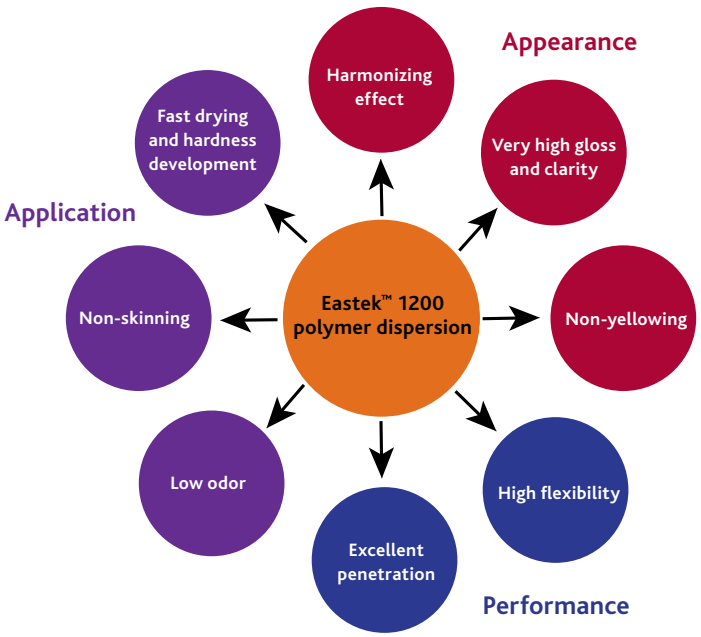
EASTMAN

Eastek™ polymer dispersions in industrial joinery applications

The growth of waterborne systems for industrial joinery applications has largely been driven by improved technical performance over traditional solvent-borne technologies rather than environmental issues alone. Coating processes employed in the manufacturing of joinery products are performed on a highly automated basis which place performance demands on the coatings.

Commonly used amine neutralized waterborne systems require continuous pH monitoring to ensure that coating properties are not compromised by the loss of volatile amine, and surfactant stabilized waterborne systems may have strong foaming tendencies on recirculation.

This technical tip describes the use of a novel binder system based upon sulfopolyester chemistry which eliminates the deficiencies of current binder systems for joinery applications providing enhanced characteristics.



Eastek™ polymer dispersions

Eastek™ polymer dispersions are aqueous dispersions of sulfopolyester polymers based upon monomer building blocks, acids, and 5-(sodiosulpho) isophthalic acid (SSIPA). The use of SSIPA to provide dispersibility in water eliminates the need for amines and provides electrostatic stabilization which reduces the need for surfactant.

Table 1

Commercially available Eastek™ polymer dispersions

Properties	Eastek™ polymer dispersions				
	1000	1100	1200	1300	1400
Water dispersability	••	•••	•	••	••
Glass transition temperature, T_g °C	38	55	63	36	29
Minimum film forming temperature, MFFT °C	<5	5	27	12	<5
Solids, wt %	30	33	30	30	30
pH	6.0	6.2	6.6	6.0	6.0
Viscosity, cP	60	89	99	14	15
Particle diameter, nm	27	20	13	54	34

• Good •• Better ••• Best

The key features of the product range are

- Neutral pH
- Relatively low solution viscosity
- Exceptionally small particle size

Since no amine is required to neutralize the polymer, the Eastek™ polymer dispersions show excellent viscosity stability when used in automated application equipment, even under extremes of temperature. During the drying process of a sulfopolyester film, it can be observed that the exceptionally small polymer particles coalesce, which helps to provide excellent clarity and gloss.

The sulfopolyester dispersions do not contain any solution polymer, and, therefore, have no tendency to skin during drying which allows the water to escape rapidly from the drying film. This characteristic also prevents drying of coating residues on the container walls, which could fall back into the bulk solution resulting in spray nozzle blockages or film contamination typical of acrylic or alkyd emulsion based systems.

