

METHODS OF ESTIMATION OF DRY RUBBER CONTENT IN NATURAL RUBBER LATEX

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INTRODUCTION

Natural rubber (NR) latex is regarded as a colloidal dispersion of rubber hydrocarbon in water, the diameter of whose molecular aggregates, range from 0.5 to 1.0 micron (1/1000 th of a mm). In addition to rubber hydrocarbon, latex contains proteinaceous and nitrogenous substances, carbohydrates, lipids, inorganic ions, carotenoids, resins and enzymes. Being a natural product, the proportions of the above substances in latex varies depending on various factors such as clone, season, soil conditions, tapping method and the frequency, the age of the tree, etc. Therefore, the density of latex also varies depending on the composition of latex, the main factor which influences the variation of density in NR latex.

A typical composition of fresh NR latex can be given as follows;

Substance	% by weight of latex
Dry rubber	30 - 35
Proteinaceous substances	1 - 1.5
Lipids	1 - 2.5
Sugar	1
Inorganic ions	1
Water	60 - 65

Since the density of rubber hydrocarbon is less than that of water, density of rubber particles (0.92gcm^{-3}) is also lower than that of water. Increasing the rubber content in latex decreases the density of latex. Depending mainly on the dry rubber content (DRC), the density of fresh NR latex varies between 0.970 and 0.985gcm^{-3} . Various methods are available to estimate the rubber content of latex. Of these, metrolac estimation is the widely practiced method as it is simple and convenient and can be practiced in the field to make on the spot payments to the suppliers (tappers) of latex.

Apart from making payment, the estimation of DRC of latex is important for,

- the incorporation of correct dosages of chemicals to latex.
- the dilution of latex to the standard DRC in the manufacture of dry forms of raw NR.

- the addition of correct quantity of acid to latex for proper coagulation.
- maintaining accounts of rubber coming into the factory.

Several methods of estimation of dry rubber content of latex are discussed in this paper.

Weighing of latex

Estimation of the amount of rubber in latex is known as weighing of latex. Before weighing, latex is subjected to a preliminary straining. On arrival at the factory (or collection station), the latex should receive a preliminary straining through a sieve fitted with monel metal mesh of 40 mesh size, in order to remove lumps, bark shavings *etc.* as these extraneous matter would influence the metrolac reading.

The usual procedure is to pour the strained latex into a standard bucket and measure the volume in litres using a dipstick. Alternatively, the weight in kg may be determined by hanging the bucket on a spring balance. The DRC of a sample of latex is then estimated and the payment is made to the tapper or to the supplier according to the calculated weight of the rubber.

Estimation of DRC of latex by the Metrolac method

The metrolac is essentially a hydrometer which measures the density of field latex. The density varies according to the amount of rubber present, and the instrument is graduated to give a direct reading of the rubber content of latex **in grams per litre**. The latex should be diluted with two volumes of water, before making the estimation, as the metrolac does not move freely in undiluted latex.

The assumption underlying the use of the metrolac is that the relation between the density and the DRC of field latex is linear, irrespective of the source and dilution of original latex, an assumption which is not necessarily correct. The latex is a heterogeneous mixture whose composition depends on the factors mentioned earlier on and therefore, the density of latex may vary from source to source even if the rubber content is same.

It should be realised that the DRC estimated by the metrolac is not as accurate as the DRC determined by laboratory methods. However, the use of the metrolac is the most convenient, rapid and reasonably accurate method for the estimation of DRC of latex in the field. It is also important that the correct metrolac chart standardised by the SLSI which carries the SLS mark is used for the calculation of the dry weight of rubber in latex.

Procedure for weighing of latex using the metrolac

1. Strain the latex using a 40 mesh sieve.
2. Pour the bulk of latex into the standard cylindrical measuring vessel and measure the volume with the dipstick.

3. Take 1 volume of well mixed latex, free of froth from the bulk and dilute it with 2 volumes of clean water in a suitable vessel and mix well, taking care to prevent bubble formation in latex.
4. Slowly pour the diluted latex into the vertically placed cylindrical vessel until it overflows.
5. Slowly insert the metrolac in latex while ensuring any froth on the surface is removed with overflowing latex.
6. Make sure that the metrolac freely moves on latex and allow it to come to rest without touching the interior of the vessel.
7. Read the lower mark in line with the meniscus of latex as shown in Figure 1.
8. Read the weight of dry rubber in latex from the metrolac chart standardised by the Sri Lanka Standards Institution and issued with the SLS mark, using the metrolac reading and the volume of latex.

