

Dealing With Frozen Rubber

Astlett Customer Help Sheet

Rubber may arrive at a factory in *hard* or *frozen* form. Three factors affect rubber hardness:

- High (Mooney) viscosity inherent at time of manufacture.
- Spontaneous cross-linking that occurs continuously, from time of production until processed, to all grades (CV grades very slowly), therefore slowly increasing viscosity. Also called *storage hardening*. Rubber will have aged for varying times prior to consumption. Rubber stores well and its qualities do not degrade.
- *Crystallization* occurs at ambient temperatures and accelerates at lower temperatures. This phenomenon is sometimes called *freezing* and is reversible by the application of heat. Any lot transported during the North American cool season can be expected to be "frozen" to greater or lesser extent. Almost all rubber will have some degree of crystallization.
- *Strain hardening* may be mistaken for freezing. It occurs when rubber flows under pressure. The stretching or distortion of the raw rubber can result in partial crystallization, making the affected rubber tougher and lighter colored. Strain hardening is typically observed where rubber has flowed into cracks between pallet boards and on bale edges extruded into voids between bales. This may occur at any temperature and is not reversible by heating but is reversible by mastication.

What is Freezing?

Freezing is an exothermic reaction where the rubber hydrocarbon goes to a crystalline formation. The color lightens and slight shrinkage may be observed.

We do not warrant that any rubber will not be frozen.

Any *freezing* (crystallization) that may occur is reversible by using premastication or by conditioning in a hot room. Even fresh rubber may need premastication (due to its toughness) or *thawing* (due to crystallization in transit in cool climates).

The Mechanics of Freezing

Freezing occurs from the outside inward from the exterior surfaces of the pallet unit. Also, if shipped in an ocean container, the surfaces against the exterior of the container will freeze first and, over time, deepest. Freezing is a relatively slow process and will be partial (in the direction it is losing heat) before it can become complete (i.e. to the interior of the pallet unit).

Partially frozen units may be usable without conditioning as only a hard crust is encountered on the sides exposed to the freezing temperature. The backside or inside of each bale may be unfrozen.

Signs of freezing are very hard bales, lighter color, and slight shrinkage. We recommend that every rubber factory use a *hot room* to condition natural rubber before use. All major rubber factories have hot rooms.

Test for Degree of Freezing

The degree of freezing can be determined by gauging the thickness of the frozen layer. Beyond 2" or 5 cm on more than three surfaces of a bale, premastication or thawing is indicated.

One method of gauging is to drill into the rubber and then probe the hole with an instrument (screwdriver) to determine elasticity. Alternatively, guillotine a bale in half and check the crystallization visually or by touch.

This test should also be done on inside surfaces and on pallet unit sides away from the cold side, as these surfaces may not be frozen.

Conditioning Rubber

Minor conditioning can be done by separating the bales for easy airflow in a warm area. Frozen rubber is typically conditioned in a hot room heated from 160 to 180 degrees Fahrenheit for four to six days.

Conditioning is always recommended, as mixing times are reduced, strain on machinery is less and peak power loads are lower. This is also true in the absence of any freezing.

Any expense for conditioning natural rubber is assumed by the factory. Most factories routinely condition natural rubber in *hot rooms* prior to mixing.

The Mechanics of Thawing

A *hot room* is a dedicated area with warm air circulating around the rubber to be thawed or conditioned. If no regular hot room is available, a temporary hot room can be constructed. Portable propane blast heaters, as used in the construction industry and available from rental dealers, together with tarps to control airflow, can be used to set up an area to thaw rubber. Arrange the tarps in a 'tent' around the spaced rubber crates (for easy circulation to all sides) and blow in hot air. Maximize circulation and temperature (up to 80°C/180°F) and check daily for thawing. A rubber temperature of 30°C/85°F is the maximum required to reverse all crystallization.

Pallets of natural rubber held in a room heated to 50°C/120°F for two weeks or 70°C/160°F for one week will thaw solidly (to the center, 100% crystallization) frozen pallets. Less time will be required when the rubber is partially frozen. Faster conditioning can be done by separating the bales for easier airflow.

When the rubber becomes elastic again and the color darkens, it is thawed.

Ideally storage temperature should not fall below 15°C for more than two months to avoid crystallization.