PRESERVATION OF FIELD COAGULUM BY TREATMENT WITH FORMALIN

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INTRODUCTION

About 20 % of the crop from rubber plantations is in the form of field coagulum. A major portion of it is used for the production of technically specified rubber (TSR). However, it remains a fact that the TSR produced in India entirely from field coagulum only partially meets the requirements of the industry with regard to quality and consistency. This could be attributed mainly to the use of very poor quality raw material. The small growers in the country usually store field coagulum at their end for a considerably long period before it is disposed off. The maturation of the coagulum and its storage environment (Chin, 1971) have a marked effect on the viscosity and thermo-oxidative degradation of the material. Baker and Bristow (1991) have identified the critical properties of the raw material that are to be controlled for making TSR of consistently good quality.

The oxidisability of raw rubber has an important bearing on its processing behaviour and vulcanizates performance. The Plasticity Retention Index (PRI) test has been designed to provide a rapid assessment of the susceptibility of the raw natural rubber to thermo-oxidative degradation. (Bateman *et al.*, 1966). In many cases, due to low PRI the rubber may fail to meet the requirements specified for a particular grade. Hence it is very essential to improve the PRI of the raw material so as to ensure that the resultant rubber meets the specifications of the required grade.

Methods to improve the PRI of TSR are reported by several workers (Watson, 1969; Mathew *et al.*, 1975). One of the major reasons for the low PRI of field coagulum during storage is the bacterial decomposition of proteins and other non-rubber constituents in the rubber. In the present work attempts are made to prevent the degradation occurring in field coagulum on storage by treatment with certain bactericides. The extent of degradation of field coagulum during storage can be followed by measuring Po and PRI

IRRDB Symposium "Challenges for Natural Rubber in Globalization", 15-17 September 2003, Chiang Mai, Thailand.

EXPERIMENTAL

Field coagulum for the study was collected from the RRII farm .The bactericides tried were formalin, sodium hypochlorite, Navadeepol – L1 and Navadeesan –174. Navadeepol-L1 and Navadeesan -174 are biocides manufactured by M/s Navadeep Chemicals Pvt. Ltd., Mumbai.

To study the variation in Wallace plasticity (Po) and PRI during storage, field coagulum was collected and stored for a period of one month. It was processed periodically and Po and PRI measurements were done using a Wallace Rapid Plastimeter and a Wallace-MRPRA Ageing Oven as per BIS 3660 (Part 2). PRI is given by the expression PRI=P30/Po x 100 where Po is the initial plasticity and P30 is the plasticity after ageing at 140°C for 30 min.

Treatment of field coagulum with bactericides

Field coagulum was immersed in 1% solutions of the different bactericides for 24 hours, processed periodically and tested for Po, PRI and Mooney viscosity. As the PRI could be substantially improved by treatment with formalin, further trials were carried out using the same. The effect of different concentrations of formalin (0.25 to 1%)and varying periods of immersion (4 to 24 hours) were studied. The treated coagulum was stored up to one month, processed after 10,20 and 30 days and the properties were compared with an untreated sample stored for the same period.

RESULTS AND DISCUSSION

Effect of storage on properties of field coagulum

Figure 1 shows the effect of storage on Po and PRI of field coagulum stored up to 30 days. It is observed that there is an increase in Po and a considerable decrease in PRI during storage. The increase in Po is due to the crosslinking through the abnormal groups in rubber (David, 1986). It could be seen that as the storage period is increased the resistance towards degradation as indicated by PRI is reduced

Being an elastomer of appreciable olefinic unsaturation, natural rubber is prone to thermo-oxidative degradation, which results in deterioration of physical properties. Some of the non-rubber substances like the tocotrienols (Morimoto, 1985) proteins and amino acids had been shown to have a positive relationship with the resistance of NR towards oxidation. They could thus act as antioxidants for NR. However, some inorganic constituents like copper, manganese and iron were shown to be deleterious to NR by acting as pro-oxidants, copper being the most active. (Bateman, 1966). The ratio of these two groups will thus control the susceptibility of NR towards oxidative degradation. The amount of tocotrienols in NR remained sufficiently active even when exposed to severe microbial attack as in the natural coagulation process. The low PRI of the autocoagulated rubbers were more related to the high free copper content. (Hasma et *al.*, 1990, Shelton, 1972). Copper in fresh latex might complex with proteins and amino acids and in this form it does not impart any deleterious effect on the ageing of NR. However, when the latex is exposed to microbial activity the microbes degrade the protein -amino acid complex, releasing free copper. It is reported that the amount of copper retained in autocoagulated rubbers increase with the storage period of the coagulum (Watson, 1969). The improvement in PRI by soaking the autocoagulated crumbs in phosphoric acid or thiourea is observed to be due to the extraction of undesirable free copper from the rubber. (Mathew *et al.*, 1975; Hasma et *al.*, 1990).

