Issued on April 22, 2011
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Polymer-Alloy Type Permanent Antistatic Agent
for Styrene Resins (Low-Resistivity)

# PELECTRON HS

## Preface

PELECTRON HS is a polymer-alloy type permanent antistatic agent for styrene resins which was developed by using an original Sanyo Chemical compatibilization technique.

This product imparts a long-lasting antistatic property to styrene resins while causing practically no lowering of their physical properties and moldability by being kneaded into resins such as HIPS*, ABS resins and modified PPE**. In addition, compared to conventional permanent antistatic agents, PELECTRON HS exhibits an excellent antistatic property even when used in small amounts because this product substantially decreases surface resistivity of styrene resins.

* High impact polystyrene
** Polyphenylene ether

## Typical Properties

| Property | Value | Remark |
|---|---|---|
| Appearance | Pale yellow pellet | − |
| Melting point | Approx. 135 °C (275 °F) | DSC, ASTM D 3418 |
| Surface resistivity | Approx. $2 \times 10^{6}$ Ω | − |
| Thermal degradation temperature | Approx. 240 °C (464 °F) | * |

* The lowest temperature at which PELECTRON HS begins to thermally decompose.
(Measured using a thermal gravimeter in air)

## Features

PELECTRON HS has the following features:

· Imparts an excellent antistatic property (the ability to prevent problems such as dust and electrostatic faults) to styrene resins when the amount added is between 3 and 15 wt %.

· Exhibits a long-lasting antistatic property immediately after molding. The antistatic property in the resulting plastic minimally changes even after washing with water because it is a high-molecular-weight antistatic agent. In addition, it works even in low humidity due to its low dependency on humidity.

· Minimally affects the mechanical properties and moldability of the resins themselves.

## Application Methods

1. General Procedure

As shown in Figure 1, resins and PELECTRON HS are dry-blended using a blender. This blend is then molded using an appropriate molder (e.g., an injection molding machine). Fillers and dispersants can be added during the dry-blending process if necessary.

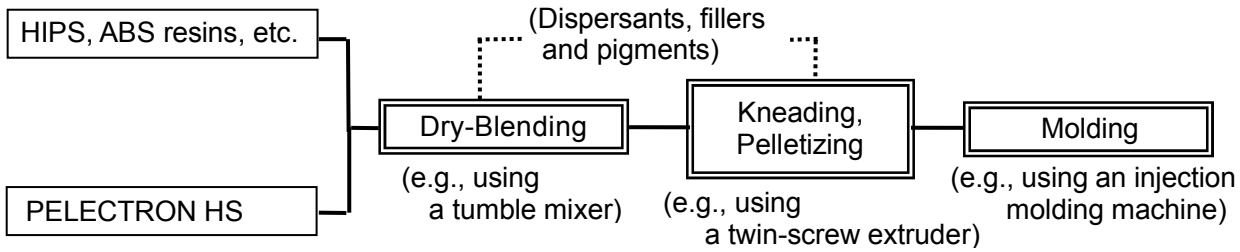


Figure 1. General Procedure for Application of PELECTRON HS

2. Amount to be Used

The standard amount of PELECTRON HS is between 3 and 15 wt %.

Determine the optimal amount by referring to the results of its performance tests.

3. Kneading Conditions

A high share rate kneader (e.g., a twin-screw extruder) should be used if the kneading process is required. The standard kneading temperature is between 180 and 230 °C (356 – 446 °F). Determine the kneading temperature according to the resin applied.

4. Drying of PELECTRON HS

· This product can be immediately used after the factory sealed package is opened because this product is packed under moisture-proof conditions.

· Drying is necessary when the factory sealed package is kept unsealed for several hours because this product has some hygroscopic properties.
The following are examples of the conditions for drying.

