Seminar on Latex Products, 1991, Tvm.
pp. 63-70. ~~351~~ 1416

PRODUCT TESTING AND QUALITY ASSURANCE IN LATEX PRODUCTS

by
N.R.Peethambran,
Rubber Technologist,
R.R.I.I., Kottayam.

Quality assurance is a broad term used to cover all aspects of the control of quality of raw materials processing and production of finished products. The object of quality control is to produce quality that satisfies the customer and he should receive the quality and reliability for which he has paid. For a manufacturer, the quality standards and specifications have to be met and controlled in the midst of several limitations. In this paper a few technical aspects of q uality control have been discussed.

A. Quality Control of raw materials - a few guidelines

Processability requirements of latices normally vary from product to product and for different processes for making the same product. There are different methods for product manufacture like dipping, extrusion, foaming and spraying. During product manufacture a latex mix undergoes many processes which include agitation, pre-vulcanisation, coagulation, gelation, drying and vulcanization. The properties of raw latices have got tremendous effect on each of the above processes.

Centrifuged latices are available commercially as high and low ammonia types (BIS 5430-1981). In the case of high ammonia latex, variability in the ammonia centent of the latex is a serious headache to the product manufacturers under the small scale sector. But in the case of low ammonia type, the deammoniation process can be eliminated and the subsequent variability in ammonia content can be eliminated. A good state of preservation in the LA types such as LA-TZ latex is indicated by its low VFA and carbon dioxide number. This is very essential for imparting viscosity stability to the latex. Control of MST of the latex is a complex matter since this property changes with the age of the latex. The Zinc oxide stability time (ZST) gives a chemica l stability index which is basically a mechanical stability time with the destabilising effect of Zinc oxide and soap super imposed on it. (Test method - Appendix-I). An indication of the control of the ZST value with respect to processing aspects have been reported.

Table - 1

ZST Values		Indications
1. Less than 150 seconds	-	Low zinc stability - unsuitable for foam rubber production.
2. 150-300 seconds	-	Medium Zinc stability - suitable for foam rubber and for most latex processing.
3. Greater than 300 seconds	-	A high Zinc stability - suitable for process which require good storage stability with Zinc oxide.

A latex with poor chemical stability will produce a compound showing steadily increasing viscosity on storage leading to premature gelation.

Creamed natural rubber latex is also being used by the manufacturers in the production of certain latex products. In our country creamed latex is comparatively cheaper than centrifuged latex and hence it reduces the cost of production. The flow properties of creamed latex is different from that of the centrifuged latex and is depicated below in Fig. 1.

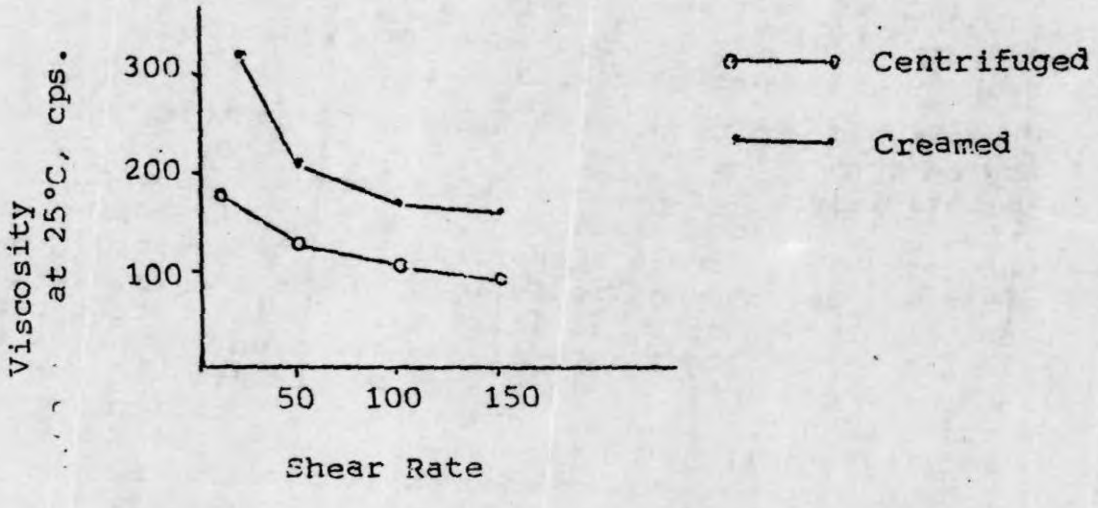

Fig. 1 Effect of shear rate on Viscosity of Latices.

The double centrifuged latex (BIS 11001-1984) is actually a purified form which contains very low non-rubber solids. It offers good compounded latex stability, cleaner films, and a vulcanisate with low water absorption. So it is ideally suited for the manufacture of electrician's gloves, feeding bottle teats, prophylactics, etc.

B. Compounded latex testing - a general outline

Without adequate compounded latex testing it is difficult to control the production process. Compounded latex testing serves as a guide against manufactured product quality and it varies with each product. Generally the following tests are recommended.

1. Total Solids Content (TS)

TS is to be determined as it can give the following informations.

a) It is a check on possible errors in the compounding process.

b) It has a great effect on compound viscosity.

2) Viscosity measurements

Viscosity measurement of the latex compound is essential as it has got direct effect on production process - thickness of the latex deposit in dipping or the count of latex thread in extrusion etc. For control of the flow behaviour of the latex compound the viscosity measurements should be done at two rpm. - 6 and 60. The ratio of these two values $\frac{\eta_6}{\eta_{60}}$ will give a better basis for comparison between batches. The flow behaviour of the latex compound can be adjusted by the addition of viscosity modifiers such as casein, polyvinyl alcohol or Na CMC (Carboxy Methyl Cellullose).