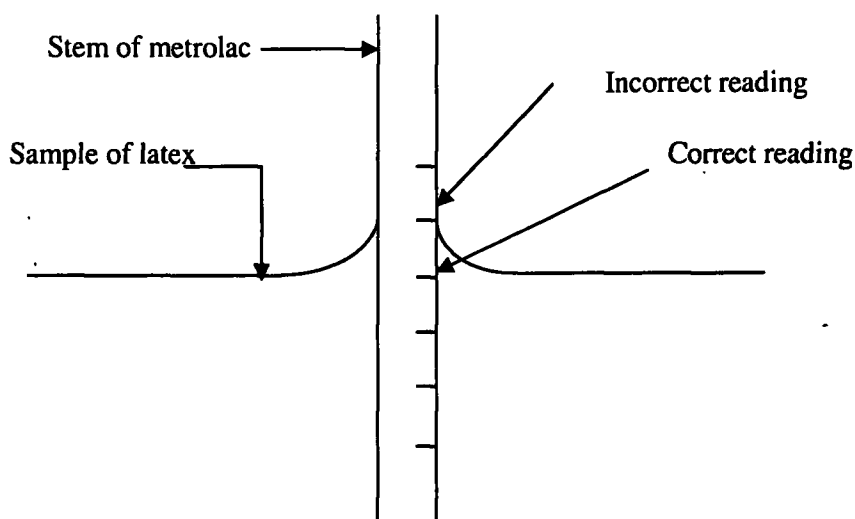


Fig.1 Reading the metrolac

Determination of DRC by other methods

Trial coagulation method

There are two methods of carrying out trial coagulation determinations. These two methods are suitable to be practiced in estates.

Estate method of trial coagulation

A sample of the bulked latex is diluted with water according to the ratio of 1:1 and 5 litres of it is poured into a coagulating pan. The measure is rinsed with 250 ml of water, which is added to the latex. A second quantity of 5 litres of diluted latex is measured in the same way and poured into another pan. The latex in each pan is then coagulated by adding 300 - 350 ml of a 1% solution of formic acid (made by

adding 30 ml of 85% formic acid to 2.5 litres of water). After the addition of formic acid, stirring is done with a suitable paddle. When coagulation is complete, the coagulum is rolled either in a sheet roller or in a creping mill. In the latter case, care is required to ensure that not even a tiny particle of the sample coagulum is lost; the rollers should be opened slightly to reduce the pressure on the rubber. After drying, the samples are weighed together on a top-pan balance, accurate to 10 g. One fifth of the combined weight of the two samples in grams represents the rubber content of the original undiluted latex in grams per litre. The accuracy of the trial can be checked by weighing the two samples separately. If they differ by more than 20 g the results are not considered accurate.

The Chee method

A dipper calibrated to deliver 500 ± 0.5 g of field latex is used. This is immersed slowly in a representative sample of latex. One dipper full of latex is drawn out gently and transferred to a coagulating dish. After dilution with equal quantity of water, it is coagulated. A mixture of 10 parts by volume of 85% formic acid and 90 parts by volume of methylated spirit is used for the quick coagulation of latex. The coagulum is fed through a pair of rollers a number of times at different gap settings. The coagulum is washed and pressed between blotting paper to remove as much water as possible, before it is weighed on an analytical balance. The coagulum is reweighed after drying at ambient temperature until no visible virgin spots are found on the rubber. This process is continued for several days and the ratio of dry weight to wet weight is calculated. This ratio is a constant unless there are day to day variations of thickness of the dry rubber mat. Once this ratio is found the DRC of the latex is obtained by multiplying the wet weight of the coagulum by this ratio, which will be around 0.80.

Laboratory methods for DRC determination

There are three methods for the determination of DRC of field latex in the laboratory and are described below. The second and the third methods are very fast but not as accurate as the first method unless tests are performed by experienced personnel with utmost care.

Standard laboratory method

A test portion of 10 ± 2 g from a representative sample of latex, accurately weighed by difference, using a 20 ml weighing bottle, is poured into a petri dish having a diameter of 10 cm. The latex is coagulated using a sufficient quantity of acetic acid and heated over a steam bath until a clear serum is obtained before it is pressed with a glass stopper to a uniform thickness not exceeding 2 mm. The coagulum is thoroughly washed and placed in a thermostatically controlled oven at about 60°C. After drying, rubber is cooled in a desiccator and weighed using an analytical balance. Drying and weighing procedures are continued until the coagulum

is dried to a constant weight and the dry rubber content is calculated from the weights of the dry coagulum and the latex sample.

Rapid laboratory method using air circulating oven

A representative sample of latex in a cylindrical plastic vial (about 2ml capacity) is weighed together with a glass dropper using an analytical balance. From the glass dropper, approximately 0.5 g of latex is added dropwise into a glass plate and immersed in a mixture of five parts by volume of glacial acetic acid and 95 parts by volume of methylated spirit in a petri dish. The dropper, together with the balance of latex, is reweighed to obtain the weight of the latex transferred. Pieces of coagulum on the glass plate are pressed carefully, washed with distilled water before it is dried in an air-circulating oven. The dry film on the glass plate is rolled off and weighed, using an analytical balance.

Rapid laboratory method using microwave oven

Two to three drops of latex from a representative sample are carefully taken into a small petri dish (dia. 25 mm) and weighed on an analytical balance. Few milli litres of 5 % alcoholic solution of acetic acid are poured into the dish so that latex is completely covered with the coagulant. Press the coagulum carefully with a glass stopper till all the latex trapped inside the coagulum is completely coagulated and a very thin film of the coagulum is obtained. The film is carefully and thoroughly washed in running water and dried using a microwave oven at medium power level for a period of 10 minutes initially. The film is then turned over and dried again in the oven for 5 minutes. Make sure that there are no white spots on the film. It is cooled in a desiccator before weighing and then the DRC is calculated. Carry out the procedure in triplicate. If the DRC calculated on three samples differ by more than 0.05 %, the procedure has to be repeated.

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