Seminar on Latex Products, 1991, Tvm.

PRODUCTION AND QUALITY ASSURANCE OF CONCENTRATED NATURAL RUBBER LATEX

By

Smt.G.RAJAMMAL
Rubber Research Institute of India
Kottayam - 9

INTRODUCTION

Concentrated Natural Rubber latex is the main raw material for the manufacture of a variety of rubber goods such as foam products, various types of gloves such as examination, household, carpet backings, leather board, elastic thread, balloons, cast toys etc. It is processed from preserved field latex which has a dry rubber content of 30 - 40%. The advantages of concentrated latex are:

* Economy in transportation
* Ideal for latex products manufacture
* Uniformity in quality
* Higher degree of purity

Depending upon the method of production, there are four types of concentrated latices.

1. Centrifuged latex
2. Creamed latex
3. Evaporated latex
4. Electro decanted latex

Of these, centrifuged latex is the most popular and widely used type. This is due to its excellent quality which is suited for the manufacture of any type of latex product. Creamed latex is processed with the use of materials known as creaming agents. The process is simple and involves only simple machinery and low power consumption. The other two latices are not being commercially produced in large scale in India.

Concentrated latices require preservatives to inhibit bacterial growth which would destabilise the latex and bring about spontaneous coagulation. Centrifuged and creamed latices are generally preserved with ammonia which has the advantage of being completely volatile, leaving no residue in the product. But it has strong objectionable orour, handling difficulties and pollution problems. Hence low ammonia systems with secondary preservatives have been developed. Some of the preservative systems are given below:-

* Centrifuged latex HA Type (High Ammonia)

Ammonia	- 0.7% by wt. of latex

* Centrifuged latex LA Type (Low Ammonia)

Ammonia	- 0.2% by wt. of latex
Sodium pentachlorophenate (SPP)	0.2% "

* Centrifuged latex LA Type - LA-ZDC

Ammonia	- 0.2% by wt. of latex
Zinc diethyl dithio carbamate (ZDC)	- 0.2% "
Lauric acid	- 0.02% "

* Centrifuged lated - LA-BA

Ammonia	- 0.2% by wt. of latex
Boric Acid	- 0.2% "
Lauric Acid	- 0.02% "

* Centrifuged latex - LA-TZ (Low Ammonia-TMTD/ZnO)

Ammonia	- 0.2% by wt. of Latex
TMTD(Tetra Methyl Thiuram Disulphide) and	- 0.025% "
Zno (Zinc Oxide)	- 0.025% "
Lauric acid	- 0.05% "

In addition to these, some special type of concentrated latices suited for special applications have been developed by different techniques or chemical modification. Some of these latices ar given below.

*Doubly Centrifuged latex :- This latex has been centrifuged twice and preserved with 0.7% Ammonia. This latex is more pure, pale coloured and has excellent electrical insulation properties.

* Prevulcanised Latex :- It is prepared by heating centrifuged latex with vulcanising ingredients until the rubber particles are crosslinked.

* Heveaplus MG latex:- It is produced by graft polymerisation of methyl methacrylate in natural latex. Commercial product generally contains 30% or 49% polymerised methyl methacrylate. The main application for graft polymer latices are in adhesives and as self reinforcing or stiffening agents.

India produces about 33000 MT(drc) of natural rubber latex concentrate annually. Of this, more than 95% is in the form of HA type centrifuged latex and the remaining creamed latex.

Doubly centrifuged and prevulcanised latices are prepared on special request. By the middle of 1990, the pilot latex processing centre of Rubber Board has started production of Centrifuged Latex (LA-TZ type). This latex has got many advantages both in the processing sector as well as manufacturing sector and is gaining much commercial significance. Many units are now switching over to production of LATZ latex.

Quality control is of prime importance in the manufacture of any product. Concentrated latex being the most important raw material for latex products manufacture, the importance of its quality cannot be overemphasised. To maintain the quality of latex, the Bureau of Indian Standards in collaboration with Rubber Board is now operating a quality control scheme for centrifuged latex.

