

Chapter 3

Development and Modification of Natural Rubber for Advanced Application

Kanoktip Boonkerd
Chulalongkorn University, Thailand

ABSTRACT

Although natural rubber is a challenging elastomeric material for both dynamic and static engineering applications, there are some inherent drawbacks such as the poor oxygen, ozone, oil and heat resistance and also the low compatibility with the polar materials. To loosen these inferior properties and also to transform natural rubber into new polymeric materials, natural rubber needs to be either chemically or physically modified. Moreover, to make natural rubber become a promising elastomeric material for the advanced application, the development of natural rubber with the superior mechanical strength, the low gas permeability or the high conductivity is recently focused. And these can be done by reinforcing natural rubber with nanofillers. This chapter presents a broad review on the recent research and development of natural rubber including the modification of natural rubber and the preparation of various natural rubber nanocomposites for advanced application.

INTRODUCTION

Natural rubber (NR) is a high molecular weight polymeric substance with viscoelastic properties. Structurally it is cis 1,4-polyisoprene. Isoprene is a diene and 1,4 addition leaves a double bond in each of the isoprene unit in the polymer. Natural rubber is considered as a renewable resource and an environmentally friendly materials. Because of this, natural rubber shows all the reactions of an unsaturated polymer. It gives addition compounds with halogens, ozone, hydrogen chloride and several other reactants that react with olefins. An interesting reaction of natural rubber is its combination with sulfur. This is known as vulcanization. This reaction converts the plastic and viscous nature of raw rubber into elastic. Vulcanized rubber will have very high tensile strength and comparatively low elongation. Its hardness and abrasion

DOI: 10.4018/978-1-5225-1971-3.ch003

Development and Modification of Natural Rubber for Advanced Application

resistance also will be high when compared to raw rubber. Because of the unique combination of these properties, natural rubber finds application in the manufacture of a variety of products.

Although natural rubber is a challenging elastomeric material, there are some inherent drawbacks. These drawbacks are attributed to the high unsaturation and also the non-polar character of natural rubber chain. Moreover, to make natural rubber become a promising elastomeric material for advanced application, the development of natural rubber with the superior mechanical strength, the low gas permeability and the high conductivity is recently focused. This broad review is contributed to the research and development of NR including the overview about modification of natural rubber and the preparation of various natural rubber nanocomposites for advanced application.

MODIFIED FORMS OF NATURAL RUBBER

Modification of natural rubber can be carried out in many forms. Mainly, it can be divided into two categories including physical and chemical modification as shown in Figure 1.

Physical Modification of Natural Rubber

Oil Extended Natural Rubber (OENR)

Petroleum oils are used in rubber, either as a process aid or as an extender. When the oil added is below 10 parts per hundred rubber, it is termed as process aid and above that is termed extender, which cheapens the product. Natural rubber, which contains oil as an extender is termed oil extended natural rubber or OENR. In tires OENR can impart high skid resistance on wet road, and resistance to wear and groove cracking. Oil addition to rubber can be carried out in latex or dry stage.

Table 1. Typical properties of natural rubber

Property	Specified Values
Specific gravity	0.92
Refractive index	1.52
Coefficient of cubical expansion	0.00062/°C
Cohesive energy density	63.7 Cal/cc.
Heat of combustion	10547.084 Cal/g
Thermal conductivity	0.00032 Cal/sec/cm/°C
Dielectric constant	2.37
Power factor (at 1000 cycles)	0.15-0.2
Volume resistivity	1015 ohm.cm
Dielectric strength	3937 V/mm

31 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:
www.igi-global.com/chapter/development-and-modification-of-natural-rubber-for-advanced-application/173853

Related Content

Wear and Friction Effects on Engine Materials of N-Butanol in Ultra-Low Sulfure Diesel Mixtures

Gustavo J. Molina, John L. Morrison, Valentin Soloiuand Cesar Carapia (2022). *International Journal of Surface Engineering and Interdisciplinary Materials Science* (pp. 1-11).

www.irma-international.org/article/wear-and-friction-effects-on-engine-materials-of-n-butanol-in-ultra-low-sulfure-diesel-mixtures/298707

Design and Fabrication of a Strain Gauge Type 3-axis Milling Tool Dynamometer: Fabrication and Testing

Bhargav Prajwal Pathri, Arpit Kumar Garg, Deepak Rajendra Unune, Harlal Singh Mali, Sukhdeep S. Dhamiand Ravindra Nagar (2016). *International Journal of Materials Forming and Machining Processes* (pp. 1-15).

www.irma-international.org/article/design-and-fabrication-of-a-strain-gauge-type-3-axis-milling-tool-dynamometer/159819

Effect of TiCN and AlCrN Coating on Tribological Behaviour of Plasma-nitrided AISI 4140 Steel

Santosh Vitthal Bhaskarand Hari Narayan Kudal (2017). *International Journal of Surface Engineering and Interdisciplinary Materials Science* (pp. 1-17).

www.irma-international.org/article/effect-of-ticn-and-alcrn-coating-on-tribological-behaviour-of-plasma-nitrided-aisi-4140-steel/192111

Banana Fiber Reinforcement and Application in Composites: A Review

Abhinav Shandilya, Ayush Guptaand Deepak Verma (2016). *Green Approaches to Biocomposite Materials Science and Engineering* (pp. 201-227).

www.irma-international.org/chapter/banana-fiber-reinforcement-and-application-in-composites/156909

Study of Mechanical Properties and EMI Shielding Behaviour of Al6061 Hybrid Metal Matrix Composites

Ch Hima Gireesh, Koona Ramji, K.G Durga Prasadand Budumuru Srinu (2019). *International Journal of Surface Engineering and Interdisciplinary Materials Science* (pp. 48-63).

www.irma-international.org/article/study-of-mechanical-properties-and-emi-shielding-behaviour-of-al6061-hybrid-metal-matrix-composites/234399