" To stride into the future before it arrives!"

Good Practices in Latex Processing

- Formation of field Latex
- Formation of ribbed smoked sheets

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TWC is funded by ADB personnel Development project

Importance of Latex

Natural Rubber Latex is the material of choice in the preparation of thin films for excellent barrier protection, Natural foams for personal comfort etc. It is a material that has built in properties, for wide range of applications and immense possibilities despite some opposition to its use due to allergy problem on rare occasions. Moreover, Natural Rubber Latex is product coming from plantations resembling the tropical jungle needing less energy to produce thus making it environment friendly.

Rubber latex is naturally very clean and consistent, so in fact it only had to stay that way once it is processed up to the time it is used. However, improper practices performed from the field after dropping from the tree all the way to the product manufacturing stage may result in low quality. Although it seems obvious, the quality of the latex used has a direct impact on the quality of the product produced. In fact, many of the early cases of latex protein allergy might be traced to latex that hadn't been properly centrifuged (as well as to poor factory conditions). Today, improvements to latex quality such as pretreatment and additional centrifuging are done to remove as many of the remaining impurities and proteins as possible, ensuring a better quality of latex for production.

Improvements in quality and availability

In recent years, natural rubber producers have been working together with major consumers, particularly the global tyre industries and shipping companies to bring natural rubber to cope with the requirements of the modern tyre industry. Basically these requirements can broadly be categorized into three Cís, namely: Cleanliness, Consistency and Cost-effectiveness.

Cleanliness obviously means freedom from dirt or foreign matter contamination. Consistency sounds pretty straightforward, although the true interpretation can vary substantially with different users.

In general, consistency means constant quality of raw materials, steady processing conditions and good packaging practices.With regard to Cost-effectiveness, natural rubber price must be kept competitive to maintain its market as a general-purpose elastomer.

Preparation and mixing of compounding ingredients

To ensure uniform mixing of chemicals and to avoid settling, chemical preservatives are added to latex as aqueous solutions and aqueous dispersions or emulsions. In the preparation of such solutions and dispersions Deionised or Soft water should be used. The water in soluble chemicals such as Zinc oxide and TMTD are prepared in a ball mill or attritor, or a similar grinding device, using dispersing agents. Water-insoluble liquid compounding ingredients are emulsified with suitable emulsifying agents using a high-speed stirrer or homogenizer. It is essential that the particle size of the dispersed material is less than 5 microns. Coarse particles can make processing difficult by set tling in the dipping tanks, and may also cause defects in the products.

Harvesting the Latex /Crop collection

Latex is a white, milky liquid that flows from the tree when the tree bark is tapped. The latex so obtained should be collected in clean collecting cups firmly fixed to the tree. During this period every effort should be made to prevent contamination of latex from foreign materials and rainwater.

Foreign matter contamination in natural rubber mainly consists of:

- Bark and light wood particles, inserted deliberately or accidentally into smallholder coagula;
- Fibers of polypropylene (from used fertilizer-bags), nylon or strings (from ropes to tie coagula together) and textile rags
- Wood chips from broken pallets.

1) Concentration by Creaming

The processing of latex into creamed concentrate involves the mixing of a creaming agent such as ammonium alginate or tamarind seed powder with properly preserved field latex and allowing the latex to separate into two layers; an upper layer of concentrated latex and a lower layer of serum containing very little rubber. The lower layer of serum is removed, leaving the latex concentrate having about 50-55% DRC (dry rubber content), which is often tested, packed and marketed.

2) Concentration by Centrifugation

The processing of latex into latex concentrate by centrifugation involves the separation of preserved field latex into two fractions, one containing the concentrated latex of more than 60% dry rubber and the other containing 4-8% dry rubber (skim latex). Skim latex is generally coagulated with sulphuric acid, made into crepe, dried and marketed as skim rubber, which is a low-grade rubber.

Pre-Centrifugation

Some manufacturers are experimenting with the addition of proteolytic enzymes prior to centrifugation to break down proteins in the mix, and reduce the amount of available proteins in the final products. Enzymes can significantly reduce protein levels, but some authors believe they may also adversely affect the mechanical properties of the latex film

Centrifugation

Centrifuging the latex concentrates the rubber content up to about 60 percent, but also reduces the protein content. Double centrifuging can reduce protein content even further.