This paper discusses in detail the production of various types of concentrated latices processed in India and their quality assurance offered by the quality control scheme.

1. Process details of Centrifuged Latex-HA type

Fresh field latex collected from large estates and small growers is bulked and ammoniated to 1 per cent. The preserved latex is packed in barrels and is transported to the centrifuging unit. A process flow chart is given in Fig. 1. On arrival at the factory, the latex is tested for DRC, Ammonia content, Magnesium content and Volatile Fatty Acid (VFA) number. The latex is then poured into small reception tank after sieving. From the reception tank, it is allowed to flow into a desludging tank. Calculated quantities of Diammonium Hydrogen Phosphate is added to precipitate the Magnesium as Magnesium Ammonium Phosphate and the sludge so formed is settled to the bottom of the tank.

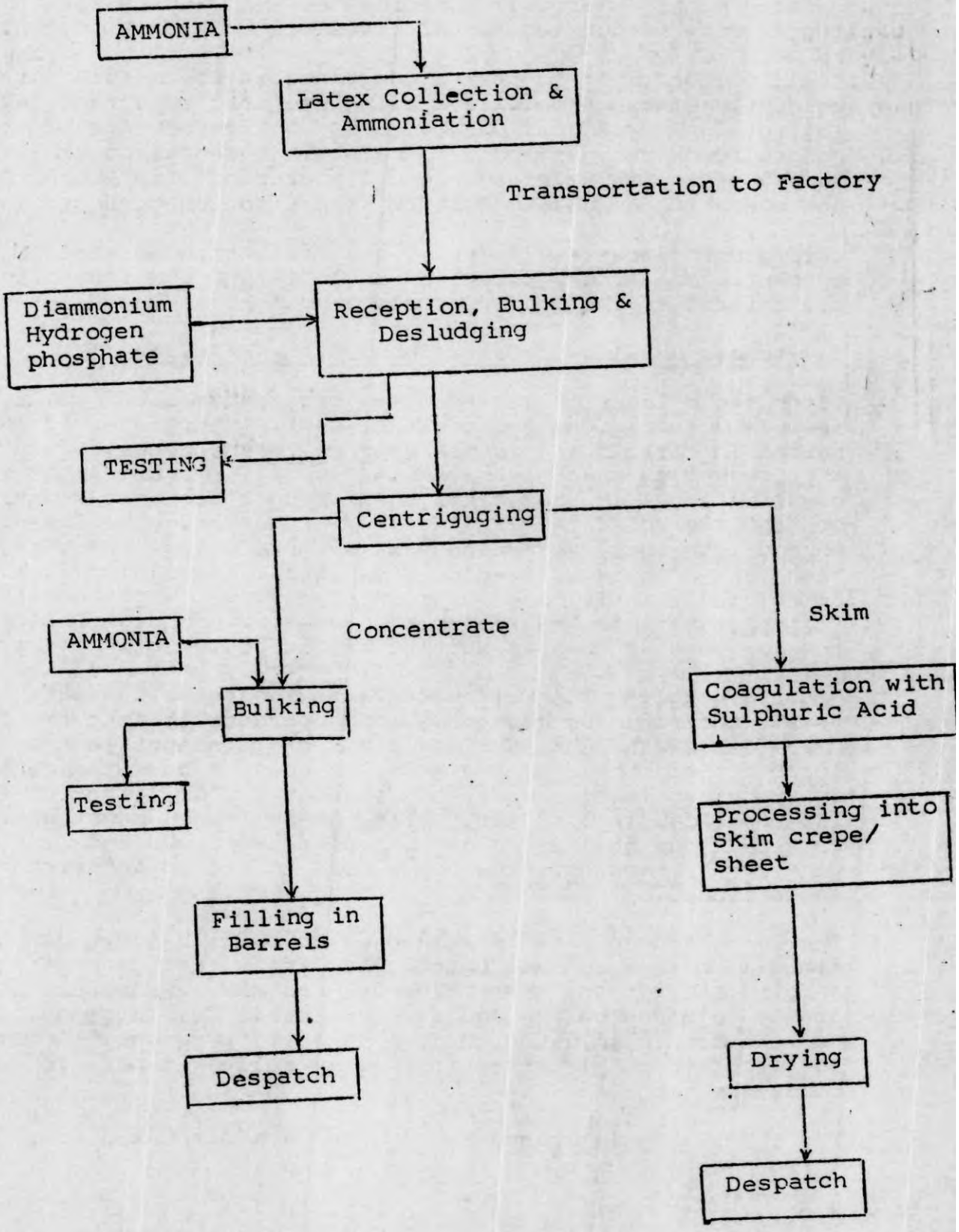
After a settling time of about 12 to 16 hours, the latex is fed to the centrifuging machine which separates it into two fractions viz. the CONCENTRATE AND THE SKIM. The Concentrate has a drc of about 60% and the skim has a drc of about 4 to 8 per cent. One centrifuging machine can process about 10,000 litres of field latex per day in 3 shifts. After every 3 to 4 hours of continuous working, the bowl is taken out and cleaned. To reduce the down time of the machine, the spare bowl is fitted and processing is continued.

