



BENEFITS

- Understanding the adhesion mechanism process
- Identifying modes of failure
- Formulation and process optimization

TARGET MARKETS/ APPLICATIONS

- Textile Treatment

ADDITIONAL INFO

- **MSDS/TDS:** Ricobond® 7004

Ricobond® 7004 for Rubber to Textile Adhesion: Understanding its Adhesion Mechanism and Process Optimization Using Scanning Electron Microscopy

Description

This work is part of a series of testing and analysis to develop a basic understanding of the adhesion mechanism of Ricobond® 7004 and to identify materials and processes required to achieve optimum adhesion performance. Scanning Electron Microscopy (SEM) was used to examine peel adhesion specimens to determine mode of failure and thereby a path forward to achieve rubber cohesive failure, i.e. 100% rubber coverage.

Procedure and Testing

Peel adhesion samples with three different fabric treatments were examined using SEM. Magnification in the range of 15X to 5000X was used. The samples are designated CV1, CV2, and CV3. Table 1 details the chemical treatment and fabric treating conditions for each sample. The fabric treated is a non-adhesive-activated polyester. Resorcinol formaldehyde latex (RFL) treated fabric was obtained from an outside source.

In the SEM images, lack of bonding is shown by gaps between layers of fabric, adhesive, and rubber. Each material can be identified by its texture — Filaments are generally smooth and uniform; Adhesives are layered, smooth and have no fillers; Rubber is grainy with a rough surface and has fillers.

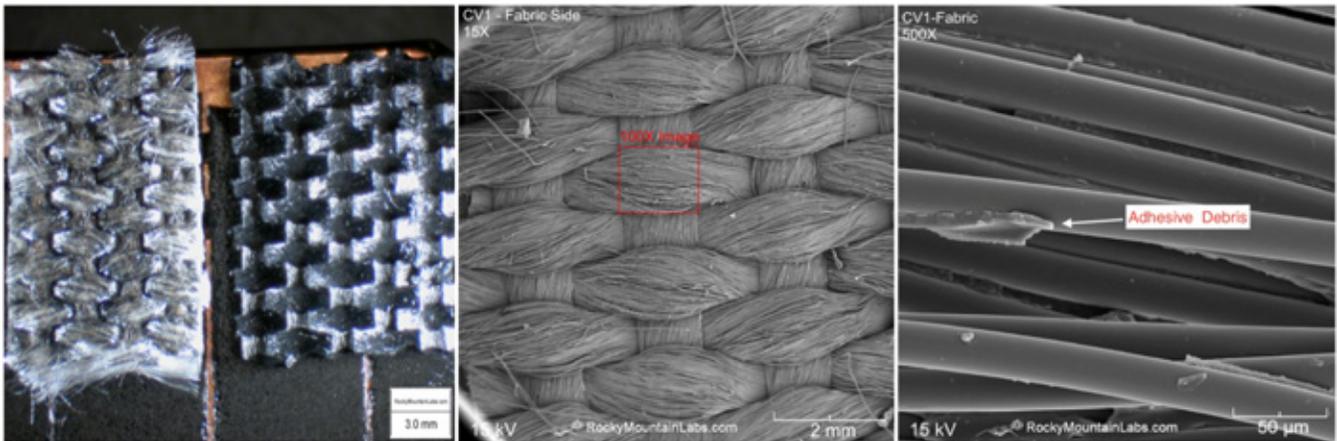
Table 1: Samples examined by SEM.

Sample Number	Chemical Treatment	Fabric Treating Conditions	Peel/Adhesion (lbs/in)	Observations
CV1	Ricobond 7004/ GenTac 106 Blend	12 minutes at 150 °C	22.7	Treated fabric was light in color and less stiff than CV2
CV2	Ricobond 7004/ GenTac 106 Blend	Air dried to evaporate water plus 3 minutes at 215 °C	36.1	Treated fabric was darker in color and more stiff than CV1
CV3	IL-6/RFL	Dried at 100 °C plus 1 minute at 205 °C	64.7	Treated fabric is typical reddish brown color of RFL