Drying under reduced pressure
Vacuum : Below 1300 Pa (0.2 psi)
Temperature: 70 – 80 °C (158 – 176 °F)
Duration : 2 – 4 hours

Hot-air drying
Temperature: 85 – 95 °C (185 – 203 °F)
Duration : 4 – 6 hours

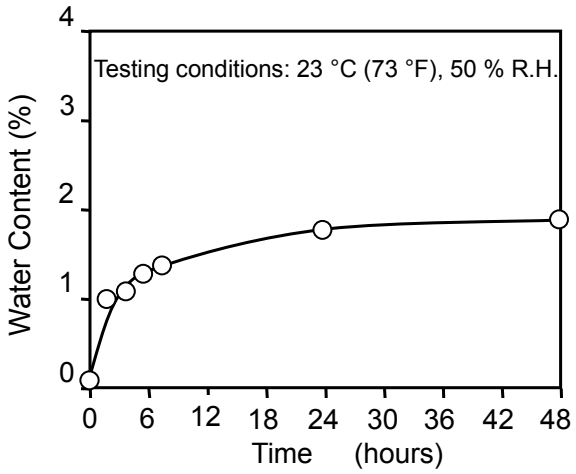


Figure 2. Hygroscopic Properties of PELECTRON HS

## Precaution Against Mishandling

· In the case of using resins at molding temperatures below 160 °C (320 °F), PELECTRON HS may not fuse, possibly resulting in poor effectiveness. Furthermore, in case of using resins at molding temperatures above 240 °C (464 °F), this product may thermally decompose, possibly resulting in poor effectiveness. The recommended molding temperature is between 160 and 230 °C (320 – 446 °F).

· Depending on the kind of resin, this product may have an influence on the resin's physical properties including mechanical properties. Test their influence on each other's physical properties beforehand to ensure that there are no problems.

## Performance Tests

The examples on pages 4 to 8 are the results of performance tests using styrene resins mixed with PELECTRON HS.

This product imparts a long-lasting antistatic property to styrene resins that cannot be attained by any other conventional blend-type, low-molecular-weight antistatic agents. In addition, compared to conventional permanent antistatic agents, this product exhibits an excellent antistatic property even when used in small amounts.

1. Application to HIPS

A. Relationship Between Amount of PELECTRON HS and Resulting Surface Resistivity

HIPS containing PELECTRON HS is highly antistatic when the concentration of this product is between 3 and 7 wt %. Refer to Figure 3 and determine the optimal amount according to the desired surface resistivity.

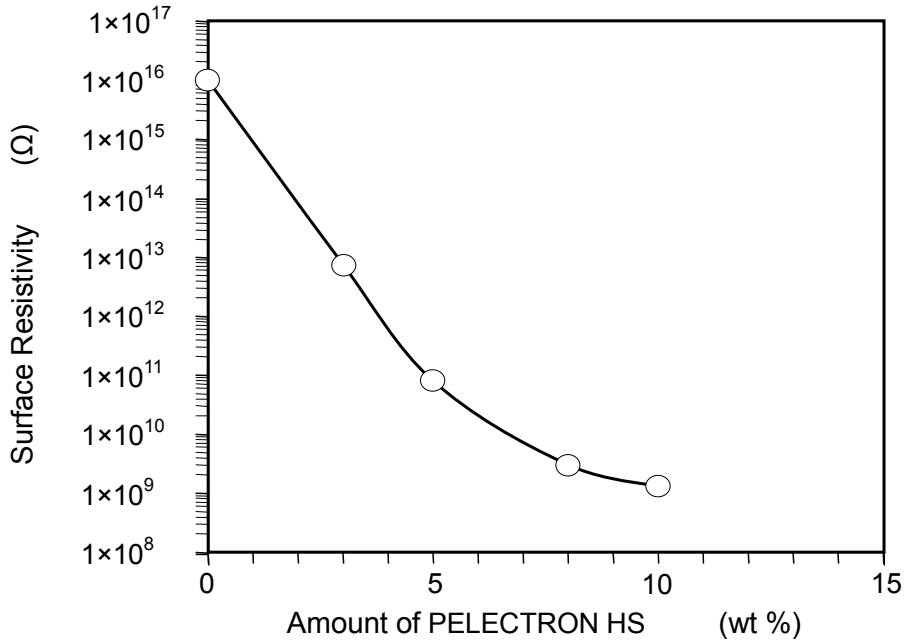


Figure 3. Relationship Between Amount of PELECTRON HS and Surface Resistivity

Materials and Methods:

Materials:

A predetermined amount of PELECTRON HS was dry-blended with HIPS*, and the mixture was molded using an injection molding machine [nozzle temperature: approx. 220 °C (428 °F), mold temperature: approx. 50 °C (122 °F)] into samples 2 mm (approx. 0.08 inches) in thickness.

