

Belland Alkaline Soluble Polymers

Application and Processing

The Company

BellandTechnology is a polymer technology company, originally founded in Switzerland 1983. BellandTechnology developed a proprietary „selectively soluble“ polymer and the proprietary polymer manufacturing process. The unique polymers are soluble in aqueous alkaline solutions and recyclable through subsequent precipitation in acids. Based on R&D and pilot plant operations, BellandTechnology is growing to an industrial technology leader. In cooperation with partners in industry and research we handle the demanding requirements of customers.

The Products

Belland® Polymers are primarily acrylics based co- and terpolymers with defined solubility. These thermoplastic materials can be processed by standard polymer converting equipment. Under normal conditions they are water resistant but on demand the material can be dissolved in aqueous alkaline solutions. Different grades of BellandTechnology polymers cover a wide range of applications:

extrusion, thermoforming, injection moulding, film extrusion, coatings, hot melts

The range of applications encompasses recyclable catering products to industrial applications, where primarily the unique solubility properties offer technical solutions for:

- labels
- detergent packaging,
- laundry bags
- shoe industry
- medical applications
- tapes
- coatings
- pressure sensitive hot melts

Belland Resins for Extrusion, Thermoforming and Injection moulding

Technical Information

BellandTechnology polymers are terpolymers based on styrene and acrylates, which are soluble in aqueous alkaline solutions. This unique property allows a simple recycling of the used articles. BellandTechnology polymers are amorphous thermoplastics which can be processed by extrusion, thermoforming or injection moulding. The products comply with the European requirements for food contact.

Sheet Extrusion and Thermoforming

Broad processing experiences with BELLAND®Material where made on industrial equipment for sheet extrusion and in line and off line thermoforming.

Processing is performed on conventional equipment.

The best results are achieved on extrusion lines equipped with degassing equipment.

The typical extrusion temperature is about 200 °C. The melting temperature should not exceed 220 °C significantly. Grooved feeding zones should not be cut too deep.

Product change from e.g. Polystyrene to BELLAND®Material is uncomplicated.

It can not be recommended to apply processing temperatures above 230°C in combination with a long residence time, due to a tendency to crosslinking. The extrusion equipment should not be shut down if filled with BELLAND®Material.

Edge trim and punching lattice can be shredded and fed back into the extruder. In an on line operation up to 50% of shredded material can be used.

Cups, dishes and plates are produced on thermoforming machines with up to 48 molds. Sheet is extruded from 0.2 to 1.8 mm thickness.

Articles from BELLAND®Material are easily printable with conventional printing methods without the need of surface treatment.

Typical Parameters on extrusion lines:

Extruder temperature	180°C – 200°C
Adapter and die	200°C – 220°C
Calender heating	70°C – 100°C
Thermoforming heating temperatures	240°C – 260°C

Injection moulding

For example cutlery for catering applications is produced by injection moulding.

The processing temperatures depend on the type of machine and are typically between 230°C and 250°C. Cycle times are similar to Polystyrene.

The cuttings can be shredded and fed back into the machine.
BELLAND®Material can be processed on hot runner equipment.

Modern tooling steel enables easy removal from the mould.

Data sheet

Belland® Resin BelleX 1000/1010

for Extrusion and Thermoforming

BelleX 1000 is translucent
BelleX 1010 is white

Properties*

MFI 200°C/10 kg 4 g/10 min

Specific gravity 1.06 g/cm³

Glass transition temperature 112 °C

Extruded sheet:

Tensile strength 40 N/mm²

Elongation at break 9 %

Tensile impact strength 180 kJ/m²

Flex¹ test (Belland test) 30

Processing temperature: 200°C – 220°C

European food contact approval

*Typical values, not to be construed as specification

® A product of BellandTechnology

¹ Score of bending to break

Data sheet

Belland® Resin BelleX 1100/1110

for Injection moulding

Properties*

BelleX 1100 is translucent

BelleX 1110 is white

MFI 210°C/5 kg 6 g/10 min

Specific Gravity 1.06 g/cm³

Glass transition temperature 112°C

Tensile strength¹ 45 N/mm²

Elongation¹ 6 %

Charpy impact strength 130 kJ/m²

Shrink 0.5 %

Parameters for injection moulding:

