Advisory Circular No. 2013/05

RSS Manufacture

Rubber Research Institute
of Sri Lanka

RSS MANUFACTURE

INTRODUCTION

Since the inception of local raw rubber processing industry over 100 years ago, Ribbed smoked sheet (RSS) has been the major form of raw rubber produced in Sri Lanka (above 40%). Practically entire volume of this grade of rubber is produced by small and medium scale rubber growers who own below 10 acres and between 10-50 acres respectively, scattered in the rubber growing districts in the country. This is mainly due to the simplicity and low cost of the processing machinery, easily adaptable processing technology, and the viability of the manufacturing process with any amount of latex. RSS are graded according to visual appearance, into six different grades; RSS No.1X to RSS No. 5. While this grading system is not based on any technical properties of RSS, it indicates the degree of cleanliness and adaptation of the correct manufacturing practices during the manufacturing process of RSS. Even though RSS manufacturing process is well established in all aspects, only a small percentage of RSS is still produced to reach the quality of RSS No. 01. In the face local scientific research in rubber in the country completing 100 years it is important that we attempt to reach 100% RSS No.1 production in the country which is achievable. This article summarizes the recommended procedures to be followed for the production of high quality sheet rubber without involving additional manufacturing cost.

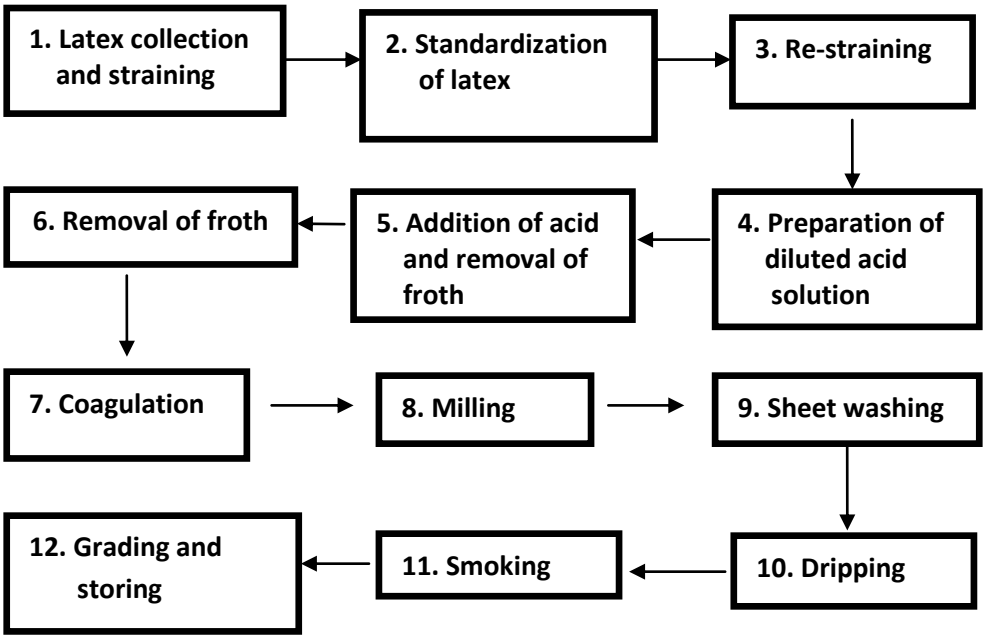

Fig. 1. Unit operations of manufacturing process of RSS

1. LATEX COLLECTION AND STRAINING:

Recommended procedure

Cleaned coconut shells are recommended for the collection of latex from rubber trees. Cups made out of plastic or thermoplastic natural rubber (TPNR) cups introduced by Rubber Research Institute of Sri Lanka are also recommended for this purpose. Contamination with foreign materials such as tree barks, sand particles and rain water should be completely avoided. If there is a tendency for pre-coagulation of latex, sodium sulphite should be added to the latex in the field.