The latex concentrate is collected in bulking tanks and the ammonia content is made upto 0.7%. After thorough mixing, a sample is drawn and tested for drc and MST. Necessary boosting of MST is given by the addition of lauric acid soap (0.025%) and the drc is adjusted to 60.1 to 60.15 per cent. A sample is taken for complete testing, latex filled in barrels and kept ready for despatch.

The skim latex is coagulated, dried and processed as skim crepe/sheet.

Fig. 1 - Process Flow Chart for Centrifuged Latex

HA Type



1. High Ammonia Type (HA)
2. Medium Ammonia Type (MA)
3. Low Ammonia Type (LA)

The requirements for centrifuged latex as per IS 5430-1981 are given below.

Characteristics	Type HA	Type MA	Type LA
1. Colour	The colour of all types of latex when visually examined shall not be pronounced blue or grey.		
2. Odour	For all types of latex there shall not be any odour of putrefaction after neutralisation with boric acid.		
3. Dry rubber content, per cent by mass (min)	60.0	60.0	60.0
4. Non rubber solids, per cent by mass (max)	2.0	2.0	2.0
5. Coagulum content, percent by mass of latex, max.	0.05	0.05	0.05
6. Sludge content, per cent by mass, max.	0.10	0.10	0.10
7. Alkalinity as ammonia, percent by mass of latex	0.6 (min)	Above 0.3 but below 0.6	0.3 (max)
8. KOH number, max.	1.0	1.0	1.0
9. Mechanical Stability, Sec. Min.	475	475	475
10. Volatile fatty acid number, max.	0.15	0.15	0.15
11. Copper content, ppm of total solids, max.	8	8	8
12. Manganess content, ppm.of total solids, max.	8	8	8

Optional requirement

The limit of magnesium content shall be as agreed to between the purchaser and the supplier.

Importance of each parameter

1) Dry Rubber Content (drc) is the weight of rubber in 100 gms. of latex. Estimation of drc is essential for two reasons. Transaction of latex are based on the drc and not on the wet wieght Secondly, while designing a formulation for latex products, the weights of the compounding ingredients are based on the dry weight of rubber.

2) Total solids content (TSC) is a measure of the dry rubber and non rubber materials in latex. Hence the difference between TSC and DRC gives a fair approximation of the non rubber components in latex. Also it helps to detect the presence of some possible adultrants. The non rubber materials will increase the water absorption and will affect the electrical conductivity of the product.

3) Sludge refers to non polymer impurities in latex which will sediment under the influence of gravity. Sludge in latex is constituted mainly of magnesium ammonium phosphate, small quantities of bark, sand, other particles etc. Since these impurities are inert to vulcanising ingredients, they will not have any chemical bonding to the rubber article and can result in failures.