Barrel temperature 230°C – 250°C

Die temperature 220°C – 230°C

Hot runners 260°C

European food contact approval

*Typical values, not to be construed as specification

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¹ according to DIN EN ISO 527

Belland Polymer Solutions for Rigid Coatings and Bonding

The extrusion grade material can be dissolved in alcohol or aqueous alkaline solution to create film building liquids for coating or bonding applications. Dependent on the solvent, the coatings can be removed by caustic solvents or water.

Solution in Alcohol

Example with granules of Belland Polymer 88140:

Polymer	60 wt %
Ethanol	40 wt %

At room temperature dissolution might take several hours.

When heated, dissolution is achieved within a reasonable time.

For example heat alcoholic mixtures under reflux cooling.

Put the granules into ethanol and heat to 40°C. Without stirring dissolving granules form a transparent gel (2 phases).

Upon stirring the 2 phases mix and become a hazy liquid.

This liquid can be diluted with ethanol until the desired viscosity is achieved.

The typical viscosity of a 60 wt% ethanolic solution at 70°C is 150 Pas.

For easier dissolving, a 1:4 mixture of MEK¹/Ethanol is recommended.

Example:

Polymer	20 %
MEK/Ethanol (1:4)	80 %

A solution can be achieved in about 30 min. at room temperature (RT).

The polymer solution can be applied to substrates and dried at RT or in an oven with the necessary precautionary equipment at up to 40°C.

The coating builds a film, which can be removed (dissolved) by aqueous alkaline solution (pH-value 10-12). Higher temperature reduces dissolution time.

¹Methylethylketone

Preparation of Aqueous Alkaline Solutions

Example: Dissolution of granules of grade 88140 in caustic soda:

Polymer	10 wt %
NaOH flakes	2 wt %
Water, de-ionized	88 wt %

(higher pH-value does not improve solubility)

Properties of the solution:

pH-value	10
Viscosity at RT	16 Pas

The solution can be applied with a doctor roller or by spraying.

Drying at 100°C is recommended.

The coating is soluble in water.

Preparation of Aqueous Ammoniacal Solutions

Example: preparation of a 10 wt% polymer solution:

Granules of grade 88140	10 wt %
25 % ammonium hydroxide in water	3.7 wt %
Water, de-ionized	86.3 wt %

Dissolve at 70°C in 2 h

Properties of the solution:

Polymer concentration	10 wt %
Viscosity at RT	5 Pas
pH-value	8

The solution can be applied with a doctor roller or by spraying.

Drying at 100 °C is recommended.

The film is water resistant, but soluble in aqueous alkaline solutions.

Belland alkaline soluble Hot Melt Adhesives

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Belland® Hot Melt Adhesives (PSA)

Belland „BellStx™“

Belland Hot Melt for Pressure Sensitive Adhesives (HMPSA)

Our Research Department achieved a break through in the development of water resistant, but in the alkaline cleaning agents soluble adhesives.

BellStx HMPSA offer the solution for applications where the adhesive layer has to be removed stainless. Although the products are water resistant, they offer some hydrophilic characteristics which are of special interest for hygiene applications.

In our research we succeeded in providing a broad spectrum of base polymers, which can be modified with tackifiers and plasticizers for specifically tailored performance properties.

Converting

Our products can be processed on conventional hot melt coating equipments.

Typical coating temperature is around 160°C.

Under padding extended storage at elevated temperatures is permitted.

Approvals and delivery form

BellStx™ hot melts comply with the requirements of BGVV-XIV for composition and they are not skin irritant.

