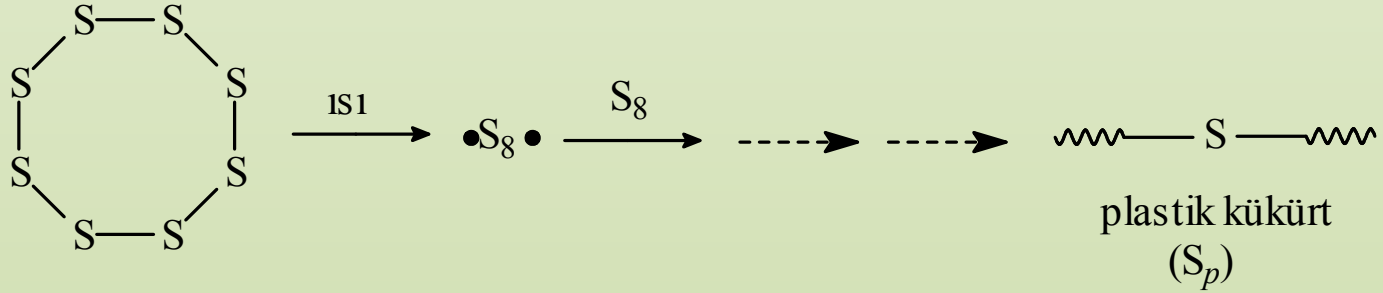
Classification of rubbers

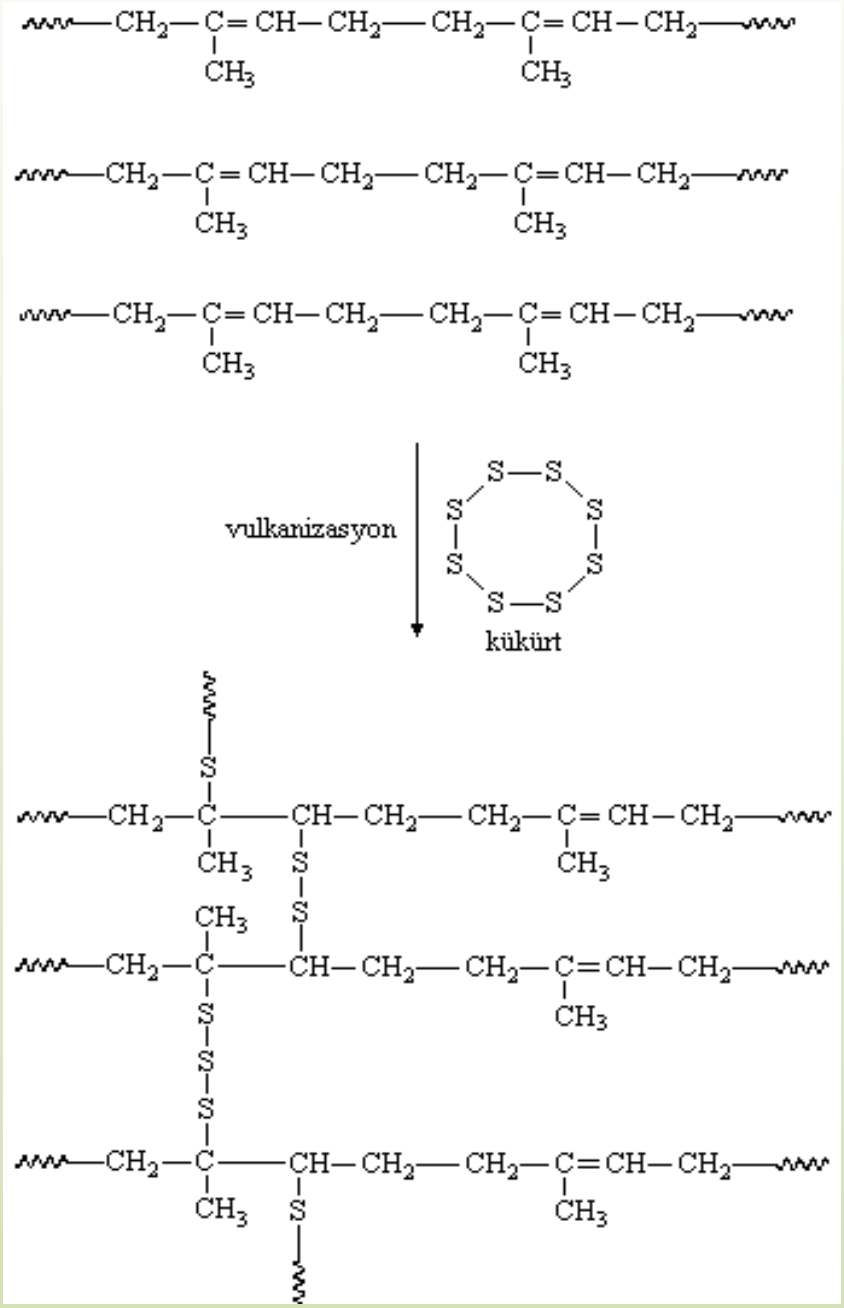
Sulfur vulcanization occurs by the formation of sulfur linkages or cross-links between rubber molecules, as shown in Figure 2. In conventional sulfur vulcanization the resultant network is rich in polysulfidic sulfur linkages.

