Eco-materials and Recycling Technology in Hitachi Cable

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OVERVIEW: Hitachi Cable Group was early to recognize the importance of environmental issues in its management, and took bold steps to include eco considerations in all its business activities and pursue aggressive proactive efforts to protect the environment. At the same time, Hitachi Cable has stepped up efforts to develop and deploy environmentally conscious products ranging from eco-friendly cable for power and equipment applications to thermofin tubing that markedly improves the thermal efficiency of air-conditioning equipment. Committed to achieving a sustainable society, Hitachi Cable is also pursuing a range of material recycling initiatives including everything from critical metals such as copper to the plastic sheathing used to cover wiring and cables.

INTRODUCTION

AFTER setting up the Environmental Promotion Center in 1972 and beginning to make significant investments in plant and equipment and monitoring our own activities from the standpoint of environmental protection, Hitachi Cable, Ltd. has moved ahead with a number of bold environmental initiatives to reduce emissions from manufacturing processes to zero, to make Hitachi Cable products as green and environmentally friendly as possible, and to closely monitor and manage the chemical substances that go into Hitachi Cable products through the development of the Hitachi Cable product environmental CSR (corporate social responsibility) and chemical substance control system.

Meanwhile, we have also developed an extensive array of Eco-Products based on Hitachi Cable's own environmentally conscious product guidelines and standards and close collaborations between the various business groups and Hitachi Cable divisions concerned with environmental protection. And to squeeze to most efficient use out of resources, we have also developed and deployed a nationwide Waste Wire and Cable Recycling System that reduces waste and promotes recycling. Fig. 1 shows some of the ways in which Hitachi Cable Group is making a difference and addressing global environmental challenges as one of the world's leading manufacturers of nonferrous metal

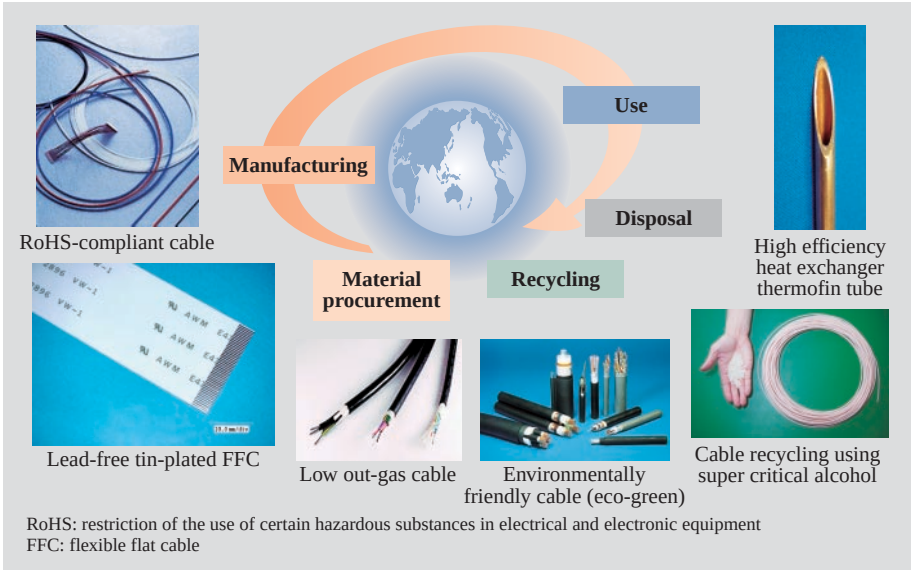

Fig. 1—Hitachi Cable Group's Eco-materials and Recycling Technologies.
Efforts are focused on producing a wide range of environmentally friendly energy-efficient products, and developing metal and plastic recycling technologies to realize a sustainable society.

