



Eco-Products and Technologies

Since Shin-Etsu Chemical is the largest manufacturer of polyvinyl chloride in the world, its image is that of a petrochemical industry manufacturer. In fact, however, the primary raw material in products such as silicone (silicone resin) and synthetic quartz, which is used to make optical fibers, is silicon, a material that is abundantly present in nature. In addition, the composition ratios of salt and petroleum in chlorinated vinyl are 57% and 43%, respectively, indicating that the petroleum content is remarkably low compared with other plastic products.

| Products | Usage | Ecological function | Point of products |
|--|--|--|---|
| Polyvinyl chloride  |  Polyvinyl chloride materials at large (production process) | Energy-saving | The material comprises salt (57%) and petroleum (43%); the ratio of petroleum is lower in comparison with other plastic products, with minimal adverse environmental effects against the life cycle assessment (LCA)* in comparison with other materials. |
| | Products such as chlorinated vinyl sash | Energy-saving | Compared with other materials, is better able to insulate against heat; accordingly, enables the saving of fuel for air conditioners and electric power. |
| | Products such as chlorinated tube | Excellent durability | Compared with other materials, is more durable in general. |
| Synthetic pheromones  |  Mating disruptant | Harmonization with ecosystem, ecological agrochemicals | Since it is a synthetic natural substance with minimal toxicity that also decomposes into water and carbon dioxide in the natural environment, it is environmentally friendly compared with former agrochemicals. |
| POVAL  | Adhesive agent, laundry starch, etc. | Harmonization with ecosystem, water-soluble high polymer | Compared with other materials, is environmentally friendly, since it is biodegradable through bacterial action. |
| Cellulose derivatives  | Admixture for underwater concrete | Prevents water contamination | Prevents water contamination at the time of construction and enables the reduction of the quantity of effluent. |
| Rare earth magnets  |  Compressor motors for air conditioners | Resource-saving, compact in size, energy-saving | Reduces annual electric power consumption. Reduces the quantity of lead. |
| | Wind-power motors | New energy | Compared with thermal power generation, enables a reduction of the amount of CO ₂ , nitrogen oxides (NO _x), sulfur oxides (SO _x), etc., that are generated, and consequently helps prevent global warming and environmental pollution. |
| | Electric vehicle motors | Clean energy | Compared with gasoline, enables a reduction of the amount of CO ₂ , nitrogen oxides (NO _x), sulfur oxides (SO _x), etc., that are generated, and consequently helps prevent global warming and environmental pollution. |
| Epoxy-molding compound  | Resin encapsulating material for semi-conductors | Controls chemical substance generation | By introducing a special silicone hard-combustive system, achieves halogen-free and antimony-free operation. |

*Life Cycle Assessment (LCA)

Method to evaluate the degree of environmental influence in the process of production through collection and reuse.

Here we would like to introduce our typical products that help reduce adverse effects on the environment, among the wide range of materials we produce and supply to the market. The ecological functions vary from resource-saving, energy-saving, efficient use of resources through effective recycling, discharge of toxic substances, products in harmony with the environment, protection of petroleum resources, and fusion with ecosystems. Through these products, we continue to work to reduce negative effects on the environment as well as reduce the use of resources such as petroleum.