Sulfur chain linkages can contain six or more sulfur atoms. Lower sulfur-to-accelerator ratios produce networks that are characterized by a greater number of sulfur linkages containing fewer sulfur atoms.

Thus, the so-called efficient vulcanization systems higher cross-link densities for the same loading of sulfur. At very low sulfur-to-accelerator ratios, networks can be produced that are composed predominantly of monosulfidic and disulfidic cross-links.

Each elastomer shows differences in various aspects of its vulcanization chemistry. These differences are related to the physical and chemical nature of the elastomer under consideration and to the cure systems employed.

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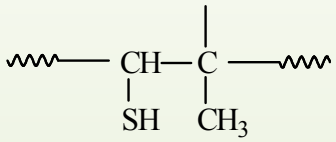
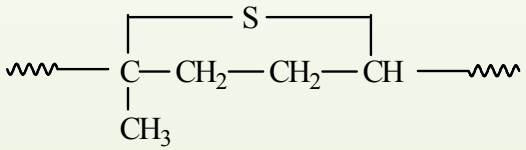
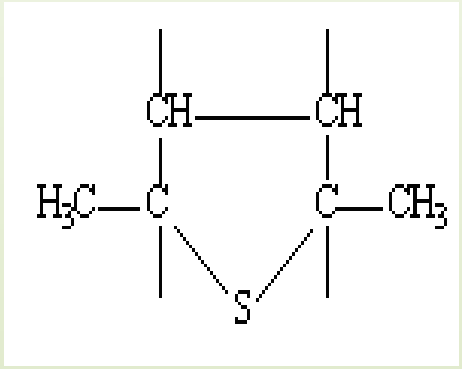
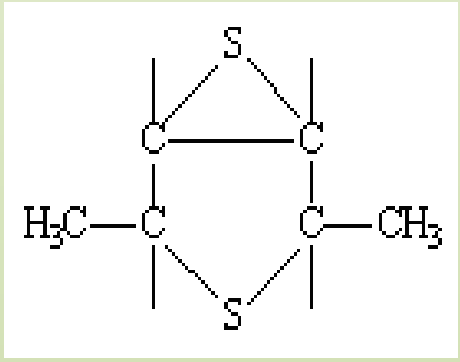
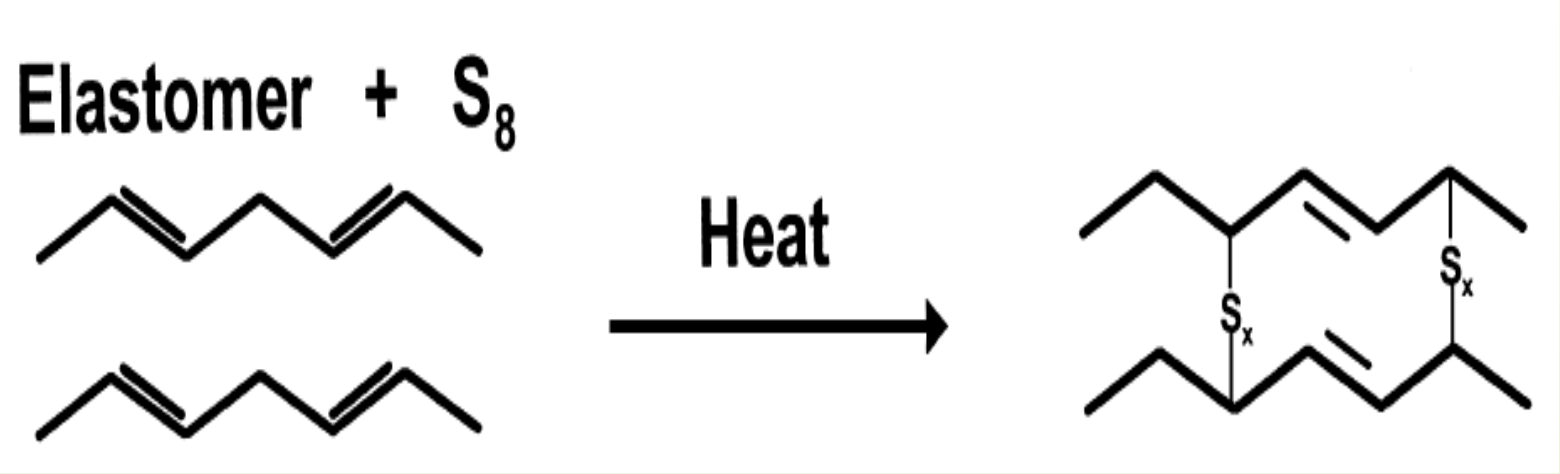