3) p^H

Regular p^H determination is necessary because of its effect on colloidal stability, surface tension and the wetting behaviour of the latex compound.

4) Degree of compound maturity/pre-vulcanization

The degree of compounded latex maturity or the extent of pre-vulcanisation should be monitored on a regular basis so that a historical picture of the process can be established with respect to compound performance and quality of finished product. In the case of latex thread manufacture, the pre-vulcanization of the latex compound should be adjusted so that the swell index value in toluene should lie between 9 and 6 g/g to get good extrusion behaviour and technical properties for the thread. The test can be done by the equilibrium swelling and the method is given in Appendix - 2. Heat sensitivity viscosity stability and MST of the latex compound can also be tested depending on the production process.

All the data obtained by the tests should be recorded with the latex compounds' batch No. and date so that a better control on production can be obtained.

C. Testing of latex products - a discussion

The Bureau of Indian Standards (BIS) and the International Standard Organisation (ISO) have laid down the minimum requirements for the physical properties of the products so that their quality is assured. For certain products such as latex thread and Examination Gloves there is no BIS specifications now. For this we have to consult either the American Standards (ASTM) or the ISO standards. A list of products with its quality standards are given in Appendix 3.

In this part of the paper we may discuss the testings of a few items as given under:

Latex thread:- Its testing is different from that of other products. The important properties are count, Schwartz value and elongation under fixed load. The count is calculated using the equation, count = $\frac{25.4}{D}$; where D = diameter of the thread.

The Diameter is calculated using the equation $D = 0.02\sqrt{\frac{m}{d}}$;

where m = mass of 1 m of thread, d = density of thread.
The schwartz value of the thread is the mean modulus on extension and retraction during the sixth cycle of a sample of thread which has been extended to and from an elongation 100 percent greater than the elongation at which the modulus is required. Eg:- if the Schwartz value at 300% elongation is desired, the thread sample is extended from zero to 400% and back six times and on the sixth cycle the load at 300% is noted. Typical properties of latex thread is given below.

	Standard Type	Heat resistant
Elongation at break (%)	525	525
Tensile strength, MPa	30	30
Schwartz value 400/300 MPa	1.3	1.3
Acclerated ageing (percent retained Tensile Strength after 14 days at 70°C)	>80	>80
Schwartz value (per cent retained after 4 hr. at 140°C)	-	>55

K.O. Calvert, Polymer latices and their applications.

As the latex thread is used in garments, the thread should also be resistant to detergents. ASTM D-3855-79 describes the test methods on this. A typical compound formulation for the heat and detergent resistant thread is given in Appendix 4.

Latex Foam:- The properties of latex foam products are (1) great cushioning comfort, ability to absorb shock, vibrations, high durability and free from odour. To satisfy the requirements of the consuming industry, the foam rubber manufacturer has to exercise very strict control at various stages of processing. The BIS has laid down specifications for the foam products produced in India and is given in BIS 1741-1960.

1. Indentation Hardness:

This is defined as the load in Kgs. required to give an indentation in the sample equivalent to 40% of the original thickness of the sample under specified conditions. It is a measure of the load bearing capacity of the product. The indentation hardness depends on three factors.

* Density
* Microstructure of the Foam
* Cavities in the product

The load bearing capacity of the foam increases as the density of the foam increases. Density is influenced by several factors such as expansion during foaming, shrinkage which takes place after moulding and the specific gravity of the total solids contents of the latex coumpound. It has been shown that the indentation hardness of foam increases linearly with cell diameter, the effect being more pronounced with high density foams than with those of low density foams. Although fine celled foams have a greater demand because of appearance and smooth surface feel, they are inferior in load bearing capacity to coarser foams of the same density. The hardness of the latex foam is also influenced by the geometry of the cores, their spacing and their configuration in relation to each other. In practice, it is possible to effect a material saving of upto 35% by the use of cavities in the case of unfilled natural rubber latex foam with out seriously compromising the fatigue resistance.

Compression set: This property is a measure of the state of cure of the foam and is the percentage loss in thickness resulting from holding the foam at 50 percent compression for 72 h. at 70°C and allowing to recover for 30 minutes at room temperature.

Fatigue Testing:

Static Fatigue:- This test measures the loss in hardness and thickness of a foam sample subjected to a static load for 72 hrs. at room temperature. The load is applied on a circular indentor, the magnitude of the load depending on the initial hardness of the foam sample.

Dynamic Fatigue:- To measure the fatigue resistance, the sample is submitted to continued flexing with an indentor for 2,50,000 cycles at 4 cycles/second and the loss in hardness and thickness are measured. In this test, the quality of polymer phase is important as it gives an idea on excessive filler loadings which can lead to damage to the foam structure. In mouldings with large cores, the design and layout of the cores can influence the fatigue behaviour.

Resistance to ageing:

The ageing test consist in subjecting samples to controlled deterioration by hot air at atmospheric pressure, measuring the hardness and comparing the result with that of unaged sample.

Gloves;

In the case of gloves items, the properties of importance are its dimensions, modulus, tensile strength and its degradation resistance. Degradation of latex films may be due to heat, humidity, U.V. light, ozone, oxygen, detergents and stress. The retardation of degradation can be effected by the use of proper vulcanization systems, antioxidants and antiozonants. Proper leaching of the product and packing has also got its importance to prevent degradation. The accelerated air ageing and the heat ageing in autoclave are used for testing the degradation resistance of latex products.

So in order to assure the quality of latex products, control of the production process and the final testings of the vulcanisate are unavoidable. Marketing of the products with BIS certificate is to be enforced.

--