Preservation of Centrifuged Latex

Centrifuged latices are commercially available as high ammonia (HA – minimum 0.6% ammonia) and low ammonia (LA - 0.2 to 0.3% ammonia) types. The former is preserved solely with ammonia and the latter contains one or more preservatives in addition to ammonia. The most popular LA type latex is low ammonia TMTD – Zinc oxide (LA-TZ) which contains 0.2 to 0.3% ammonia, 0.013% TMTD, 0.013% zinc oxide and 0.05% lauric acid.

Specifications

Preserved latex concentrates shall be graded and marketed in conformity with the standards specified by the Bureau of Indian

Ribbed Smoked Sheet (RSS)

Latex is coagulated in suitable containers into thin slabs of coagulum and rolled through a set of smooth rollers followed by a grooved set and dried to obtain sheet rubber. Depending upon the drying method, sheet rubbers are classified into two: Ribbed Smoked Sheets and Air Dried Sheets (Pale Amber Unsmoked Sheets).

For processing latex into sheet rubber, it is important that the latex collected is brought to the processing centre before pre-coagulation sets in. In cases where the latex is found to be prone to pre-coagulation, an anticoagulant is used.
Latex brought to the centre is strained through 40 and 60 mesh stainless steel sieves. The volume of latex is measured with a standard vessel and a calibrated rod. The dry rubber content (DRC) is estimated with a metrolac, which is a special type of hydrometer calibrated to directly read the DRC.
Latex is diluted in bulking tanks to a standard consistency of 1/2 kg of dry rubber for every 4 litres of the diluted latex (12.5% DRC). The diluted latex is allowed to stand in the bulking tank for a fixed time (usually 15 to 20 minutes) for the heavy dirt particles to sediment. The diluted latex is drawn out from the bulking tank without disturbing the sedimented layer of impurities into the coagulation pans or tanks. Four litres of latex is usually transferred to each pan.

1) Coagulation

Formic acid or acetic acid is generally used for coagulation. The quantity of acid required for satisfactory coagulation depends on various factors like the amount and type of anticoagulant used, the duration of coagulation, the season, and the nature of the latex. The acid requirement may slightly change under varying conditions and can be fixed up by experience. Only diluted acid should be used for coagulation and should be thoroughly mixed with latex.

Acid requirement for coagulation of 4 litres of diluted latex containing ½ kg rubber

	Acetic acid	Formic acid
For the next day sheeting	3 ml diluted to 300 ml with water	1.5 ml diluted to 300 ml with water
For the same day sheeting	4 ml diluted to 400 ml with water	2 ml diluted to 400 ml with water

2) Concentration by Centrifugation

The processing of latex into latex concentrate by centrifugation involves the separation of preserved field latex into two fractions, one containing the concentrated latex of more than 60% dry rubber and the other containing 4-8% dry rubber (skim latex).
Skim latex is generally coagulated with sulphuric acid, made into crepe, dried and marketed as skim rubber, which is a low-grade rubber. The formation of organic acids neutralizes the negative charge on rubber particles and the latex gradually gets coagulated on keeping. Therefore, fresh latex cannot be kept for long without preservative treatment.
The collectors of the latex follow the farmers (kind of a second shift) usually between 6:00 a.m. and 8:00 a.m. and take the tapping cups, which are attached to the tree, and load the contents into larger, easy-to-carry containers. The latex needs to be treated with chemicals quickly or it hardens into a gum. Ammonia along with a small amount of thiurams is added to stop microbiological spoilage and curdling of the latex. Ammoniation can, if performed at the right time, aid in the hydrolysis of proteins. The processing of preserved field latex consists essentially of adding the preservative (usually ammonia, minimum 1%) to the sieved latex, bulking, settling, blending and packing. Field latex can also be preserved with LATZ (Low ammonia – TMTD – Zinc oxide) system.