| Products | Usage | Ecological function | Point of products |
|---|--|--|---|
| Silicone  See Page 16 <i>Typical form of silicone</i>  <i>Form of silicone oil</i>  <i>Form of silicone grease</i>  <i>Form of silicone resin</i>  <i>Form of silicone rubber</i> | For plastic (modified resin) | Reduces adverse effects on the environment | By not using environmentally hazardous substances, improves safety and is superior to recyclability. |
| | For tires (modified rubber) | Energy-saving, improvement in fuel charge countermeasures, dust | By improving fuel charges, enables a reduction in the amount of CO ₂ , nitrogen oxides (NOx), and sulfur oxides (SOx), etc., that are generated, and consequently helps prevent global warming and environmental pollution. |
| | Water-repellent agent for construction | Reduces adverse effects on the environment, harmonization with ecosystem | By not using environmentally hazardous substances, improves safety. |
| | Lubrication oil | Energy-saving | Superior to lubrication in low temperature. |
| | For addition to paints | Resource-saving | Superior to corrosion resistance and weather resistance. |
| | LIMS (for liquid silicone, injection molding system) | Energy-saving | Energy-saving in the process of the molding and increase in productivity. |
| | For heat radiation and insulation | Energy-saving and resource-saving | Efficient in energy-saving and reduces the quantity of CO ₂ , resulting in the minimal use of products. |
| | For hardening of UV (ultraviolet rays) | Energy-saving, non-solvent agent | Saves more energy compared with heat curing type products. |
| | Non-solvent type products (for release paper, etc.) | Reduces adverse environmental effects, non-solvent agent | Use of both a solvent agent and dilution solvent are unnecessary, and consequently there is a reduction in capacity and saving of energy at the stage of transportation. Organic solvent is not used, thus the product is safe for humans. Enables a reduction of adverse effects on the environment involving discharge into the atmosphere. |



Eco-Friendly Products (1):
Polyvinyl Chloride



Agricultural Vinyl Film

Since a characteristic of polyvinyl chloride is that even one piece of resin can be processed freely “from soft to hard” according to the purpose of usage, its usage ranges widely from the necessities of life to industrial materials.

Ecological Performance of the Product

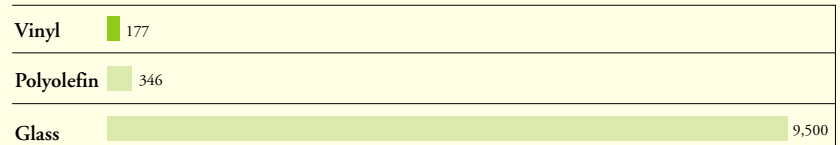
The most remarkable characteristic is the recycling rate of about 51%. More than 50,000 tons out of about 112,000 tons of the used agricultural vinyl film that are disposed of every year are recycled and reused as floor materials and materials for sheets. The incineration rate is 8%, and recycling enables substitution for approximately 40,000 cubic meters of timber, meaning that the product helps prevent the cutting of about 4,000 hectares of forest per year.

Comparison of Agricultural Vinyl Film and Agricultural Polyethylene Film

| Quality of materials | | 1997 | 1999 |
|----------------------|--------------------|------|------|
| Recycling | Vinyl | 45% | 51% |
| | Polyethylene, etc. | 4% | 17% |
| Reclamation | Vinyl | 26% | 26% |
| | Polyethylene, etc. | 21% | 30% |
| Incineration | Vinyl | 15% | 8% |
| | Polyethylene, etc. | 66% | 31% |
| Others | Plastics | 13% | 20% |

Source: Ministry of Agriculture, Forestry and Fisheries, Agricultural and Horticultural Products Bureau, Vegetable Promotion Section, “The Outline of Investigation Results for Installation Conditions of Horticultural Glass Rooms and Houses.”

Quantity of Discharged CO₂ Accompanying the Manufacture of Agricultural Vinyl Houses (per Square Kilometer)



(Unit: Tons)

Source: “Research Report by Kem System, Inc.”

Vinyl Sash

Since polyvinyl chloride is very durable against corrosion and climate, it is used widely in the field of architecture. Above all, vinyl sash is remarkable because of its ability to keep a room warm and preserve heat.

Ecological Performance of the Product

This material is superior in retaining heat; in this regard, it is 1,000 times greater than aluminum. When used as a window frame, it enables a reduction in energy consumption by up to half at the stage of heating and cooling in comparison with our former products. As a result, it can effectively save energy, equivalent to 436 liters of lamp oil (per household annually). In Germany, an environmentally advanced nation, its usage for window frames has become generalized, and the ratio of its usage is over 50%. In Japan, its usage is spreading, mainly among districts that experience comparatively colder weather.

