Bulletin No. ES30000017A
Date issued: July 17, 2020

Polyurethane Solutions, Suitable for Manufacturing Wet-Process Synthetic Leather and Poromeric Leather

Polyurethane Solutions for Wet-Process Leather and Fabric Coating

Preface

Research and development of synthetic leather and poromeric leather as alternatives to natural leather has been ongoing for many years. High breathability, a smooth or suede-like unique appearance or unique tactile property depending on the leather, which natural leather originally has, have been pursued.

We provide a variety of polyurethane solutions for wet processes that produce poromeric and synthetic leather. These solutions differ in compositions, physical properties of dry films, viscosity and tactile properties, and the appropriate solutions can be selected according to the application.

We also provide polyurethane solutions for dry-process leather and fabric coating. These typically include: manufacturing dry-process synthetic leather; processing for surface finishing of smooth poromeric leather, wet-process synthetic leather, natural split leather and PVC leather; and coating of waterproof moisture permeable fabric and waterproof fabric.

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Typical Properties

Tables 1-a and 1-b show the typical properties of the following SANPRENE products. The values are representative.

Table 1-a. Typical Properties of Polyurethane Solutions and Solvent Contained

Product Name	Typical Properties			Solvent*
	Appearance	Viscosity mPa·s (20°C)	Evaporated Residue wt %	
Polyester type				
SANPRENE LQ-X5	Yellow liquid	45,000	30	DMF
SANPRENE LQ-3358	Colorless to pale yellow liquid	230,000	30	DMF
SANPRENE LQ-X31A	Pale yellow liquid	87,000	30	DMF
SANPRENE LQ-336N		90,000	30	DMF
SANPRENE LQ-660		100,000	30	DMF
SANPRENE LQ-X3800	Colorless to pale yellow liquid	90,000	30	DMF
Polyester/polyether type				
SANPRENE LQ-258	Pale yellow to yellow liquid	105,000	35	DMF
Polyether type				
SANPRENE LQ-3300	Pale yellow liquid	25,000	30	DMF
SANPRENE LQ-2300	Colorless to pale yellow liquid	90,000	30	DMF

* DMF: dimethylformamide
** The method described in ISO 37-2011

Note: For each composition, this table lists 100% modulus of dry film in ascending order.

Table 1-b. Physical Properties of Dry Films, and Features

Product Name	Physical Properties of Dry Film				Features
	100% Modulus** MPa	Tensile Strength at Break** MPa	Elongation at Break** %	Softening Point °C	
Polyester type					
SANPRENE LQ-X5	4.1	62	560	185	Softness
SANPRENE LQ-3358	5.4	74	610	215	Cold flexibility, High molecular weight
SANPRENE LQ-X31A	5.9	64	650	215	Cold flexibility
SANPRENE LQ-336N	5.9	64	650	215	Cold flexibility, Yellowing resistance
SANPRENE LQ-660	10.1	69	530	215	Hardness
SANPRENE LQ-X3800	16.4	61	460	215	Hardness
Polyester/polyether type					
SANPRENE LQ-258	11.3	61	500	205	Hydrolysis resistance, Hardness
Polyether type					
SANPRENE LQ-3300	2.2	24	870	155	Hydrolysis resistance, Softness
SANPRENE LQ-2300	11.3	72	450	210	Hydrolysis resistance, Hardness

Note: In the Features column, each item may be expressed as having softness or hardness. There are three classifications of tactile properties: softness represents leather which can withstand a 100% modulus of 4.9 MPa·s or lower; hardness represents leather which can withstand a 100% modulus of 7.8 MPa·s or higher; and standard tactile property (the term does not appear in the table) represents leather between 4.9 MPa·s and 7.8 MPa·s.

Application Methods

1. Selection of Product

On the basis of the application and tactile properties, product names of polyurethane resin solutions for wet processes are shown below.

Table 2. Applications and Product Names

Application		Tactile Property *	Recommended Sanyo Chemical Products
End Product	Leather Type and Layer		
Clothes	Microporous layer of smooth synthetic leather	Standard	SANPRENE LQ-336N
		Hard	SANPRENE LQ-660
	Microporous layer of poromeric suede	Standard	SANPRENE LQ-3358
Shoes	Impregnated layer of poromeric leather	Standard	SANPRENE LQ-258
	Microporous layer of smooth synthetic leather and poromeric leather	Soft	SANPRENE LQ-X5
		Hard	SANPRENE LQ-2300
Bags	Microporous layer of smooth synthetic leather	Standard	SANPRENE LQ-336N
		Hard	SANPRENE LQ-660
	Microporous layer of poromeric suede	Standard	SANPRENE LQ-3358

*There are three classifications of tactile properties: softness represents leather which can withstand a 100% modulus of 4.9 MPa·s or lower; hardness represents leather which can withstand a 100% modulus of 7.8 MPa·s or higher; and standard tactile property represents leather between 4.9 MPa·s and 7.8 MPa·s.

