

Development of Environment-Friendly Products at Furukawa Electric

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1. INTRODUCTION

Environmental problems are increasing in severity, creating a need for initiatives at the corporate level. To protect the environment and contribute to the realization of a sustainable society, Furukawa Electric recognizes that "the 21st century is the century of the environment", and in response to the needs of society and our customers, is actively working to develop environment-friendly products and technologies. Our aim is to develop a range of commercially viable "environment-harmonized" products--products that at every stage, from materials selection, manufacture and use to distribution and disposal, will be non-toxic and of low environmental impact.

2. DEVELOPMENT PROGRAM

The Committee for the Development of Environmentally Friendly Products has been set up as a company-wide organization, with subsidiary working groups dealing with each area of operation. It comprises a Research and Development Section, Marketing Section, Operations Section and Environment Control Section, and its function will be to harmonize company requirements with customer needs, to plan and develop commercially viable environment-friendly products reflecting this, and to introduce them to customers. Each working group will proceed with planning and developing products in the area under its control.

3. DEVELOPMENT CONCEPT AND REPRESENTATIVE ENVIRONMENT-FRIENDLY PRODUCTS

The development of environment-friendly products aimed at the reduction of environmental impact and the realization of an environment-conscious society will be carried out in accordance with the following basic concepts:

(1) Development of Products with Reduced Environmental Impact

It is essential that products not create environmental problems when they are used, but further, they should not be the source of toxic by-products when they are eventually disposed of by incineration or in landfills.

Furukawa Electric has developed an electrical wire with low environmental impact sold under the ECO-ACE brand, which uses no PVC, other halogenous substances or lead compounds. Also, with a view to recyclability, we are also proceeding with the development of modular products that will be easier to recycle.

In the field of electronics there is strong demand for lead-free solder, and we are developing such materials for both plating and soldering applications.

(2) Development of Products to Prevent Ozone Layer Depletion

The main agents of ozone layer depletion are chlorofluorocarbon compounds, or CFCs. We are developing devices and processes that do not use CFCs, together with products adapted to CFC substitutes. We are also developing a reflow oven that eliminates washing and use of CFCs, and refrigerant-resistant windings capable of being used in cooling systems using CFC substitutes.

(3) Development of Products that Contribute to Reducing Waste and Achieving a Recycling-Oriented Society

Waste not only causes environmental pollution, it depletes the limited stock of natural resources. We are moving to develop products that reuse waste materials, products that feature unification of materials to facilitate recycling, and products that are biodegradable and thus do not leave residual waste products. These include underground ducts made from cable waste, can stock made from recycled aluminum, biodegradable resin sheet, etc.

(4) Development of Products that Contribute to Preventing Global Warming

Through the development of products that realize energy savings, clean energy systems and the like, we are developing products that contribute to the prevention of global warming. These include high-performance heat-exchanger materials, solar photovoltaic systems, products using micro heat-pipes, and more.

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Table 1 Typical environment-friendly products

Name of product	Field of application	Stage of development*	Features
1. Products with reduced environmental impact <ul style="list-style-type: none"> • ECO-ACE environment-friendly electrical wire • Lead-free electrical wire • Lead-free plated parts of electronic equipment 	Home appliances, power distribution, communications Automobiles Electronic parts	NP/UD NP NP	Non-halogen, lead-free Lead-free Lead-free
2. Products that contribute to preventing ozone layer depletion <ul style="list-style-type: none"> • HPWR II heat- and refrigerant-resistant windings • SALAMANDER nitrogen-atmosphere reflow ovens • "FULL-COAT" functional resin-coated aluminum sheets 	Home appliances, automotive Electronic equipment Electronic equipment	NP NP NP	For CFC substitutes Eliminates CFCs Eliminates lubricants and cleansers
3. Products designed for reduced waste disposal and improved recyclability <ul style="list-style-type: none"> • Recycled aluminum can stock • Recycled aluminum distribution wire • All-aluminum air-conditioners • CCBOX and Information Box underground ducts • BIO-ACE biodegradable resin sheets 	Cans Wire and cable Home appliances Cable laying Packaging materials	NP NP NP NP NP	Recycling Recycling Unification of materials Reuse of materials Biodegradability
4. Products that contribute to preventing global warming <ul style="list-style-type: none"> • MCPET high-reflectivity foamed sheets • High-performance heat-exchanging material • Products containing micro heat-pipes • Solar photovoltaic systems • Deep-sea CO₂-fixing systems 	Lighting Automobiles Electrical equipment Electric power Power generation	NP NP NP NP NP	Saves energy Lightweight, saves energy Saves energy Clean energy Reduces CO ₂