Comparison of the Degree of the Heat Temperature Decrease (Aluminum Sash + Single-Layer Glass = 100)

| | |
|--|------|
| Vinyl sash + highly heat preserved multiple-layer glass | 35.7 |
| Wooden sash + highly heat preserved multiple-layer glass | 35.7 |
| Aluminum combined vinyl sash + multiple-layer glass | 53.5 |
| Aluminum sash + multiple-layer glass | 71.4 |
| Aluminum sash + single-layer glass | 100 |

Source: Japan Building Material Industry Association, “Promotion of Energy Saving Building Materials Diffusion Center.”



Eco-Friendly Products (2): Pheromones



Insect Pest Control Chemicals

Synthetic insect sex pheromone is a significant product that replaces the ordinary method which kills pests using insecticides.

When the pheromone is released in apple, peach, pear, and plum orchards and so on, mating is disrupted, and infestation is prevented.

Ecological Performance of the Product

Because the synthetic pheromone chemicals are made of synthetic natural substances, their toxicity is minimal, compared to conventional insecticides and agricultural chemicals. The synthetic pheromone does not cause environmental pollution, since it breaks down quickly in the natural environment and the decomposition produces only carbon dioxide and water.

| | Classification of poisonous substances, powerful substances and fish toxicity | Chemical structure | Effect on natural enemies | |
|-----------------------------------|---|--|---------------------------|------------|
| Pheromone chemicals | Normal substances, fish toxicity A | Ordinary carbohydrate | Harmless | |
| General agricultural chemicals | Normal substances, fish toxicity B | Special synthetic substances sometimes including P,S | Very harmful | |
| Toxicity LD ₅₀ (mg/kg) | | | | |
| Pheromone chemicals | Oriental fruit moth | | Peach leafminer moth | |
| | Rat | Over 17,120 | Over 17,080 | Over 5,000 |
| | Mouse | Over 5,000 | Over 17,080 | Over 5,000 |
| Fenitrothion | Rat | | 500-800 | |
| | Mouse | | 1,030 | |

Source: Shin-Etsu Chemical.



Eco-Friendly Products (3): Rare Earth Magnets

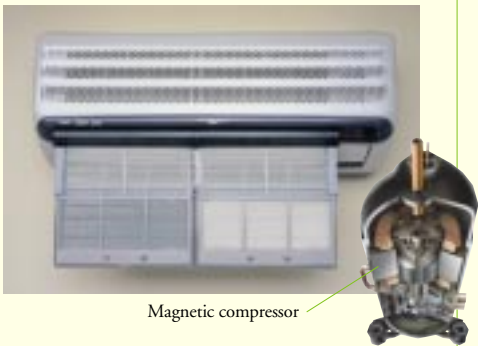
Motors Used for Air-Conditioning Compressors

Rare earth magnets are high-performance, permanent magnets whose ingredients are of rare earth type such as neodymium and samarium. They possess a strong magnetic power and are used for the hard disk drives of computers, stereo headphones, as well as motors for factory automation (FA) and office automation (OA) equipment. Also employed for air-conditioning compressors for which a highly efficient motor is essential, they are highly evaluated as a new energy-saving motor.

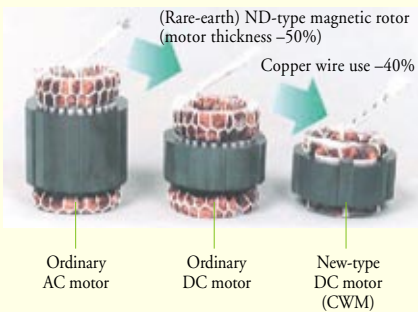
Ecological Performance of the Product

The reduction of the size and weight of the motors was realized by using rare earth magnets, a high-performance permanent magnet, for air-conditioning compressors. The capacity and weight of the motors was reduced to 85% of the ordinary motors, and the use of the copper wire for the motors was reduced 40%.

In addition, the COP (efficiency of energy consumption) was improved by 5% to 10%, and the amount of power consumption was largely reduced. In this way, we contribute to the achievement of energy-saving, reduction of the amount of discharge of carbon dioxide and the prevention of global warming.