· Normally, the lower the 100% modulus, the softer the tactile property of the leather. In order to obtain the standard tactile property, mix products with different 100% modulus values. It should be noted that when mixed, some products may become a turbid white color or separate because of poor
compatibility. Please check compatibility in advance. When mixed, products differing in composition, such as polyester-type solution and polyether-type solution, may separate.

· To form an impregnated layer and a microporous layer, use products with the same resin composition as much as possible. For example, if polyester-type solution is used to form an impregnated layer, and polyether-type solution is used to form a microporous layer, the layer tends to peel.

2. Method to Prepare Coating Solution

The coating solution for the wet process is normally prepared by mixing diluent (DMF), wet-coagulation accelerator (surfactant), coagulation core agent (e.g. cellulose powder), toner (coloring agent that has pigment dispersed over polyurethane resin solution) and other agents, with polyurethane resin solution for the wet process.

Diluent

Usually, keeping the evaporated residue of the coating solution within the range of 7 - 18 wt %, mix the amount of DMF necessary to optimize the coating viscosity. Figure 1 on the next page shows the relationship between viscosity and the evaporated residue of SANPRENE LQ products diluted with DMF.

Wet-Coagulation Accelerator (surfactant)

Use one or more of the surfactants listed below. Mix 0 - 5 wt % of surfactant with the coating solution.

Unless wet-coagulation accelerator is mixed in, a porous wet film may not form.

Table 3. Wet-Coagulation Accelerator

Product Name	Active Ingredient wt %	Ionicity	Performance
SANMORIN OT-70 *	70	Anionic	Coagulation rate: high Form of cell: vertically long
IONET S-80 *	100	Nonionic	Coagulation rate: medium Form of cell: globular
NEWPOL LB-1800X *	100	Nonionic	Coagulation rate: medium Form of cell: globular

* Sanyo Chemical products

Coagulation Core Agent (cellulose powder)

When coagulation core agent is mixed with microporous-layer coating solution, cells are made uniform

to form a microporous layer of superior surface flatness. Usually, 0 - 5 wt % of coagulation core agent is mixed with the coating solution. As the additive amount of the coagulation core agent is higher, the strength of the microporous layer tends to be lower. The additive amount of the coagulation core agent may be judged from its relationship to physical properties such as tensile strength and the peeling strength of the microporous layer. Cellulose powders include KC FLOCK produced by Nippon Paper Industries Co., Ltd.

Toner

For the wet process, a wet film of superior color development is obtained by using toner containing a medium that has the same composition as the polyurethane resin solution. Particularly when this product is used for poromeric suede production, the appearance of the leather depends greatly on the color development of the toner. When mixing, select a toner that has excellent color development. Usually, 0 - 5 wt % of toner is mixed with the coating solution, and in the case of poromeric suede, 5 - 15 wt %.

Others

Coagulation of the coating solution for a microporous layer is facilitated and the time required to form a film is shortened in the solution, when the proper quantity of water is added to the solution. However, when polyether-type polyurethane resin solution for wet processes is used as a coating solution, water should not be generally added to the resin solution because the resin solution has a high coagulation rate. Otherwise, the addition of water may cause problems such as poor appearance which includes stripes on the surface of the microporous layer during coating processes, and lowering peel strength between the base fabric and the microporous layer.

To prevent precipitation of polyurethane resin during the preparation for coating solution, for example, water should be mixed with DMF before being mixed with the coating solution.

