

ROLE OF THE QUALITY OF THE CHEMICALS FOR THE DEVELOPMENT OF THE RAW RUBBER INDUSTRY

BY

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Sri Lanka exports over 110,000 tons of raw rubber every year in the form of sheet rubber, crepe rubber and technically specified rubber (TSR), commonly known as 'block rubber'. In addition to these, from the middle of 1988 there has been a tremendous demand for concentrated latex in the world market and hence there is a tremendous interest among the industrialists here to manufacture concentrated latex by centrifuging for export.

In all the above raw rubber industries chemicals are used at various processing stages to obtain a good quality product and also to protect the raw rubber produced, from mould contamination and all the other possible discolourations.

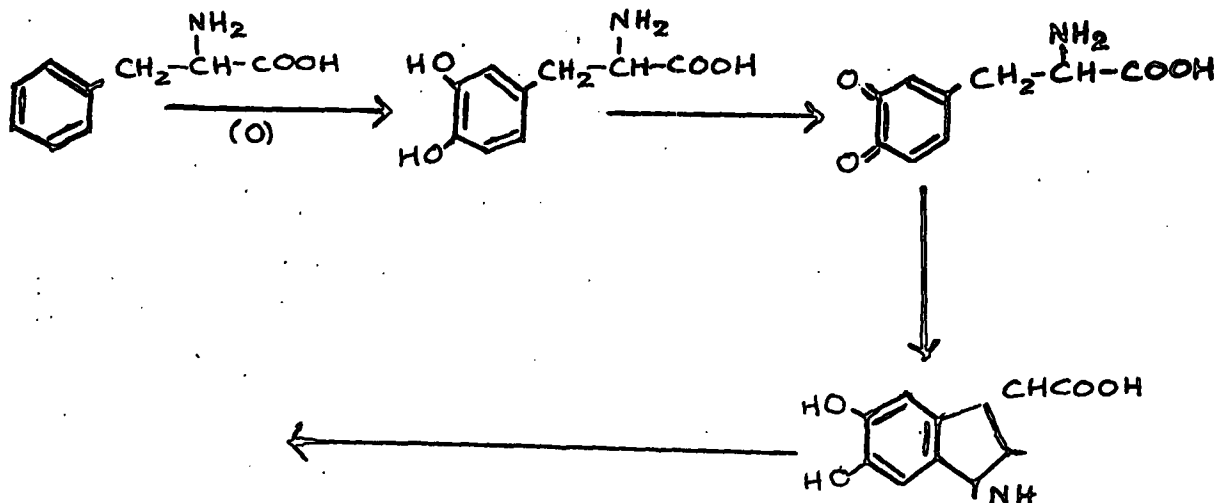
In latex crepe light colour is important and this ultimately determines the price of the commodity too.

No 1 grade latex crepe rubber is pure water white in colour and it is the rubber used in the manufacture of medical and surgical rubber appliances and in food applications. Hence in addition to light colour it is also important to produce a safe raw material which does not contain toxic chemicals even in trace quantities.

In the manufacture of all grades of rubber the initial step is the stabilisation of latex by means of preservatives.

This is a very important step in raw rubber manufacture.

Enzymatic discolouration is another serious problem in latex causing brown or grey discolouration of the dry rubber produced. This is due to the oxidation of the amino acid tyrosine in the latex in the presence of the enzyme tyrosinase to give an intermediate product which then reacts with the proteins to produce a coloured pigment of melanin type.



Depending on the amount of oxidation undergone by these melanin type pigments; the ultimate raw rubber produced will undergo either pink, brown or grey discolouration. This is controlled by adding the enzyme inhibitor sodium bisulphite. Sodium bisulphite is a white crystalline powder with a strong sulphur dioxide smell. On exposure to damp air it undergoes fast deterioration and hence it should be stored under perfectly dry conditions. However since all the crepe rubber factories in Sri Lanka are situated in mostly humid parts of the country, it is extremely difficult to handle this material in rubber factories and hence every year a lot of latex crepe rubber produced in Sri Lanka goes to lower grades due to this discolouration.

Attempts have been made at the RRISL to identify an alternate enzyme inhibitor which is safe and easy to handle under normal factory conditions. It has been found that Hydrogen Cyanide and Mercuric Chloride gives a very good white rubber when used in trace quantities in the latex. But since crepe rubber is made mainly for making surgical rubber appliances and toys for children, presence of HCN even in trace quantities is not allowed.