Treatment of field coagulum with bactericides

Effect of treatment of field coagulum with 1% solutions of the different chemicals is given in Table 1. It is observed that the PRI values are improved by the treatment with formalin, navadeepol and navadeesan and this could be attributed the bactericidal activity of these chemicals. It is also observed that the initial plasticity and Mooney viscosity remained almost constant for the formalin treated sample. Formaldehyde treatment is reported to reduce the storage hardening by inhibiting part of the crosslinking in rubber (Sekhar, 1960) and this could be the reason for the above observation. Viscosity stabilization of natural rubber using formaldehyde was also reported by Nadarajah *et al* (1985).

Table 1. Effect of chemical treatment on Po, PRI & viscosity

Treatment	Po	PRI	Mooney viscosity
Fresh	46	75	82
Stored for10 days	49	55	86
Formalin	46	72	82
Sodium hypochlorite	47	58	84
Navadeepol – L	46	70	82
Navadeesan – 174	55	72	88

Effect of formalin concentration

Field coagulum was immersed in formalin solutions of different concentrations (0.25,0.5,0.75 &1 per cent) for a period of 24 h and subsequently stored for 10 days. Figure 2 shows the effect of the treatment on Po and PRI. Treatment with 0.75 % solution was effective in retaining the Po and PRI. The same effect was noticed for the samples treated with 1 % solution also, while treatments with lower concentrations were not very effective. Hence it is concluded that a minimum of 0.75 % solution is required for the effective preservation of the coagulum.

Effect of period of immersion

The coagulum was immersed in 0.75% solution of formalin for varying periods (2h to 24 h) and processed after storing for 10 days. Figure 3 shows the effect of the treatment on Po and PRI. It could be seen that treatment for a period of 16 h can retain the Po and PRI of the sample.

Effect of storage of treated coagulum

The coagulum treated with 0.75 %solution of formalin for 16 h along with an untreated control was stored up to 30 days and processed. Figure 4 shows the effect of storage on Po of the treated coagulum. It is seen that for the treated coagulum the Po values are retained while for the untreated sample it is increased. The same effect was noticed for Mooney viscosity also as is shown in Figure 5.

Figure 6 shows the effect of storage of the treated coagulum on PRI. It is observed that for the treated sample the PRI remains almost unaffected up to a storage period of 20

days and afterwards decreases slightly. For the untreated sample the PRI decreases as the storage period is increased.

CONCLUSION

Treatment of field coagulum with formalin can prevent degradation of the same thereby retaining the plasticity retention index. Immersing the coagulum for 16 –24 h in 1% or 0.75% formalin solution could retain the PRI even after storage of 1 month The increase in initial plasticity and Mooney viscosity of the sample could also be reduced by the treatment. Immersion in lower concentrations of the solution did not have a significant effect.

ACKNOWLEDGEMENT

The facilities and support rendered by the staff of Pilot Crumb Rubber Factory are gratefully acknowledged.