Latex Concentrate

There is good market for preserved latex concentrate, as it is an important raw material with a wide range of applications. Two important methods of processing latex into preserved latex concentrate are commercially practiced.

Catalyst AC and sulphuric acid are also used by growers. Catalyst AC is a dry powder and comparatively a safe coagulant. Normally 100 ml of a 5 per cent solution of this chemical is enough for making a ½ kg sheet. Since sulphuric acid is highly corrosive, care should be taken in its handling and dilution. 300 ml of a 0.5% solution of the acid is required for same day sheeting and 250 ml for next day sheeting.

Coagulum from latex often shows a tendency for surface darkening. To prevent this, a small quantity of sodium bisulphite (1.2 g per kg DRC), dissolved in water may be added to the diluted latex before coagulation.

After coagulation, the coagulum is removed from the pan or tank and thoroughly washed in running water. They are rolled either in a sheeting battery or smooth rollers to a thickness of 3 mm and finally passed through the grooved roller. While sheeting, the coagulum is continuously washed. The sheets are again washed in running water in a tank.Mould growth on sheet rubber can be prevented by treating freshly machined sheet in a dilute solution of paranitrophenol (PNP). The concentration of paranitrophenol is 0.05 to 0.1% in water. 100 litres of the solution will be sufficient for treating 100 sheets. The wet sheets are allowed to drip on reapers arranged in a well-ventilated dripping shed.

Smoking and Smoke Houses

The sheets after two or three hours of dripping in shade are placed in the smoke house where the temperature is maintained between 40° and 60°C. In the smoke house, sheets are dried gradually whereby blisters are avoided. In addition, the creosotic substances present in the smoke prevent mould growth on smoked sheets.It is preferable to smoke the sheets on the first day at a low temperature (40° to 45°C).

For the subsequent days (i.e. the second to the fourth day the sheets are to be dried at a higher temperature (not exceeding 60°C) and fairly low relative humidity. Sheets can be dried by placing them on the first day on the reapers at the bottom region of the smoke house and at the higher regions on the subsequent days of smoking.

The requirements of a good smoke house are:

* Minimum drying time
* Minimum drying cost
* Continuous operation
* Good ventilation
* Maximum fuel efficiency
* Minimum heat loss
* Maintenance of temperature in the range of 40-60° C
* Easy loading/unloading of sheets
* Minimum labour requirement
* Minimum number of defective sheets

Major Defects in Smoked Sheets

Defects	Causes	Prevention
Small sand dirt, or foreig particles in the sheet	Due to improper bulkin and sieving	Practice proper bulking in suitabl tanks for the sedimentation of th dirt and use proper sieves.
Small bubbles along th edges of rubber sheets	Due to (1) insufficien mixing of the acid wit latex and (2) insufficien acid for coagulation	Ensure thorough mixing of acid wit latex. Use adequate quantity o acid.
Pinhead bubbles in cluster all over the sheets	Caused by bacterial growth	The latex tanks and coagulatin pans should be cleaned regularly preferably with a small quantity o disinfectant solution (Lysol o formalin).
Small white specks an irregular bubbles	Mainly due t precoagulated latex	Use of anticoagulants in the field.
Blisters and large Bubbles	Rapid drying in the smok house	Resort to gradual drying b regulating the temperature.
Burnt and oxidized Sheets	High temperature dryin and flame directly reachin the sheet	Sheets have to be initially dried a 40° - 45°C and then at 60°C unti completely dry.
Weak sheets	High dilution of field late and sheeting befor maturation. Use of late from slaughter tapping.	Dilute the field latex to 12.5% DR and roll the coagulum afte obtaining sufficient strength.
Mould	Improper drying an storage under mois conditions.	Dry the sheets after dipping i paranitrophenol solution. Prope drying and storing in dr atmosphere.
Rust	Improper washing of th coagulum during and afte sheeting.	Wash the coagulum during and afte sheeting.
Stickiness	High dosage of coagulan and high temperatur drying and drying i sunlight alone.	Use only sufficient quantity of aci and dry at the specifie temperature.
Discolouration	Atmospheric oxidatio during coagulation.	Use sodium bisulphite solutio before coagulation.