Further in the case of mercuric chloride, the rubber produced was pure water white in colour at the beginning. But when kept for some time a strong pinkish brown discolouration develops due to the complexing of the Hg ions with the amino acids and proteins in the rubber. Hence at present only sodium bisulphite, or meta bisulphite with a longer shelf life is used to inhibit enzymatic discolouration of the latex, and hence lot of latex crepe rubber goes to lower grades due to the enzymatic discolouration.

Yellowing of latex crepe rubber

This is due to the presence of carotenoid pigments in different quantities in different clones of Hevea rubber. These variations are overcome by bulking latex prior to processing.

However by removing the yellow fraction containing most of these pigments the yellow discolouration could be minimised. But in order to get pure water white colour in latex crepe, most of the carotenoids are removed in the first fraction and the fractionated latex is bleached by adding a bleaching chemical.

The bleaching agent used for this purpose before 1980 was xylyl mercaptan, which is used as a 35% solution in white spirit. In 1979, the USA authorities banned the manufacture of xylyl mercaptan in USA due to health reasons. Inhaling over 50 ppm of these mercaptan vapours cause health hazards.

When xylyl mercaptan was no more available, the RRISL introduced the use of a similar mercaptan available in the market namely tolyl mercaptan to be used in the crepe rubber industry. This tolyl mercaptan is more volatile than the xylyl mercaptan and it has a melting point of only 41°C. Hence the users of this mercaptan as a 35% solution in oil had problems, technical as well as health. Poor efficiency of the oil based bleaching agent is because it has to be added into the latex as an emulsion and the dispersion of the emulsified mercaptan in the aqueous latex is slow.

Hence the RRISL did further research and in 1984 introduced a new modified form of tolyl mercaptan for the crepe rubber industry. That is the sodium salt of tolyl mercaptan. This new sodium salt of para tolyl thio phenol (PTTP) has a very high melting point and does not volatilise at the room temperature and hence does not cause any health risks. It is soluble in water and hence mixes easily and evenly in aqueous latex thereby giving the maximum efficiency. During the usage of this chemical for the last 4 years, many satisfactory results were obtained. It has been able to eliminate the problem of storage softening of crepe rubber caused by the oil in the oil based bleaching agent. It does not absorb into the human tissues like the non polar mercaptan as it is ionic.

Acid for coagulation of latex

pH of the freshly tapped latex is around 7.0. In deliberate coagulation of latex dilute weak acids are used to bring the pH value below 4.5 which is its isoelectric point. In early days only acetic acid was used for this purpose. But now formic acid is used because of the following reasons.

1. Acetic acid is more expensive compared to formic acid.
2. Acetic acid has no tendency to prevent bacterial fermentation and hence cause discolouration and pin head bubble formation in the coagulum.

In the case of formic acid, it has bactericide properties and hence the discolouration of the coagulum and pin head formation is minimal. Hence acetic acid is no more used for the coagulation of latex in raw rubber manufacture. Strong oxidising acids like sulphuric and Hydrochloric acids are also not used in the coagulation of normal latex.

In sole crepe manufacture instead of formic acid, oxalic acid is used either as a part or full coagulant. Oxalic acid has a tendency to complex with Ca and Mg ions present in the water used in rubber manufacture thereby preventing the storage discolouration of sole crepe. Storage discolouration is a serious problem resulting in heavy quality claims. Therefore if the metal ion content in the water is too high, full or part oxalic acid coagulation will help to eliminate the storage discolouration problem. While doing so it will improve the plasticity retention index (PRI) of the rubber too by complexing polyvalent metal ions which are causing the oxidation of the rubber.

Mould contamination

Mould contamination of raw rubber, specially thin lace crepe is also a serious problem. The main cause for mould contamination is the presence of too much of moisture in the rubber. There are instances where people apply formic acid and tale to avoid mould contamination, as a result the quality of the rubber get further lowered. The best way of solving this problem is by taking hygienic measures at all stages of rubber manufacture and also by storing rubber under dry conditions. Chemicals such as paranitrophenol and sodium pentachlorophenate are not allowed on any grade of rubber as they are injurious to human health. However the use of formalin solution or formaldehyde vapour for sterilisation of smoke houses drying towers and utensils used in the rubber industry is permitted.

Recent work carried out by the specifications section of the RRI have shown that the sodium salt of the Benz Isothiozalone when incorporated into the latex for making RSS or Crepe rubber upto a maximum of 0.1% can control mould growth on the rubber.