Tests applied to rubbers-2:

In conjunction with the chemicals used in a rubber formulation to ensure acceptable product characteristics, a number of ingredients may be incorporated to allow or improve processing with the manufacturing equipment available in the plant.

In the vulcanization process good flow properties are needed in order to

1. Obtain adequate compound–compound adhesion
2. Obtain compound–metal and/or compound–textile adhesion
3. 3. Fill the mold quickly, uniformly, and free of blisters or trapped air, particularly with transfer and injection molding equipment.

Table 2 Processing Additives—Chemical Structure

Group	Examples
Mainly hydrocarbons	Mineral oils
	Paraffin waxes
	Petroleum resins
Fatty acid derivatives	Fatty acids
	Fatty acid esters
	Fatty alcohols
	Metal soaps
	Fatty acid amides
Synthetic resins	Phenolic resins
Low M.W. polymers	Polyethylenes
	Polybutenes
Organothio compounds	Peptizers

Source: Schill + Seilacher, Hamburg, Germany.

Table 3 Processing Additives—Applications

Processing aid	Application	Examples
Chemical peptizer	Reduces polymer viscosity by chain scission	2,2′ -Dibenzamidodiphenyl-disulfide Pentachlorothiophenol
Physical peptizer	Reduces polymer viscosity by internal lubrication	Zinc soaps
Dispersing agent	Improves filler dispersion Reduces mixing time Reduces mixing energy	Mineral oils Fatty acid esters Metal soaps Fatty alcohols
Lubrication agent	Improves compound flow and release	Mineral oils Metal soaps Fatty acid esters Fatty acid amides Fatty acids
Homogenizing agent	Improves polymer blend compatibility Improves compound uniformity	Resin blends

Tackifier	Improves green tack	Hydrocarbon resins Phenolic resins
Plasticizer	Improves product performance at low and high temperatures	Aromatic di- and triesters Aliphatic diesters Alkyl and alkylether monoesters
Stiffening agent	Increases hardness	High styrene resin rubber Masterbatches Phenolic resins *Trans*-Polyoctenamer
Softening agent	Lowers hardness	Mineral oils
Mold release agent	Eases product release from mold	Organosilicones Fatty acid esters
	Decreases mold contamination	Metal soaps Fatty acid amides

In no case this can not be achieved only by cross-linking itself, but also some other additives must be added to rubbers. Except of cross-linking agents and antidegradants (they reduce ageing process) those are mainly fillers (they are making rubbers not only cheaper but they positively influence also some of their commercial properties).

Processing additives may be subdivided according to their chemical structures (Table 2), or according to their application (Table 3). Several classes of substances can have more than one application. For example, fatty acid esters act as lubricants and dispersing agents.

Mineral oils act as physical lubricants in rubber compounds, reducing viscosity, and also help in the filler dispersion process.

In this chapter we discuss the following compounding ingredients with respect to their influence on processing behavior and their relevant compound vulcanizate properties:

The rubbers gain optimum properties of engineering materials only in form of vulcanizates. It is possible to transfer them into this form by means of vulcanization. Basis is in creating of chemical and physical cross-links among rubber macromolecules, in consequence of that three-dimensional network is created and material obtains unique properties.

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Mainly hydrocarbons	Mineral oils
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Source: Schill + Seilacher, Hamburg, Germany.

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For example, fatty acid esters act as lubricants and dispersing agents. Mineral oils act as physical lubricants in rubber compounds, reducing viscosity, and also help in the filler dispersion process. In this chapter we discuss the following compounding ingredients with respect to their influence on processing behavior and their relevant compound vulcanizate

Physical and chemical peptizers

Lubricants

Homogenizing agents

Dispersing agents

Tackifiers

Plasticizers

Masterbatches

Sulfur

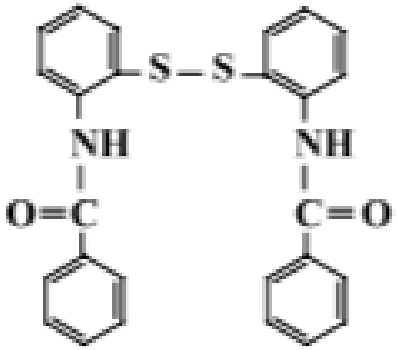
Accelerator

Mineral oils

Anyway, the optimum vulcanizate (rubber) properties cannot be achieved only by cross-linking rubber molecules, but other additives must be added. Besides crosslinking agents and antidegradants (used to slow down the process of aging), they include fillers that have a positive influence on some of the utilisation properties and make them cheaper, as well as additives allowing admixture of all the powdery or liquid additives.

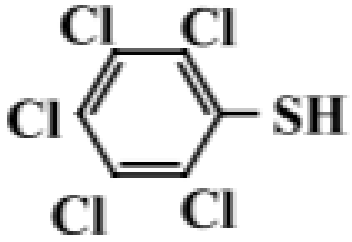
Dibenzamido
diphenyldisulphide (DBD)

+ Activator

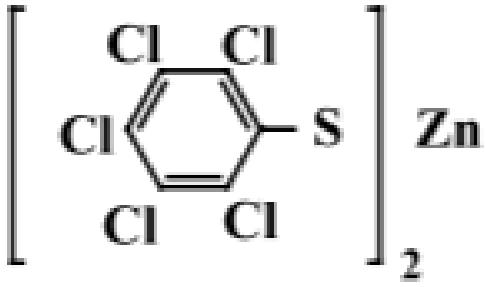


Pentachlorothiophenol
(PCTP)

+ Activator



Zinc pentachlorothiophenol



Common peptizing agents. (Courtesy of Schill + Seilacher.)