DuPont Packaging & Industrial Polymers

Elvanol®
polyvinyl alcohol

Click to print.

For more information, e-mail us at: industrial.polymers@dupont.com

Elvanol® in the Paper Industry

The performance advantages of DuPont™ Elvanol® PVOH

Barrier Properties	Resistant to oil, grease and water
Film Strength	Tensile = 9,000 psi (vs 600 psi for starch)
Binding Capacity	4-5 times the capacity of starch 2.5 times the capacity of synthetic latex
Environmental	Lower BOD than starch
Ease of Preparation	Can be batched or jet cooked; or co-cooked with hot-water-soluble polymers

Because of its outstanding film strength, barrier properties and binding capacity, DuPont™ Elvanol® polyvinyl alcohol enjoys wide use in the manufacture of paper and paperboard. DuPont manufactures Elvanol® PVOH in a number of specialized grades offering a range of useful performance features and convenient processing characteristics.

Reviewed below are some of the most common uses for Elvanol® in this industry, as well as frequently used product grades and typical application methods.

Surface application at the size press or calender stack

When a specialty or commodity paper grade needs more performance than a starch can provide, Elvanol® offers significant advantages for strength and barrier properties.

Surface Barrier

Elvanol® polyvinyl alcohol is the strongest waterborne film former commercially available to the paper industry. It is chemically resistant to oils, greases, waxes, organic solvents, and more resistant to water than starch.

Using a higher viscosity grade will keep the film on the surface of the sheet for optimum barrier performance. The grade of Elvanol® selected is governed by the end-use properties needed, application equipment, and post-dryer capabilities of the paper machine or off-machine coater.

For oil and grease resistance, film formation plays a key role in closing the sheet for holdout. This excellent film formation gives superior barrier qualities.

In addition, Elvanol® is an excellent carrier for oil and grease-resistant fluorochemicals to give more efficient coverage of the base sheet. Elvanol® 51-05, 52-22, and 50-42 are recommended to obtain the best film formation to achieve these resistant barrier qualities.

For water resistance, the higher the degree of hydrolysis, the greater the water resistance. Elvanol® 70-06, 90-50 and 71-30 are fully hydrolyzed grades that give superior water resistance.

To further improve the water resistance of polyvinyl alcohol, Elvanol® may be cross-linked using an insolubilizer. Common chemicals used as insolubilizers are salts of multivalent ions (i.e., ammonium zirconium carbonates), aminoplast resins (i.e., cyclic amide condensates), and aldehyde or aldehyde derivatives.

Surface Strength

Films made of Elvanol® are much stronger than those made of starch alone. Elvanol® based surface sizes containing as little as 10 percent Elvanol® provide a surface that resists surface abrasion and cracking, and improves folding and bursting strength.

Surfaces sized with starch needing scuff resistance or surface pick resistance will benefit from incorporating Elvanol®. The strong film with excellent binding properties ties the fibers and the surface debris to the paper or paperboard surface to reduce linting and dusting. This helps keep offset printing blankets cleaner and reduces press downtime.

The strength and moisture resistance of Elvanol® surface treatment can also improve curl control.

The binding strength from Elvanol® allows costly fiber to be economically replaced with filler and still maintain the strength of the paper. Similarly, the hardwood or recycle content of paper can be increased, while maintaining strength and printability properties with Elvanol® applied as a surface treatment.

Surface Properties

Elvanol® gives paper and paperboard excellent printability, smoothness, and print gloss. The oil and solvent resistant properties keep ink from penetrating into the paper and allow clear, glossy printing with outstanding print clarity, and fidelity. The excellent film coverage by polyvinyl alcohol closes the sheet, which is beneficial for specialty papers that require lower porosity.

Applications with Pigments or Optical Brighteners

Pigmented Size Press

Elvanol® is an effective binder in coating formulations at the size press. Because of its binding power, Elvanol® can replace starch on a 1-to-5 basis. It is possible to replace all or part of the starch in pigmented size with Elvanol® and raise the pigment-to-binder ratio. With the incorporation of Elvanol® and reduced level of binder in the pigmented size, the optical and surface properties are improved over a clearsize, uncoated sheet.

The following advantages have been demonstrated using Elvanol® in pigmented size applications:

- Excellent way to achieve filler or fiber economies
- Improved opacity and brightness
- Improved drying and moisture profile uniformity
- Reduced calendar loading to achieve surface smoothness
- Uniform ink receptivity, reduces two-sidedness
- Reduced binder reduces mottle
- Economical method to reduce sheet porosity
- Holdout and smoothness to the topcoat
- Coatings

Elvanol® has stronger binding power than acrylic latexes, styrene butadiene, soy protein, casein, and starches. It can be used as a partial binder replacement by 1-3 parts of Elvanol® into a coating formulation. By reducing the total binder levels, optical properties improve.

