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# A STUDY OF THE RATE OF DISSOLUTION OF DIFFERENT GRADES OF LATEX CREPE RUBBERS IN PETROLEUM SOLVENTS

*By*

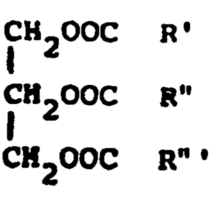
L. M. K. Tillekeratne, M. C. S. Perera and Sriyanthi Weeraman

## INTRODUCTION

Latex crepe rubber is the purest form of natural rubber available in the market. Owing to the very high purity and the pure water white colour of No. 1 and No. 1X grades of this rubber, it is used for the manufacture of surgical and pharmaceutical rubber goods, rubber appliances used in contact with food and for the manufacture of light and bright coloured rubber articles (Tillekeratne, 1985). In addition to this, another important use of this grade of rubber is in the adhesive industry. In the adhesive industry and in the manufacture of chemically modified forms of natural rubber such as chlorinated rubber and the rubber hydrochloride, crepe rubber is mainly used as a solution in a petroleum solvent. In order to make the rubber solution, crepe rubber presented in the form of a thin irregular network, commonly known as lace crepe is used.

According to the " International Standards of Quality and Packing of Natural Rubber Grades, (commonly known as the " Green Book ") specifications ; among the three types of latex crepe fractioned and bleached (FB), unfractioned and bleached (UFB), and the yellow fraction (YF) presented to the market ; the fractioned and bleached latex crepe rubber has the minimum quantity of non-rubber constituents of proteins and phospholipids type ; compared to the other two types. The unfractioned bleached grade has the normal amount of the non-rubber constituents present in any other conventional grade of rubber such as smoked sheets and TSR ; while the yellow fraction rubber contains mainly (Tharmalingam *et. al.*, 1980) these non-rubber materials in high proportions.

Pure natural rubber is cis-polyisoprene which is a hydrocarbon and hence the natural rubber molecule is non-polar. Owing to the non-polar nature, natural rubber has no resistance to non-polar petroleum oils, such as diesel fuel, petrol or low aromatic white spirit (LAWS), and in these solvents natural rubber in the raw form in any of the above mentioned types dissolves readily. Non-rubber constituents in natural rubber consists mainly of proteins and lipids of the following type (Blackly, 1966).



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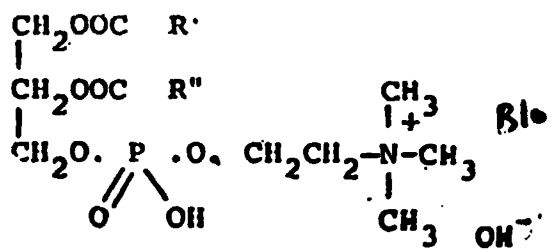

Fatty lipid

Phospholipid

They have complex molecules which are found to be in cross-linked form. These cross-linked non-rubber constituents do not dissolve readily in petroleum solvents ; but they form a gel by absorbing solvent molecules into their cross-linked networks. Therefore when any conventional grade of rubber is dissolved in a petroleum solvent a rubber solution containing some gel results. When this solution is strained through a fine sieve, the gel part will remain in the sieve.

Therefore gel formation is a big problem for industries where rubber solutions are used for making various products. In order to overcome this problem rubber giving the minimum quantity of gel and easy to dissolve must be used in such industries.

However in normal method of grading crepe rubber according to the " Green Book " this important factor is overlooked completely ; and the grading is done according to the colour and the physical appearance of the rubber. Hence this project is an attempt to find out the effect of the presence of different proportions of non-rubber constituents in crepe rubber grades as it was believed that this is an important property, which would effect their performance in certain industrial applications.

## EXPERIMENTAL

10g samples, each cut from the same sheet of fractioned bleached crepe rubber, unfractioned bleached crepe rubber or the yellow fraction rubber separately for the experiment, were immersed in 100 ml of LAWS in small conical flasks. They were allowed to stand at room temperature without stirring for different intervals of time. The solutions, made in duplicate, were then drained out of the flasks by carefully tilting the flasks and filtered through

a. A Whatman lilter paper

b. A sieve of mesh size 50

separately. The resulting filtrates were made to 150 ml with pure LAWS. 10 ml samples of the resulting solutions were then subjected to total solids determination by the British Standards test method no. 903. The rate of dissolution of the rubber was then calculated by dividing the dry matter content in the filtrate by the time of immersion in the LAWS (Tables 1 and 2).

