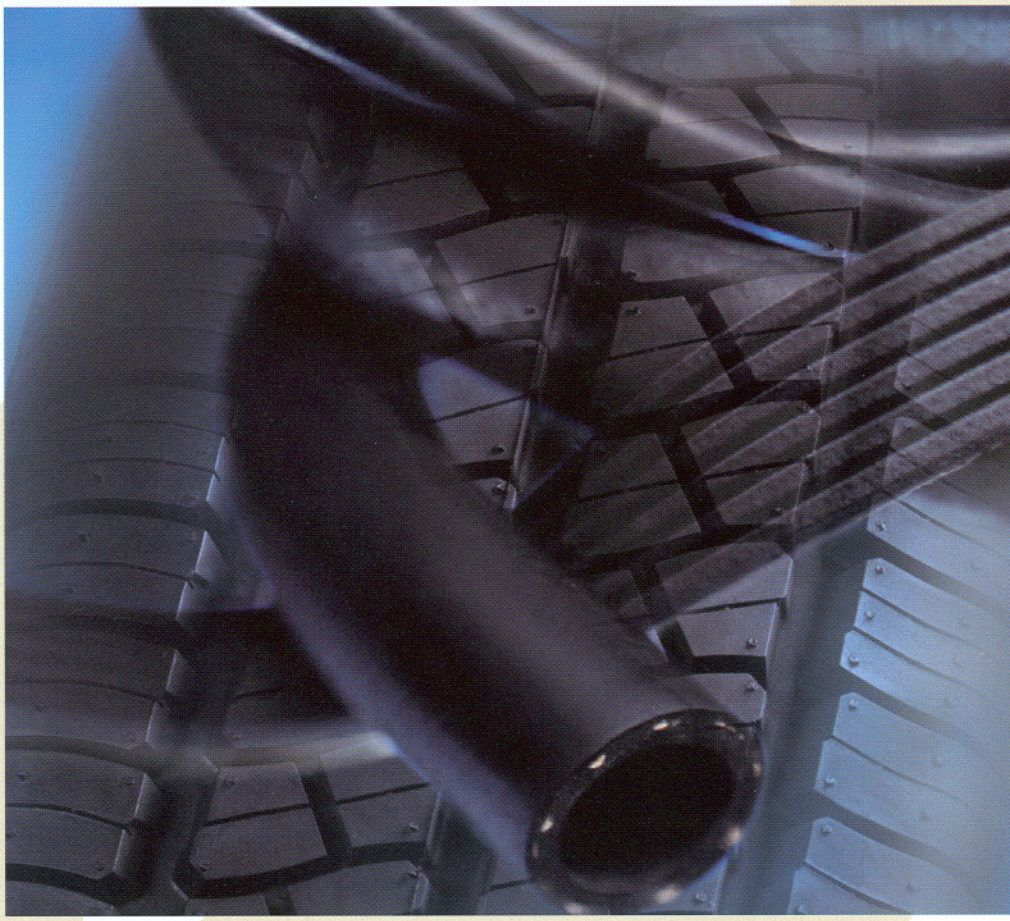
Di-Cup® and Vul-Cup®



the first names in

cross-linking peroxides

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Di-Cup® and Vul-Cup® Peroxides

Optimum elastomer properties are obtained when cross-links exist between polymer chains, providing a continuous elastic network. This cross-linking can be accomplished with a variety of chemicals, which, depending on polymer type, generally include sulfur and peroxides. Although the use of peroxides as cross-linkers for elastomers was first discovered in the early 1900s when benzoyl peroxide was used to cross-link natural rubber, product and performance deficiencies limited widespread use of the technology until the 1950s.

At this time, Di-Cup® dicumyl peroxide was developed and became the first commercially available peroxide to combine high efficiency, good vulcanizate properties and low cost, thus providing a peroxide cross-linker with broad-spectrum utility.

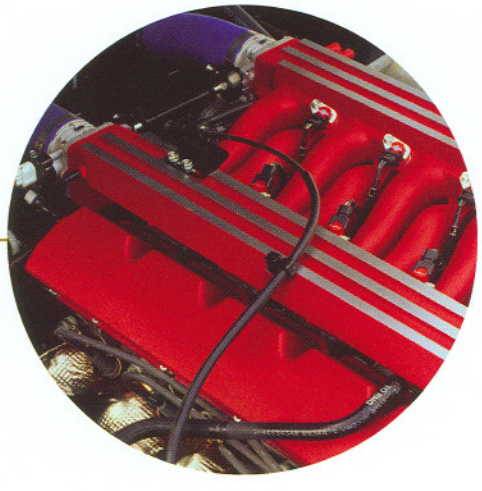
To complement Di-Cup, another high-efficiency bisperoxide was commercially introduced in 1970. Vul-Cup® peroxide [a mixture of the *meta* and *para* isomers of *a,a'*-bis(*tert*-butylperoxy)-diisopropylbenzene] is a low-odor peroxide with improved scorch resistance.