NP = new product; UD = under development

Table 2 Eco-Ace products for electrical equipment

Product category	Insulation material	Rated temperature	Flame retardancy	Previous wire/cable	Applicable standard
Substitutes for PVC wires and cables	Cross-linked polyolefin	105°C	Perpendicular-class flame retardancy (ULVW-1)	UL1007 UL1015 UL1429 UL1430 UL1431	UL and CSA approval for temperature rise limit of 105°C for electrical appliances
Substitutes for cross-linked polyethylene cables	Cross-linked polyolefin	125-150°C	Perpendicular-class flame retardancy (ULVW-1)	UL3265 UL3266 UL3271 UL3398 UL3289	UL and CSA approval for temperature rise limit of 125°C for electrical appliances
Substitutes for PVC power cords	Polyolefin	60-75°C	60°-class flame retardancy (ULVW-1)	KIV, HKIV VSF, HVSF VFF, VCT	Conforms to JIS C 3316 Conforms to JIS C 3302 Conforms to JIS C 3312

In the following paragraphs we will present examples of products based on these concepts that are providing solutions in a wide range of fields (see Table 1).

3.1 Products with Reduced Environmental Impact

- ECO-ACE Environment-Friendly Non-Halogenous Wire and Cable

By developing polymers and flame-retarding agents, we have achieved products free of halogens, lead and phosphorous. These wires and cables use no lead or other heavy metals, phosphorous, or even haloge-

nous substances such as PVC in the sheath.

UL and CSA approval has been obtained for wires for electrical appliances, and they are now in use (Table 2).

With regard to power transmission and distribution cables, development work on general-use cables and highly flame-retardant low-voltage cables for indoor use has been completed, and they are already in use. Furukawa Electric is building up inventories to enable immediate delivery (see Table 3).

We have also developed flame-retardant optical fiber cables for telecommunications.

Table 3 ECO-ACE power and distribution cables

Cable category		ECO-ACE			Comparable conventional product		
		Type designation	Insulation material	Sheath	Type designation	Insulation material	Sheath
Low- and high-voltage cable		EM-CE EM-CET	Cross-linked polyethylene	Special polyolefin	CV CVT	Cross-linked polyethylene	PVC
Low-voltage flat-strip cable		EM-EEF	Polyethylene	Special polyolefin	VVF	PVC	PVC
Control and instrumentation cable		EM-CEE EM-CEE-S	Polyethylene	Special polyolefin	CVV CVV-S	PVC	PVC
Insulated cable		EM-IE	Special polyolefin	—	IV	PVC	—
Flame-resistant cable for fire-fighting (FP)*1		FT-8-C	Polyethylene	Special polyolefin	FT-8-C	Polyethylene	Special polyolefin
Flame-resistant cable for fire-fighting (HP)		NH-FT-3	Cross-linked polyethylene	Special polyolefin	FT-3	Cross-linked polyethylene	PVC
Cable with junctions*2	Cable	EM-BH EM-CET	Cross-linked polyethylene	Special polyolefin	BH CVT	Cross-linked polyethylene	PVC
	Molded junctions		Special polyolefin			PVC	

*1 Flame-resistant cable has always been made of ECO-materials

*2 Polyolefin is used for both the cable and the molded junctions



Figure 1 SALAMANDER-XN nitrogen-atmosphere reflow oven



Figure 2 "KOTA-KUN" underground cable duct using recycled resins

• **Lead-Free Electrical Wire**

International trade in products containing lead compounds is restricted under the terms of the Basel Treaty. As one step toward complete non-toxicity, Furukawa Electric has developed electrical wire that uses no lead compounds. By developing non-lead stabilizers for insulating resins, we have eliminated lead thereby solving the problem of lead leaching from landfills. These are already being used in automotive applications.

