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Technical Article
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Vulcanization (Part 1 of a 3-Part Series)

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The vulcanization or curing process occurs in three stages and each stage is of importance and thus affects the service life of the finished product:

(1) Induction or flow time
(2) Crosslinking or rate of cure
(3) Optimum state of cure or overcure

This article will focus on the first stage of the curing or vulcanization process.

Vulcanization is the conversion of raw rubber molecules into a tightly linked network by the formation of molecule-to-molecule crosslinks and thus into an elastic state. As long as these molecules are not linked to each other, they can move freely especially at elevated temperatures: at that point the uncured rubber compound is in a thermoplastic state.

In general, the temperature at which this irreversible thermoplastic flow state occurs is a range from 180°F to 230°F and represents the time at which no measurable crosslinking is occurring. Thus the rubber compound flows uninhibited; this is called flow time.

During this flow time period for example, as in value-added cleat molding and/or vulcanized splicing, it is necessary for the rubber compound to maintain a prolonged flow time in order to fill all voids and for all entrapped air to escape completely to give the finished product a smooth “factory” finish.

A simple but effective process to produce this smooth finish is to turn off the power to the vulcanizer as it enters this flow time range during heat up, while under full pressure. A power down time of five minutes is all that is needed to produce a smooth “factory” finish on your finished product.

Following this flow period, crosslinking proceeds at a rate that is dependent on the cure temperature and the compounding of the uncured rubber. Since all technological properties are now forming, it is necessary to cure the rubber to its optimum state of cure (maximum stress value), but not past that point.

Be sure to follow the uncured rubber manufacturer’s curing tables for optimum cure temperatures, dwell times, and pressures.