Sludge content in latex can be determined by centrifuging a known weight of latex at about 2500 rpm. The residue is washed with ethanol-water-ammonia mixture. The washed residue is dried and sludge content is estimated.

4) Coagulum content in latex is formed mainly by the irreversible aggregation of rubber particles. This can happen if the stability of latex is too low. When products are made from lattices containing coagulum of large size, the interior of the particle cannot be vulcanised, thus creating a region of lower mechanical strength. The coagulum content in latex is determined by sieving a 1:1 mixture latex - soap (50%) through a 180 mesh sieve. The residue is washed and dried.

5) Ammonia in latex functions as an alkali,, bactericide and complexing agent to metal ions. Ammonia content is estimated by titrating a known weight of latex against a standard acid.

6) The VFA No. of latex is a measure of the volatile fatty acid soaps present in the latex. The volatile fatty acids are formed in latex by microbial attack. Good quality centrifuged latex produced from well preserved field latex will have low VFA Number (less than 0.05). Lattices with high VFA No. have low machanical stability, low colloidal stability and chemical stability.

7) KOH number of latex is a measure of the total fatty acid soaps present in the latex ie. both volatile and non volatile. The non volatile fatty acid soaps increase the mechanical stability of latex and the volatile fatty acids decrease the stability of latex. The non volatile fatty acid soaps increase on storage and hence KOH No. gives a measure of the age of the latex.

8) Copper and manganese are pro-oxidants and will accelerate the thermal degradation of raw or vulcanised rubber. Hence latices with high Cu & Mn content will have poor ageing characteristics.

9) Mechanical stability Time (MST) is the time required for coalescence of rubber particle to be initiated, when latex is subjected to high speed stirring under closely defined condition. It is a measure of the resistance of latex to machanical egitation during centrifuging, transporting, processing, etc. The machanical stability time increases initially on storage due to the formation of higher fatty acid soaps in the latex. Hence it is determined only after 20 days from the date of processing of latex, after reaching equilibrium.

BIS CERTIFICATION Mark Scheme

Since centrifuged latex is an important raw material for any latex product, its quality control is of prime importance. To get a correct picture about the quality of centrifuged latex, extensive laboratory testing is required. This may not be possible by the small scale consumers of centrifuged latex. Hence to protect the interests of all consumers, Section 48 of the Rubber Rules says that producer of any form of technically specified natural rubber shall grade and market his produce in conformity with such standards as are specified by the Bureau of Indian Standards (BIS) from time to time.

The BIS, in association with the Rubber Board is now operating a quality control scheme for centrifuged latex. Any processing unit who becomes a member of this scheme is licenced to use the standard mark on their produce which conforms to the standards prescribed in IS 5430-1981. A unit intending to produce and market raw rubber with ISI mark has to build up a laboratory with facilities to test all the parameters prescribed in the Indian Standards.

A licence is issued to a unit under the following conditions.