Results

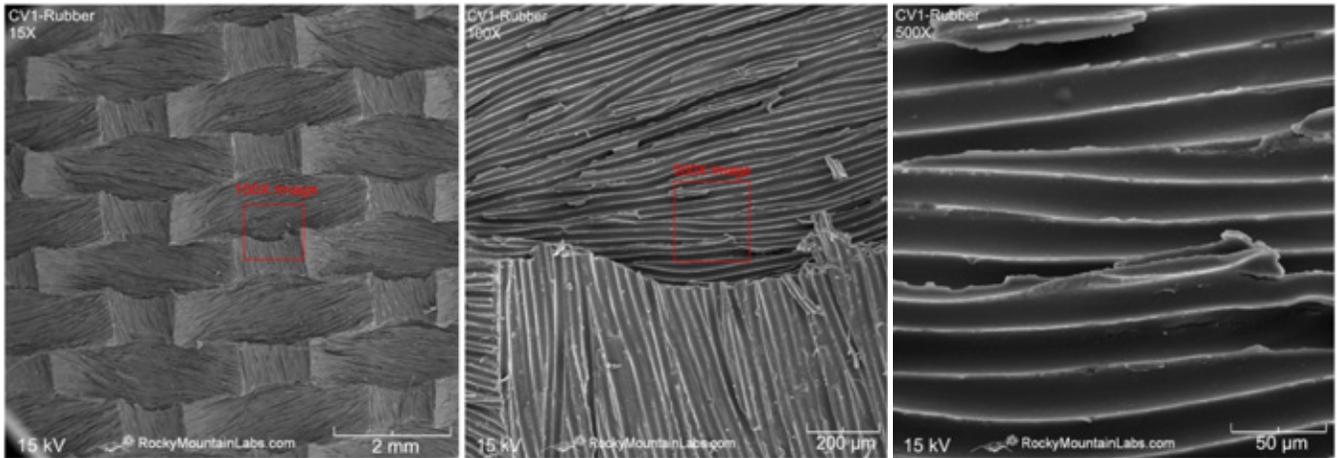
The surfaces of rubber and fabric of each sample were examined. The resulting images allowed accurate and facile assessment of failure modes.

Figure 1: CV1 – Fabric Surface



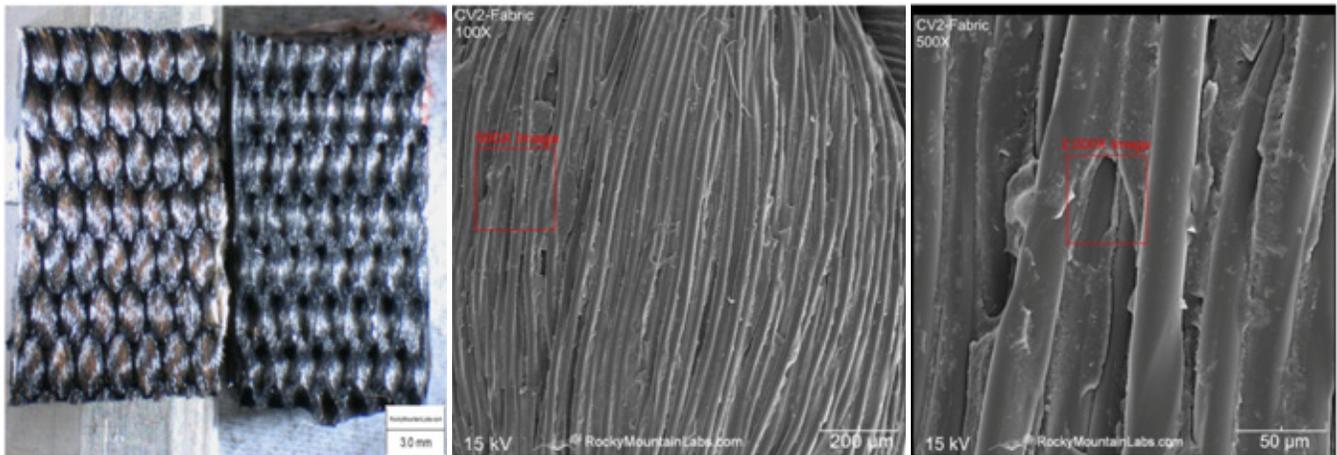
The first image shows the overview of CV1 where very little black from the rubber is showing on the surface. Pieces of adhesive debris are identified in the close up view of filaments. The gap seen between the adhesive debris and the filament in the 500X image indicates the adhesion is low.

