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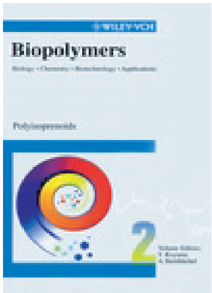
# Natural Rubber: From Cradle-to-Grave

*Robert G. Gilbert**

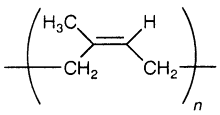



**Polyisoprenoids**

Eds T. Koyama and A. Steinbüchel

(Volume 2 in the series *Biopolymers*
(A Steinbüchel, Ed.)
Wiley–VCH, Weinheim
June 2001, 436 pp.
ISBN 3 527 30221 2
Hardcover, 224 USD.

This is a comprehensive overview of the science and technology involved in natural rubber and its applications. Natural rubber (usually vulcanized) has certain properties that still cannot be matched by synthetic rubbers. Primary of these is polymer confirmation: for example, the enzymatic processes in the rubber tree *Hevea brasiliensis* (the most common source of natural rubber) result in a polymer that is virtually 100% *cis*-polyisoprene (see Scheme 1); 100% *cis*




**Scheme 1**

conformation cannot be achieved by any current synthetic method. This conformation means that when natural rubber is stretched, individual chains go from a random coil to a more aligned conformation, and because of the *cis* geometry, neighbouring chains can fit closer together. This puts them closer to the minimum in their van der Waals interaction potential. Hence natural rubber becomes stronger when stretched, better than any current synthetic elastomer (of course, the polymer will eventually undergo cohesive failure if stretched too far). This also results in an increase in crystallinity (an effect which can be easily in a rubber band, which becomes whiter when stretched). This is why there are certain applications for which natural rubber products are best suited: some high-performance tyres, surgical gloves (better resistance to stick injuries), and so on. In addition, natural rubber latex has excellent tack and is often used in pressure-sensitive adhesives. Moreover, natural rubber is a renewable resource. There are also downsides: for example, natural rubber latex contains proteins which can cause severe allergic response in a small percentage of the population, an effect which can be exacerbated by sensitisation following extensive exposure, e.g. among medical professionals.

This book gives an excellent cradle-to-grave overview of natural rubber (as well as some information on synthetic ones). It covers chemical structure and occurrence, their biosynthesis and associated biochemistry, technical production of synthetic isoprene-type rubbers, processing of natural and synthetic rubbers, world rubber producers, biodegradation and biological processes for recycling. The technical details for engineering applications and recycling are excellent. The allergy problems are also discussed extensively. The index is unfortunately rather incomplete, which should not happen given the excellent indexing capability of today's word-processing software. There are also some inconsistencies in where topics are located: for example, technical details and history of emulsion polymerization production of styrene-butadiene rubber is treated under *Producers and World Market* and not under *Technical Production of Synthetic Rubbers*. It would also have been good to see more space to technical details of latex glove production (e.g. the complex process of dipping) and condom manufacture, which are now enormous and high-value markets for natural rubber products. The use of natural rubber in adhesives is also much less than merited by the market size.

Happily, this book does not overly suffer from a common fate of edited books: a lack coherence and being more a collection of individual reviews than a consistent approach. The editors have done a good job avoiding some, but not all, of these pitfalls.

The book is worth purchasing for those involved in synthetic and natural rubbers, particularly in large-scale engineering applications.

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