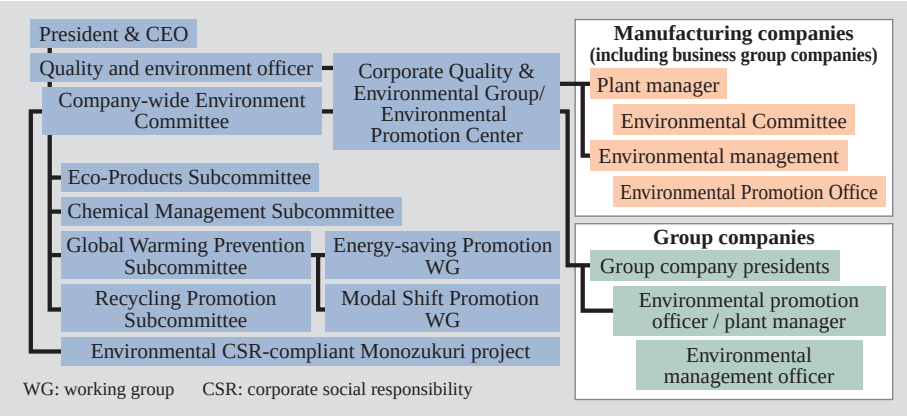

Fig. 2—Hitachi Cable Environmental Management Structure.
An environmental management structure and Hitachi Cable Group Environmental Action Plan have been implemented with mechanisms for verifying the degree plan targets are met.

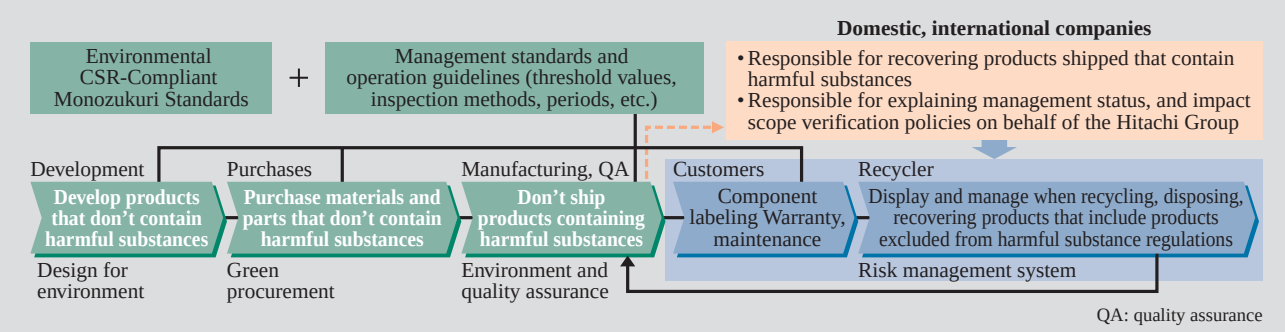

Fig. 3—Management Processing Flow of Chemical Content of Products.
Product Environmental CSR and Chemical Substance Control System were developed to monitor and regulate chemical substances in materials and parts Hitachi procures and in products that Hitachi ships.

materials. This paper will highlight some of Hitachi Cable's environmental initiatives focusing on environmental management, development of eco-materials, and recycling technologies.

ENVIRONMENTAL MANAGEMENT

In order to achieve its environmental management objectives, Hitachi Cable organized group-wide environmental committees and subcommittees (see Fig. 2), and drafted a Hitachi Cable Group Environmental Action Plan with specific mechanisms for verifying the degree that plan milestones are met. Each Hitachi Cable business and group company pursues efforts to reduce its environmental impact based on this Environmental Action Plan[(1)]. Coordinating all the Environmental Management Departments is the Environmental Center in the Corporate Quality and Environment Group that is responsible for conveying action policies and information to the group companies, collecting environmental action results[(2)], and other tasks.

Based on its corporate vision "Empowering Energy & Communication," Hitachi Cable is committed to "contributing to society by continuing to improve the speed, accuracy, and efficiency of energy and information." This involves an ongoing commitment to pursue manufacturing activities and product development that are friendly to the global environment.

