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Coating, Kneading and Reactive Types

Antistatic Agents for Synthetic Resins

Preface

Synthetic resins have high insulation resistance and their surfaces easily become charged with static electricity. Therefore, the static electricity in synthetic resins often causes problems. For example, dust spoils the beauty of synthetic resins due to static adhesion. Moreover, static electricity interferes in plastic production processes, and causes other problems such as the destruction of electronic circuits, electrical shock, and malfunction of appliances. We offer a wide range of antistatic agents for synthetic resins in accordance with the kind of resins applied and production process to prevent such electrostatic hazard.

<Lists of CHEMISTAT and SANSTAT products>

Product Name	Uses for Applications							Registry No. Identified by Positive List System*
	Kneading (for polymer alloy)					Coating	Reactive	
	Polyolefin	Polyvinyl chloride	Polyester	ABS resins	Various inks	Various resins	Polyamide	
CHEMISTAT 1100	A	A	–	–	–	–	–	[B]NJ-0276
CHEMISTAT 2500	A	–	–	A	–	A	–	[B]NM-0274, [B]NL-23092
CHEMISTAT 3033	A	A	A	A	–	–	–	[B]NM-3184
CHEMISTAT 3500	–	–	–	–	A	–	–	–
CHEMISTAT Y-400	–	–	–	–	–	–	A	–
SANSTAT 2012A	–	–	–	–	–	A	–	–

A : Applicable, * The Japan Hygienic Olefin and Styrene Plastics Association Provides it.

We offer a wide range of permanent antistatic agents as antistatic additives under the trade name of PELESTAT and PELECTRON.

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1. Typical Properties

Tables 1-a and 1-b show the typical properties and features of antistatic agents for synthetic resins. The values are representative.

Table 1-a. Typical Properties

Product Name	Appearance	Ionic	Solids Content wt %	Melting Point* °C
CHEMISTAT 1100	White granule	Nonionic	99	66
CHEMISTAT 2500	Pale yellow liquid	Nonionic	99	–
CHEMISTAT 3033	Pale yellow granule - flake	Anionic	99	70 *
CHEMISTAT 3500	Pale yellow paste	Anionic	97	–
CHEMISTAT Y−400	Straw-colored granule	Nonionic	98	55
SANSTAT 2012A	Pale yellow liquid	Cationic	50 (aq.)	–

*Softening point

Table 1-b. Features

Product Name	Features
CHEMISTAT 1100	Easy to handle due to its granule form. Minimally affects the physical properties of resins because this product excels in heat resistance.
CHEMISTAT 2500	Relatively high antistatic property. Applicable in both kneading and coating processes.
CHEMISTAT 3033	Excellent heat resistance. Effective when used with resins having a high Tg (inappropriate for transparent products).
CHEMISTAT 3500	Applicable to inks and paints.
CHEMISTAT Y−400	Reactive type (copolymerized as a component of polyamide **) Imparts flexibility besides antistatic property.
SANSTAT 2012A	Effective for almost all resins.

** Polyoxyethylene diaminopropylether (total of amine values: approx. 25)

2. Heat Resistance

Figure 1 shows the TG curve.

