TECHNICAL UPDATE

CRAY VALLEY
A BRAND OF TOTAL

BENEFITS

- TOTAL Cray Valley liquid poly(butadiene)s are available in a wide range of vinyl contents
- Damping compositions can be formulated for maximum performance based on either sulfur or peroxide vulcanization
- Low-VOC options available

MARKETS/ APPLICATIONS

- Noise/vibration/harshness control for the automotive and transportation markets
- High-performance sealant applications
- Composites

ADDITIONAL INFO

- TOTAL Cray Valley Product Guide

Damping Materials Based on Liquid Poly(butadiene)s

Introduction

Damping materials are used to reduce or eliminate vibrations and noises mainly in industrial, transportation, electronic and structural applications. Several noise and vibration sources exist, such as ambient noise, mechanical vibration and structure-borne vibration. The automotive industry has worked on a multiplicity of acoustic systems, located in several areas of cars, to control ambient noise and vibration in passenger cars. Indeed, driving comfort is considered as a key criterion in the manufacturer's development and consumer decisions in the purchase of new vehicles.

Some sound-deadening components, such as compositions based on liquid diene resins, are applied inside car cabins to mitigate noise and vibration. Liquid butadiene homopolymer-based formulations can be applied at low temperature (from room temperature to 60°C). When cured, they provide excellent damping performance.

TOTAL Cray Valley supplies liquid poly(butadiene) derivatives with different vinyl content, molecular weight and functionalizations. This technical document provides some insights on the crosslinking and subsequent effect on the damping performances of sound-deadening components.

TOTAL

Vulcanization of liquid poly(butadiene)s

Crosslinking reactivity and kinetics of liquid poly(butadiene)s are measured using an oscillating disc rheometer. All butadiene homopolymers can be vulcanized within a broad temperature range either by standard sulfur-based systems or by organic peroxides. Examples of cure profiles as a function of vinyl content and curing system can be seen in Figures 1 and 2.

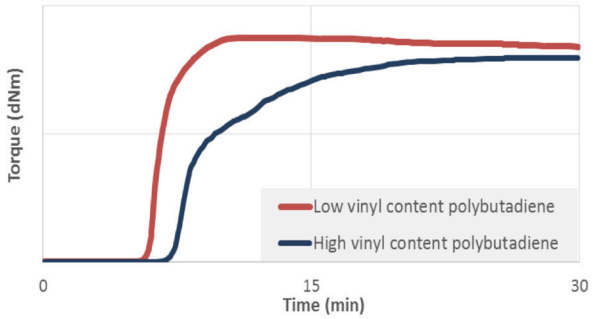


Figure 1: Crosslinking of liquid poly(butadiene)s by standard sulfur-cured system at 160°C

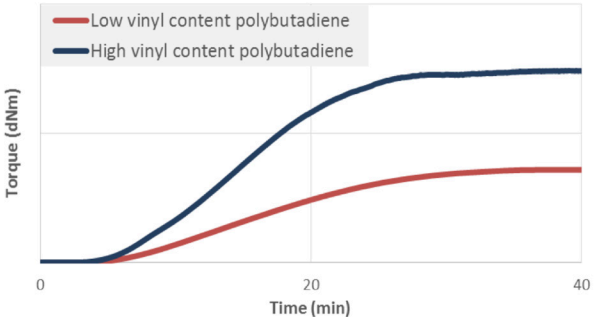


Figure 2: Crosslinking of liquid poly(butadiene)s by an organic peroxide at 160°C

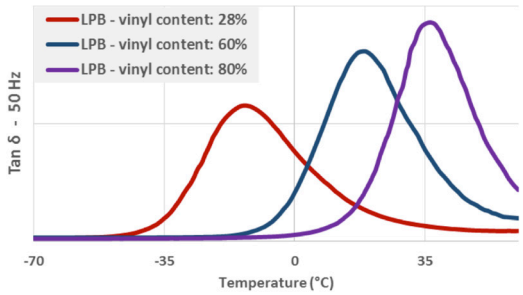
TOTAL Cray Valley has developed knowledge to optimize the type and loading of crosslinking agents in the formulations, containing only liquid diene resins, in order to reduce the VOC emissions.

Characteristics influencing damping performances of liquid poly(butadiene)-based compositions

Some sound-deadening materials based on liquid butadiene homopolymers are already used by automotive manufacturers. If the damping performance can be improved, the amount applied inside vehicles could be reduced, in turn decreasing vehicle weight.