ENVIRONMENTAL CSR-COMPLIANT MONOZUKURI PRODUCTION

First, Europe and now many countries are trying to track and manage chemical substances, and Hitachi Cable too has made good progress in managing the chemical substances in its products as part of its commitment to environmental CSR-compliant monozukuri (manufacturing) production. This work is facilitated by a powerful new tool called Hitachi Cable product environmental CSR and chemical substance control system that was developed specifically to monitor and regulate the chemical substances in the materials and parts that Hitachi Cable procures and in the products that Hitachi Cable ships. Fig. 3 illustrates how the chemical substance data is processed by the system. To closely monitor the chemical substances in the parts and materials that go into Hitachi Cable products, we require all of our suppliers to submit

documentation [certification of non-inclusion, chemical content data, chemical analysis reports, MSDS (material safety data sheets), etc.] as part of our green procurement policies for every item that we buy, particularly regarding the 15 items on Hitachi Cable's "Level A List of Prohibited Substances" and the 10 items on the "Level B List of Managed Substances."

A system has been put in place to ensure that products not satisfying Hitachi Cable's rigorous chemical content guidelines and standards are never shipped out to customers. First, the chemical content of every procurement item and product is calculated using the chemical content documentation and product/part composition data that is submitted by the providers and converted to a numerical value. The Quality Assurance Department then uses the Hitachi Cable control system to evaluate, verify, and approve (or disapprove) each procurement item and product based on prescribed content values using numerical calculated results and actual analysis data. If the chemical content is found to exceed the prescribed content value, the product is not shipped out to customers.

ECO-PRODUCTS

In the development of next-generation products, Hitachi Cable is making good progress implementing unique DfE (design-for-environment) criteria to make products as green and environmentally friendly as possible, and these DfE guidelines are based on Hitachi's unique environmentally conscious product standards. This is the first step in a process leading to the implementation of an Eco-Product standard for the entire Hitachi Group, and aims to raise each and every employee's awareness that "this is something we can accomplish so let's begin!" In short, we are raising the eco-mind awareness of our entire workforce.

The Eco-Product classification was defined in 2001, and by the end of February 2008, some 129 products had met the criteria. In March 2006 an even more rigorous category of Super Eco-Products was defined, and two products have received this designation: high performance Thermofin-HEX heat exchanger tubes, and lead-free tin-plated FFC (flexible flat cable).

Hitachi's High-performance Thermofin HEX Heat Exchanger Tubes

The performance of room air conditioners is largely determined by the heat-transfer efficiency of the heat exchanger tubes of the indoor-outdoor heat exchanger. Hitachi Cable pioneered the development of thermofin tubes with fine micro-processed grooves on the inside of the tubes that in effect greatly enlarge the surface area exposed to the coolant. Thermofin tubes have now seen extensive deployment as a standard product around the world. They result in markedly better air conditioning performance than conventional smooth tubes, and thus contribute to greater energy efficiency. Thermofin technology has also been extensively incorporated in air conditioning equipment for offices and factories. Excellent heat transfer characteristics are obtained by applying microfabrication techniques to the outside of the refrigerant-carrying tubes, and this results into superior air conditioning efficiency. Earlier attempts to improve efficiency resulted in overly tall internal fins, but unfortunately this greatly increased the mass of the tubes, which led to a demand for lighter lower profile fins. To satisfy the dual demands for both high performance and lightness, Hitachi developed the Thermofin HGL tube shown in Fig. 4 that optimizes the shape of the grooves while slimming the profile of the fins inside the heat exchanger tubes. This new design has several significant advantages:

(1) The design yielded the world's highest heat transfer coefficient (as of July 2006) copper tubing that was used in natural refrigerant CO_2 heat pump water heaters.

(2) The slimmer profile grooves on the inside surface of the tubing significantly reduced the mass of copper material by 21%, and the material is 100% recyclable.

(3) Compared to the original thermofin design, the new design achieves a remarkable heat transfer coefficient with 30% condensation and close to 65% evaporation.