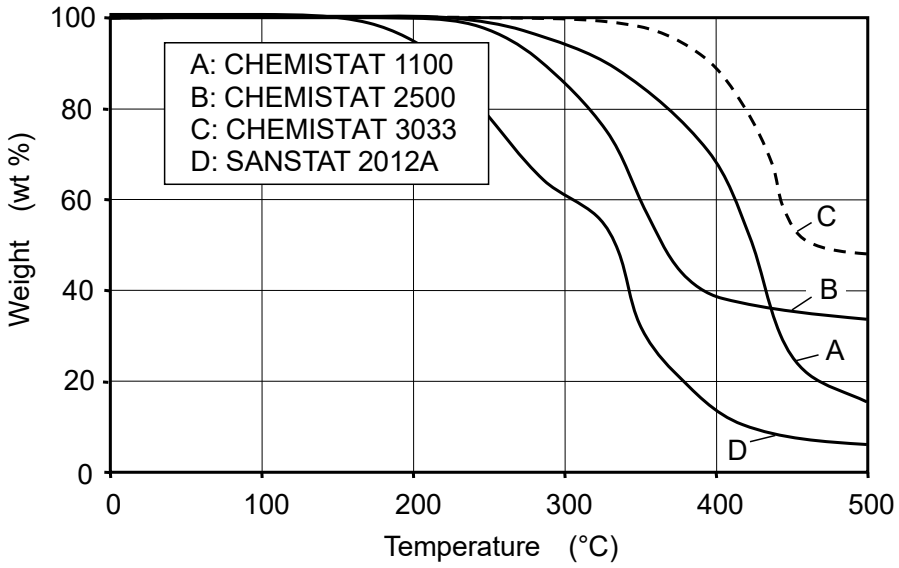

Figure 1. TG curve

Testing method:

Thermogravimetric analyzer (heating rate: 10 °C/min), in an atmosphere of nitrogen.

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The following test data shows antistatic properties of each antistatic agent as well as the relationship between humidity and antistatic properties, etc.

Antistatic properties depend on the kind of resin, reaction method, kneading method, coating method, molding conditions of the resin, etc.

1. Relationship Between the Amount of Kneading Type Antistatic Agents and the Surface Resistivity

Figure 2 shows the relationship between the amount of kneading type antistatic agents in polypropylene (PP) and the surface resistivity.

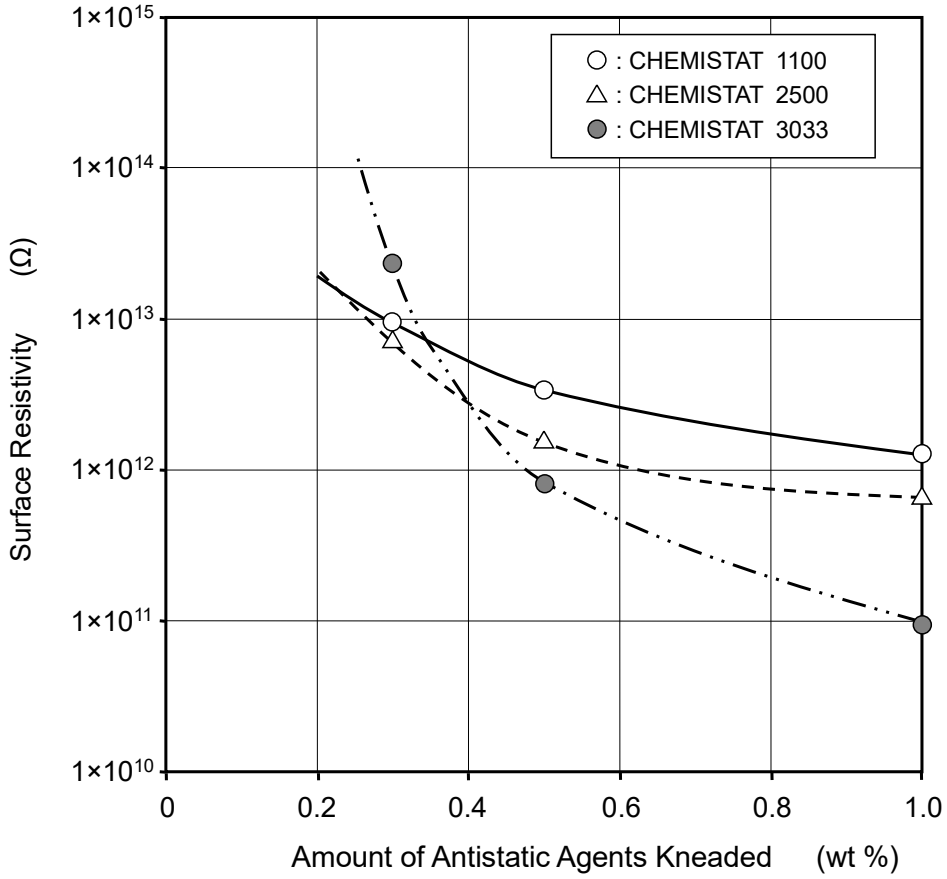

Figure 2. Relationship between Amount of Kneading Type Antistatic Agents and Surface Resistivity

Materials and Method:

Materials:

A predetermined amount of the antistatic agent as described in Figure 2 and PP were blended, and the mixture was kneaded with a Henschel mixer. The kneaded mixture was then molded with an injection molding machine [injection temperature: approx. 225 °C, injection pressure: 8MPa (gauge), molding temperature: 40 °C] into plate type samples (80 mm×80 mm×2 mm). These samples were kept at 20 °C, 65%R.H. for 1 week.