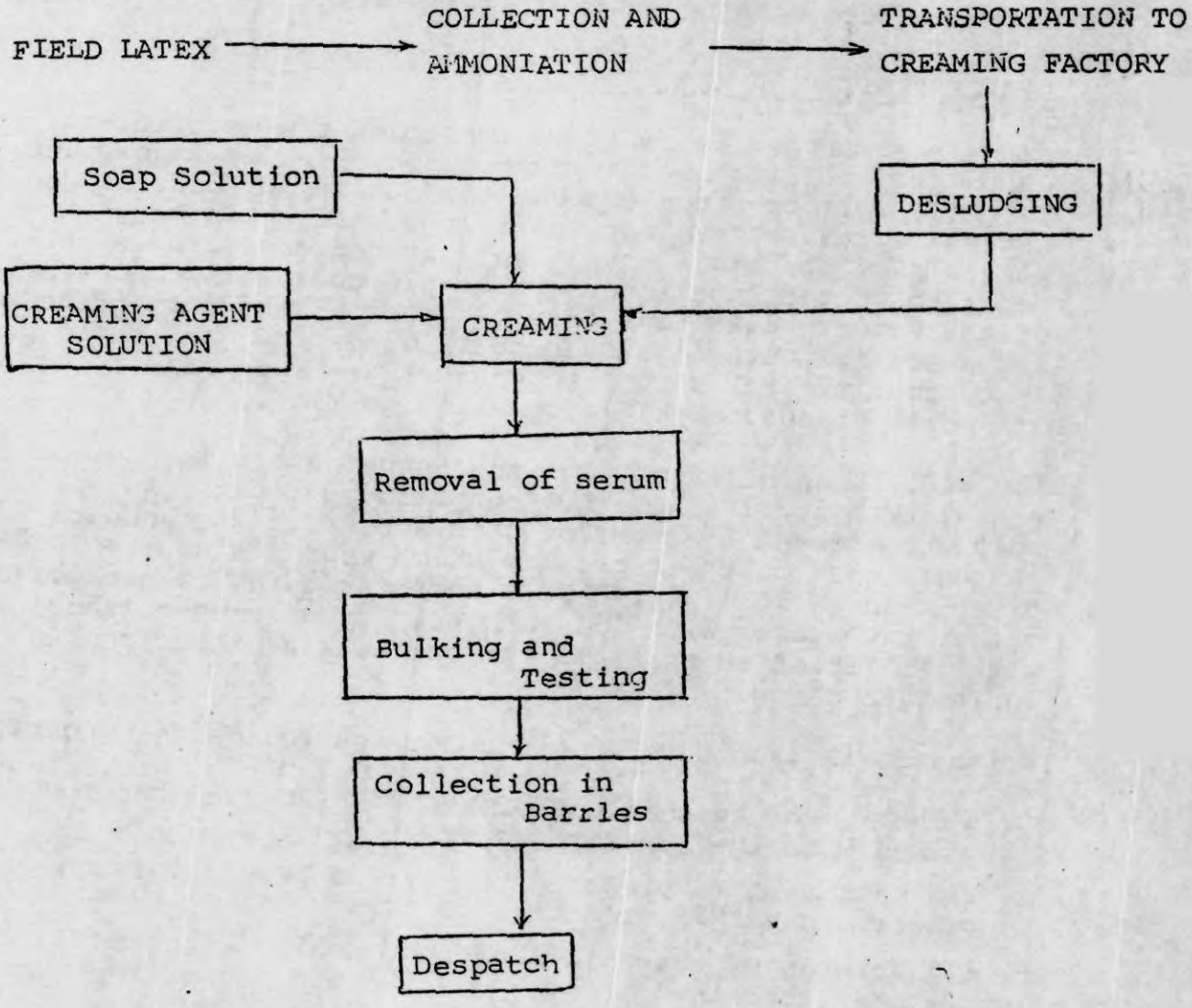
1. All the produce that conform to IS 5430-1981 has to be marked with the standard mark.
2. The unit must be prepared to pay the annual marking fee prescribed by BIS from time to time.
3. All batches of the unit's produce shall be tested for all the parameters prescribed in IS 5430-1981 and proper register has to be maintained.
4. The unit has to offer free samples for independent testing to the inspecting officers of BIS/Rubber Board.
5. The inspecting officers of BIS/Rubber Board will have the powers to inspect the process unit and the laboratory and to verify documents relating to the quality and quantity of the unit's produce.

Advantages of BIS Certification Marks Scheme

The officers of BIS and Rubber Board will be frequently visiting the unit to ensure proper quality maintenance. So the BIS certification mark stands as a token of assured quality. The product with certification marks will be welcomed in the market.

The consumers of the produce with BIS Certification marks can get protection from exploitation and get free replacement in case the product is found to be of substandard quality.