- **Lead-Free Plating for Electronic Components**
Lead-free plating for the leads of ICs, capacitors, connectors, printed circuit boards, etc. has been achieved by using a tin-bismuth alloy instead of the tin-lead material used previously.

Furukawa Electric has also developed the "ECO-LEADS" in which a base plating of tin is followed by an electroplated surface layer of bismuth-tin alloy, and then reflowed. This provides outstanding anti-whiskering properties, and also realizes lead-free soldering.

3.2 Products that Contribute to Preventing Ozone Layer Depletion

- **HPWR II for Use with CFC Substitutes**
These heat- and refrigerant-resistant windings are now in use in the compressor motors of air-conditioning and refrigerating systems using CFC-substitute refrigerants (HFC-407C, R410A, R134a).

- **SALAMANDER-XN Nitrogen-Atmosphere Reflow Oven**

This reflow oven carries out the reflow soldering process during the mounting of electronic components in a nitrogen atmosphere. This eliminates the need to cleanse completed circuit boards, obviating the use of CFCs and reducing depletion of the ozone layer (see Figure 1).

- **"FULL-COAT" Functional Resin-Coated Aluminum Sheets**

These functional resin coated aluminum sheets provide enhanced formability, corrosion resistance, scuff- and fingerprint-resistance, resistance to chemicals, electrical conductivity, ease of printing, and anti-bacterial and anti-mold properties. They are also self-



Figure 3 Illuminated signboards using MCPET high-reflectivity foamed sheets



Figure 4 Solar photovoltaic system

lubricating, so that disposal of the lubricants and cleansers formerly used in the stamping process is eliminated.

3.3 Products that Contribute to Reducing Waste and Achieving a Recycling-Oriented Society

- **Recycled Aluminum Can Stock**
The use of can stock made from used beverage cans contributes to promoting aluminum recycling.
- **Recycled Aluminum Distribution Wire**
We have succeeded in processing the old power distribution wire removed and retrieved by power utilities by developing techniques for sorting the aluminum wire, re-refining it and managing impurities, and remanufacturing it as wire rods and distribution wire.
- **BIO-ACE Biodegradable Resin Sheets**
BIO-ACE non-crosslinked foamed resin sheets are designed to be completely broken down into carbon dioxide and water by the action of microorganisms. Made of fatty polyester resins, they are biodegradable while retaining the same properties as ordinary polyolefins. When foamed sheets used in packaging and

wrapping are disposed of in landfills, they are completely broken down by the action of microorganisms in approximately one year.

- **"KOTA-KUN" Underground Cable Duct Made from Cable Waste (Figure 2)**
Plastic underground cable ducts have been developed that retain the workability of plastic while offering the resistance to soil pressure and vehicle loads equivalent to concrete products or steel pipe. This makes effective use of socially undesirable plastic waste and increases the strength of corrugated ducts, responding to the need for a compact configuration for the laying of multiple conductors.

- **"KOICHI-KUN" Information Box Made from Cable Waste**
Japan's Construction Ministry plans to have an optical fiber network of some 300,000 km in place by 2010. To this end work has begun on the underground laying of ducts to carry the optical fibers, known as information boxes, alongside the nation's highways. Furukawa Electric has developed plastic ducts made from cable waste, which have the advantages of being easier to handle, quicker to install and cheaper, and also contribute to the establishment of a recycling-oriented society.