Dose: 15-50 ml from a stock solution of sodium sulphite (prepared by dissolving 1kg of the chemical in 30 L of pure water) to 1L of field latex.

The latex should be subjected to a preliminary straining through a sieve fitted with Monel gauze of 40-50 mesh or stainless steel mesh. For this purpose, brass mesh is not recommended since minute traces of copper can affect the quality of the rubber.

Objectives

1. to avoid pre-coagulation of latex
2. to minimize the foreign material content (dirt) in the sheet

2. STANDARDIZATION OF LATEX

Recommended procedure

Dry rubber content (DRC) of latex should be brought down to a standard DRC by diluting the latex with clean and pure water prior to addition of acid for coagulation. The recommended standard DRC to be used in RSS manufacture is 12.5%. Dilution water should always be strained off through a fine cloth.

Table 1. *The quantity of dilution water in liters required for diluting field latex having different metrolac readings to a standard DRC of 12.5%*

Volume of latex	Metrolac reading				
	90	**100**	**110**	**120**	**130**
1	1.24	1.40	1.56	1.72	1.88
2	2.48	2.80	3.12	3.44	3.76
3	3.72	4.20	4.68	5.16	5.64
4	4.96	5.60	6.24	6.88	7.52
5	6.20	7.00	7.80	8.60	9.40
6	7.44	8.40	9.36	10.32	11.28
7	8.68	9.80	10.92	12.04	13.16
8	9.92	11.20	12.48	13.76	15.04
9	11.16	12.60	14.04	15.48	16.92
10	12.40	14.00	15.60	17.20	18.80

Objectives

1. to achieve quality consistency
2. to obtain a softer coagulum which can be easily be sheeted
3. to facilitate non-rubbers to wash off easily
4. to improve the clarity of the sheets
5. to reduce the drying period
6. to faster settling of impurities in the bulking tanks
7. to bring down the viscosity of the latex in order to ensure uniform mixing of chemicals added to the latex (acids)
8. to facilitate trapped air and any fermentation gases to escape from the latex.

Darkening of final RSS sheet can occurs occasionally due to enzymatic discoloration. If this discoloration is experienced then a sufficient quantity of sodium metabisulphite or sodium bisulphate should be added as 3% (w/w) solution (maximum recommended dose: 50 g/100 kg of dry rubber)

3. RE-STRAINING

Recommended procedure

As in the step 1, bulked latex should be re-strained through a sieve fitted with Monel gauge of 40-50 mesh or stainless steel mesh in to clean latex coagulating vessels (pans or DCL tanks)

Objectives

- to remove any foreign matter which are added to latex during the standardization process.

4. PREPARATION OF DILUTED ACID SOLUTION

Recommended procedure

For latex coagulation, 1% diluted formic acid is used. Stock solution should be prepared by mixing 1 part from 85% strong formic acid with 84 parts of pure water. If Formic acid with any other concentrations is used it should be diluted with pure water to bring down the concentration of the stock solution to 1%.

Objectives

- to achieve uniform and complete coagulation
- to get sheets free from air bubbles and stickiness
- to get a soft coagulum

5. ADDITION OF ACID AND REMOVAL OF FROTH

Recommended procedure

Diluted latex with standard DRC is poured into cleaned coagulating vessels and diluted formic acid solution should be added as given below to coagulate the latex.

Table 2. *Formic acid requirement for coagulation of 8 L of standardized latex (1kg of dry rubber)*

Sheeting schedule	**From 85% (w/w/) concentrated acid**	**From diluted (1%) solution**
Processing of coagulum is carried out on the day following coagulation (ml)	3.50 – 4.00	297.50 – 340.00
Processing of coagulum is carried out on the same evening of coagulation (ml)	4.5 – 5.00 ml	382.50 – 425.00

After adding the acid solution, the latex should be mixed thoroughly using an aluminum sheet or a wooden plate and the resulting froth should be skimmed off by means of a suitable skimmer such as a piece of smooth board or Aluminum or galvanized iron sheet.

