

Cable Lore

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HAPPY BIRTHDAY! CROSS-LINKED POLYMERS ARE 127 YEARS OLD!

The cross-linking of polymers is not a recent innovation. Charles Goodyear is credited as the first to cross-link (or vulcanize) rubber. This well-known event took place in 1839 when he combined natural rubber and sulfur in the presence of heat. The use of sulfur as a cross-linking agent is still very common; although the techniques currently used are much more sophisticated than in Goodyear's day.

In order to picture the mechanism of cross-linking, it first must be realized that all polymers are composed of very long chain molecules. If it were possible to greatly magnify a few of these molecules, they would resemble tangled lengths of string. Even further magnification would reveal other details that cause the various polymers to have different properties. For the moment, however, consider these long chain molecules only as strings. Cross-linking, then, can be likened to tying these strings together. Thus, if a large number of strings were cross-linked they would resemble a badly tangled "fish net". When polymers are cross-linked their molecules are tied together with chemical bonds. In certain cases an atom of sulfur may first create and then remain as part of a "bond". Other cross-linking agents create the bond, but do not remain as a part of it.

The chemical bonds (or "cross-links") hold the molecules together, giving them the very unique combination of properties that are associated with rubber. Cross-linked polyethylene, a relatively new arrival to the industry, is also a cross-linked polymer. Its characteristic properties, like most synthetic rubber, lie somewhere between those normally associated with rubber and those of plastic.

The rubber industry is also 127 years old, for its birth occurred when the technique for cross-linking rubber was discovered. Research and Development by this industry, through the years of its existence, has resulted in a wide variety of highly useful cross-linked polymers that are available today.

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