Method:

Each sample was kept at 23 °C (73 °F), 50 % R.H. for 24 hours. Then, the surface resistivity of each was measured using a megohmmeter according to ASTM D 257.

* Melt flow rate (high-gloss HIPS): 4 g [10 min, 200 °C (392 °F), 49 N]

B. Effect on Surface Resistivity When Washed with Water (Evaluation of Durability of Antistatic Effect)

The surface resistivity of the HIPS blended with PELECTRON HS minimally changes, remaining antistatic even when washed with water. This product imparts an antistatic property that cannot be attained by any other conventional blend-type, low-molecular-weight antistatic agent, which loses its antistatic property after being washed with water approximately three times.

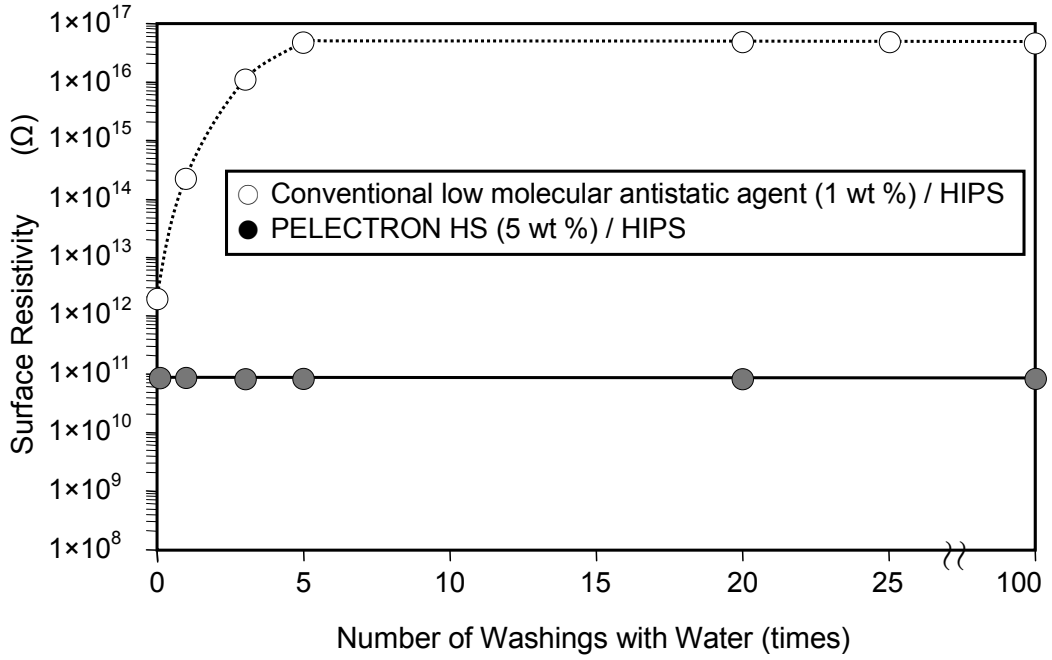


Figure 4. Effect on Surface Resistivity When Washed with Water

Materials and Methods:

Materials:

PELECTRON HS (5 wt %) / HIPS

PELECTRON HS (5 wt %) was dry-blended with the HIPS, and the mixture was kneaded using a twin screw extruder at 220 °C (428 °F). Then, it was molded using an injection molding machine [nozzle temperature: approx. 220 °C (428 °F); mold temperature: approx. 50 °C (122 °F)] into samples 2 mm (approx. 0.08 inches) in thickness.

Conventional low-molecular-weight anionic antistatic agent (1 wt %) / HIPS

A conventional blend-type, low-molecular-weight antistatic agent, a Sanyo Chemical product, was used. It was kneaded and molded into samples by using the method described above.