Objectives

- to achieve complete coagulation
- to prevent the formation of pits of the surface of the sheets

6. COAGULATION

Recommended procedure

After addition of acid, coagulating pans/DCL tanks should be covered properly and placed horizontally and kept undisturbed for adequate period for completion of the coagulation process.

Objectives

- to prevent falling any foreign particles (insects, flies and any dirt particles)
- to facilitate getting a sheet with even thickness and uniform weight

7. PRELIMINARY HAND ROLLING OF COAGULUM

Recommended procedure

After draining out the serum, the coagulum is placed on a cleaned horizontal table or an aluminium plate and hand pressed to make a uniform thickness sheet. It is important to make sure that no thick edges are formed during hand pressing.

Objectives

- to make easier to work on the machines
- to facilitate getting sheets with an even thickness
- to washout the serum substances

8. MILLING OF COAGULAM

Recommended procedure

The hand pressed coagulum is rolled on the pre-cleaned smooth rollers two to three times, the space between the rollers being reduced after each milling, and is then passed through the marking (diamond) roller. The rollers should be fitted with a water spray so that the serum is washed off the sheet as it is squeezed out. A battery consist of three to four pairs of smooth rollers and one pair of spirally grooved rollers mounted as a unit could be used for the milling purpose (preferably for medium and large scale producers).

Objectives

- to remove the water present in the coagulum
- to thin down the coagulum in to sheet form with even thickness (3.2 mm)
- to squeeze the serum from the coagulum
- to facilitate drying
- to get rubber

9. WASHING OF SHEETS

Recommended procedure

The sheets should be soaked in running water for a short time after milling.

Objectives

- to wash off the residual non-rubbers
- to prevent discoloration and mould growth of sheets during dripping period

10. DRIPPING

Recommended procedure

Milled sheets are hung up to drip off the remaining water for four to six hours preferably in an air draft in the shade. After dripping, sheets either can be smoked straight away using a smoke house or it can be sun dried for about two days before they are taken into the smoked house.

Objectives

- to drain off the surface moisture and thereby reduce the smoking period

11. SMOKING

Recommended procedure

Smoke house should be heated under moderate fire with a low level of smoke. This will lead to production of sheets with a good appearance. Temperature of

the smoke house should be maintained at correct range between 48-54 ^{o}C. The smoke house should be thoroughly cleaned prior to smoking the sheets. Sheets should be turned over daily during smoking to prevent any reaper marks on the sheets. Generally, smoking could be completed within 4-5 days.

Objectives

- to dry the sheets
- to provide a preservative effect on to the rubber
- to impart resistance to oxidative degradation.

Note: It has been now shown that sun drying of sheet rubber for three to four days for complete dryness will not adversely affect the physical or vulcanizate properties of the rubber, but in order to eliminate mould contamination of the sheet rubber, smoking in a smoke house for one to two days is recommended. Rubber Research Institute of Sri Lanka recently introduced a single day smoke drying system (SS drying system) for sheet rubber provided that sheets are manufactured according to the recommended manufacturing procedures to meet the standard specifications (Thickness -3.2 mm and weight -450-550g). It is also recommended to maintain the temperature inside the drying chamber between 55 – 65ºC throughout the drying process without any interruption.

12. Grading and storing

Recommended procedure

Smoked sheets are visually examined by holding them against clear light to inspect any speck and impurities remaining inside. Sheets are sorted into five grades on the level of colour, translucency, presence of mould, bubbles, dirt etc. However, it should be mentioned that no master or international sample has been established for theses grades. Sheets should be stored in a dry place with adequate ventilation.

Objectives

- to decide the market price
- to group the sheets based on the quality
- to avoid mould growth during storage

SOME COMMON BUT WRONG PRACTICES THAT SHOULD BE AVOIDED

1. Use of unclean utensils
2. Insufficient dilution of acid
3. Use of worn out machines
4. Manufacture of over weight sheets
5. Manufacture of thicker sheets (thickness higher than 3.2 mm)
6. Loading of wet sheets into the smoke house
7. Use of oversize smoke houses

Some of the common defects found in RSS, their causes and relevant corrective measures are summarized in Table 3.