Figure 2: CV1 – Rubber Surface



The surface of the rubber is largely intact indicating a clean separation of the adhesive from the textile. This means that very little bonding occurred between the adhesive and the textile.

Figure 3: CV2 – Fabric Surface

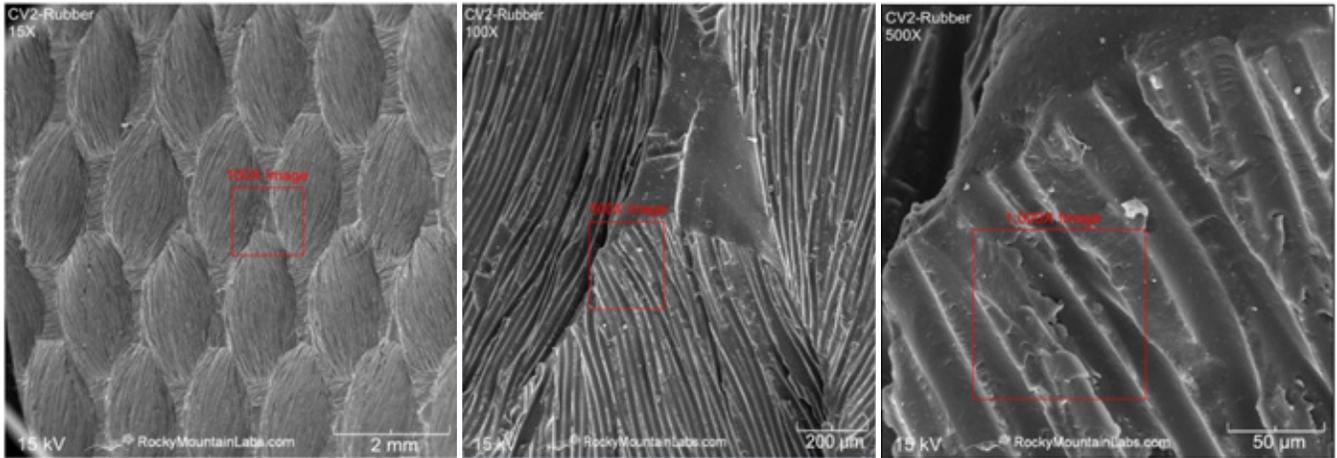


Significant rubber coverage is evident by the black color on the fabric. The Ricobond 7004/GenTac 106 treatment is bonded to the filaments and shows very little evidence of bare fibers. The rubber bonded to the fibers in several areas and rubber tear is prevalent.

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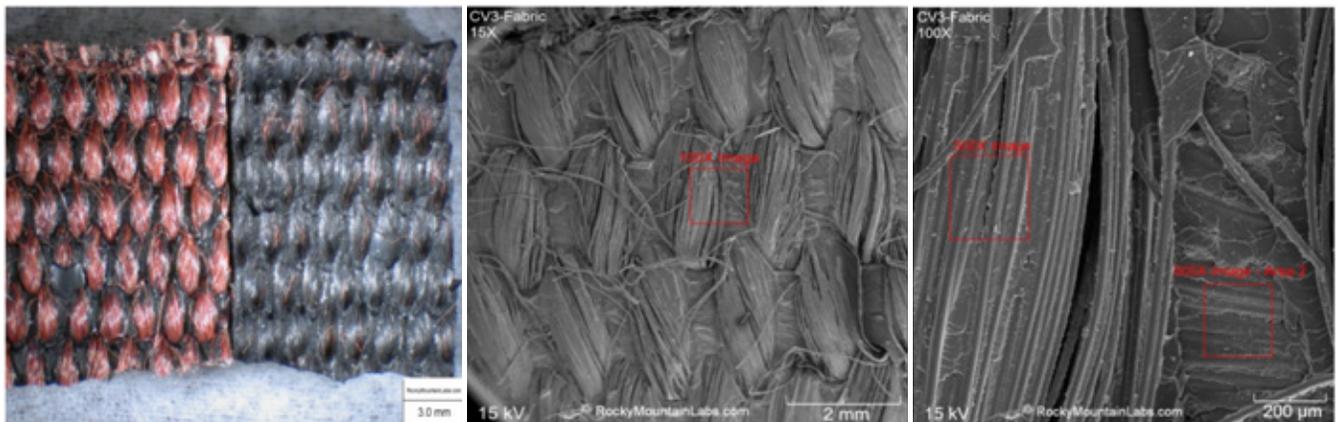
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Figure 4: CV2 – Rubber Surface