Method:

Each sample was submerged in water and their surfaces were rubbed with a cotton cloth. The samples were dried under reduced pressure [133 Pa (0.02 psi)] at 70 °C (158 °F) for 2 hours. They were kept at 23 °C (73 °F), 50 % R.H. for 24 hours, and then the surface resistivity was measured using a megohmmeter according to ASTM D 257. This process was repeated according to the number of washings with water as described in Figure 4.

C. Effect of Humidity on Surface Resistivity

The surface resistivity of the HIPS blended with PELECTRON HS minimally changes even in low humidity due to this product's low dependency on humidity. Conversely, a HIPS blended with any other conventional low-molecular-weight antistatic agent loses its antistatic property in low humidity.

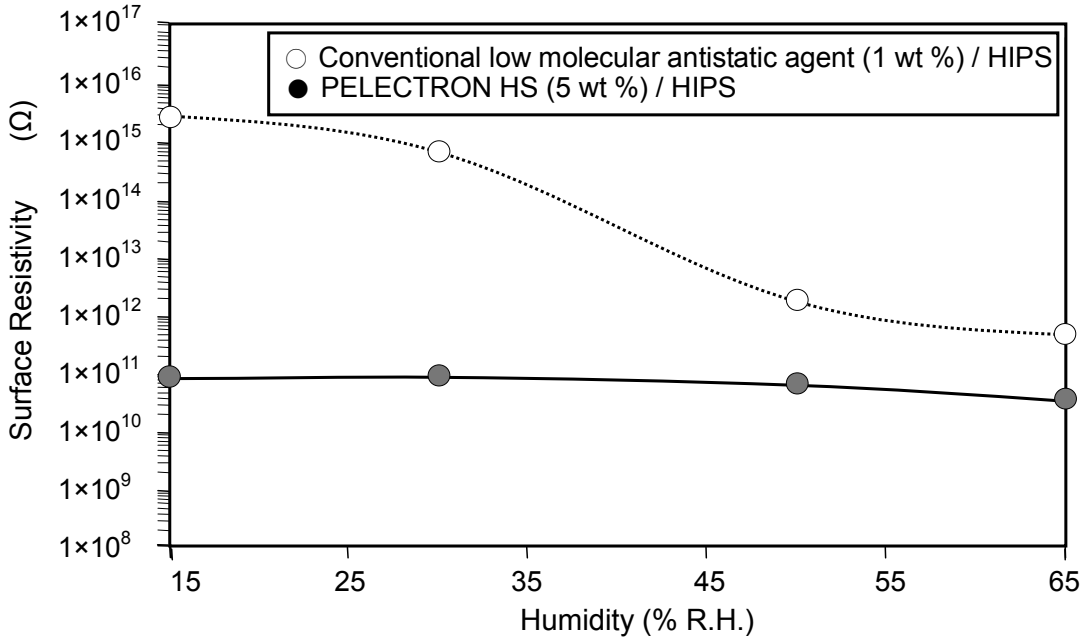


Figure 5. Effect of Humidity on Surface Resistivity

Materials and Methods:

Materials:

See Figure 4.

Method:

Each sample was kept at 23 °C (73 °F) at a predetermined humidity for 24 hours. Then, the surface resistivity of each was measured using a megohmmeter.

D. Examples of Resin Physical Properties

As shown in Table 1, PELECTRON HS minimally affects the HIPS physical properties.

Table 1. Examples of HIPS Physical Properties

| Property | | Method (ASTM No.) | HIPS / PELECTRON HS | | HIPS |
|---|---|---|---|---|---|
| | | | 3 wt % | 5 wt % | |
| Surface resistivity | Ω | D 257 | $7 \times 10^{12}$ | $8 \times 10^{10}$ | $> 10^{16}$ |
| Melt flow rate (10 min, 200 °C, 49 N ) | g | D 1238 | 5 | 5 | 4 |
| Tensile strength | MPa (psi) | D 638 | 33 (4785) | 32 (4640) | 34 (4930) |
| Fracture elongation | % | D 638 | 46 | 41 | 52 |
| Flexural modulus | MPa (psi) | D 790 | 1,880 (272,600) | 1,860 (269,700) | 1,980 (287,100) |
| Izod impact strength (notched) | J/m (ft・lbf/in) | D 256 | 91 (17) | 79 (15) | 100 (19) |
| Impact resistance Du Pont method | J (ft・lbf) | (JIS K 5600) | 13 (10) | 12 (9) | 15 (11) |
| Deflection temp. under load (1.8 MPa) | °C (°F) | D 648 | 76 (169) | 75 (167) | 78 (172) |

