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Effect of Solvents in the Rubber-Metal Bonding Agent

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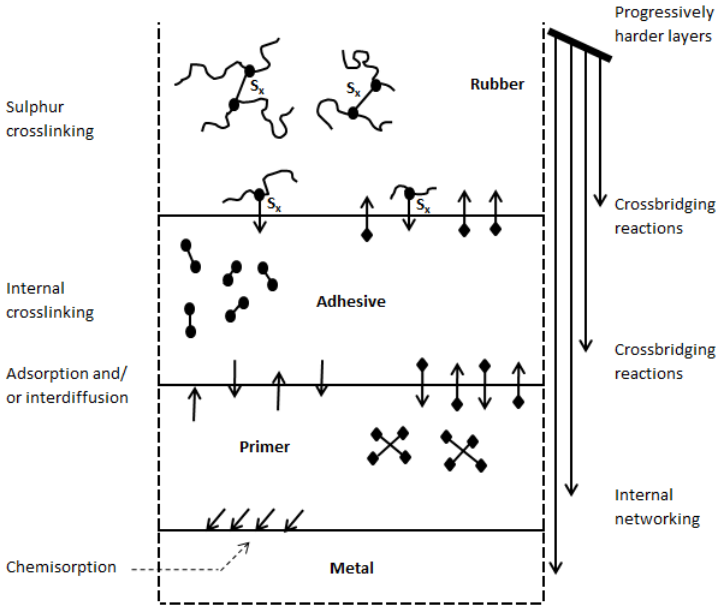
Abstract

In this study, the synthesis, characterization and applications of the adhesive for metal vulcanization of NBR rubber were investigated. The effect of 3 different solvents on adhesive was investigated. The adhesive consists of a mixture of polymers, organic compounds and resins dissolved or dispersed in organic solvent system. Two different resins and three different solvents were used. The metal plate is covered with zinc phosphate to provide surface cleanliness and roughness. Adhesive application was made by applying one coat. Adhesive was applied by spraying zinc phosphate coated plate. After vulcanization, the adhesive between the rubber and the metal was examined.

Keywords: adhesive consists, vulcanization, organic compounds

RUBBER TO METAL BONDING

Rubber finds use in many applications as a means of isolating vibration and reducing shock or as a way to seal in solids, liquids and gases. For many of these applications, it is desirable or even imperative that the rubber be attached to a metal substrate in a reliable manner. There is a fundamental difference between bonding of rubber to metal involving cross linking mechanisms and the physical 'sticking' of rubber to metal using a non-vulcanizing adhesive. The former involves a chemical reaction (generally during cure) while the latter generally relates to a physical surface tension phenomenon. Bonded rubber parts have found use in a myriad of dynamic applications such as engine mounts, suspension bushings, body mounts, torsional dampers, helicopter rotor bearings, seismic bearings, transmission and axle seals, and as flexible couplings. These parts are usually made by vulcanizing the rubber and bonding it to the metal component in a single-stage press operation.



Schematic of vulcanization bonding process

Bonding Agent Application

- Brush
- Dip
- Electrostatic
- Flow coat
- Reverse roller coat
- Roller
- Sponge
- Spray

PREPARATION

Metal Preperation

Steel is often phosphate coated for use within the engineering and decorative laminate industries to reduce corrosion. Iron or zinc phosphate can be used. However, although used for some years as a corrosion protection technique for rubber to steel bonding, it can be difficult to control the process, with a resultant variable thickness of phosphate deposit of varying crystalline structure. If too thick a phosphate layer is obtained it becomes too friable and lacking in the cohesive integrity required to maintain a rubber to metal bond under load during service.

The phosphating process usually involves cleaning of the metal, rinsing, surface activation, and phosphate conversion producing an amorphous layer before a finalrinse and seal.This sequence is:

i) Alkaline degrease,

ii) Rinse,

iii) (Surface activation),

iv) Phosphate,

v) Rinse,

vi) Seal (Passivation),

vii) Rinse,

viii) Dry.

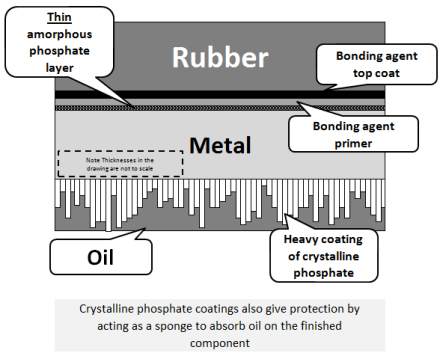
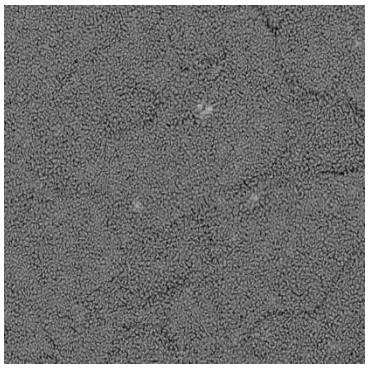


Diagram showing component with bondedlayer and oil soaked crystalline phosphate protective coating



Phosphate coating crystalline structure

Bonding Agent Preperation

Adhesive Formulation	
Ingredients	weight (%)
Polymer	13,38
Activator	0,53
Accelerator	0,40
Filler	2,68
Resin	2,68
Antioxidant	0,13
Sulphur	0,20
Solvent - 1	80,00

Formulation-1

Adhesive Formulation	
Ingredients	weight (%)
Polymer	13,38
Activator	0,53
Accelerator	0,40
Filler	2,68
Resin	2,68
Antioxidant	0,13
Sulphur	0,20
Solvent - 2	80,00

Formulation-2

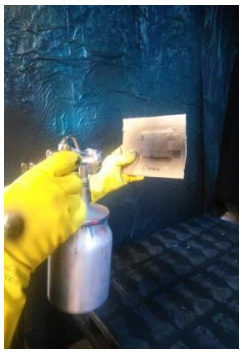
Adhesive Formulation	
Ingredients	weight (%)
Polymer	13,38
Activator	0,53
Accelerator	0,40
Filler	2,68
Resin	2,68
Antioxidant	0,13
Sulphur	0,20
Solvent - 3	80,00

Formulation-3

Weighing of Chemicals

Mixing of Chemicals

Control of solids determination



Application of adhesive to metal plate

Vulcanization together with rubber

Determination of adhesion force in tensometer

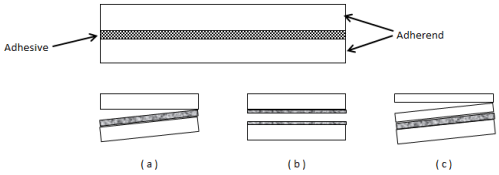
Results

TEST METHOD

ASTM D429-14 / Method B

This test is intended to determine the adhesive strength of rubber-to-metal bonding agents. The results are obtained by measuring the force necessary to separate a rubber from a metal surface. The data obtained indicates the strength of adhesion along a line across the width of the rubber strip being separated from a metal plate at a 90° angle. The test provides valuable data for development and control of rubber compounds and test methods of bonding. It also serves as a screening test for the evaluation of various bonding agents, techniques, or both.

RESULTS



(a) Adhesive failure

(b) Cohesive failure in the adhesive layer

(c) Cohesive failure in the adherend

Formulation-1 Formulation-2 Formulation-3

Result:

Rubber-Metal bonding agent prepared with solvent-1 provides better adhesion than solvent-2 and solvent-3.

REFERENCES

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[3]. Bryan Crowther - The Handbook of Rubber Bonding (Revised and Reprinted 2003).