It is known that crosslinking density influences the energy dissipation of rubber compounds. However, some characteristics of liquid poly(butadiene)s can also impact the loss factor curves of damping compositions containing liquid diene resins. Dynamic mechanical analysis (DMA) at 50 Hz is performed to determine these potential structure-property relationships.

In general, the damping formulations based on liquid poly(butadiene)s are vulcanized by systems comprising sulfur and accelerators. In Figure 3, the tangent delta curves of sulfur-cured compositions, characterized by similar crosslinking density but variable poly(butadiene) microstructure, are compared.



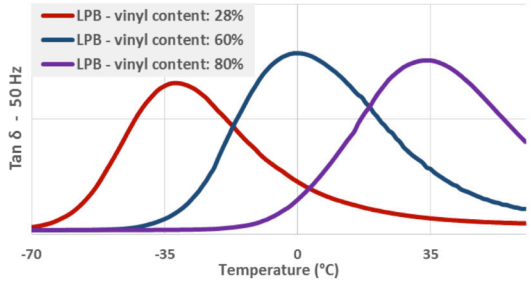
BY INCREASING THE VINYL CONTENT OF LIQUID POLY(BUTADIENE) (LPB):

Increase of max. tan δ value of by at least **25%**

Shift to higher glass transition temperature

Figure 3: Tangent delta curves measured at 50 Hz for compositions based on different liquid poly(butadiene)s (LPB) and vulcanized with sulfur system

Changing the crosslinking system incorporated in liquid diene resins-based formulations should influence their dynamic properties. In Figure 4, the tangent delta curves of peroxide-cured formulations, again characterized by similar crosslinking density but variable poly(butadiene) microstructure, are shown.



BY INCREASING THE VINYL CONTENT OF LIQUID POLY(BUTADIENE) (LPB):

Increase of max. tan δ value from **10%** to **20%**

Shift to higher glass transition temperature

Figure 4: Tangent delta curves measured at 50 Hz for compositions based on different liquid polybutadienes (LPB) and vulcanized with peroxide

The graphs above highlight that the microstructure of liquid poly(butadiene) has a strong effect on damping performances of compositions containing liquid diene resin, as well as the glass transition temperature.

According to our results, the crosslinking system also impacts the dynamic properties of compositions based on liquid butadiene homopolymers. If organic peroxides are introduced (in place of sulfur/accelerators blends), the vinyl content of liquid poly(butadiene) must be increased to maintain the glass transition temperature (Tg). The peroxide-crosslinked formulations are characterized by a broader energy dissipation peak (Figure 5).

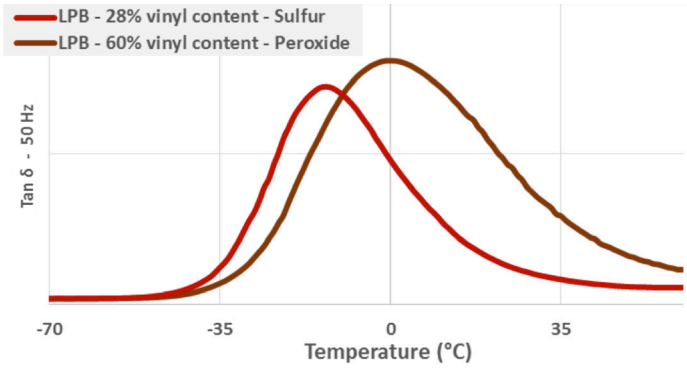


Figure 5: Effect of vulcanization system on tangent delta curves of liquid poly(butadiene) formulations

Summary

The vinyl content of liquid poly(butadiene) significantly influences the dynamic properties of sound-deadening compositions. Indeed, the damping performances should be improved significantly by incorporating liquid diene resins having a vinyl content higher than 55% without degrading the processability of formulations at low temperature.

TOTAL Cray Valley has developed know-how in the crosslinking of liquid poly(butadiene) formulations and is developing new grades with low-VOC content to optimize the properties of damping materials.

About TOTAL Cray Valley

TOTAL Cray Valley 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. 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 manufacturing, electronics, and other demanding applications.

For more information, please visit **www.crayvalley.com**.

TOTAL Cray Valley
665 Stockton Drive, Suite 100
Exton, PA 19341, USA

*The listed properties are illustrative only, and not product specifications. TOTAL Cray Valley disclaims any liability in connection with the use of the information, and does not warrant against infringement by reason of the use of its products in combination with other materials or in any process.

CV1345 1.2020