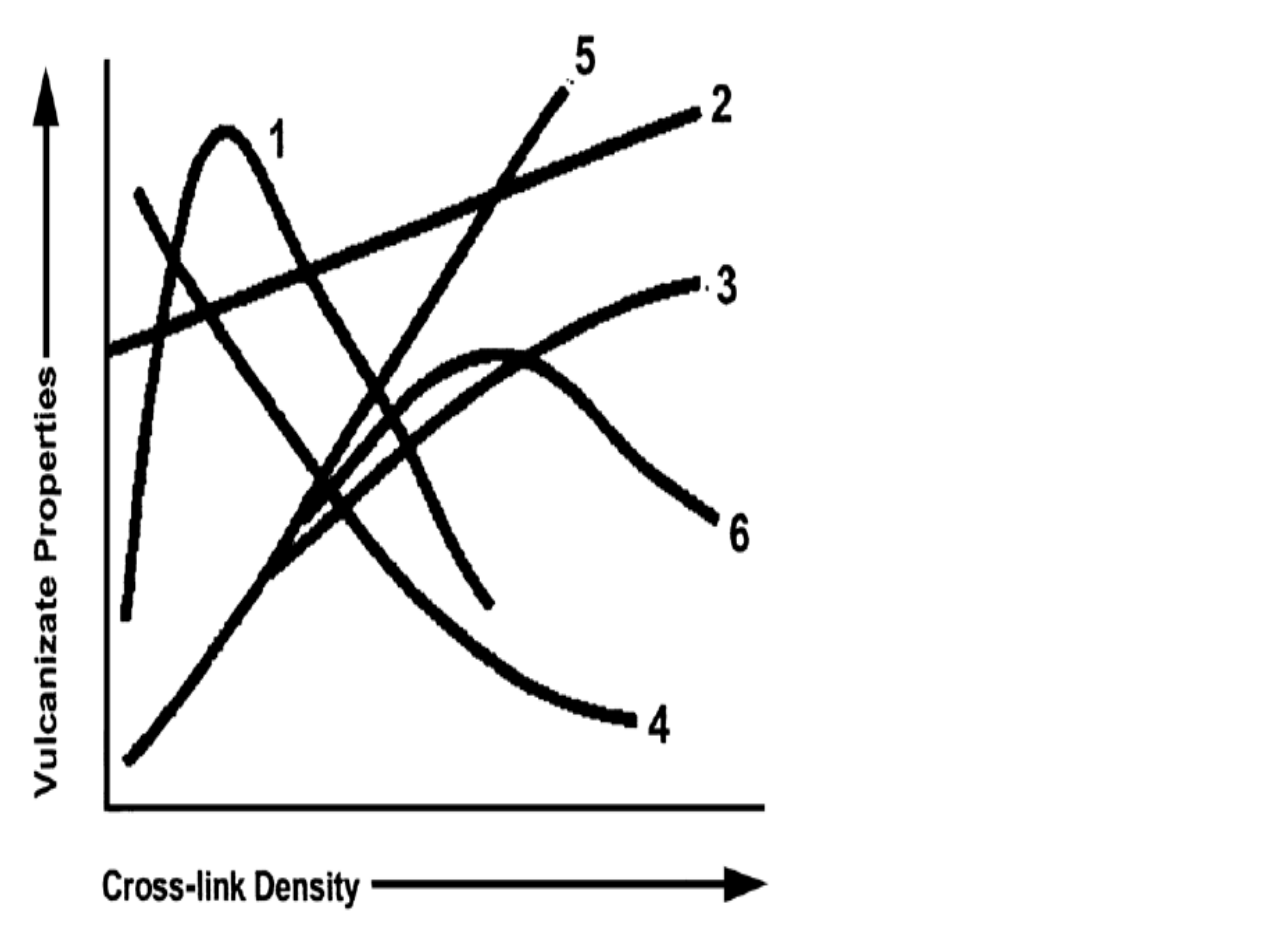






Sulfur vulcanization

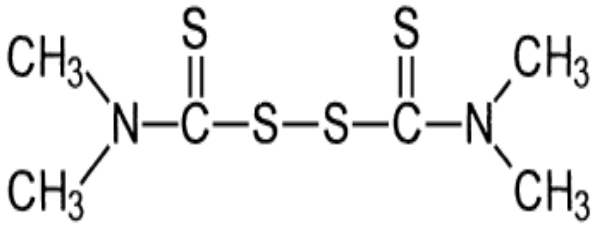
As the cross-link density of the vulcanizate increases elastic properties such as tensile and dynamic modulus, tear and tensile strength, resilience, and hardness increase whereas viscous loss properties such as hysteresis decrease.



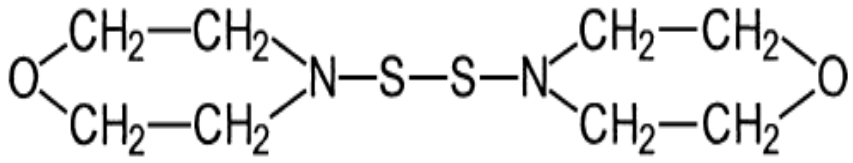
Effects of vulcanization on physical properties. 1. Tear strength: 2. dynamic modulus 3. hardness, 4. hysteresis 5. static modulus 6. tensile strength

Unaccelerated sulfur vulcanization is a slow, inefficient process. Another class of chemicals, known as sulfur donors, have been developed to improve the efficiency of sulfur vulcanization. These materials are used to replace part or all of the elemental sulfur normally used in order to produce vulcanized products containing fewer sulfur atoms per cross-link.

In other words, these materials make more efficient use of the available sulfur. The two most common sulfur donors are the disulfides tetramethylthiuram (TMTD*) (1) and dithiodimorpholine (DTDM) (2).



1



2

Use of sulfur donors increases the level of mono- and disulfidic cross-links, which are reversion-resistant and more stable toward oxidative degradation. However, sulfur donors can also be used to reduce the possibility of sulfur bloom and to modify curing and processing characteristics.

Non-Sulfur Cross-Links

There are, special cases or special elastomers for which non-sulfur crosslinks are necessary or desirable.