Experimental

An extensive program of work with Eastek™ 1200 polymer dispersion was performed on Eastman's behalf by the consultancy company 3P-ICC in Germany. The work at 3P-ICC initially focused on the use of the sulfopolyester resin dispersion in comparison with various commercial systems in the initial impregnation layer of a wood coating typically used for windows

- Impregnation behavior and appearance
- Resistance to UV light exposure
- Drying performance
- Humidity resistance and crack/blister performance
- Resistance to mechanical damage/hail

However, Eastek™ polymer dispersions are not only utilized primers, but are also used in the intermediate coating layers of joinery systems.

Impregnation behavior and appearance

Photo 1 illustrates the appearance of an Eastek™ 1200 polymer dispersion-based impregnating primer into a solid wood profile, compared with a commercial alkyd emulsion based impregnation primer.

Photo 1

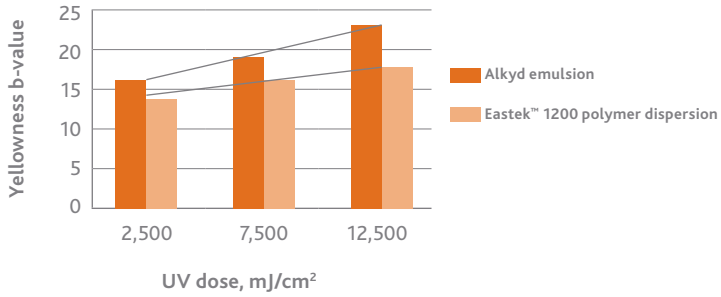
Commercial system 2 | Commercial system 1 | Eastek™ 1200 polymer dispersion

Alkyd emulsion based systems are recognized as being particularly advantaged in terms of their small particle size, and, therefore, exhibit excellent penetrating behavior. However, they are typically disadvantaged in terms of poor yellowing performance under UV light.

Figure 1 illustrates this point where a white pigmented primer system was formulated with Eastek™ 1200 polymer dispersion and compared against a primer formulated with an alkyd polymer. Both primers were subjected to a measured dose of UV light.

Figure 1

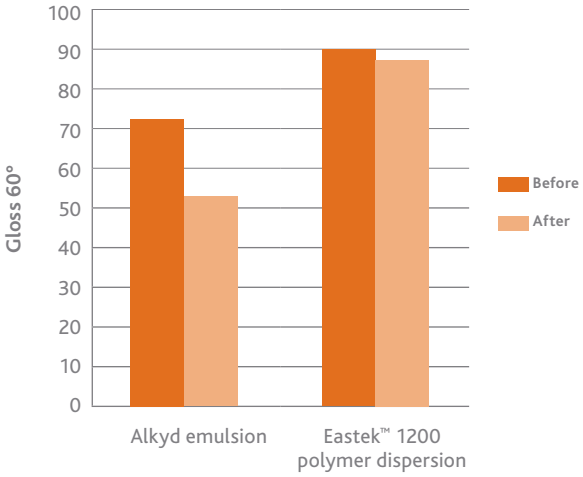
Yellowness change with UV exposure



It can be clearly seen that the sulfopolyester based coating has superior yellowing resistance. It was also interesting to observe that the gloss reduction of the formulation based on Eastek™ 1200 polymer dispersion was significantly lower than the alkyd emulsion based control (Figure 2).

Figure 2

Gloss before and after UV treatment



As mentioned earlier, the electrostatic stabilization of the sulfopolyester based dispersion can give rise to exceptionally fast drying characteristics compared with other waterborne polymer types. This effect can clearly be seen in Photo 2 and Photo 3 where 200µm films of both an alkyd emulsion and the Eastek™ 1200 polymer dispersion were observed after 5 minutes and 45 minutes respectively. The sulfopolyester dispersion would appear to offer interesting drying behavior in an industry looking to improve productivity and throughput.

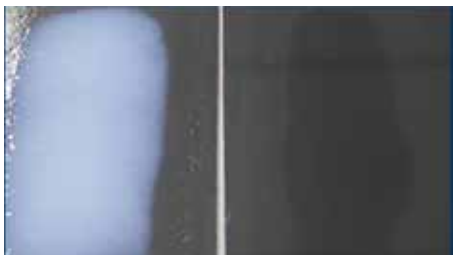
Photo 2

Appearance on drying after 5 minutes

Alkyd emulsion | Eastek™ 1200 polymer dispersion

Photo 3

Appearance on drying after 45 minutes



Alkyd emulsion | Eastek™ 1200 polymer dispersion

Impact resistance

The impact resistance of the Eastek™ 1200 polymer dispersion-based formulations was compared against commercial coating systems and found to provide equivalent performance with all systems passing.

