The Showa Denko Group contributes to the sustainable growth of society through its activities, products, and services.

Special feature 1  Realizing a sustainable society

**Utilizing the full power of the Group to reduce greenhouse gas emissions**

The Showa Denko Group develops next-generation technologies to help build a sustainable society.

**Low-Carbon Society = The battery age will be coming soon**

The Showa Denko Group is focusing on the development of lithium-ion batteries and fuel cells.

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Special feature 2  Dialogue with society through recycling businesses

**21,673 attend eco plant tours**

The plastic chemical recycling facility at the Showa Denko Kawasaki Plant. More than 20,000 visitors have toured this facility, one of the very few of its kind anywhere in the world.

**Supporting people with links to the community by collecting aluminum cans**

In addition to manufacturing aluminum cans, the Showa Denko Group continues to collect aluminum cans for reuse as raw materials.
Utilizing the full power of the Group to reduce greenhouse gas emissions

Recognizing that its businesses have a major impact on the earth's environment, the Showa Denko Group contributes to the realization of a sustainable society through the development of next-generation technologies as well as the promotion of various measures, including highly efficient operation, energy conservation, and shift to alternative raw materials and fuels.

Reducing greenhouse gas emissions

The year 2009 was the second year of the Kyoto Protocol commitment period. Progress in environmental measures, such as the GHG decomposition unit installed at the Kawasaki Plant and shift to fuels with lower GHG emissions, combined with the effects of production cuts, resulted in a decrease of 11% vs. the base year on average over the commitment period (the first two of five years).

Results showed that unit energy consumption fell to 92% of the base-year level, as in 2008, due to the effects of reduced production.

This year, we renovated our ethylene plant at the Oita Complex, introducing naphtha cracking furnaces with higher efficiency and improving the heat recovery/distillation systems. This renovation has enabled us to reduce CO₂ emissions by 59,000 tons a year, helping us achieve the reduction targets for the 2008-2012 period without the use of emissions trading.

We are considering additional measures for energy conservation and efficiency improvement to achieve long-term goals, in preparation for the new medium-term business plan for 2011 and after.
Greenhouse gas emissions*1 performance and goals; unit energy consumption*2

*1 Greenhouse gas emissions
This refers to the volume of emitted greenhouse gases under Japan’s Act on Promotion of Global Warming Countermeasures. Through fiscal 2008, this law applied only to large-scale enterprises; it has since been amended to cover all enterprises. Thus, the figure for fiscal 2009 in this report covers even small-scale facilities without manufacturing functions, such as head office and branch offices. These figures do not include emissions from the transportation sector. See pages 79-80 for greenhouse gas emission from the transportation sector.

*2 Unit energy consumption
This refers to unit energy consumption for Showa Denko K.K., based on the voluntary targets of the Japan Chemical Industry Association.
This figure represents the total consumption of energy necessary to produce one unit of a product. A lower figure means production is being carried out more efficiently and with a lower environmental impact.
Showa Denko Group's Efforts

**Kawasaki Plant**

*Plant participates in joint project at the Chidori and Yako complexes*

The Kawasaki Plant is currently participating in a joint project to recycle the steam used in power generation at Tokyo Electric Power’s Kawasaki Thermal Power Plant, supplying this steam to plants operated by ten companies in the nearby Chidori and Yako districts.

Plans call for this project to supply approximately 300,000 tons of steam per year. Supply of steam began in February 2010. This project is expected to save fuels equivalent to 11,000 kiloliters of crude oil and reduce carbon dioxide emissions by 25,000 tons per year as the ten companies.

**Showa Denko Electronics K.K.**

*Reductions in power consumption relating to air-conditioning in clean rooms*

Showa Denko Electronics is producing HD media for use in PCs and other devices, and developing LEDs that are expected to serve as the next-generation lighting technology. The power consumption due to air-conditioning in the clean rooms for the manufacture of these products accounts for roughly one-half of all the energy used by the plant.