Method:

The surface resistivity of each sample was measured at 20 °C, 65%R.H. using an ultra-megohmmeter.

2. Relationship Between the Amount of Coating Type Antistatic Agent and the Surface Resistivity

Figure 3 shows the relationship between the amount of coating type antistatic agent, in either PP or polyvinyl chloride sheets (PVC), and the surface resistivity.

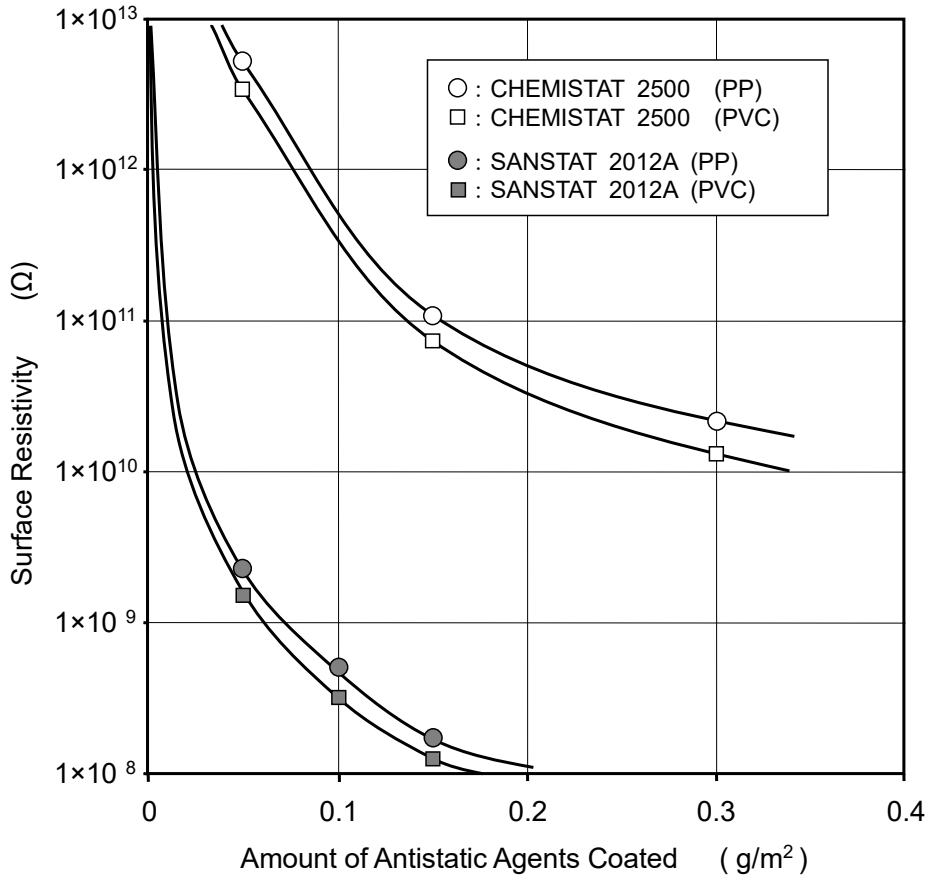

Figure 3. Relationship Between Amount of Coating Type Antistatic Agents and Surface Resistivity

Materials and Method:

Materials:

Each antistatic agent was diluted with water to achieve the required amount as described in Figure 3. PP and polyvinyl chloride sheets were separately immersed in the diluted solution. They were then dried and kept at 20 °C, 65%R.H. for 24 hours, and used for samples.

Method:

See Figure 2.

3. Relationship Between the Amount of Reactive Type Antistatic Agent and the Surface Resistivity

Figure 4 shows the relationship between the amount of reactive type antistatic agent in polyamide and the surface resistivity. Approx. 20 wt % of CHEMISTAT Y−400, copolymerized with polyamide, exhibits an excellent antistatic property.

