TECHNICAL UPDATE

CRAY VALLEY
Hydrocarbon Specialty Chemicals

Aqueous Dispersions of Functionalized Low Molecular Weight Polymers

Benefits

- Adhesion to different substrates
- Adhesion promoter of SB latexes
- Adhesion between rubber and polar substrates
- Water-based
- Low viscosity
- Small particle size
- Good wetting
- Improved water resistance
- Compatible with other water-based systems

Target Markets/Applications

- Textile treatment
- Surface treatment of polar fillers

Additional Information

MSDS/TDS: Ricobond® 7002, Ricobond® 7004, CVX 50092, CVX 50120

Description

Cray Valley's line of maleated polybutadiene resins has been contributing the following benefits to manufactured rubber goods:

- Increased adhesion to metal and plastic substrates
- Increased water, acid and base resistance
- More homogeneous dispersions of polar fillers in non-polar rubber and plastics

Due to the increasing demand for these same properties in aqueous systems, Cray Valley has developed a series of aqueous dispersions of functionalized low molecular weight polymers. Table 1 lists the chemical and physical properties of the dispersions. When mixed with other water-based emulsions, the dispersions can increase rubber adhesion to textile, metal and plastic substrates, improve chemical resistance, and yield more homogeneous dispersions of polar fillers in non-polar rubber and plastics. The hydrophobic and hydrophilic components of the dispersions allow for interaction between polar and non-polar substrates. The dispersions show good compatibility when formulated with other latexes and improve properties of the overall blend. Formulating with standard latexes can reduce surface tack while improving adhesion, water resistance, and acid and base resistance.

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Table 1: Physical and chemical properties of the aqueous dispersions of functionalized low molecular weight polymers.

Identification	CVX 59002	Ricobond 7002	CVX 50120	Ricobond 7004
Functional Groups/Chain	2	5	9	11
Viscosity, cps @ 25 °C	<100	<200	<1000	<500
pH	8.0-9.0	8.0-9.0	8.0-9.0	8.0-9.0
Solids, wt%	28-31	28-31	28-31	28-31

To demonstrate the effect of the chemical composition of the base resins on adhesion, PET film was treated using the dispersions Ricobond 7002, CVX 50120 and Ricobond 7004. Figure 1 demonstrates that the adhesion values increased as the reactive group content of the dispersions increased. Ricobond 7004, containing 11 functional groups per chain, shows the best adhesion.

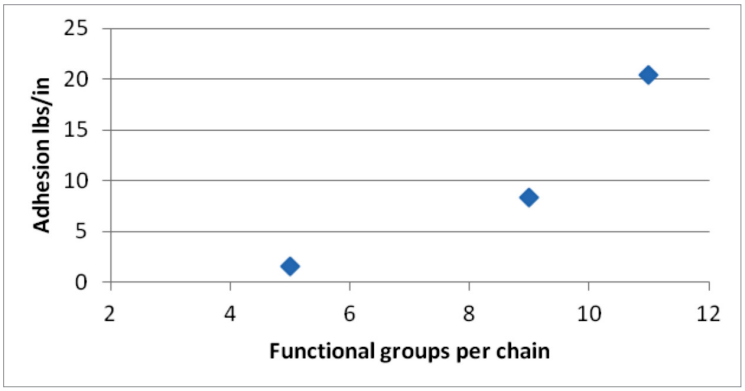

Figure 1: T-peel adhesion results as a function of the reactive groups/chain.

To demonstrate utility, the dispersions were formulated with carboxylated styrene butadiene emulsions. When 10% and 20% of the dispersions were added to the SB latex, excellent compatibility was observed. The mixtures were homogeneous, grit-free and remained stable when exposed to 50 °C for 10 days.

Since Ricobond 7004 showed better adhesion to PET, it was then formulated with two SB latexes (SBR1: GenFlo 8045 and SBR2: GenFlo 3003) and a vinyl pyridine latex (VP: GenTac 106). These blends were used to treat PET film and dip a polyester woven fabric and a nylon non-woven fabric. A modified T-peel method was used to test adhesion of the above substrates to EPDM peroxide-cured rubber.