Last year, the company made efforts to reduce power consumption relating to air-conditioning in clean rooms, by adjusting the volume of outside air intake in accordance with Japan’s characteristic seasonal changes, sharing air-conditioning equipment with other parts of the plant, and using refrigerator waste heat. As a result, the company saved electricity and steam equivalent to 2,200 kiloliters of crude oil - corresponding to about 10% of the energy use by the plant as a whole - and reduced carbon dioxide emissions by 3,000 tons.
Resource-and energy-conservation technologies; topics for 2009

Environmental and energy-related social issues are expected to increase, including climate change and the declining availability of mineral resources such as crude oil. Demonstrating the full range of its capabilities as a chemical company with special strengths in inorganic materials and metals, the Showa Denko Group is committed to building a sustainable society by creating and providing innovative technologies in areas related to the environment and energy. Introduced below are some topics that emerged in 2009 in relation to technological developments in environment and energy.

TOPICS1

Increasing the light output efficiency of organic electroluminescence (EL) devices

Organic EL devices are light-emitting devices based on organic compounds. Applications include low-energy light sources in mobile-phone displays. Organic EL devices have high theoretical energy efficiency; in contrast to LEDs, which are point light sources, the entire surface of an organic EL device emits light. For these reasons, organic EL devices are expected to become next-generation energy-saving light sources. By improving light output efficiency, the Showa Denko Group has achieved a 30 lm/W emissive efficiency for its coated phosphorescent-polymer-based organic EL devices. This represents the world’s highest level of emission efficiency for coated organic EL devices. Through the development and provision of high-efficiency organic EL devices, we intend to help develop next-generation energy-saving lighting equipment and build a sustainable society.

TOPICS2

Mass production begins for silicon carbide (SiC) epitaxial wafers with very smooth surface

Expectations are high for popularization of hybrid and electric vehicles, with their significant potential to fight global warming. SiC power semiconductors have gathered attention as power control devices for use in such eco vehicles. Not only are SiC power semiconductors smaller and lighter than the mainstream silicon (Si) power semiconductors used today, they cut energy loss in the power control process to roughly one-tenth that of Si power semiconductors. The Showa Denko Group has begun mass production of SiC epitaxial wafers with the world’s highest level of surface smoothness. By rapidly developing and introducing next-generation SiC power semiconductors for eco vehicles and other products, the Group will contribute significantly to the emergence of a “low-carbon” society.
Commencement of incinerator-based thermoelectric power generation experiments

Estimates suggest 70% of the energy used in Japan is released into the environment as waste thermal energy. Thermoelectric power generation is a new technology that puts this massive amount of unused energy to effective use by converting thermal energy into electricity. While the development of thermoelectric power generation is already under way for lower-temperature environments such as hot springs and diesel engines, the Showa Denko Group has begun experiments to verify these technologies at medium temperature range of 300-600°C, where higher output from waste heat at waste incinerators is expected. Our commitment to progress in aspects of thermoelectric power-generation modules like increased output and durability will contribute to effective use of thermal energy while helping to resolve global issues such as carbon dioxide emissions and resource depletion.
Social and Environmental Measures (CSR)

Special feature1 Realizing a sustainable society

Utilizing the full power of the Group to reduce greenhouse gas emissions

Low-Carbon Society = The battery age will be coming soon

Low-Carbon Society = The battery age will be coming soon

Next-generation batteries are expected to help us conserve energy and address environmental issues through their applications in electric vehicles and devices for storing energy from natural sources, including solar and wind power. In September 2009, Showa Denko established a new Advanced Battery Materials Department to integrate the Group’s total capabilities in the development of lithium-ion batteries and fuel cells and to open up new possibilities in this area.

Progress in battery technologies will transform the future

People have called for a response to environmental issues for some time now, and recent years have seen a boom in activities to reduce carbon dioxide emissions, said to be a cause of global warming.

A look at carbon dioxide emissions, using Japan as an example, shows that the transportation sector accounts for a large percentage of all such emissions (Fig. 1). With emerging markets gaining economic strength, the number of motor vehicles will grow, resulting in increases in carbon dioxide emissions. The European Union, often seen as taking the lead in environmental issues, has enacted the legal requirement of a reduction in carbon dioxide emissions per kilometer traveled to 120 g by 2015. Since the increasingly popular hybrid electric vehicles (HEVs) emit roughly 100 g/km of carbon dioxide, this figure would represent a considerable advance. Still, the EU has begun discussions on raising the hurdle even higher, to 95 g/km by 2020.
Fig. 2 depicts changes in the volume of electricity used daily and the shares accounted for by different power sources in Japan. It shows that increased demand during the daytime is covered primarily by thermoelectric power. Since thermoelectric power generates more carbon dioxide emissions than other power sources, reducing the share of thermoelectric power and increasing the share of nuclear power may be the most effective way to reduce the environmental impact of power generation. We must also boost our use of natural energy sources, including solar and wind power. However, it is difficult to control nuclear power generation precisely to adjust the amount of power generated in daytime and at night. It is also difficult to generate power constantly based on natural energy sources. Finding a way to increase the role played by these power sources will require a method and a place to store electricity for use during peak hours.

