

RUBBER PROCESSING TECHNOLOGY

Introduction

Production of rubber goods can be divided into two principal steps:

- ① Production of the rubber
- ② Processing of the rubber into finished good

The manufacturing processes for rubber production are beyond the scope of the present text. Interested readers should refer to more specialized books for a detailed coverage of this problem.

Processing of rubber into finished good

The process sequence includes the following principal operations:

- ① Compounding
- ② Mixing
- ③ Shaping
- ④ Vulcanizing

Compounding

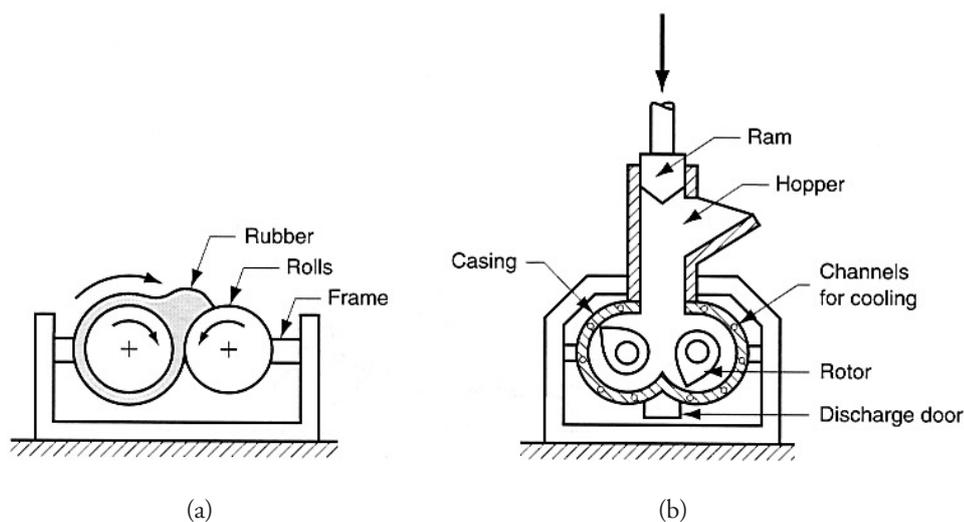
The purpose of *compounding* is to add chemicals (*sulphur*) for *vulcanization* to the rubber. Other additives are filling materials to enhance the mechanical properties (carbon black), antioxidants, ozone-protective chemicals, coloring pigments, et al. Additives are mixed with the base material during the next step, *mixing*.

Mixing

The process of mixing is accomplished in two phases to avoid premature vulcanization:

- ① Mixing all non-vulcanizing additives
- ② Mixing sulphur additive

The figure illustrates the equipment used for mixing:



Mixers used in rubber processing: (a) two-roll mill, and (b) internal mixer

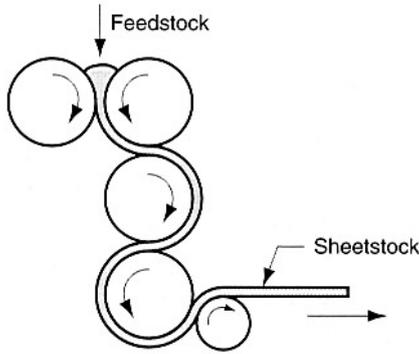
Shaping processes

Extrusion

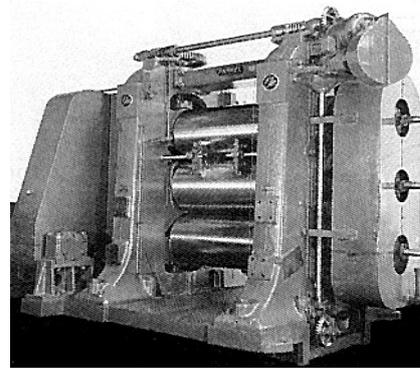
The *extrusion* process for rubber is the same as for polymers.

Calendering

Calendering is a process for producing sheet and film stocks out of rubber or thermoplastics. Extrusion and calendering can be combined in the *roller die process*.



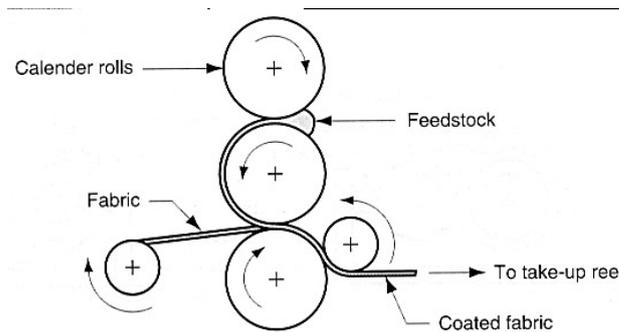
A typical roll configuration in calendering



Three-roll calender used for producing rubber sheet

Coating

This process involves coating of rubber onto substrate fabrics:



Coating of fabric with rubber using a calendering process

Other processes than calendering can also be utilized for coating.

Molding and casting

The process setup is the same as for the other materials. A special process for rubber is so-called *dip casting*, in which a mold is submersed in a liquid polymer for certain duration. Dipping may be repeated to form the desired thickness. Coating is then stripped from the form and cured.

Vulcanization

Vulcanization is a treatment for rubber to become stiffer and stronger. The process involves the use of sulphur at a temperature of 140° C for about 5 hr.; time enough to accomplish cross-linking of elastomers molecules.