The hailstorm test (falling metal balls) is designed to simulate damage to joinery coating systems which could be caused by hail, etc. Any damage or cracking observed in this test would normally be a concern since this could introduce a pathway for water ingress and premature failure. Photo 4 illustrates the excellent performance of the sulfopolyester based dispersion when used in an impregnating primer compared with a standard commercial product based upon alkyd acrylic binders.

Photo 4

Results of hailstorm test

Before hailstorm test | After hailstorm test

Commercial impregnation | Eastek™ 1200 polymer impregnation | Commercial impregnation | Eastek™ 1200 polymer impregnation

Starting-point formulations

For this work, two starting-point formulations were developed by 3P-ICC, a pigmented (white) and a transparent system (Table 2). For the transparent coating, the paint system was applied in three layers as detailed in Table 3.

Table 2

Pigmented system

	Eastek™ 1200 polymer dispersion (white)	Alkyd resin (white)
Ingredients	**Weight %**	**Weight %**
Eastek™ 1200 polymer dispersion (30% solids)	65.50	–
Uradil XP 601[1] (44% solids)	–	44.0
Luconyl white 066 TiO_2 paste (70%)[2]	25.00	25.00
Butyl glycol	6.00	6.00
Tego Foamex 822[3]	0.50	–
Tego Airex 902 W[3]	–	0.30
Byk 346[4]	1.00	1.00
TEXAPHOR 3250[5] (50% water/ BG 1:1)	2	–
ADDITOL VXW 4940[6]	–	0.60
Water	–	23.10
Total	**100.00**	**100.00**

[1]*DSM Neo Resins,* [2]*BASF,* [3]*Tego Evonik,* [4]*Byk Chemie,* [5]*Cognis,* [6]*Cytec*

Table 3

Transparent system

Layer	Description	Wet film weight (g/m^2)
1	Commercial impregnation primer (standard) **or** sulfopolyester starting-point formulation (see table 4)	160-200
2	Commercial primer	80-200
3	Commercial topcoat	200-220

Table 4

Sulfopolyester starting-point formulation for transparent system

Ingredients	Weight %
Eastek™ 1200 polymer dispersion (30% solids)	20
Butyl glycol	8-10
Water	65-70
Tego Foamex 822[1]	0.5
Byk 346[2] or EnviroGem 360 surfactant[3]	0.5-1.0
3-iode-2-propynyl-butylcarbomate	0.3
Propiconazole	1.2

[1]*Tego Evonik,* [2]*Byk Chemie,* [3]*Air Products*

Discussion

When used in an impregnation primer, the Eastek™ 1200 polymer dispersion provided alkyd-like penetration with non-yellowing and rapid drying behavior. Furthermore, the elimination of volatile amine neutralization products would help the application characteristics of these coatings, particularly under high temperature conditions on long application runs.

The work performed by 3P-ICC in Germany on Eastman's behalf has demonstrated the following benefits for Eastek™ 1200 polymer dispersion, a translucent solution with very small particle size, for industrial joinery coating systems.

- **Excellent appearance and harmonizing effect**
  - – Very high gloss and clarity
  - – Non-yellowing
- **Performance**
  - – High flexibility
  - – Excellent penetration
- **Application characteristics**
  - – Low odor
  - – Non-skinning
  - – Fast drying and hardness development

Eastek™ 1200 polymer dispersion is one of a family of sulfopolyester polymers (see Table 1) which share the same basic chemistry and attributes but which vary in physical characteristics such as hardness and degree of water dispersibility. These materials can also be blended with each other to adjust for film hardness. They show excellent performance characteristics which should allow the coatings formulator the opportunity to enhance and improve his waterborne coating systems for industrial joinery applications.

Acknowledgments

This work was performed on behalf of Eastman by the well respected German consultancy firm 3P-ICC, who have a reputation as experts in the formulation and testing of coating systems for wood.

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