Materials and Methods:

Materials:

Surface resistivity

PELECTRON HS (3 wt % or 5 wt %) was dry-blended with the HIPS, and the mixture was molded under the same conditions as described in Figure 4 into samples 2 mm (approx. 0.08 inches) in thickness.

Melt flow rate

The above molded materials were cut into pellets and used as samples.

Other mechanical properties

Samples were prepared under the same conditions described in Figure 4 except that the predetermined size described in ASTM was applied. HIPS was also molded under the same conditions.

Methods:
See the ASTM No. or JIS No. described in Table 1.

E. Dispersibility of PELECTRON HS

As shown in Figure 6, PELECTRON HS is finely dispersed in the HIPS.

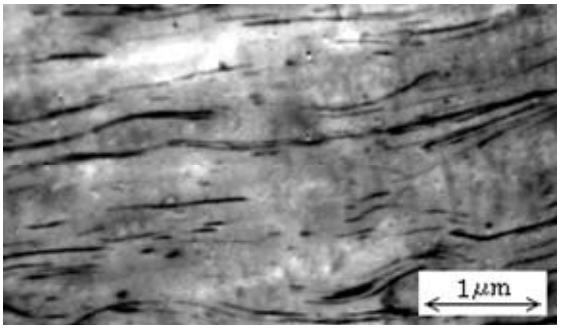


Figure 6. Transmission Electron Micrograph of Molding (TEM photo)
Composed of PELECTRON HS (3 wt %) and HIPS

[Explanation of Photograph]

Black stripes: PELECTRON HS
Black particles: Ethylene-propylene rubber component of HIPS

Figure 6 is a magnification (approx. 15,000 times) of a section of the PELECTRON HS (3 wt %) / HIPS mixture described in Figure 4. This product (black stripes) is dispersed in HIPS (white portion) and works as a conductive network.

2. Application to ABS Resins

A. Relationship Between Amount of PELECTRON HS and Resulting Surface Resistivity

ABS resins containing PELECTRON HS is highly antistatic when the concentration of this product is between 5 and 15 wt %. Refer to Figure 7 and determine the optimal amount according to the desired surface resistivity.

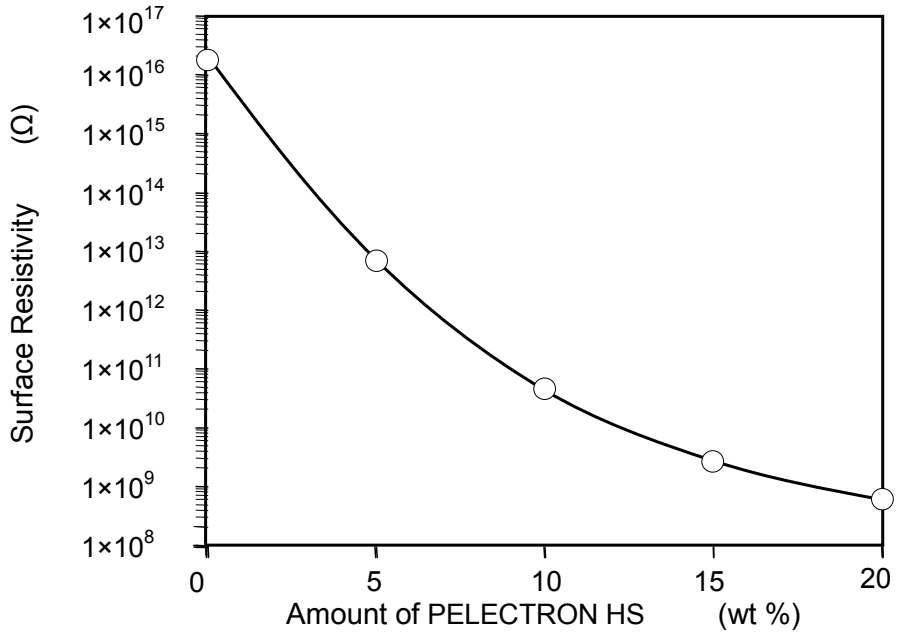


Figure 7. Relationship Between Amount of PELECTRON HS and Surface Resistivity

Materials and Methods:

