which trigger some types of plant plankton to grow abnormally. Dead planktons precipitate at the bottom and are digested by microbes. However, if oxygen is not supplied sufficiently from surface layers to bottom layers, the bottom layers become oxygen-deficient, causing substances accumulated at the muddy bottom to degrade the water environment in many ways. However, conventional improvement methods may stir up the mud and adversely affect water quality. Thus, we developed a system to supply oxygen efficiently to bottom layers only by using gas dissolving equipment to dissolve oxygen into water at high concentration, and have carried out verification experiments towards commercialization.

The gas dissolving equipment makes it possible to dissolve various types of gases into water at supersaturation. In the case of oxygen dissolution, original water is supplied to a dissolving tank as shown in the figure below. Then, oxygen at approximately 90 to 95% concentration is supplied into the same tank from the oxygen generator so that oxygen-dissolved water can be supplied at high concentration. We applied this system to the Miharu Dam in Fukushima Prefecture. We carried out experiments jointly with the Public Works Research Institute and Matsue Civil Engineering and Construction Co., Ltd. and confirmed that insufficient oxygen could be efficiently restored at lakes, marshes, and dams. We plan to conduct these experiments for three years and to continue to monitor how the water quality is improved. We have also implemented validity experiments of the oxygen supply method through gas dissolving equipment in such projects as the water quality experiments of phosphorous and nitrogen dissolving controls with the Lake Biwa-Yodo River Water Quality Purification Joint Center (Biyo Center) and the insufficient oxygen countermeasure experiment at the Ohashi River in Matsue City, Shimane Prefecture.

External View of Gas Dissolving Equipment



System Configuration of Gas Dissolving Equipment

In addition to the above, we have other solutions such as the "Econo-Pilot" energy saving system for water pumps (see page 16) and the "Eco-based Monitoring System (EBMS)" solution for avoiding soil and ground water contamination risks, which we developed in cooperation with Kajima Corporation. We will continue to propose solutions to tackle global environmental problems.