The reduced level of binder increases the average difference in refractive index between the pigment particles and their surroundings. This increase in refractive index increases light scattering, which can improve both opacity and brightness.

In most cases, the reduced level of binder also allows an increase in coating solids, which can increase machine speed. Because of rheology considerations at high shear conditions, Elvanol® 90-50 and 70-06, fully hydrolyzed grades with low molecular weight, are recommended for coating applications.

Optical Brighteners

Fluorescent whitening agents (FWAs) are commonly used in coated offset papers to provide high brightness properties. The effectiveness of the brightener in coatings can be enhanced with the use of Elvanol® polyvinyl alcohol as a carrier. The use of 0.5 to 2.5 parts by weight of polyvinyl alcohol based on 100 parts of pigment results in whitening significantly better than that with the FWA alone.

Similar improvements in FWA performance also apply to size press applications. Compared to starch and casein as a carrier, polyvinyl alcohol generates significantly higher brightness when used at lower size press

pickup.

Typical Product Grades Used in the Paper Industry

The most common grades of DuPont Elvanol® polyvinyl alcohol used in the paper industry are:

Elvanol® 70-06

Low viscosity, fully hydrolyzed PVOH.

Uses include:

- FWA and optical brightener carrier.
- Fluorochemical extender.
- Ink jet applications.
- Clear and pigmented sizing.
- Grease and water resistance.
- Increases internal dry strength.
- High solids coatings and sizings.
- Compatible with starch and CMC.

Elvanol® 90-50

Medium-to-low viscosity, fully hydrolyzed PVOH

Uses include:

- FWA and optical brightener carrier.
- Grease and water resistance.
- Excellent coating binder.
- Combines efficient binding with excellent high shear rheology.
- Controls backside lint and surface debris.
- Provides superior holdout and coating appearance properties for clay coated recycle board.
- Compatible with modified starches.

Elvanol® 71-30

Medium viscosity, fully hydrolyzed PVOH

Uses include:

- FWA and optical brightener carrier
- Surface sizing. Controls backside lint and surface debris
- Controls dusting and picking on high filler content papers
- Grease proofing reprographic papers
- High gloss ink printing surfaces
- Compatible with starch and CMC

Elvanol® 51-05

Low viscosity, partially hydrolyzed PVOH

Uses include:

- FWA and optical brightener carrier
- Fluorochemical carrier/extender
- Ink jet applications
- Protective colloid

Elvanol® 52-22

Medium viscosity, partially hydrolyzed PVOH

Uses include:

- FWA and optical brightener carrier
- Fluorochemical carrier/extender
- Ink jet applications
- Protective colloid
- Oil and grease resistance

Elvanol® 50-42

Medium viscosity, partially hydrolyzed PVOH

Uses include:

- FWA and optical brightener carrier
- Fluorochemical carrier/extender
- Ink jet applications
- Protective colloid

The degrees of hydrolysis and polymerization influence film strength, binding power, and water sensitivity. These characteristics must be considered when choosing a grade of polyvinyl alcohol for a particular end-use.

There are specialized applications where Elvanol® is used alone or in combination with specialty chemicals to provide:

- surface and internal strength;
- barrier to grease, oils, solvents and waxes; and
- release to adhesives, coatings, and plastisols.

Elvanol® also is used to reinforce and enhance starch performance in the paper and paperboard industry.

Suggested Formulations

The following formulations are suggested as a place to begin optimization. For more information, contact DuPont

- Elvanol® as the sole size component
  Size press: 2-5% solids
  Calender stack: 2-8% solids
- Elvanol® with starch for enhancing performance
  For equal add-on:
  10% Elvanol®, 90% starch

  For reduced add-on:
  25% Elvanol®, 75% starch

Compatibility

Solutions of polyvinyl alcohol are compatible with most of the common materials used in paper-making and with size additives such as modified starches, alginates, sodium CMC, wax emulsions, and defoamers.

Sizes made from Elvanol® and modified starch are generally stable at room temperature with no agitation up to 24 hours before phase separation takes place. However, it is recommended that blends of starch Elvanol® be agitated continuously. Whenever phase separation occurs, the separate phases can be reblended by agitation.

Certain compounds cause gelation of Elvanol® solutions and should be avoided. These compounds include borax, aromatic hydroxy compounds, and inorganic complexing agents. Surface size dyes should be checked for compatibility before use.