Secondary lithium-ion batteries and fuel cells are promising technologies for addressing these concerns, and work on these technologies is proceeding worldwide. The Advanced Battery Materials Department has been established to accelerate the development and sale of materials for use in these lithium-ion batteries and fuel cells, drawing on the broad range of technologies accumulated by the Showa Denko Group to date to create next-generation batteries.

Fuel cells

A fuel cell is a clean energy system that generates electricity directly from the chemical reaction between hydrogen and oxygen in the air. Compared to existing power generation methods, fuel-cell equipment will make it possible to harness waste heat and offers high energy efficiency and reduced carbon dioxide emissions. They are also quiet. Fuel cells are eventually expected to be widely deployed for a wide range of applications, including motor vehicles, stationary power plants, and PDAs.
Lithium-ion batteries are secondary batteries using lithium oxide in the cathode and graphite in the anode. When the battery is charged, lithium ions move from the cathode into the layers of graphite of the anode, and when the battery is discharged, lithium ions move back to the cathode. Since the movement of lithium ions is the only change that follows charging and discharging, the electrodes and liquid electrolyte are not subject to chemical reactions. The most important characteristic of lithium-ion batteries is that they can store a larger amount of energy than any other secondary batteries. As such, they are expected to be used in electric vehicles and other applications for large-scale electricity-storage systems.

### Principle of a secondary lithium-ion battery

- **Cathode**
- **Anode**
- **Electrolyte**
- **Separator**
- **Charge**
- **Discharge**
- **Power supply**
- **Load**

### Individualized Products of the Showa Denko Group

#### Main structural materials
- Anode (SCMG™): now on the market
- Cathode: under development
- Electrolyte: under market evaluation

#### Other materials
- Conductive additive (VGCF™): now on the market
- Carbon-coated Al collector foil: now on the market
- Packaging material (Al laminate): now on the market
## Four strategic approaches

### Separators

**Bringing fuel cells closer to home using carbon separators**

Fuel cells, which generate electricity through the reaction between hydrogen and oxygen, represent a clean energy source whose emissions consist almost entirely of water vapor and are expected to power the motor vehicles of the future. We are currently pursuing research to manufacture separators - crucial fuel cell components - from carbon, a lightweight material that is also resistant to corrosion. The current development efforts for motor-vehicle applications focus on surface treatment of metal separators, an approach that involves corrosion and cost issues for long-term use. On the other hand, carbon at this point lacks sufficient strength when used in thin structures. We are striving daily to overcome this problem to help accelerate the use of fuel cells.

### VGCF™ conductive additive

**Extending battery life through high-performance conductive additives**

VGCF™, developed jointly by Prof. Morinobu Endo of Shinshu University and Showa Denko, is a type of carbon nanotube with high dispersibility due to its large fiber diameter. It has demonstrated the effects of lengthening the cycle life of lithium-ion batteries when added to battery cathodes and anodes. As batteries increase in size for use in motor vehicles and other applications, it becomes increasingly important to achieve longer lifespan to lengthen battery replacement intervals. For this reason, interest in VGCF™ is certain to increase in the future. We believe thoughtful response to the individual needs of battery makers and improved quality will help expand the applications for lithium-ion batteries.
SCMG™ anode material
Developing high-quality anode materials using graphite-based technologies

Lithium-ion batteries, already widely used in mobile devices such as laptop computers and mobile phones, are expected to enter even broader use in applications such as electric vehicles and as storage devices for power generated from wind and solar power. Demand for ever better performance continues to grow. In response, Showa Denko has developed SCMG™ (a synthetic graphite anode material) to improve battery capacity and lengthen cycle life (i.e., the number of times a battery can be charged and discharged). SCMG™ is based on Showa Denko’s graphite technologies. We are currently striving to improve quality and reduce costs to meet large-scale demand for this material, including use in motor vehicles.