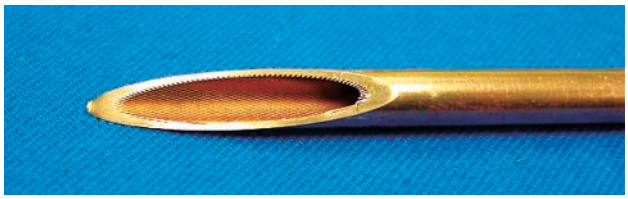

Fig. 4—Hitachi's High-performance Heat Exchanger Thermofin HGL Tube.
Demands of both high performance and lightness were achieved by optimizing the shape of the grooves while slimming the profile of the fins inside the heat exchanger tube.

Lead-free Tin-plated FFC

FFCs are flat flexible ribbon-shaped cables with multiple metallic conductors sandwiched between two insulating tapes such as shown in Fig. 5, and are used extensively in consumer electronic products such as

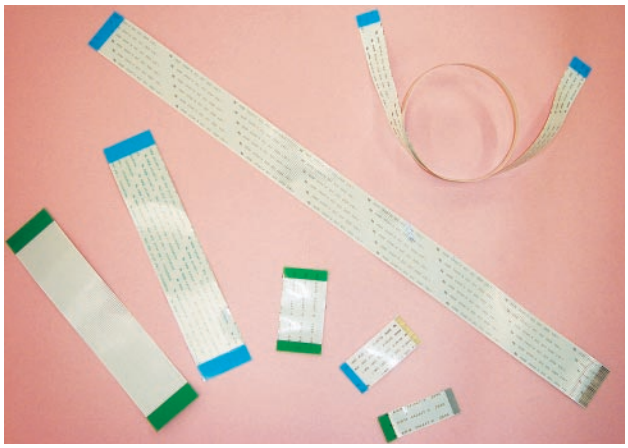

Fig. 5—Assortment of Lead-free Tin-plated Flexible Flat Cables.
Hitachi received the Fourth Monozukuri Manufacturing Award for an Electric or Electronic Component for its development of the whisker-suppressed tin-plated FFC that efficiently suppresses tin whiskering.

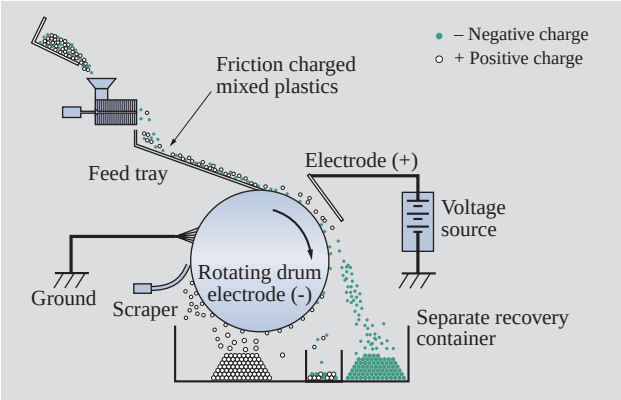

Fig. 6—Principle of the Electrostatic Separator.
Schematic of the electrostatic separator that exploits differences in charge is shown.

digital cameras, audio equipment, flat-screen TVs (televisions), as well as office equipment. Tin/lead alloy solder was used on the conductors of FFCs, but the recent RoHS (restriction of the use of certain hazardous substances in electrical and electronic equipment) is driving the development of lead-free FFCs. The drawback of applying plain electroplated tin to FFC conductors is that minute filiform hairs called tin whiskers form in the area between the FFC and the connector, and these whiskers can cause short circuits and arcing in electrical equipment. This led Hitachi Cable to develop a modified tin-plated conductor that efficiently suppresses tin whiskering by applying a very thin nanocoating of zinc to the electroplated tin surface. In recognition of its development of the whisker-suppressed tin-plated FFC, Hitachi Cable received the Fourth Monozukuri Manufacturing Award for an Electric or Electronic Component sponsored by Nikkan Kogyo Shimbun Ltd. for "the development of an original high-value-added component that helps strengthen the foundation of Japan's industrial craftsmanship (monozukuri)."