Products are offered in

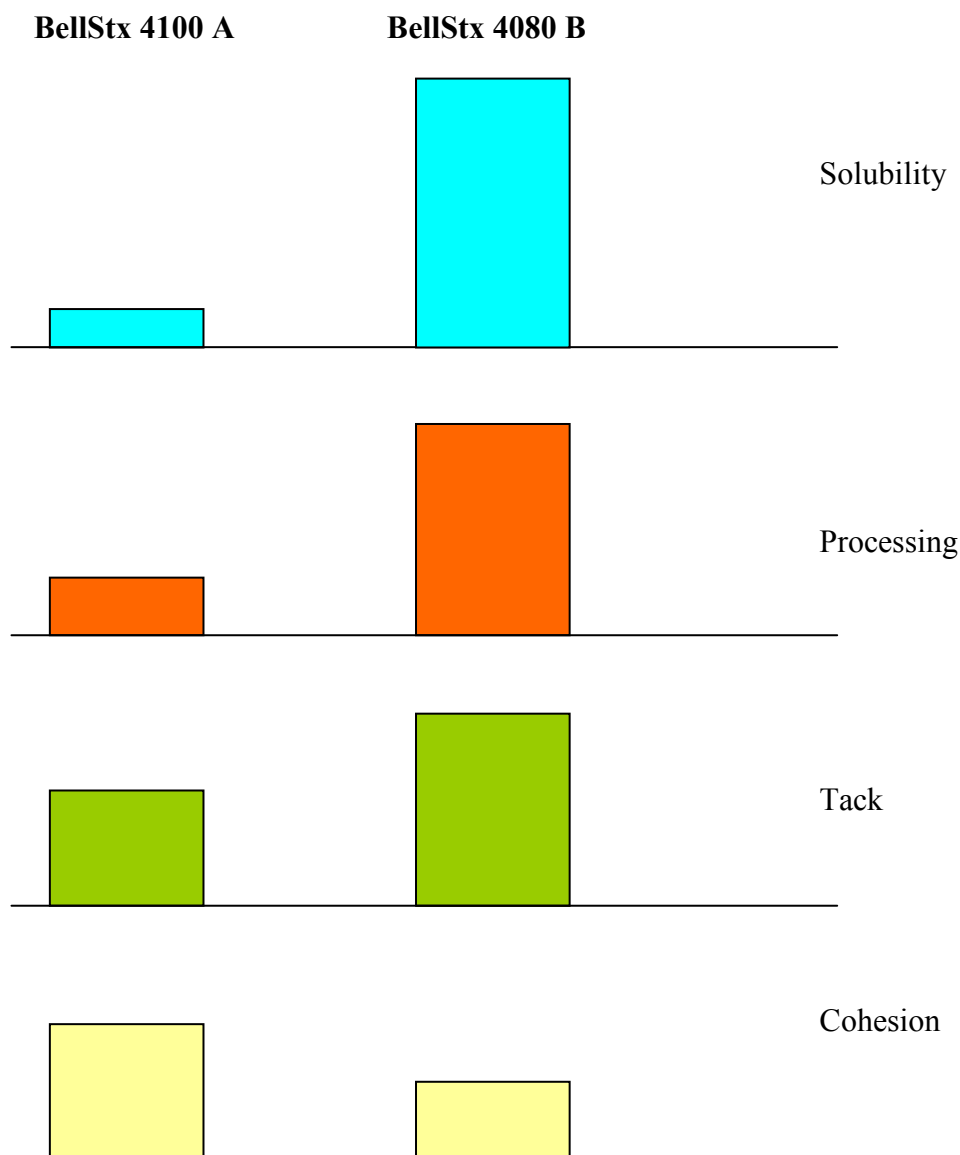
1 - kg boxes
or
10 - kg boxes

Other packaging, like barrels can be delivered upon request.