Carbon-coated Al collector foil
A low-resistance cathode realized through the Group's collective strengths

Full-fledged sales of electric vehicles, picked as a favorite in the race to make eco-vehicles a reality, have now begun. The battery plays a critical role in an electric vehicle, and we have succeeded in commercializing cathode materials for lithium-ion batteries to minimize resistance, increase capacity, and reduce size by coating an ordinary aluminum-foil cathode with carbon. While the theory behind this technology was known before, practical use involved resolving numerous difficulties. We have commercialized this product by integrating a wide range of knowledge and technologies possessed by the Showa Denko Group, including knowledge of aluminum and carbon materials and roll-to-roll technologies for high-speed carbon-coating.

Utilizing the full power of the Group to reduce greenhouse gas emissions
21,673 attend eco plant tours

In addition to contributing to the realization of a sustainable society through recycling businesses linked with its main operations, the Showa Denko Group aims to achieve dialogue with society and coexistence with the community through activities such as the recycling of used plastics and aluminum cans. The chemical recycling plant for used plastics at the Kawasaki Plant offers tours where members of the general public can see separated plastic wastes being recycled, thus contributing to raising environmental awareness.

Making ammonia from used plastic

In 1931, the Kawasaki Plant became Japan’s first facility to produce ammonia and ammonium sulfate by a domestically developed process. With its long history and numerous achievements, it continues to serve as the major manufacturing site for Showa Denko’s Chemicals Sector. Even today, it remains a core manufacturing facility for the industrial ammonia used as raw material for synthetic fibers and as nitrogen oxide reducing agent. In 2003, at a time when collection and reuse of plastics had spread throughout society, the Kawasaki Plant became the site of a new advanced plastic chemicals recycling facility that produced ammonia from used plastic.

Recycling of plastics includes thermal recycling, whereby heat energy is collected; materials recycling, whereby recycled materials are reused as materials; and chemical recycling, whereby recycled materials are broken down into their original chemical substances. This facility within the premises of the Kawasaki Plant produces ammonia as a means of chemical recycling. As one of the very few facilities in the world employing the method of a pressurized two-stage gasification furnace, the plant conserves energy and reuses all carbon dioxide, and other emissions generated by the production process.

Ever since the start-up of this facility, the Kawasaki Plant has welcomed visitors from outside so that they can see how used plastics collected from sorted household recyclables are reused.

Visitors on site tours can view the recycling process through windows.
The flow of plastic chemicals recycling

Collecting used plastics from ordinary households and businesses

Turning the plastic into refused plastic fuel (RPF) after crushing it and removing metal such as the iron

Reforming the material into synthetic gas in the low- and high-temperature pressurized two-stage gasification furnaces

Producing ammonia through the reaction of the synthetic gas with a catalyst under high temperature and pressure

Shipping the resulting product nationwide as ECOANN™ eco-ammonia

Used to make clear resins, acrylic fibers, adhesives, nitrogen fertilizer, and nylon fibers
In question-and-answer sessions, visitors have the opportunity to ask various questions. One example: "Can you recycle even dirty plastics?"

Today, the plant accepts groups of 11 or more members for tours of the plastics recycling facility. Individuals are welcomed once a month, on the third Thursday of the month. For a brief time after the tours began in 2003, most visitors were from companies buying the ammonia produced at the plant. However, as awareness of environmental issues spread, starting about four years ago, the general public has accounted for a steadily growing proportion of visitors. The plant tours are currently thriving, booked to full capacity each day. Visitors include members of the general public, citizens groups, children on school field trips, and families, as well as members of local governments and businesses and overseas visitors.

The recycling process is separated into two facilities: one plant that crushes, selects, and molds the used plastics brought on site, and a gasification facility that recycles this material into hydrogen and carbon monoxide. Tour groups are first given a description of the entire process at the crushing and molding facility and a tour of that facility. After a question-and-answer session, they move to their next destination - the gasification plant at the Kawasaki plant by bus. In this way, visitors get to see how used plastics in familiar forms (like food trays) are crushed, formed into RPF, and then processed at the gasification plant - which is as big as a 20-story building - to be finally converted into ammonia.

