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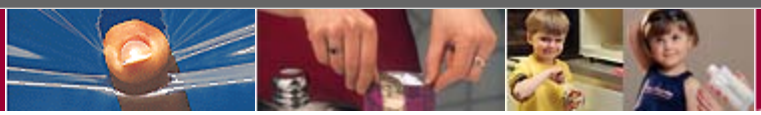
Product Information

Bynel® resins



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Bynel® 3000 Series adhesive resins

Anhydride-modified ethylene vinyl acetate (EVA), including grades 30E670, 30E671, and 30E699

Table 1 — Typical Property Data

Property	ASTM Test Method	Unit	Bynel® Grades[1]		
			30E670	30E671	30E699
Melt Index	D1238, 190°C/2.16 kg	dg/min	0.8	2.1	2.0
Density	D792	g/cm^3	0.93	0.93	0.93
Melt Point	DSC, D3418	°C (°F)	96 (205)	99 (210)	100 (212)
Freeze Point	DSC, D3418	°C (°F)	83 (181)	87 (189)	92 (198)
Vicat Softening Point	D1525	°C (°F)	84 (183)	81 (178)	83 (181)

1. Values are typical and should not be interpreted as specifications.

Additives

Slip	None
Antiblock	None

Description

Bynel® Series 3000 resins are anhydride-modified ethylene vinyl acetate polymers. They are available in pellet form for use in conventional extrusion and coextrusion equipment designed to process polyethylene (PE) resins.

Applications

Bynel® 30E670, 30E671, and 30E699 adhere to a wide variety of materials. They are most often used to adhere to PE, ionomers, EVA, and polyamide.

Physical properties of Bynel® Series 3000 resins are typical of EVA resins with similar density and melt index values. The rheology characteristics of each grade are different, so one may be better suited than the others for a particular extrusion process.

General Processing Information

Bynel® Series 3000 adhesive resins can be processed over a wide range of conditions. Factors that impact the optimal extruder temperature profile include:

- The position of Bynel® in the structure (interior versus exterior layer)
- The thermal stability of all materials in the structure
- The physical properties of all materials in the structure
- The processing equipment design

Interior Layer Extrusion

The temperature profile shown in Table 2 is suggested for initial evaluations of Bynel® Series 3000 adhesive resins when they are used as an interior layer in a structure. This profile is designed to provide adequate exposure time of the adhesive resin to elevated temperatures.

Because these resins have low softening points, it is a good idea to run the rear of the extruder as cool as possible, then build quickly to the melt temperature. Water cooling of the screw and/or hopper feed throat may help avoid bridging problems.

Table 2 — Bynel® Series 3000 Resins Suggested Extruder Temperature Profile

Temp.	Rear Zone	Second Zone	Forward Zone	Adapter	Die
°C	120,	220	235	235	235
°F	248	428	455	455	455

The suggested temperature profile may be modified as necessary to meet specific requirements. Variation of the suggested temperature profile may be appropriate depending upon the screw configuration, potential extruder horsepower limitations, potential backpressure limitations, the need to match rheologies, and/or the stability of the other resins in the coextrusion. Film quality will also depend on the residence time of the adhesive resin in the system. Dead spots may result in localized overheating and should be avoided by ensuring that the flow path for the adhesive is as streamlined as possible. Regardless of the profile used, the adhesive resin should be exposed to temperatures above 200°C (392°F) for several minutes prior to contact with other molten resins in coextrusion to activate the anhydride component of Bynel® Series 3000 adhesive resins.

We suggest that the maximum melt temperature be limited to approximately 238°C (460°F) to guard against thermal degradation of the EVA component of the resin. If adhesion is adequate we suggest running at temperatures below 238°C to prevent gel formation.

Exterior Layer Extrusion

When Bynel® Series 3000 resins are extruded as an exposed outer surface in a multilayer coextrusion, problems related to the tackiness and the high coefficient of friction of these products may be evident. If these symptoms occur and interlayer adhesion is adequate, it is suggested that the adhesive extrusion temperature be reduced. The resin temperature should be maintained above 200°C (392°F) to obtain adhesion to a barrier material such as nylon or EVOH, but it may be lowered to 150-175°C (302-347 °F) for bonding to polyolefins.

Addition of slip and silica-based antiblock packages may also be appropriate to prevent blocking and improve film handling, although these additive packages may modify the resin's bonding characteristics.