Advantages of Peroxide Cure vs. Sulfur Cure

Why should a polymer compounder be interested in a peroxide cross-linker? Because a peroxide cure:

- Increases thermal and oxidative stability of the cross-link
- Improves compression set resistance of the compound
- Eliminates discoloration
- Provides greater low-temperature flexibility of the vulcanizate

In applications where abrasion resistance and tensile and tear strength are primary considerations, sulfur vulcanizates may be more suitable.



Fundamentals of Peroxide Cross-linking

Peroxides function by thermally cleaving to produce two oxy radicals, which generally abstract (remove) hydrogen atoms from a carbon atom in the backbone of the polymer chain. The two carbon radicals in the polymer backbone then combine to form a cross-link.

How does a peroxide-cured elastomer compare with its sulfur-cured counterpart? The structural differences between the two cross-links provide a clue.

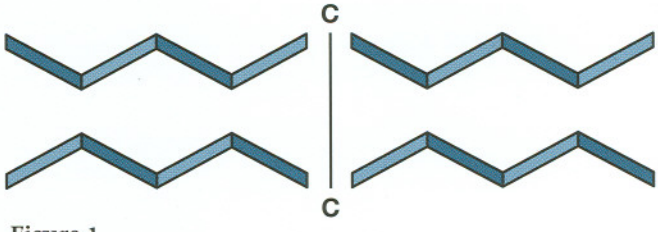


Figure 1
A peroxide cross-link is a carbon-to-carbon covalent bond between adjacent polymer chains.

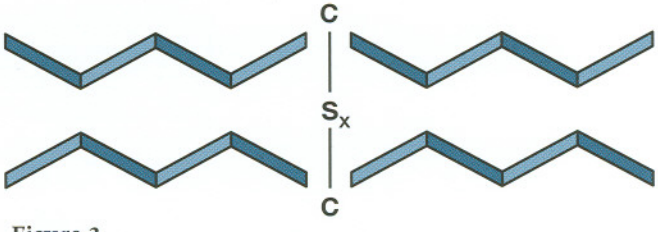


Figure 2
The sulfur cross-link is a polyatomic S-molecule between adjacent polymer chains.

In terms of thermal stability, the peroxide cross-link has an 82-kilocalorie bond energy, and is as stable as any of the carbon-carbon bonds in the polymer backbone. The sulfur cross-link is composed of both carbon-sulfur and sulfur-sulfur bones having lower bond energies; this results in a weaker cross-link.

A variety of elastomers can be cross-linked with peroxides in order to obtain the advantages outlined previously.

Polymers that can be peroxide-cured include:

NR	Natural Rubber
SBR	Styrene-Butadiene Rubber
BR	Polybutadiene Rubber
IR	Polyisoprene Rubber
NBR	Nitrile Rubber
CR	Neoprene Rubber
EPM	Ethylene-Propylene Copolymer
EPDM	Ethylene-Propylene Terpolymer
FKM	Fluoroelastomers
MQ, VMQ	Silicone Rubber
ACM	Acrylic Rubber
AU, EU	Polyurethane
ABS	Acrylonitrile-Butadiene-Styrene
PE	Polyethylene
CSM	Chlorosulfonated Polyethylene
CM	Chlorinated Polyethylene (CPE)

The use of coagents or reactive monomers further modifies the performance provided by an elastomer cross-linked with a peroxide. Coagents generally increase hardness and modulus and improve processibility.

Peroxide Cures of EPDM and Nitrile Rubber

Di-Cup and Vul-Cup peroxides provide a different vulcanizate performance balance than do the normal sulfur accelerator systems. Figures 3 and 4 compare the performance of EPDM and NBR, respectively, cross-linked with Di-Cup peroxide vs. sulfur. Vul-Cup provides comparable performance.

Applications

Parts made of peroxide-cured elastomers include hose and tubing, diaphragms, O-rings, oil patch components, foam products and a variety of other molded and extruded parts. Our highly trained sales and technical personnel will work with you to develop the compound design that best fits your performance demands.