Process details & Quality Control of Creamed latex



Fresh field latex collected from rubber plantations is ammoniated to 1-1-2% by wt.of latex, and dry rubber content is determined. The latex from the collection centre is brought to the creaming factory and aged for a few days (10-15 days). Before creaming it is first sieved into the desludging tank, treated with diammonium hydrogen phosphate if required and the sludge is allowed to settle for 12-16 hours. The latex is then transferred to creaming tanks without disturbing the sludge at the bottom.

The creaming agents generally used are temarind seed powder, sodium/ammonium alginate. A 3% solution of creaming agent is prepared by boiling the required quantity of creaming agent in water, and removing the uncooked materials by sieving. Calculated quantities of the creaming agent solution and soap solution are added to the latex in the creaming tank and stirred thoroughly for 20-30 minutes. After stirring, the latex is allowed to stand as such for 3-4 days. During the creaming process, the serum separates at the bottom and boundary layer separating the serum and cream rises upwards reducing the volume of cream. When the desired degree of creaming is obtained, the serum at the bottom layer is drained off, the upper cream is bulked, ammoniated to 0.7% by weight of latex and tested, packed in drums and marketed.

Specifications

At present creamed latex is not covered by Indian Standard specifications, although a draft specification is approved by BIS. The following specifications may be considered typical.

Property	Specifications
1. Colour	Latex shall not have any pronounced blue or grey colour.
2. Odour	Latex shall not have any pronounced odour of putrefaction.
3. Dry rubber content (Per cent by mass, min)	55.0
4. Non rubber solids (per cent by mass)	2.0
5. Alkalinity as ammonia per cent by mass (min.)	0.6
6. Machanical Stability in secs. (min.)	450
7. Volatile fatty acid number (max)	0.20

Note: Test for machanical stability shall be carried out at least 20 days after the production of creamed latex.

Packing:

Creamed latex shall be packed in drums, so that each drum shall contain 200+ 5 litres. The inside surface of the drum shall be painted with ammonia resistant paint. The drums shall have the following marking.

a) Name of the producer and trade mark, if any.

b) Net weight and gross weight in Kg. and volume in litres.

c) Dete of packing.

Doubly Centrifuged Latex

In this case, centrifuged latex is diluted with 1% ammonia water and centrifuged again. The properties of doubly centrifuged latex are given in BIS 11001-1984.

Sl. No.	Characteristic	Requirement
1.	Dry Rubber Content,% by mass (min)	60.00
2.	Non rubber solids, % by mass (max)	0.80
3.	Sludge content, % by mass (max)	0.01
4.	Ammonia content, % by mass (min)	0.70
5.	KOH number (max)	0.50
6.	Mechanical Stability Time, Seconds (min)	650
7.	Volatile fatty acid number (max)	0.05
8.	Coagulum content, % by mass (max)	0.01
9.	Copper ppm, max	5.00
10.	Iron ppm, max.	8.00
11.	Manganese ppm, max.	8.00

Prevulcanised latex

Prevulcanised latex is prepared from centrifuged natural rubber latex (HA type or LA type). Latex is suitabily stabilised and compounded with dispersions of sulphur, ZDC and Zinc Oxide. The latex compound is vulcanised by heating at 70°C in a water jacket for 4-5 hours, when all the rubber particles get crosslinked. The latex is then clarified and can be used for the manufacture of dipped products. The modulus of the latex can be varied by adjusting the level of sulphur, ZDC and Zinc Oxide.

Typical properties of prevulcanised latices

Grade	Tensile Strength(N/mm^2)	M-300_2 (N/mm^2)	M-700_2 (N/mm^2)	E.B.(%)
Low modulus	29.7	0.80	6.85	1000
Medium Modulus	25.7	1.08	9.76	970
High modulus	23.6	1.02	13.72	860

Conclusion

The production details and properties of various types of latex concentrate such as centrifuged latex HA type and LA type, creamed latex, doubly centrifuged latex & prevulcanised latex are discussed. The advantages offered by the LA-TZ system in comparison with the conventional HA system is emphasised. The BIS certification Mark Scheme for centrifuged latex stands as a token of assured quality to the consumers.