Procedure and Testing

Sample preparation

A one-step dipping process was used to treat the polyester and nylon fabrics. The blends used to treat the fabrics were 10:90 and 20:80 ratios of Ricobond 7004 to latex. Each fabric was dipped in a bath, then passed through rollers to remove excess material. The treated fabric was then dried in an oven for 6 minutes at 150 °C. The PET film was coated using a #20 Mayer rod. The treated film was then dried in the oven for 1 minute at 150 °C. Plaques of rubber-fabric-rubber were made and cured at 160 °C for 35 minutes in a heated press. These plaques were then cut into four 1-inch by 5-inch strips.

Testing

A modified ASTM D1876 T-peel method was adapted to test the adhesion of the treated fabric to cured EPDM rubber. Figure 2 provides a visual description of the modified test. A Thwing-Albert EJA Vantage 10 tensile tester was used to perform the testing. T-peel speed and distance were constant for all samples. All strips were tested at room temperature (27 °C) and at 50% relative humidity.

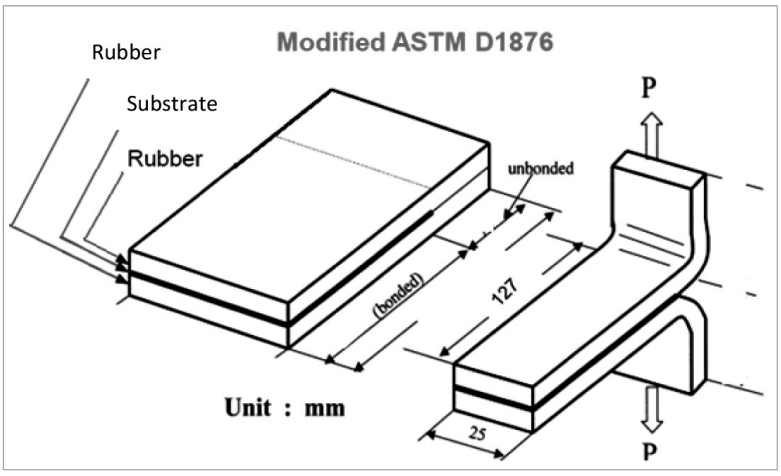

Figure 2: Modified ASTM D1876 test.

Results

The addition of Ricobond 7004 to the three emulsions showed substantial improvement in adhesion between coated PET film and EPDM rubber. Figure 3 shows that the greatest improvement was demonstrated by the 80:20 ratio blend with SBR1. Though the adhesion value (% load) shown in Figure 3 is ~25 lbs/in, the initial load average is 40 lbs/in. Inspection of the test sample indicated the mechanism was clearly cohesive failure of the rubber. Therefore the % load value recorded does not reflect adhesive failure but rather the tear strength of the rubber. A slight improvement in adhesion is also observed with the blend using SBR2. No significant difference in adhesion was observed between the 90:10 and 80:20 ratios for any base latex. Polyester and nylon fabric treated with Ricobond 7004/latex blends produced significant improvement in adhesion. Figures 4 and 5 provide a comparison of the adhesion as a function of Ricobond 7004/base latex blends for both polyester and nylon fabrics, respectively. Though the greatest improvement with the addition of Ricobond 7004 is demonstrated by blends using VP (96% increase for polyester and 63% increase for

nylon), blends with VP show the lowest total adhesion values when compared to blends with SBR1 and SBR2. There is an overall increase in adhesion when increasing the amount of Ricobond 7004 in the blend. All samples show better adhesion at the 80:20 ratio.