Magnetic compressor



Ordinary AC motor

Ordinary DC motor

New-type DC motor (CWM)

Weight Comparison of Compressors (kg)

| | |
|------------------|-----|
| New-type DC twin | 6.5 |
| Ordinary DC twin | 8.2 |
| Ordinary AC twin | 10 |

Cooperation: Sanyo Denki Co., Ltd./Sanyo Denki Kucho Co., Ltd.



Eco-Friendly Products (4):
Silicone



Non-Solvent Silicone

Silicone (silicone resin) is a highly functional industrial material with both organic and inorganic characteristics. Its various forms include oil, emulsion, and liquid rubber. As people's needs for products of a type harmonious with the environment have increased, we are progressing toward non-solvent silicone such as electricity/electronics and release paper, etc.

Ecological Performance of the Product

Since this is a non-solvent type, it does not require organic solvent such as toluene, which is a subject substance under the PRTR Law. In addition, it can reduce its capacity to 1/10th the original level, and saves energy at the stage of transportation, etc.

Since solvent is not used, it is safe for human beings. Furthermore, it can greatly reduce the adverse effects on the environment caused by its emission into the atmosphere. Moreover, it contributes to the saving of petroleum resources, which is the material in the solvent.

Silicone for Plastic

Applications related to modified silicone resin quality improvement have been developed in a number of fields. A typical example is "Nucycle[®]," a product jointly developed and manufactured by NEC Corp. and Sumitomo Dow Ltd. This ecoplastic, featuring an additive of silicone flame retardant jointly developed by NEC Corp. and Shin-Etsu Chemical, is employed in the housing of liquid crystal displays and the bodies of personal computers.

Ecological Performance of the Product

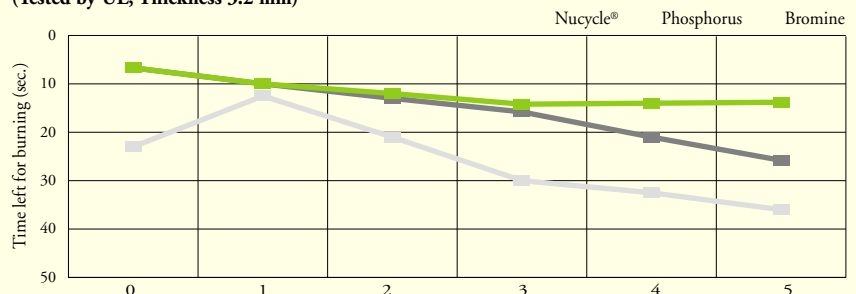
Nucycle[®], supplemented by a flame retardant agency of new silicone type, can retard fire to a greater degree than a flame retardant agency adding toxic substances such as halogen (bromine) and phosphorus. Its shock intensity has also been greatly enhanced. Moreover, it can be reused for electric device-related materials such as PC bodies, since it maintains a flame retardant nature even when material recycling is repeated. As such, it contributes greatly to the construction of a "cyclical society."

Recycling Ability of Nucycle[®]

| Characteristics | | Before recycling | Recycling 1st time | Recycling 2nd time | Recycling 3rd time |
|------------------------------------|-----------------------|------------------|--------------------|--------------------|--------------------|
| Flame retardant | (UL94, 1.6 mm) | V-0 | V-0 | V-0 | V-0 |
| Bendable intensity | (kg/cm ²) | 920 | 930 | 940 | 950 |
| Bendable elasticity rate | (kg/cm ²) | 22,800 | 22,800 | 22,900 | 23,000 |
| Stretchable intensity | (kg/cm ²) | 650 | 650 | 640 | 640 |
| Heat modification temperature (°C) | | 133 | 133 | 133 | 133 |
| Melt flow rate | (g/10 min) | 22 | 22 | 23 | 23 |

Source: NEC Technical Report, Vol. 53, No. 3/2000 Measured by NEC Corp. with the cooperation of Sumitomo Dow.

Flame Retardance of Polycarbonate Added to Various Flame Retardant Agents (Tested by UL, Thickness 3.2 mm)



Source: NEC Technical Report, Vol. 53, No. 3/2000 Cooperation: NEC Corp.

No. of recycles