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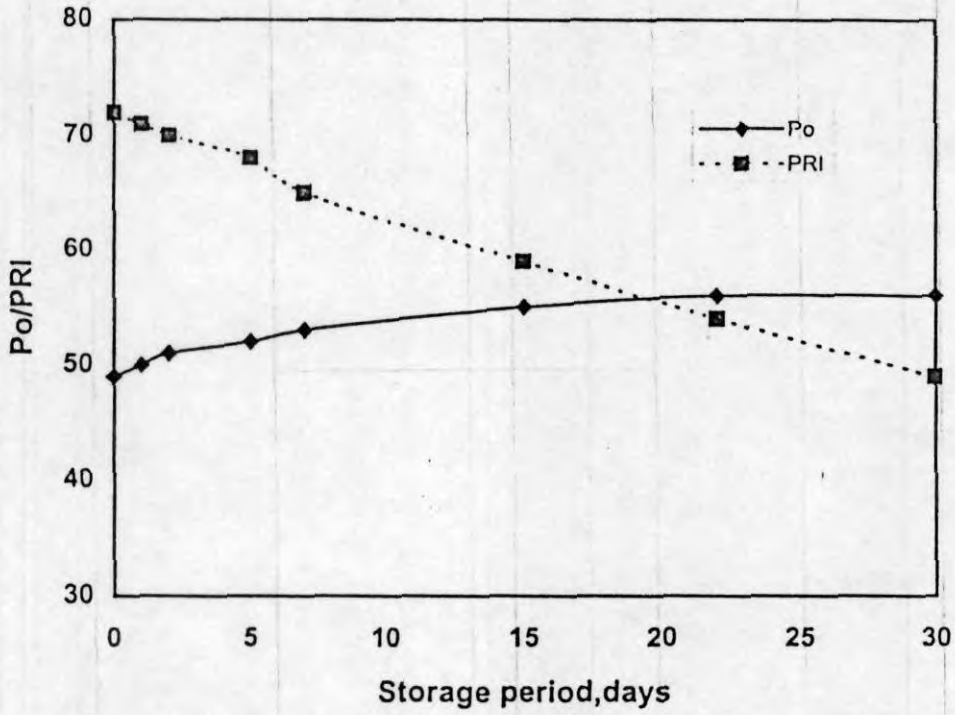

Fig.1. Effect of storage on Po & PRI

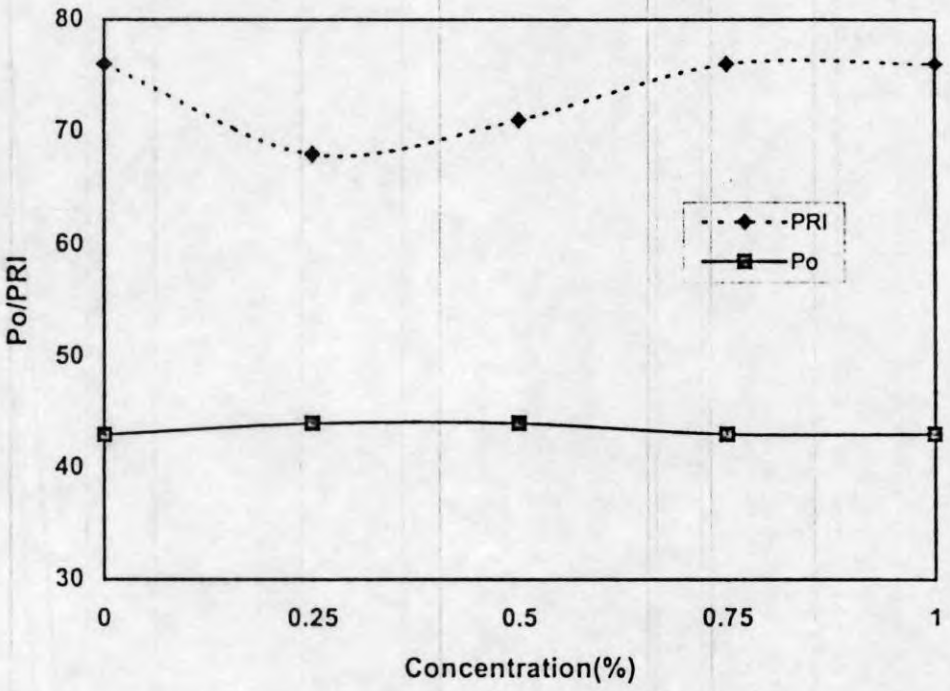

Fig.2. Effect of formalin concentration on Po& PRI (after 10 days)