For producing monolayer adhesive films with Bynel® Series 3000 adhesive resins, extrusion conditions commonly used for converting ethylene vinyl acetate resins with similar melt index and vinyl acetate content into monolayer films can be employed.

Other Processing Considerations

We suggest using any standard polyolefin working screw when extruding Bynel® Series 3000 resins. Excessively deep flights should be avoided as they might result in poor melting of the adhesive resin. It is also important to properly size the extruder for the output desired. Running large extruders at very low rpm should be avoided.

Rheology curves for Bynel® 30E670, 30E671, and 30E699 are included in this product information sheet to assist in matching melt viscosities for coextrusion processing.

If the extrusion process is stopped for short periods of time, the screw in the adhesive extruder should be kept turning at a low rpm level. For a permanent shutdown, the Bynel® adhesive resin should be purged using an available polyethylene resin run at the same extrusion temperature used during the extrusion process of the adhesive resin. Making frequent changes in screw speed during the shutdown process and subsequent start-up will help remove the previous material from the system more effectively. Sometimes excessive amounts of gel may be observed upon start-up of the adhesive resin. This may be due to the natural ability of the adhesive resin to act as a purging compound. In this case, continued extrusion will eventually clear up the problem.

Adhesive Evaluation

The performance of any adhesive resin should be evaluated within the context of the application. The adhesive is designed to bond materials that would not ordinarily adhere to each other. Many variables can affect adhesive strength, including the physical properties of the substrates comprising the structure, layer thicknesses, melt temperatures, process equipment type, throughput rate, end use environment, and numerous others.

In most cases peel strength is used as a measure of performance. Although this is a convenient test, peel strength is affected not only by adhesion but also by peel angle, separation rate, temperature, tensile and modulus properties of the materials, and often by the time elapsed since the formation of the bond. Post-treatment of the multilayer structure, such as heat sealing, thermoforming, orientation, irradiation, sterilization, and pasteurization can also affect peel strength.

If peel strength is used as a measure of adhesive performance, it is imperative that peel strength be evaluated not only at the time of manufacture but throughout the life of the product and under all the conditions to which the structure will be exposed. Only then does peel strength provide a reliable indication of adhesive performance in the specific application.

Regulatory Compliance

Bynel® 30E670, 30E671, and 30E699 comply with FDA regulation 21 CFR 175.105 - Adhesives. This regulation describes adhesives that may be safely used as components of articles intended for use in packaging, transporting, or holding food. This regulation requires that either the adhesive is separated from the food by a functional barrier or the quantity of adhesive that contacts fatty or aqueous foods does not exceed the trace amounts at seams or edges. Customers should satisfy themselves that the food contact material is an effective functional barrier to the adhesive, under the intended conditions of use.

For information on regulatory compliance outside of the U.S., consult your local DuPont representative.

Safety

Bynel® Series 3000 adhesive resins have a history of safe manufacture, processing, use, and disposal. Nevertheless, melt processing operations with any plastic material can expose personnel to potentially hazardous situations. Some are obvious, such as contact with molten plastic. Others are less apparent, including exposure to fumes produced during melt processing and from waste disposal by burning. Some safety guidelines are listed below, but because different processing operations may produce different potentially hazardous situations, safety guidelines particular to the process operations should also be used.

Spills

Resin pellets can be a slipping hazard. Loose pellets should be swept up promptly to prevent falls.

Fumes

Thermal decomposition of Bynel® Series 3000 resins can produce potentially dangerous fumes. The maximum recommended processing temperature for Bynel® Series 3000 resins is 238°C (460°F). Under normal processing temperature and throughput conditions the amount of resin decomposition is minimal. Decomposition, however, is a function of both exposure temperature and time at that temperature. Significant decomposition can occur when the resin is exposed to abnormally high temperatures or if the resin remains molten for excessive periods of time. Lower operating temperature is suggested for low throughput conditions.

Bynel® Series 3000 adhesive resins may contain a small amount of volatile residuals that can accumulate in confined areas, such as shipping vehicles and containers. These residuals result in odors typical of the resin chemistry and exposure to these fumes might cause discomfort in some individuals. Adequate ventilation should be provided to minimize exposure when working in enclosed spaces.

Ventilation hoods are recommended to prevent fumes from being discharged into and accumulating in the work area. Proper hood design is important to ensure collection and disposal of these by-products. Hood design and calculation of minimal functional air velocity is best performed by knowledgeable design engineers.

Skin Irritation

It is good practice to avoid skin contact with resins. Contact with resin and vapors contained in headspace areas should be minimized and hands should be thoroughly washed after exposure.