Figure 3

Performance of Di-Cup Peroxide-Cured vs. Sulfur-Cured EPDM
Retention of Properties after Air-Aging 70 Hours at 302°F (150°C)

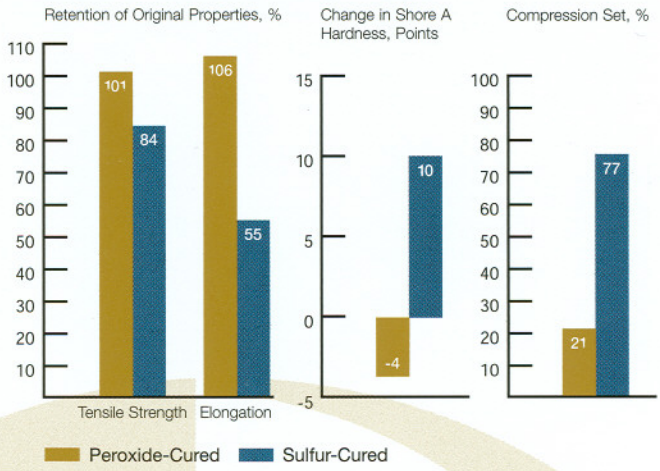
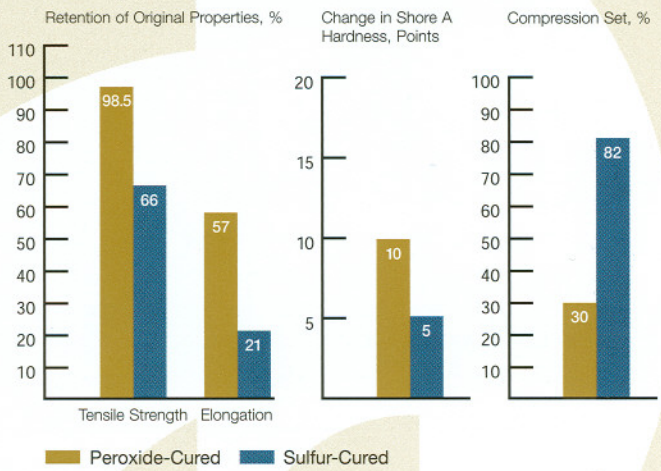


Figure 4

Performance of Di-Cup Peroxide-Cured vs. Sulfur-Cured NBR
Retention of Properties after Air-Aging 70 Hours at 257°F (125°C)



Handling and Product Safety

GEO Peroxy Chemicals Group offers a variety of forms for the user. Available as crystalline solids (packaged in drums or in specially designed stainless steel semibulk containers) and in free-flowing supported grades, Di-Cup and Vul-Cup peroxides can be readily handled by both the small and the large user.

The materials are nonvolatile and have flashpoints and thermal decomposition temperatures that require minimum handling precautions at ordinary temperatures. However, because the use of Di-Cup and Vul-Cup stems from their ability to decompose and form free radicals at elevated temperatures, they should be treated with respect. Toxicological data and information on safe handling procedures are available.

Read and understand the Material Safety Data Sheets (MSDSs) before using these products.

The Peroxy Chemicals Group of GEO Specialty Chemicals

is building on a reputation that encompasses over 50 years of leadership in manufacturing and marketing a variety of organic peroxides. The Group developed the first commercially available peroxides to combine high efficiency and thermal stability with good vulcanizing properties and low cost.

Today, the Peroxy Chemicals Group is one of the world's leading suppliers of organic peroxides for the wire and cable, rubber, plastics and polymerization industries. Our customers are familiar with recognized dialkyl peroxide brands such as Di-Cup® (dicumyl peroxide) and Vul-Cup® (organic peroxide) as well as our Liqua-Cup® liquid peroxides, hydroperoxides and ECHO® vulcanizing agent. They know they can count on the Peroxy Chemicals Group for quality, technical leadership and innovative solutions.

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HARWICK™ STANDARD

Harwick Standard Distribution Corpora
is our exclusive distributor of Di-Cup®,
Vul-Cup® and Liqua-Cup® brands for the
rubber markets in the US.

PEROXY CHEMICALS GROUP
340 MATHERS ROAD
AMBLER, PA 19002
888 / 519-3883
WWW.GEOSC.COM

GEO SPECIALTY CHEMICALS, LIMITED
IMPERIAL HOUSE
LYPIATT ROAD
CHELTENHAM, GL50 2QJ
ENGLAND
+44 (0) 1242 255 772
FAX: +44 (0) 1242 262 804

HARWICK STANDARD
DISTRIBUTION CORPORATION
60 S. SEIBERLING STREET, P.O. BOX 9360
AKRON, OH 44305-0360
330 / 798-9300
FAX: 330 / 798-4089
WWW.HARWICKSTANDARD.COM