Materials:

A predetermined amount of PELECTRON HS was dry-blended with the ABS resin*, and the mixture was kneaded using a twin screw extruder at 230 °C (446 °F). Then, it was molded using an injection molding machine [nozzle temperature: approx. 230 °C (446 °F), mold temperature: approx. 50 °C (122 °F)] into samples 2 mm (approx. 0.08 inches) in thickness.

Method:

Each sample was kept at 23 °C (73 °F), 50 % R.H. for 24 hours. Then, the surface resistivity of each was measured using a megohmmeter according to ASTM D 257.

* Melt flow rate (a general, high impact ABS resin): 17 g [10 min, 220 °C (428 °F), 98 N]

B. Effect on Resin Physical Properties

As shown in Table 2, PELECTRON HS minimally affects the ABS resin physical properties.

Table 2. Effect of ABS Resin Physical Properties

| Property | | Method (ASTM No.) | PELECTRON HS (5 wt %) / ABS Resin | ABS Resin |
|---|---|---|---|---|
| Surface resistivity | Ω | D 257 | $6 \times 10^{12}$ | $> 10^{16}$ |
| Melt flow rate (10 min, 220 °C, 98 N) | g | D 1238 | 28 | 17 |
| Tensile strength | MPa (psi) | D 638 | 42 (6,091) | 46 (6,672) |
| Fracture elongation | % | D 638 | 21 | 21 |
| Flexural modulus | MPa (psi) | D 790 | 2,190 (318,000) | 2,430 (352,000) |
| Izod impact strength (notched) | J/m (ft・lbf/in) | D 256 | 240 (4.5) | 240 (4.5) |
| Impact resistance Du Pont method | J (ft・lbf) | (JIS K 5600) | 12 (8.85) | 13 (9.59) |
| Deflection temp. under load (1.8 MPa) | °C (°F ) | D 648 | 73 (163) | 75 (167) |

Materials and Methods:

Materials:

Surface resistivity

PELECTRON HS (5 wt %) was dry-blended with the ABS resin, and the mixture was kneaded using a twin screw extruder at 230 °C (446 °F). Then, it was molded using an injection molding machine [nozzle temperature: approx. 230 °C (446 °F), mold temperature: approx. 50 °C (122 °F)] into samples 2 mm (approx. 0.08 inches) in thickness.

Melt flow rate

The above molded materials were cut into pellets and used as samples.

Other mechanical properties

Samples were prepared under the same conditions described in the above surface resistivity description except that the predetermined size described in ASTM was applied.
ABS resin was also molded under the same conditions.

Methods:

See the ASTM No. or JIS No. described in Table 2.

## Examples of Applications

PELECTRON HS has been used as a permanent antistatic agent in styrene resins such as HIPS, ABS resins and modified PPE in the following applications:

- Various containers and storage cases for electric and electronic parts, etc.
- Household electrical goods (TV, air conditioners, air purification systems, etc.), office equipment, etc.
- Floor materials, base materials for tapes, etc.

## Hazards Description

PELECTRON HS is a polyether-polyolefin block copolymer.

This product is insoluble in water.

This product has no flash point (by Sets Closed Cup) below 300 °C (572 °F).

UN dangerous goods regulations are not applied to this product.

Vapor or fume from molten material causes eye and nose irritation.

This product has low acute oral toxicity and has no acute dermal irritation.

Acute oral toxicity (rat): $LD_{50}$> 2,000 mg/kg (similar product)

Acute dermal irritation (rabbit): Non-irritant (similar product)

This product is for industrial use only.

*Important* :

Before handling this product, refer to the Material Safety Data Sheet for recommended protective equipment, and detailed precautionary and hazards information.



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