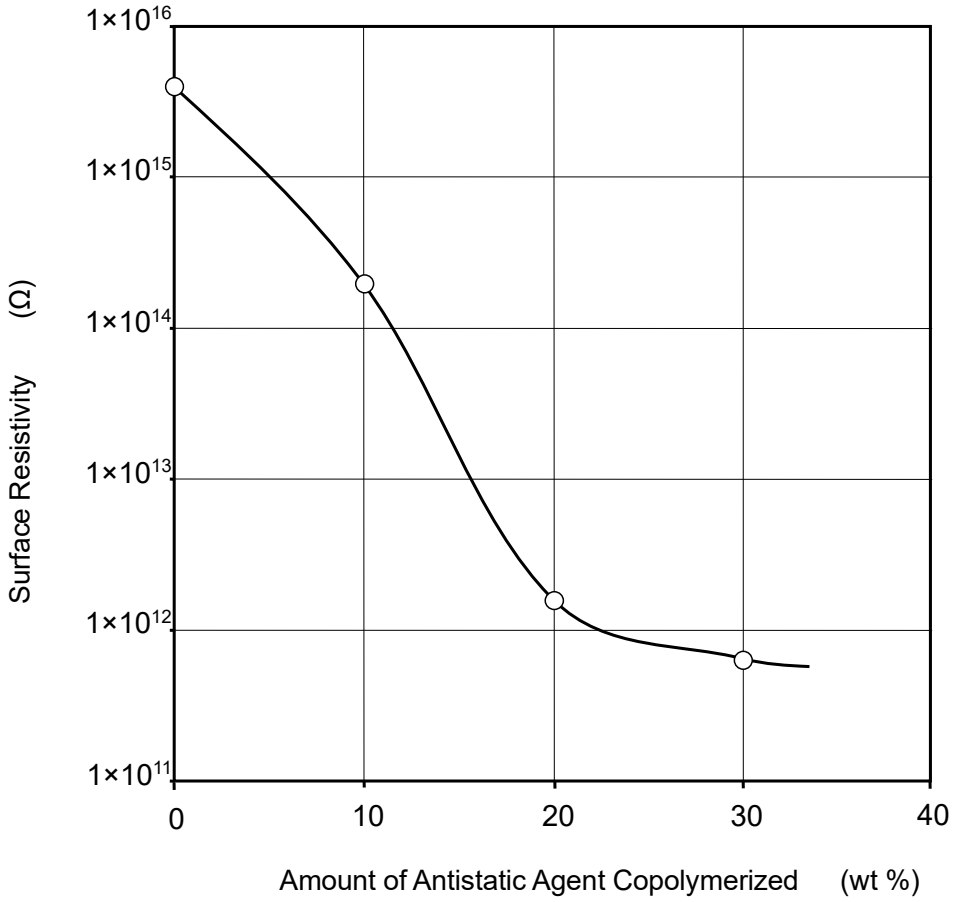

Figure 4. Relationship Between Amount of Reactive Type Antistatic Agents and Surface Resistivity

Materials and Method:

Materials:

A predetermined amount of CHEMISTAT Y−400 as described in Figure 4, adipic acid having an identical amount of substance concentration (mole) to CHEMISTAT Y−400, and the required amount of ε– caprolactam* were copolymerized with polyamide, and pellets were made. The pellets were molded using a press at 200 °C, 30 MPa for 3 min into sheets 500 μm in thickness. They were then kept at 20 °C, 65%R.H. for 1 week, and used for samples.

Method:

See Figure 2.

* To achieve the amount of copolymerized CHEMISTAT Y−400 with polyamide as described in Figure 4.

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4. Relationship Between the Amount of Antistatic Agents for Inks and the Surface Resistivity

Figure 5 shows the relationship between the amount of CHEMISTAT 3500, added to a commercially available gravure ink, and the surface resistivity.

Approx. 1 wt % of CHEMISTAT 3500 (for ink resin content) inhibits both ink blots caused by static electricity and ink-scattering.