RECYCLING TECHNOLOGIES

Scrap Wire and Cable Recycling System

Committed to making the most efficient use of resources, Hitachi Cable has long pursued efforts to develop technologies for recycling scrap electrical wires and cables. Indeed, these technologies have been used for some time to recover scrap wire and cable from commercial-scale utility customers. More recently in June 2000 we began operating a nationwide waste cable recovery network for recovering and recycling cable from general industrial customers, primarily in the construction sector. Featuring gravity separators and advanced electrostatic separators, the system sorts the recovered scrap wire and cable with a very high degree of accuracy, so we are able to recycle 100% of the copper and aluminum, and more than 90% of the sheathing material. Fig. 6 shows an overview of the system.

Some of the recycled material is reused as electrical wire and cable, but a wide range of other products are also made from the reused materials including roadside barrier posts, sheets, and pallets. The residue that cannot be readily recycled as material is turned into RDF (refuse-derived fuel) or nugget-shaped pellets that are thermal recycled as fuel.

Cross-linked Polyethylene Material Recycling

Cross-linked polyethylene is so called for intermolecular bridges formed between polyethylene molecules through a chemical reaction. This material is far tougher and has much better thermal deformation resistance than plain polyethylene, and it is used extensively as insulating material for power cables. Unfortunately, the same properties that are advantageous for insulation are disadvantageous for recycling. Because of the bridges, cross-linked polyethylene does not readily melt with the application of heat, and therefore cannot be heat formed into material recycle products. Basically, all you could do with it was burn it as fuel (thermal recycling) or bury it in a landfill.

With the goal of recycling cross-linked polyethylene into useful material, Hitachi Cable has

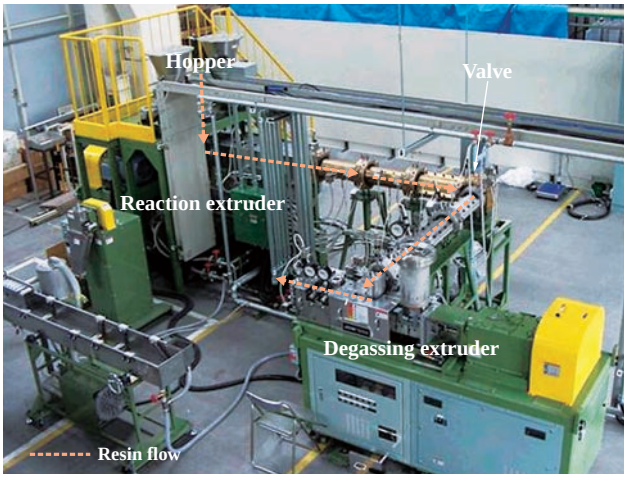

Fig. 7—Overview of Silane Cross-linked Polyethylene Continuous Processing Line.
Overview of the silane cross-linked polyethylene continuous processing line consisting of supercritical alcohol and plastic extruder is shown.

come up with a way of breaking down the intermolecular bridges in silane cross-linked polyethylene (one of the primary methods of manufacturing cross-linked polyethylene by chemical reaction) so that the material can be heat formed into useful shapes after all[3]. The system combines supercritical alcohol and plastic extrusion equipment. Supercritical alcohol exhibits both liquid and gaseous properties under high temperature and pressure conditions above the critical point (240 ℃ at 8 MPa). Fig. 7 shows a silane cross-linked polyethylene continuous processing line based on this technology. Following the arrows in the figure, scrap cross-linked polyethylene is fed into the system from a hopper, and then emerges from a degassing extruder as plain polyethylene that can be readily recycled as heat formable material.

CONCLUSIONS

This paper highlighted some of Hitachi Cable's recent environmental initiatives focusing on environmental management, development of eco-materials, and recycling technologies.

Committed to achieving a sustainable society, Hitachi Cable Group has taken bold steps to include environmental considerations in all its business activities, to closely monitor the chemical substances that go into Hitachi Cable products, to develop a wide range of Eco-Products, and to develop advanced recycling technologies to squeeze the most efficient use out of limited resources. While reaching out to collaborate with other Hitachi Group companies, we will continue to pursue hard-hitting environmental initiatives and contribute every way we can to the emergence of a sustainable society.

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