Table 1. *Rate of dissolution of latex crepe rubber in g/h when the filtration is done by means of a Whatman No. 1 filter paper*

| | Time | | | | |
|---|---|---|---|---|---|
| Sample | 2h | 4h | 6h | 15h | 24h |
| FB | 0·2487 | 0·1681 | 0·1447 | 0·0960 | 0·0787 |
| UFB | 0·1890 | 0·1502 | 0·1252 | 0·0863 | 0·0603 |
| YF | 0·1431 | 0·1280 | 0·1140 | 0·0770 | 0·0560 |

Table 2. *Rate of dissolution of latex crepe rubber in g/h when the filtration is done by means of a sieve of mesh size 50*

| Sample | Time 2h | 4h | 6h | 15h | 24h |
|---|---|---|---|---|---|
| FB | 0·1902 | 0·1763 | 0·1081 | 0·1180 | 0·0979 |
| UFB | 0·2312 | 0·1790 | 0·1082 | 0·1251 | 0·0983 |
| YF | 0·3486 | 0·2260 | 0·1822 | 0·1361 | 0·1044 |

## RESULTS AND DISCUSSION

Fig. 1 is a plot of the rate of dissolution of the rubber versus time of immersion in LAWS for all three grades, where the filtration was done through filter papers. It is clear from this plot that the rate of dissolution of the fractioned and bleached rubber (containing the least amount of proteins and non-rubber substances) is the highest. The rate of going into the solution of the yellow fraction rubber is very much lower in this case at short periods of immersion while the same for the unfractioned and bleached grade of rubber lies in between the rates for fractioned and bleached and the yellow fraction rubbers.

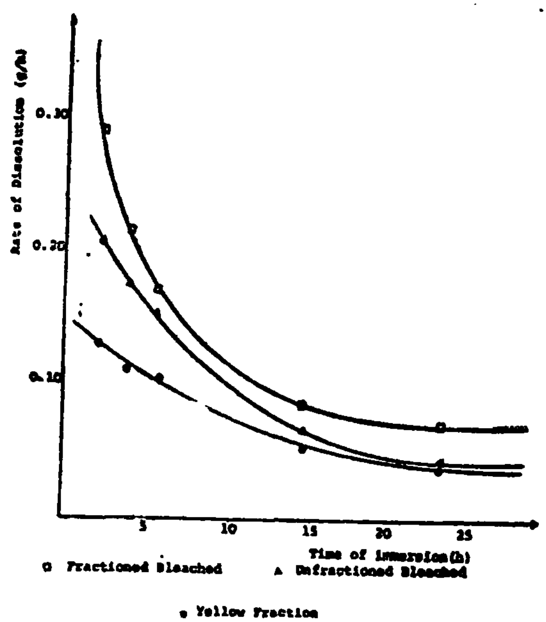


Fig. 1. Rate of dissolution of crepe rubber in g/h when the filtration is done by means of a Whatman No. 1 filter paper.

However when the same experiment was repeated by using a 50 mesh sieve instead of the filter paper, it was observed that the rate of dissolution of the yellow fraction is more (Fig. 2). But it was observed that the size of the rubber particles in the solution of the yellow fraction rubber are much bigger than the particles of rubber in the solutions of other grades of crepe rubber ; and they were visible to the naked eye as tiny clots of gel. This indicates that the rate of formation of gel in the yellow fraction rubber is greater them the rate of dissolution of the fractioned and bleached clean grades of rubber, into a fine solution. But after a long period of immersion the rates of all three grades of rubber going into the solution become very near and hence the tails of the three curves converge very close to each other.

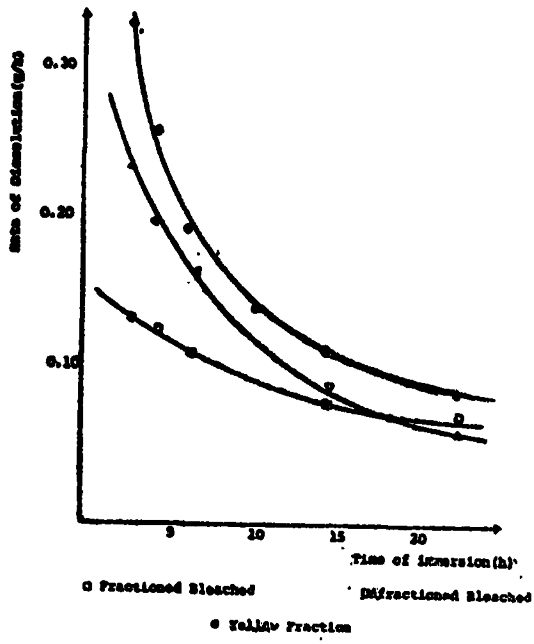


**Fig. 2. Rate of dissolution of crepe rubber in g/h when the filtration is done by means of a sieve of mesh size 50.**

Hence it is possible to conclude from these results that the fractioned and bleached rubber dissolve faster in petroleum solvents to give a neat rubber solution containing the least amount of gel and almost no solid residue, owing to its very high purity. The unfractioned and bleached grade also give a clean and solid residue free rubber solution at a medium speed ; but with some gel formation.

The tendency of the yellow fraction rubber to give a thin rubber solution containing fine rubber particles is very low. The solution obtained at a fast rate is not a true solution. But a suspension of gel particles in a dilute rubber solution, which is unsuitable for products manufacture by dipping, or for adhesives.

Hence for making dipped rubber products or for making rubber derivatives by the solution process the best and the most convenient grade of natural rubber available in the market is the fractioned and bleached latex crepe rubber preferably in thin lace form or in thick blanket form, usually graded-as No. 1 or No. 1X. Unfractioned and bleached crepe rubber normally going to No. 1 grade is a pure and light coloured form of natural rubber more suitable to be used in the solid phase. But the yellow fraction rubber is not suitable for solution uses or for making adhesives. However it could be used for making extra hard products by the dry rubber process.

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