Seeing the actual plant in operation gives a deeper understanding of the meaning of waste sorting and plastic recycling than can be communicated through repeated accounts in print or in speech. The tours also help visitors learn about the inside of a chemical plant, a place few have the opportunity to see, and to feel close to the plant.

The tours also benefit the plant; accepting regular tour groups made up of members of the general public creates an atmosphere with a stronger awareness that the plant is a part of the local community.

Since beginning operations seven years ago, we've obtained a true sense of how the tours of the plastics recycling facility not only help more people understand our environmental efforts, but also serve as opportunities to broaden communication with a wide range of people, ranging from children to adults, including students, homemakers, businesspeople, and overseas visitors.
From Outside

Seeing the results of waste sorting increased my motivation to sort waste

Based on the recommendations of someone who had taken part in a site tour in the past, I applied for the tour with the members of a citizens' group in which I take part. I try to sort plastic waste every day, but I was delighted to see the results of these efforts at the plant. Seeing with my own eyes the actual process of recycling plastics increased my motivation to sort waste. I would recommend this plant tour to others as well.

From Inside

I try to describe things from the perspective of the general public

My job is to accept applications for the site tour and to guide visitors on the tour. I haven't been doing this job for long and I still have things to learn, but I hope this helps me describe things from a perspective closer to that of the general public. Many visitors do some research before their tours and ask lots of questions. I think this is a good experience for me, too. I think another good point of these tours is the way they let people feel close to the plant by seeing its interior and speaking with us, the staff members.
21,673 attend eco plant tours

Supporting people with links to the community by collecting aluminum cans

Society has developed various systems for recycling aluminum cans, including collection by municipalities. As part of these efforts, the Showa Denko Group, which also produces aluminum cans, continues its own activities to collect and recycle aluminum cans, with the cooperation of a broad range of parties, including employees, suppliers, and community members.

Our aluminum-can recycling activities have continued since 1972

The Showa Denko Group traces its aluminum-can collection and recycling activities back to their start in 1972, when it asked employees to recycle cans. In 1982, the Oyama Plant (in Tochigi Prefecture) and the Sakai Plant (in Osaka Prefecture) opened recycling centers at which they purchased aluminum cans directly from members of nearby communities. In 1990, this program expanded to include the Head Office and all aluminum-related plants. The Showa Aluminum Can Recycling Center K.K. was established in 1995. Since then, we've continued to expand our aluminum can recycling operations.

Today, Showa Aluminum Can Recycling Center has branch offices in Oyama, Hikone (Shiga Prefecture), and Yachiyo (Chiba Prefecture). The center handles the collection, selection, and pressing of used aluminum cans. Furthermore, it commissions outside firms to melt them and produce recycled aluminum metal. An important characteristic of the business is its continued focus on collection activities rooted in the local community. In particular, it encourages welfare facilities and schools located near its offices to handle the primary collection of cans, then collects the cans from these partners. This generates revenue for the schools and other facilities, which helps people with disabilities achieve economic independence and helps provide operating funds for schools and student associations.
Based on the idea of getting more welfare facilities and schools to take part in recycling programs, we've continued to rely on such facilities for a significant portion of the cans we gather. However, it is supermarkets and other businesses that account for the larger proportion of the volume of cans collected. This helps broaden the scope of cooperation in recycling to include more members of the community. We work with local supermarkets by installing recycling boxes in front of their stores and encouraging their customers to recycle.

Activities to collect aluminum cans from Showa Denko Group employees, ongoing for many years now, have spread throughout the Group. In fiscal 2009, approximately 6,890,000 cans were collected, with an employee participation rate of 93.7%. As part of the revenue generated by these activities, 1,540,000 yen was donated to welfare organizations in each community.

Indisputably, aluminum can recycling helps protect the environment, by putting resources to effective use and reducing energy use. The Showa Denko Group strives to broaden the scope of grassroots aluminum-can recycling to benefit the community.

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**The flow of aluminum-can recycling**

1. **Collecting cans from supermarkets, schools, welfare facilities, and other facilities**
2. **Removing foreign matter such as steel cans, then compressing the aluminum cans**
3. **Melting the cans at high temperature after removing materials such as iron, glass, stone, and sand**
4. **Producing recycled metal by casting the melted aluminum**
5. **Forming the recycled metal into rolls of aluminum for delivery to aluminum can plants**
6. **Creating new aluminum cans from used ones**

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**Total donations made through aluminum-can recycling activities (cumulative)**

(ton-thousand yen)

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Aluminum-can recycling is supported by the kindness of individuals and the community.