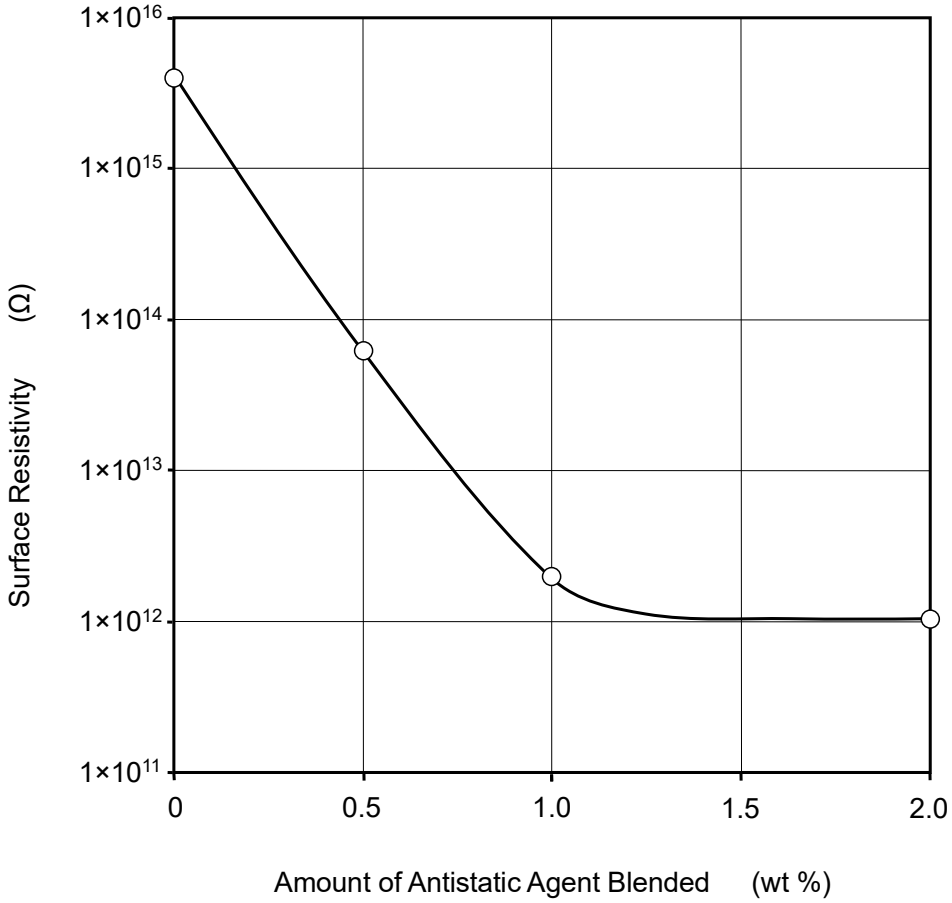

Figure 5. Relationship Between Amount of Antistatic Agents and Surface Resistivity

Materials and Method:

Materials:

A predetermined amount of CHEMISTAT 3500 as described in Figure 5 was blended with commercially available gravure ink (Each proportion of CHEMISTAT 3500 to the ink resin content is described in Figure 5.). Dried PP films were coated with ink at 2 μm in thickness, and dried. They were then kept at 20 °C, 65%R.H. for 24 hours.

Method:

See Figure 2.

5. Relationship Between the Humidity and the Surface Resistivity

Generally, the antistatic property of antistatic agent depends on the humidity. As an example, Figure 6 shows the relationship between the humidity of a PP sheet coated with SANSTAT 2012A * and the surface resistivity.