Table 3. *Common defects in RSS, causes and corrective measures*

Defects	**Cause**	**Corrective measures**
Pin head bubbles	Precoagulation Use of dirty utensils Latex contamination with rain water Use of excess acid or too high concentration Insufficient dilution	Addition of anti-coagulants in the field Use of clean utensils Prevention of the contamination Use of correct amount of diluted acid (1%) Correct dilution of latex
Medium size bubbles	Fast coagulation Insufficient dilution Insufficient skimming of the surface	Use of correct amount of diluted acid (1%) Correct dilution of latex Complete removal of froth after addition of acid correct thickness of sheets
Large bubbles	Too high drying temperature High thickness of sheets	Maintain the correct drying temperature Use sheets with recommended thickness
Reaper marks	Not turning sheets daily Use of dirty reapers	Turn sheets by turning reapers Use of clean reapers

Defects	Cause	Corrective measures
Dirt	Improper straining of latex Rubbing the sieves too vigorously during straining Use of bad quality water Un-covered coagulation Un-cleaned smoked houses	Proper straining of latex Avoidance of the causing malpractice Use of pure water after strain through a fine cloth Prevention of falling foreign materials onto latex Maintain the cleanliness of smoke house
Dull colour	Enzymatic discolouration Insufficient washing of sheets Smoking of insufficiently drained sheets Prolonged smoking Unevenly thick sheets	Add sodium bisulphate solution Sufficient washing of sheets Avoidance of cover smoking Use sheets with recommended thickness
Rust	Insufficient washing of sheets during milling Prolonged dripping of wet sheets Restricted air flow inside the smoke house Too low temperature in the smoke house Use of badly worn-out mills	Washing the sheets properly. Shorten the dripping time. Maintain a good air flow inside the smoke house Maintain ace of correct drying temperature Maintain machines in good condition Use of dry firewood
Glossy surface	Use of wet firewood Use of certain firewood types such as coconut shells, coconut husks and paddy husks	Avoidance of such firewood types
Mould growth	Delaying in drying Storage of sheets under high humidity without adequate ventilation inside the store room insufficient removal of non-rubber Excessive use of sodium sulphite/bisulphate	Dry the sheets without delay Store dried sheets with proper arrangements Maintain adequate ventilation in the store room Adequate washing Use of recommended levels of these chemicals

Defects	Cause	Corrective measures
Greasy sheets	Insufficient washing of sheets Inadequate dilution of latex Use of excess of sodium salts Drying at high temperature Contamination with oil and grease on rollers Contamination with copper ions	Sufficient washing in running water Dilution of latex at recommended DRC
Tackiness	Use of excess of sodium salts Drying at high temperature Contamination with oil and grease on rollers Contamination with copper ions	Use of the chemicals in correct doses Maintain the correct drying temperature Prevention of latex contamination with oil and grease
Thick edges	Insufficient dilution of latex Use of out of shaped pans Placing coagulating pans on non-horizontally negligence during milling	Diluting the latex into recommended level Use of pans of correct dimensions and shape Draw more attention on milling
Flat roller marks	Insufficient dilution Use of excessive amounts of acid Using of worn out diamond rollers	Correct dilution of latex Use of accurate amounts of properly diluted acid Use of good rollers
Tar spots	No ceiling in the smoke house	Introduction of a V-shaped ceiling to the smoke house Maintain a good ventilation in the store room
Ash particles	Using a smaller baffle plate No baffle plate Careless operational practices	Fixing a baffle plate of correct measurements Adequate ventilation
Appearance	Lack of attention on the recommended manufacturing process	Pay proper attention to all steps of manufacturing process

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February 2014