BellStx Base polymers

BellStx 4100 A high viscosity, soluble at elevated temperatures, good tack, good cohesion

BellStx 4080 B low viscosity, very good solubility, high tack, medium cohesion



For details please read technical information

Technical Information

Hot Melt PS Adhesive	Belland BellStx™ 4100 A
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Alkali soluble hot melt

Physical appearance	clear, highly viscous
Solidification temperature	ca. 80°C
Processing temperature	ca. 160°C

Specific gravity	1.1 g/cm ³
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Melt Index 100°C/2.16 kg	4.5 g/10min
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Viscosity 160°C (Brookfield)	220 Pas
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180° Peel test (Finat-1 Glass)	22 N
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Adhesion (Finat-9)	4 N
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Cohesion (Finat-8)	ca. 26 min.
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Cold Flow (Belland method)	0.1 cm/10 days
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*Typical values, not to be construed as specification

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Technical Information

Hot Melt PSA	Belland BellStx™ 4080 B
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Alkaline soluble hot melt

Appearance	clear, highly viscous
Solidification temperature	ca. 80°C
Processing temperature	ca. 160°C

Specific gravity	1.1 g/cm ³
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Melt Flow Index 100°C/2.16 kg	15 g/10 min
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Viscosity 160°C (Brookfield)	40 Pas
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180° Peel test (Finat 1 Glass)	24 N
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Adhesion (Finat-9)	5 N
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Cohesion (Finat-8)	20 min.
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Cold Flow (Belland method)	0.5 cm/10 days
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Formulations with BellStx Base Polymers

BellStx hot melts can be modified with tackifiers and plasticizers. The solubility in aqueous alkaline solutions is not constrained.

The base polymers are thermally stable for about two days at temperatures up to 160°C. They do not gel and the viscosity does not alter.

The following are examples for products that can be used:

Tackifiers

- Polymerized rosins
- Partially hydrogenated rosins
- Terpene phenolics
- Partial esters of dibasic modified tall oil rosin

Plasticizers

- Dipropylen glycol dibenzoate
- Pentaerythritol- tetra benzoate
- Polyethylene glycol 400-di-2 ethylhexanoate
- 2-Ethylhexyl- diphenyl phosphate
- Butyl benzyl phthalate

Hydrocarbon waxes show no or limited compatibility.

Solubility of BellStx Hot Melts

BellStx hot melts are soluble in organic solvents like alcohols and ketones, but their uniqueness is the solubility in aqueous alkaline solutions. The dissolution speed depends on the layer thickness, the temperature and concentration of the solvent.

At room temperature

1% NH ₄ OH	aqueous solution pH 10	(ammonium hydroxide)
1% NaOH	pH 13	(sodium hydroxide)
1% Na ₂ CO ₃	pH 11	(sodium carbonate)

Useful at elevated temperature:

Various alkaline cleaning agents

0.1 % - 0.5 % NH ₄ OH	aqueous solution
1 % Na ₂ CO ₃	aqueous solution

In general, the addition of surfactants increases the dissolution speed.
The products are typically water resistant.

Dissolution in Aqueous Bases:

BellStx HMA is soluble in aqueous alkaline solution.

This property is exploited in removing hot melt adhesive coatings from substrates such as tapes or labels.

In those applications, where a liquid coating should be applied, the Belland HMA can be dissolved in aqueous caustic solutions. After drying, this coating is soluble in water.

Example for dissolving Belland HMA in aqueous caustic solutions:

Belland HMA	38 wt %
NaOH	4 wt %
Water, de-ionized	58 wt %

Procedure:

Heat the solution to 95 °C.

After 2 h the HMA-block is soft and gentle stirring can start.

After 1/2 hour a whitish solution of adhesive is formed. To ensure complete dissolution it has to be stirred vigorously.

Properties of the solution:

Polymer concentration:	38 wt %
Viscosity at 21°C	110 Pas (Brookfield DV-II. Spindle 6.5 UPM)
pH-value	8.5

The solution adheres to glass and polar substrates. The dried film is water soluble and not sticky.

To achieve an alkaline soluble coating (not water soluble), the above solution needs to be precipitated with acid.

Example for precipitation:

Solution with	38 % MHA
Dilute with water	1:10
Heat to	70°C
Add Phosphoric Acid (85% conc.)	18 g
Heat to	boiling
Precipitation results in a milky dispersion with a gel phase.	
pH-value of dispersion	3.1

Apply the dispersion e.g. on a glass plate and dry in an oven at 120°C for one hour.

The water resistant film adheres to the glass and solar substances, is sticky and soluble in aqueous alkaline solutions.