- **National Project for the Development of Recycling Technology**
During the 5-year period 1991-96, the Japan Electric Cable Technology Center (JECTEC) has been involved with cable manufacturers under the aegis of the Ministry of International Trade and Industry (MITI) in research on thermal recycling through the development of liquefaction and pulverization technologies. Since fiscal 1998, research has been going forward on the use of PVC as solid fuel.

With respect to aluminum, funding from the New Energy and Industrial Technology Development Organization (NEDO) made it possible for the Japan Research and Development Center for Metals (JRCM) and seven manufacturers of aluminum rolled products to embark in 1993 on a 10-year project to develop technology to promote aluminum recycling.

3.4 Products and Systems that Contribute to Preventing Global Warming

- **MCPET High-Reflectivity Foamed Sheets (Figure 3)**
Furukawa Electric is the first in the world to succeed in the commercial-scale production and marketing of white sheets 1 to 2 mm in thickness made of extra-fine foamed polyethylene terephthalate (PET). Bubble diameter averages 10 μm or less, so small that optical performance is outstanding, with a total reflectivity of 99% or more and diffused reflectivity of at least 95%.

Furthermore, there is no dependency of reflectivity on wavelength, such as is characteristic of white-

painted steel sheets. Thus when they are used for reflective panels in illuminated signboards, it is possible to reduce the number of fluorescent tubes by 30% and to eliminate color distortion for more natural color rendition. It is anticipated that this product will find applications in advertising signboards and directional signs for railway stations, roads, etc., as backlighting systems for LCDs, and in lighting fixtures of all types.

- **High-Performance Heat-Exchangers Material**
High-performance internally multigrooved pipes deliver energy savings in home and industrial air-conditioners. We have also developed aluminum radiator and air-conditioner materials for automotive applications that are lighter in weight, promoting better fuel economy and reducing CO₂ emissions.
- **Solar Photovoltaic Systems (Figure 4)**
These clean distributed power generating systems use solar batteries to convert the sun's rays directly into electricity. From engineering through construction, metering and maintenance, we can provide total solutions, and have built a track record with both power utilities and local government bodies. And MITI has awarded us the Minister's Prize for our solar photovoltaic system with snow-melting capability.
- **Micro Heat-Pipes**
Computers, servers and other electronic equipment are becoming more compact, and device packing densities move steadily upward. Furukawa Electric's micro heat-pipes provide a solution to the associated problems of heat-dissipation and cooling, making possible greater availability of computing power along with energy savings. And they use water as the working fluid, avoiding restrictions on the use of CFCs.
- **Deep-Sea Piping Systems for the Transport of Liquefied CO₂**
Deep-sea fixing of CO₂ is considered one of the most effective measures against global warming. In cooperation with the Research Institute of Innovative Technology for the Earth, Furukawa Electric is conducting research on a system that can transport and store liquefied CO₂ in the sea at depths in excess of 3000 m using flexible pipes suspended from floating base-stations.

3.5 Miscellaneous

In future, new product development must take account of the environmental impact over the whole life of the product, and life cycle assessment is a technique that is gaining wide acceptance. Furukawa Electric has already begun conducting life cycle assessments in relation to the development of insulated cables and aluminum heat exchangers.

4. CONCLUSION

We have introduced some of the environment-friendly products that have been developed by Furukawa Electric. Recognizing as we do that the protection of the global environment is one of the most important issues we face, Furukawa Electric is committed, through the activities of its Committee for the Development of Environmentally Friendly Products, to continue with the development of products that are responsive to the needs of society and our customers.

Furukawa Electric manufactures a broad range of products, from electrical wire and cable to fiber-optic components, machinery, and plastic and metallic materials, and we will mobilize all of our expertise to advance solutions to problems of the environment.

We invite interested readers to read further about our environmental initiatives and environment-friendly products by visiting our web-site at:

<http://www.furukawa.co.jp/enviro/english/index.html>

Manuscript received on July 17, 1999.