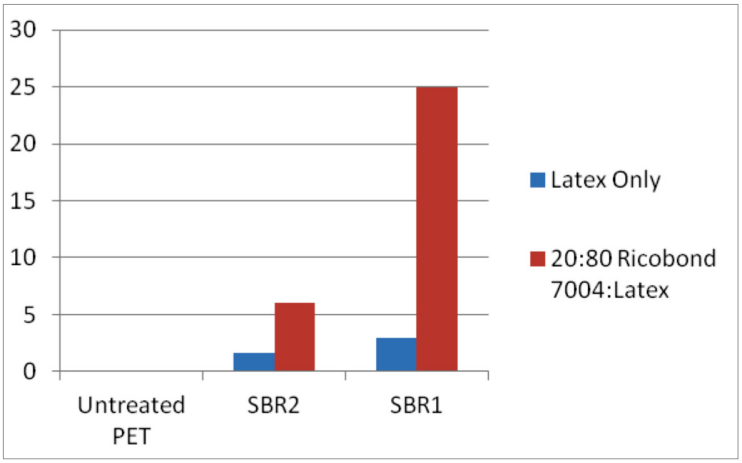

Figure 3: Adhesion of coated PET film to peroxide-cured EPDM rubber.

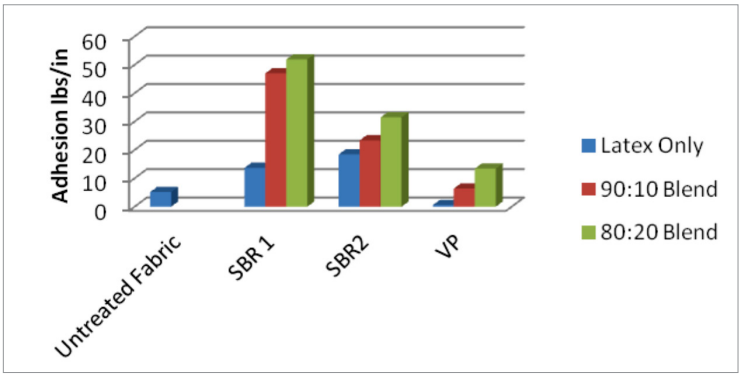

Figure 4: Adhesion of polyester to peroxide-cured EPDM rubber.

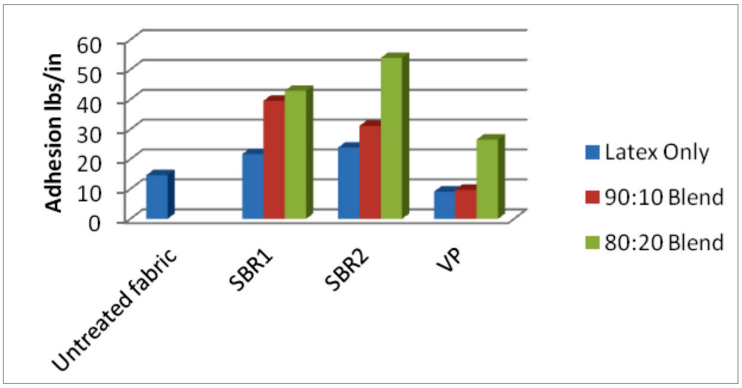

Figure 5: Adhesion of nylon to peroxide-cured EPDM rubber.

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Summary

Aqueous dispersions of functionalized low molecular weight polymers can be blended with SBR and VP latexes as adhesion promoters for textile treatment formulations. The addition of Ricobond 7004 to the latexes improves adhesion, enhances water resistance, reduces tack and improves the overall physical properties of the blend. Future work will include evaluating adhesion of the textile substrates to sulfur-cure natural rubber as well as treating other substrates such as carbon fiber, aromatic polyamides, polyolefin-based nonwovens and metals.

Other Suggested Applications

Aqueous dispersions of functionalized low molecular weight polymers may also be used as additives in other water-based formulations such as adhesives, coatings, paper sizing, construction materials and composites. The aqueous dispersions can also be used to pre-coat high surface energy fillers to improve wetting and ultimate dispersion in elastomers and thermoplastic/thermoset resins.

About Cray Valley HSC Division

Cray Valley USA, LLC, is the premier global supplier of specialty chemical additives, hydrocarbon specialty chemicals, and liquid and powder tackifying resins used as ingredients in adhesives, rubbers, polymers, coatings and other materials. Cray Valley has pioneered the development of these advanced technologies, introducing hundreds of products that enhance the performance of products in energy, printing, packaging, construction, tire manufacture, electronics and other demanding applications.

For more information, please contact **TechSupport@CrayValleyUS.com** or visit **www.crayvalley.com**.

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