Many people with disabilities work every day to collect aluminum cans in their communities. Our job is to collect these cans from them. I visit many facilities at which people with disabilities collect cans. Each time I do, the same thing happens: facility users say “Thank you” with heartfelt smiles. Behind this “thank you” is the kindness of community residents who want to put their aluminum cans to use for the operation of these facilities. Aluminum-can recycling links together the kind hearts of individuals.

I am glad to see that our recycling business can help contribute to society as much or even more than to the environment.

In the future as well, I will keep doing my work with the awareness that I am making a contribution to society in my own small way.
Examples of efforts at our plants and Group companies

**CASE1 Recycling activities conducted jointly with schools, local governments, and others**

Many worksites run active aluminum can collection programs in partnership with nearby schools and local communities. Some of the partner schools incorporate aluminum can recycling into lessons on the environment. At the Kitakata Plant, pupils in two elementary schools bring aluminum cans collected from home. The money earned from these cans is used to buy school supplies and to meet other needs. In 2009, the two schools together collected about 25,000 cans. Recycling partnerships are also under way with local children's clubs, sports clubs, and other organizations. Similar activities are under way at the Omachi Plant, the Higashinagahara Plant, and the Tokuyama Plant. In 2009, in partnership with 12 elementary and junior high schools, the Omachi Plant collected 530,000 aluminum cans.

**CASE2 Community cleanup activities and aluminum can collection**

The Hikone Plant, Showa Denko Packaging's Hikone Plant, Showa Aluminum Can's Hikone Plant, and Sanyo Showa Panel System Corp.'s Hikone Plant, all located in the city of Hikone in Shiga Prefecture, participate in various local cleanup events, including Environmental Beautification Day, Zero Waste Day, Lake Biwa Day group cleanup, and the Omi Eco-Foster Project. These activities are joint efforts involving government, community members, and business, whose purpose is to beautify the local environment and collect and recycle aluminum cans left on roads and lake shores. The Omi Eco-Foster Project enrolls volunteers from government, the community, and business for work to beautify roads and other public spaces in Shiga Prefecture. Group facilities at the Hikone district have participated in this project since 2002; through 2009, more than 200 Group employees have volunteered, helping solidify ties to local communities.

**CASE3 Activities to aid those with disabilities**

Since August 2009, Union Showa Yokkaichi Plant has worked with the I-Project in aluminum can collections. The I-Project promotes the independence of children with disabilities. Union Showa supports activities that help those with disabilities achieve independence by returning earnings from the aluminum recycling to the I-Project. Similarly, the Higashinagahara Plant in Fukushima Prefecture supports Kureyon, a facility where individuals with disabilities can find work, and Fure-Aizu Smile, an organization active in caring for those with disabilities. It supports these organizations by contributing proceeds from the recycling of aluminum cans gathered by these individuals from local homes to defray project costs and to provide an income source for those with disabilities. Kureyon began collecting aluminum cans 10 years ago. In 2009, it collected over 30,000 cans.
Launched in 2005 as a workshop involving the families of children with disabilities and other concerned individuals, the I-Project later became a nonprofit organization and source of support for such individuals. Last October, it assumed the structure of a social welfare corporation dedicated to the continuing struggle to help provide individuals with permanent support. The goal of the organization is to provide the support needed by those with disabilities to gain their independence while remaining in the regions where they were born. This support provides opportunities for individuals to mature into adulthood with as much work experience as possible, regardless of disability. We believe this opportunity to take part in the process of aluminum recycling gives those with severe disabilities an ever-growing understanding of work. Aluminum cans are collected with the cooperation of neighborhood residents and nearby stores, eldercare facilities, and other facilities. Participants set the aluminum cans in the compactor, then step on the foot pedal and apply their full weight to crush the cans one by one. This is an important task for those assisted by the I-Project. Countless crushed cans are shipped from the Union Showa Yokkaichi Plant. While this tends to be a slow process, with a specific goal set before them, the participants gradually became more proficient and productive. Our goal is to handle a large volume of cans and to increase income for participants.

Hiroyuki Imamura
Chief Director of the I-Project