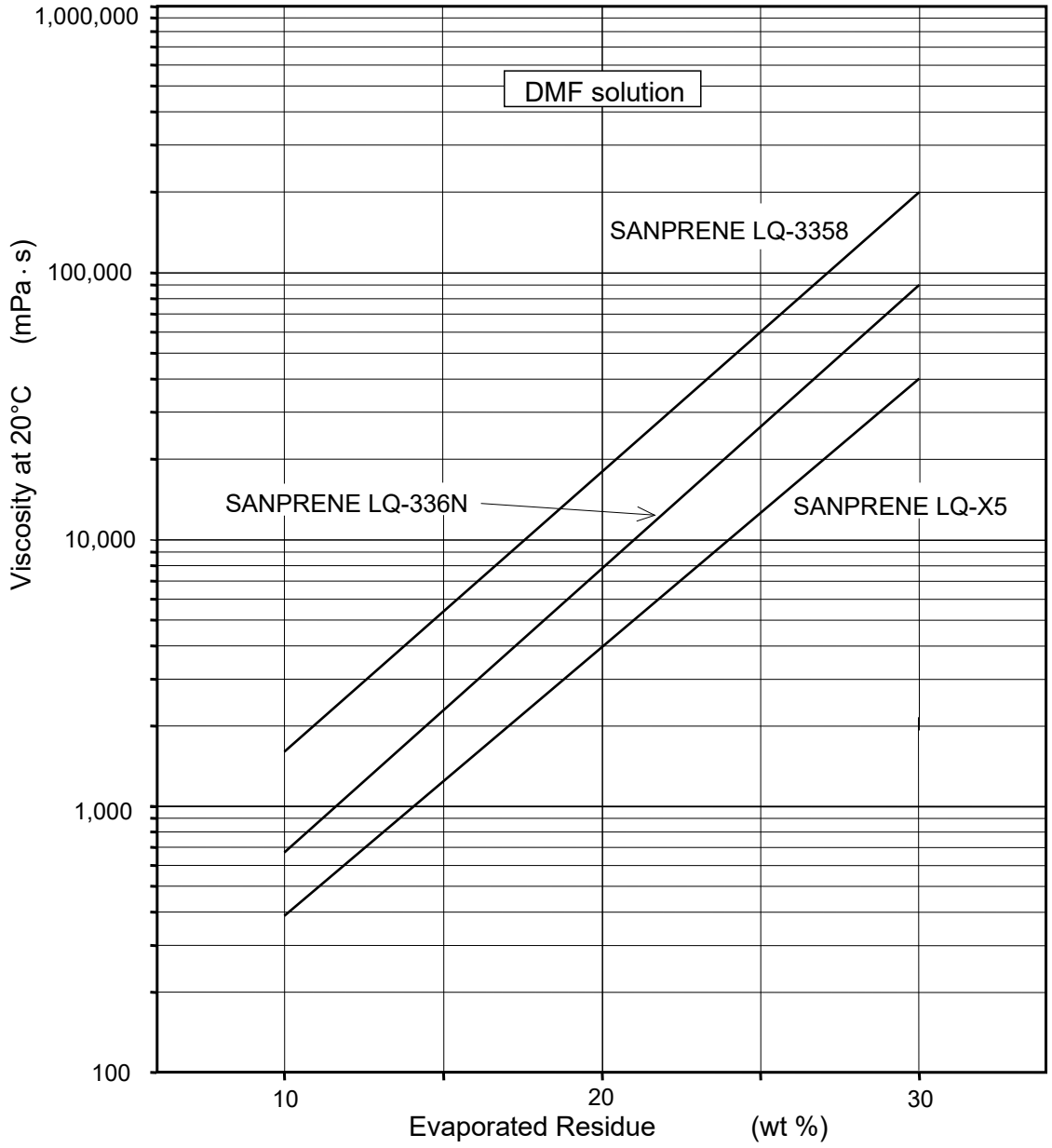

Figure 1. Relationship Between Evaporated Residue and Viscosity of Polyurethane Solution

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3. Wet Process

The wet process includes the impregnation method that impregnates the base fabric with coating solution and then causes wet coagulation; and the coating method that coats the base fabric with coating solution and then causes wet coagulation. These methods are outlined below.

A. Impregnation Method

This method impregnates base fabrics including nonwoven fabric with coating solution, and then causes wet coagulation. This is a common method of producing suede-like poromeric and smooth poromeric leather. The merit of this method is the ability to produce leather that feels wellbonded with the base fabric.

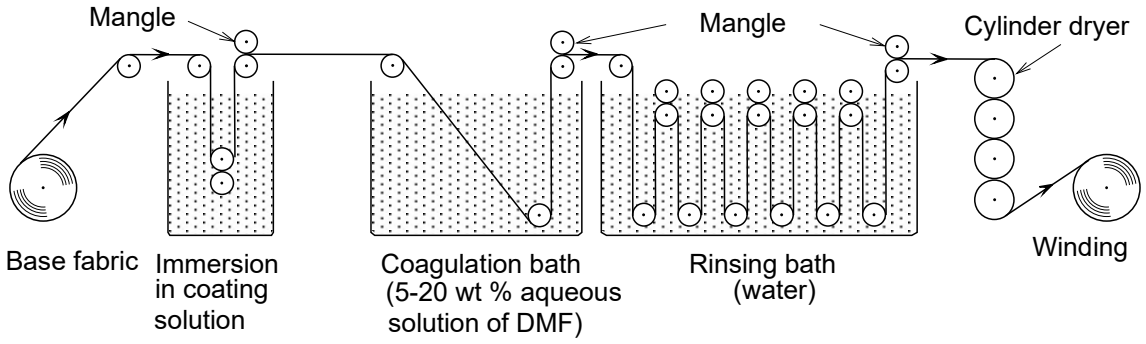

Figure 2. Schematic View of Impregnation Method

B. Coating Method

This method coats base fabric including woven fabric, knitted fabric or impregnated fabric with wet-process coating solution, and then causes wet coagulation. This is a common method of producing wet-process synthetic leather and smooth poromeric leather. The merit of this method is the ability to produce leather of superior surface flatness.