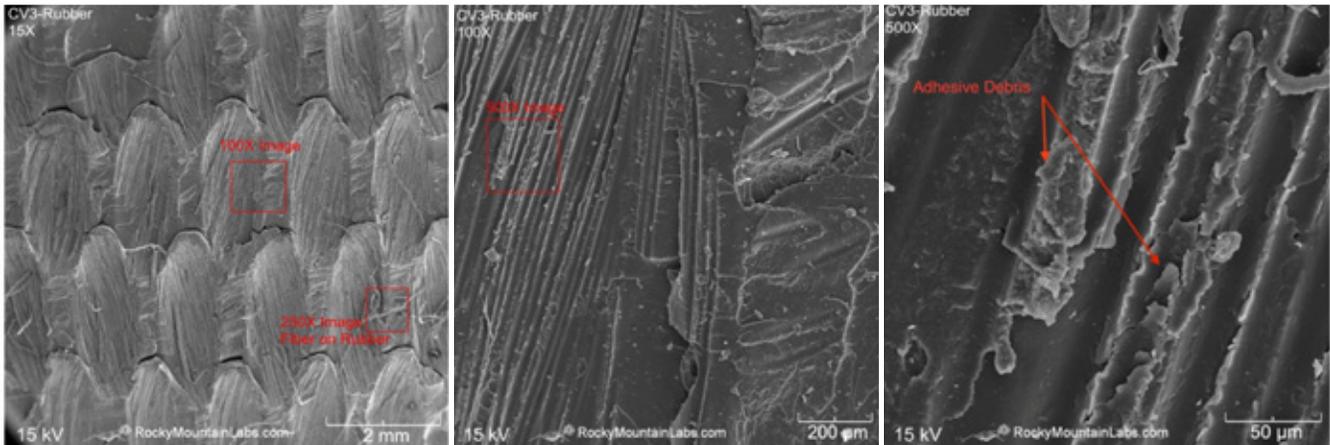
The close up of rubber shows a few areas where adhesive has unbounded from the filament. The high magnification shows the few pieces of adhesive unbounded from filament.

Figure 5: CV3 – Fabric Surface



Significant amounts of rubber bonded to filaments in the layers next to the fabric's surface. Rubber tear is prevalent.

Figure 6: CV3 – Rubber Surface



RFL treatment debris is identified clinging to the rubber. This indicates that some adhesive was pulled from the fiber. Some fibers were also pulled from the fabric.

Summary and Future Studies

The information obtained from the SEM images explains the adhesive values and some of the adhesion mechanisms. In the case of CV1, the low adhesion values are substantiated by the lack of bonding of the adhesive treatment to the fabric. The fabric curing of CV1 was done at a lower temperature. CV2 which was cured to a higher state than CV1 generated excellent textile/adhesive bonds. In addition, CV2 also generated significant adhesive/rubber bonds (rubber tearing). The results confirm the importance of achieving proper cure of the Ricobond 7004/GenTac 106 adhesive treatment on the fabric. CV3 generated the highest peel values, but showed less than 10% rubber coverage. The low coverage suggests the sample configuration may need to be changed. The thickness of the rubber in the peel specimen is one factor to consider.

Subsequent to this study, higher adhesion values have been achieved using the Ricobond 7004/GenTac 106 treatment. SEM images of those samples will be generated to analyze the adhesive and rubber bonding.

Other Suggested Applications

Ricobond 7004 may also be used as additives in other water-based formulations such as adhesives, coatings, paper sizing, construction materials, and composites. It can also be used to treat high surface energy fillers to improve wetting and ultimate dispersion in elastomers and thermoplastic/thermoset resins.

About TOTAL Cray Valley

TOTAL Cray Valley is the premier global supplier of specialty chemical additives, hydrocarbon specialty chemical, and liquid and powder tackifying resins used as ingredients in adhesives, rubbers, polymers, coatings, and other materials. TOTAL 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.

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