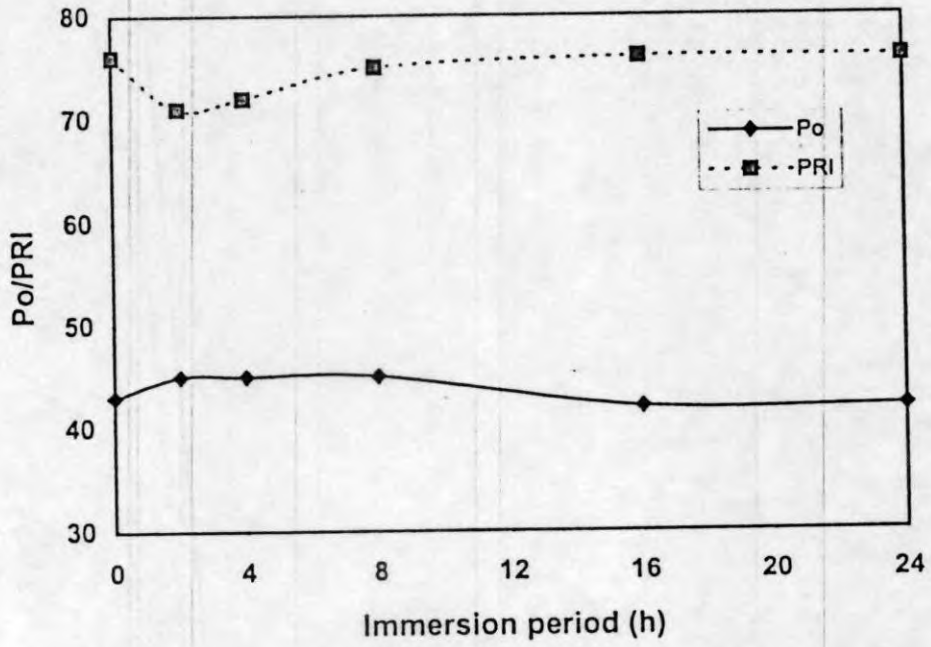

Fig 3. Effect of immmersion period on Po & PRI (after 10 days)