Thermal Burns

If contact with molten polymer is made, immediately flush the burned areas of the skin with cold running water or treat with ice packs. Continue the treatment for 15 minutes or until the pain has diminished. Do not attempt removal of the hardened polymer. Obtain immediate medical attention.

Flammability

During normal processing, storage, and use, Bynel® adhesive resins do not present a significant flammability hazard. They will, however, like most organic materials, burn under suitable conditions. In the event of a fire, personnel entering the area should use a fresh air supply. Dry chemical, carbon dioxide, and foam type extinguishers are recommended to fight fires involving Bynel® Series 3000 adhesive resins.

Disposal

Disposal of scrap material presents no special problems and may be accomplished by landfill or by incineration at a properly operated incinerator. Disposal must comply with local, state, and federal regulations.

For more detailed information on the safe handling and disposal of these resins, please consult DuPont's Material Safety Data Sheets, which can be obtained from DuPont regional offices. MSDS contact information is available on the Web at http://www.dupont.com/corp/products/msds.html.

Figure 1. Bynel® 30E670 Rheology

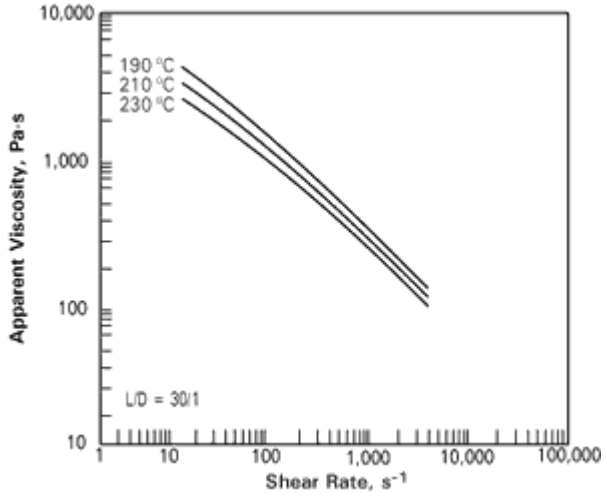


Figure 2. Bynel® 30E671 Rheology

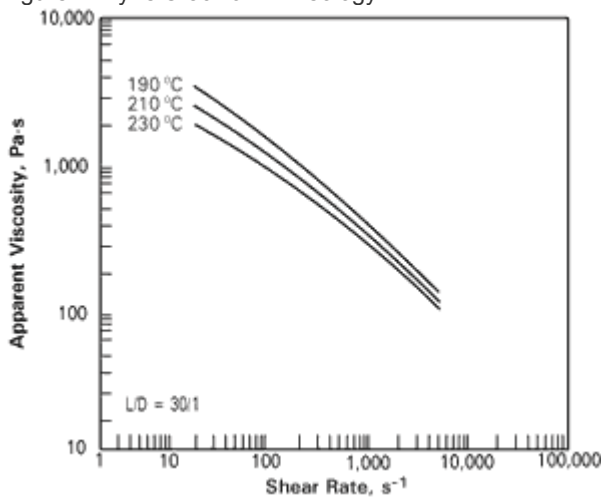
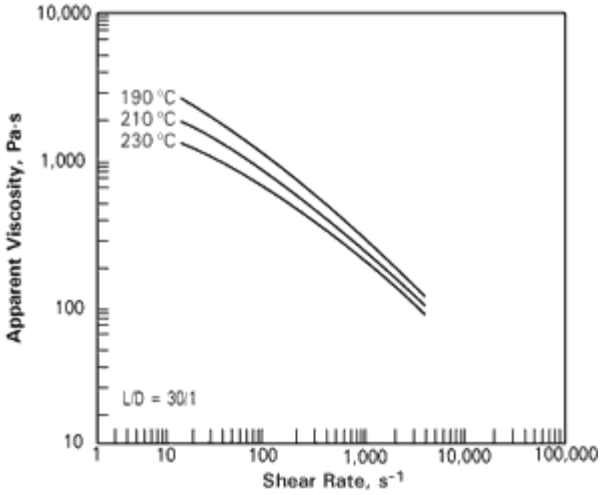


Figure 3. Bynel® 30E699 Rheology


10,000
1,000
100
10
Apparent Viscosity, Pa·s
190 °C
210 °C
230 °C
L/D = 30/1
1
10
100
1,000
10,000
100,000
Shear Rate, s-1