* A coating type antistatic agent, a Sanyo Chemical product

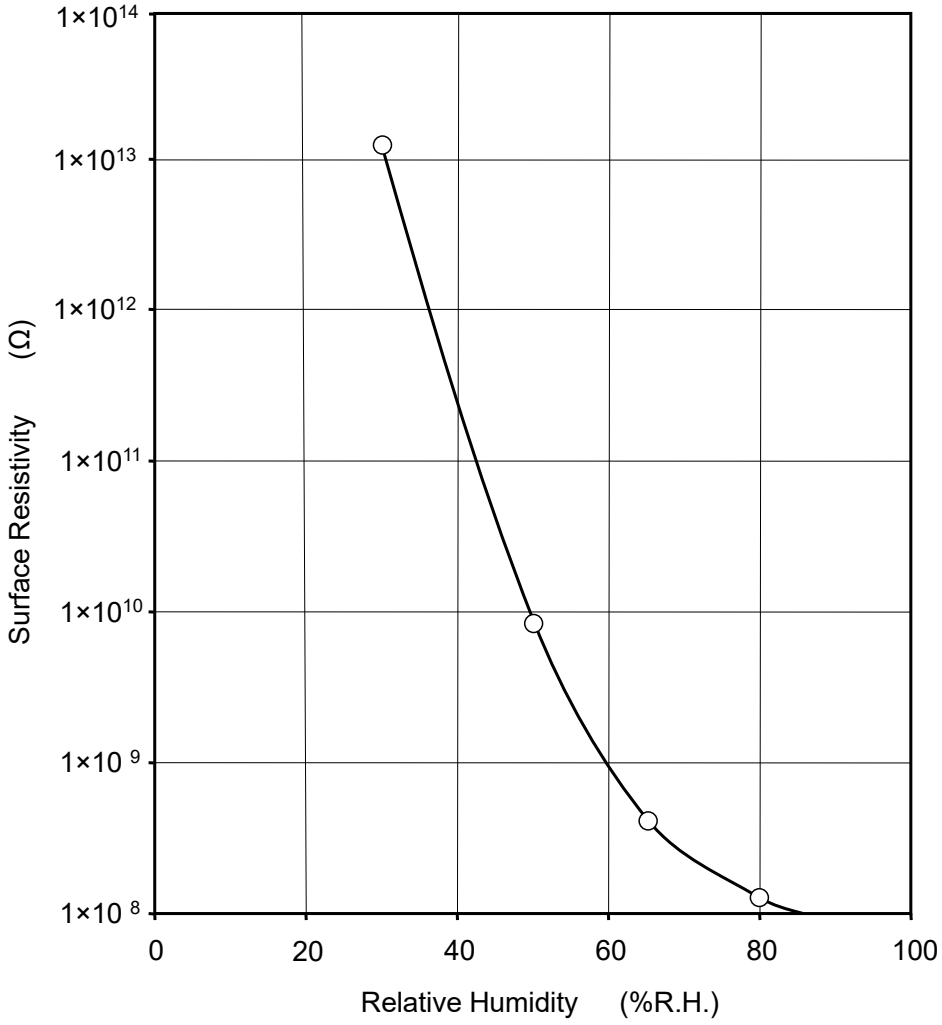

Figure 6. Relationship Between Relative Humidity and Surface Resistivity

Materials and Method:

Materials:

A PP sheet was coated with SANSTAT 2012A (0.1g/m^2) according to a brief immersion method. It was then kept at 20 °C, at the predetermined humidity level as described in Figure 6 for 24 hours, and used for the sample.

Method:

Same as Figure 2, except that they were measured at 20 °C at the predetermined humidity level described in Figure 6.

1. Recommended Amount

The amount of antistatic agents to be applied depends on the performance requirements, the kind of resin and the molded form, however, the standard amount is as follows:

Table 3. Standard Amount

Compounding Method	Molded Form	
	Molded Material	Film, Sheet
Kneading	1 – 2 wt %	0.3 – 1 wt %
Coating	0.05 – 0.1 g/m^2	
Reactive	2 – 10 wt % (CHEMISTAT Y−400)	

2. Compounding Method

Kneading

There are two different methods

· Mix antistatic agents into pellets or powder to achieve the required concentration, using a blender.

· Produce master batches which contain a higher concentration of antistatic agents beforehand, and then mix them into pellets or powder to achieve the required concentration.

Recommended mixer: Henschel mixer

Coating

· Dilute antistatic agents with water to achieve the required concentration, coat resins with them using the brief immersion method, or a spray coater or a roll coater, and then dry the coated resins.

Reactive

· The composition of CHEMISTAT Y−400 is polyoxyethylene diaminopropylether (total of amine values: approx. 25). Refer to Figure 4 on page 6, CHEMISTAT Y−400 should be copolymerized with polyamide as a component of polyamide.

Precautions Against Mishandling

· Too much additive amount of antistatic agents may have a negative effect on the resin's physical properties such as defective moldings/stickiness. Test the effect on their physical properties beforehand to ensure that there are no problems.

· Use these products under optimal conditions after studying kneading, coating, reactive methods, etc.

· Seal these products closely under moisture-proof conditions after use because they have some hygroscopic properties.

Important :

Before handling these products, refer to the Safety Data Sheet for recommended protective equipment, and detailed precautionary and hazards information.

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