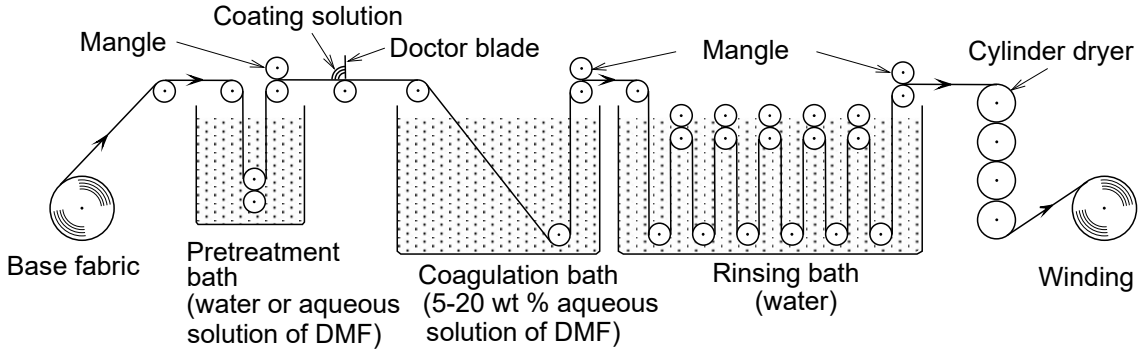

Figure 3. Schematic View of Coating Method

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4. Examples of Coating Solution and Wet Process

Examples of coating solution formulas and the wet process for synthetic leather and promeric leather are shown below as applications of SANPRENE products (polyurethane resin solutions).

A. Microporous Layer of Smooth Synthetic Leather and Smooth Poromeric Leather

<Example Formulas of Coating Solution>

The numbers in the tables describe the weight ratio of the formula.

Soft Leather	
General-Purpose Type	
SANPRENE LQ-X5:	100
DMF:	100
IONET S-80:	2
NEWPOL LB-1800X:	2
Toner:	proper quantity

Standard Leather	
General-Purpose Type	
SANPRENE LQ-336N:	100
DMF:	100
IONET S-80:	1
NEWPOL LB-1800X:	2
Cellulose powder:	5
Toner:	proper quantity

Hard Leather	
General-Purpose Type	
SANPRENE LQ-336N:	50
SANPRENE LQ-660:	50
DMF:	100
SANMORIN OT-70:	2
IONET S-80:	2
Cellulose powder:	5
Toner:	proper quantity

<Example of Wet Process> Refer to Figure 3.

Pretreatment:

Performed through immersing the base fabric in water or aqueous solution of DMF, and squeezing (70 - 90% pick up).

Coating:

Performed using a doctor blade.
The amount of coating solution coated: 600 - 1200 g/m^2

Coagulation:

Performed in a coagulation bath containing 5 - 20 wt % aqueous solution of DMF at approx. 20°C for 5 - 10 min.

Rinsing:

Performed in water at 40°C - 60°C for 10 - 30 min. During the rinsing process the cloth is squeezed several times using a mangle to remove residual DMF.

Drying:

Performed at 120°C

B. Impregnated Layer of Poromeric Leather

<Example Formulas of Coating Solution>

The numbers in the table describe the weight ratio of the formula.

SANPRENE LQ-258:	100
DMF:	150
Toner:	proper quantity

<Example of Wet Process> Refer to Figure 2.

Coating:

Performed through immersing the base fabric (nonwoven fabric) in the coating solution and squeezing using a mangle.
The amount of coating solution coated: 600 - 1200 g/m^2

Coagulation:

Performed in a coagulation bath containing 5 - 20 wt % aqueous solution of DMF at approx. 20°C for 5 - 10 min.

Rinsing:

Performed in water at 40°C - 60°C for 10 - 30 min. During the rinsing process the cloth was squeezed several times using a mangle to remove residual DMF.

Drying:

Performed at 120°C

Precautions Against Mishandling

· When other resins are used together with these products listed in this brochure, test their compatibility beforehand to ensure that there are no problems.

· Before use, completely dry the coating solution preparation bath, the coating machine, and other plant units.
If moisture remains, part of the polyurethane resin solution in the coating solution coagulates and precipitates, resulting in formation of a microporous layer with inferior surface lubricity and tactile property.

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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