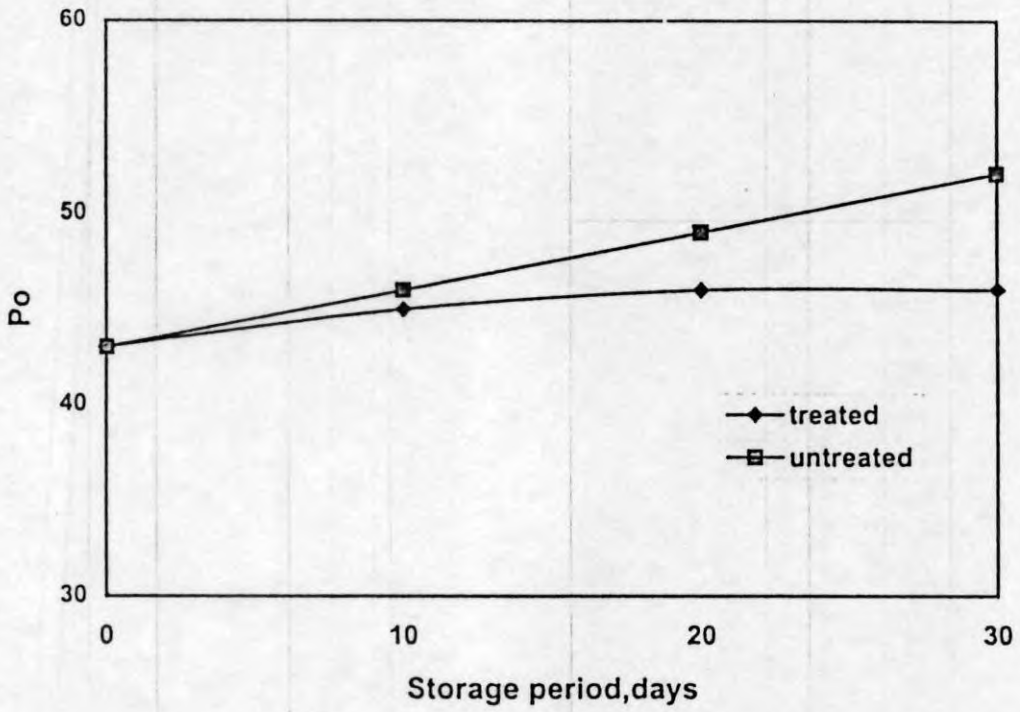

Fig.4. Effect of storage of treated coagulum on Po

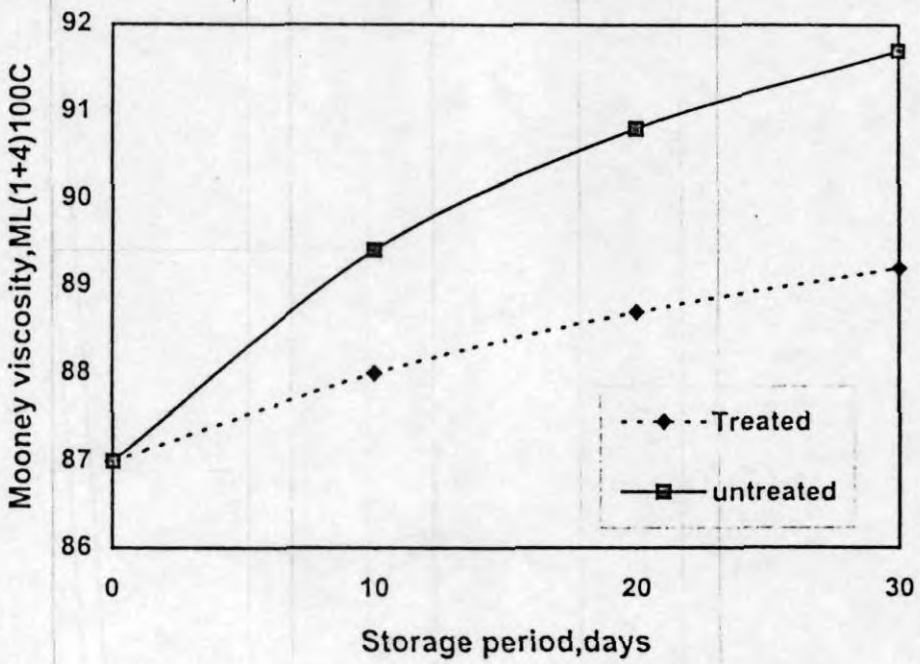

Fig .5. Effect of storage of treated coagulum on Mooney viscosity

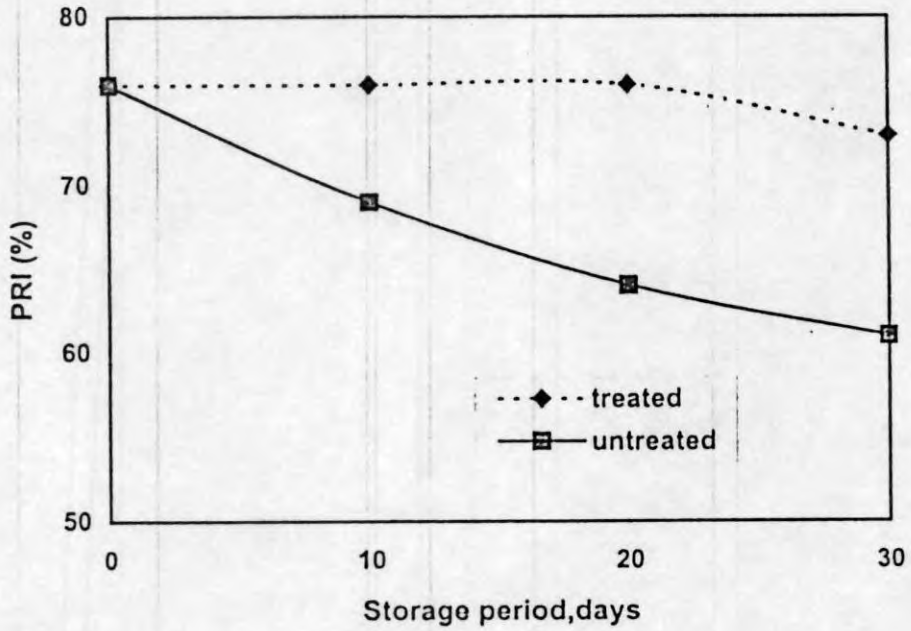

Fig.6. Effect of storage of treated coagulum on PRI