Effect of Enzymatic Discoloration Inhibitor on Plasticity of Sole Crepe Rubber

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Introduction

Rubber plant (*Hevea brasiliansis*) is a member of the spurge family Euphobiaceae. Milky latex is extracted from the bark of tree which is basically used industry of dry rubber and latex based. Durability of rubber product is one of the most important quality character sought by the customer. Therefore, manufacturers of rubber products try to protect good properties throughout the consuming time period. Durability of raw rubber product is affected by aging properties. The degradation of raw rubber with the time is common for most of the rubber based products and as a result the properties of raw rubber deteriorated and lead to a low product's performance. Thermal oxidation is one of factors which badly affect on the aging property of raw rubber products. The rubber molecular weight of product will be reduced from thermal oxidation (Swanson *et al*, 1979). Resistance to thermal oxidation is measured by plasticity retention index. Sole crepe rubber manufacturing industry always tries to produce higher grade sole crepe. Colour, clearness and purity are the quality parameters used in grading of sole crepe. The colour of sole crepe rubber is mainly affected by enzymatic discoloration of the natural rubber latex. In sole crepe manufacturing industry under fractionation step, Sodium metabisulfite (enzymatic inhibitor) is used to prevent enzymatic discoloration (Tillekeratne, *et al*, 2003). Through this process, resistance of oxidative components is removed with yellow fraction. Therefore, this research was carried out to determine the effect of Sodium metabisulfite on plasticity of different selected rubber clones.

Methodology

The study was carried out at the Kalani Vally Plantation PLC, Panawatta estate in Yatiyanthota and Rubber Research Institute, Rathmalana. Five different rubber clones (PB 86, RRIC 100, RRIC 101, RRIC 121, RRIC 130) were used for this experiment. Four levels of different dosages of Sodium matabisulfite were used in the experiemnt. The treatments were arranged according to two factor factorial using complete randomized design with 3 replicates for each treatment (Table 1).

Table 1. Treatment combination (Clone with different dosage of Sodium metabisulfite).

Clone	Treatment			
	Non (W1)	1.25 g(W2)	2.5 g(W3)	3.75g(W4)
RRIC 121 (C1)	C1W1	C1W2	C1W3	C1W4
PB 86 (C2)	C2W1	C2W2	C2W3	C2W4
RRIC 130 (C3)	C3W1	C3W2	C3W3	C3W4
RRIC 100 (C4)	C4W1	C4W2	C4W3	C4W4
RRIC 101 (C5)	C5W1	C5W2	C5W3	C5W4

According to experiment layout 12 experimental units (sole crepe) were prepared from one clone. Recommended procedure of sole crepe rubber manufacturing was followed to prepare the experiment units. Except for the treatment step (addition of Sodium metabisulfite), other steps and conditions were kept same for all. Fractionation percentage was measured by amount of dry weight of yellow fraction. Plasticity retention index (PRI) of each experiment unit was tested in

accordance with ISO 2007 standard and colour index was tested according to the ISO 4660 standards. Data were analyzed according to General Linear Model by using Minitab computer package.

Results and Discussion

P value for clone and the treatment was 0.000 whereas clone*treatment 0.288. R^2 (adj) is 85.40%. Table 2 shows the clone effect to PRI value, combination of both two factors; clone and Sodium metabisulfite dosage. According to Tukey test , "P" value was less than significant level ($P < 0.05$) and therefore clones affect on PRI value of sole crepe rubber. High poly isoprene synthesis may lead to the production of macromolecular chain with incomplete protection after synthesis. The condition leads to higher sensitive to thermal- oxidative degradation (Ehabe *et al*, 2002). Thermal- oxidative degradation leads to decrease PRI value. The highest value was recorded from clone C1 while the lowest value was recorded from clone C5. The PRI value of clone C1 and clone C2 were also statistically on par with each other. The PRI value of clone C4 and C5 were also not significantly different.

Table 2. Mean PRI value of rubber clones (Considering, combination of both factors).

Clone	Mean of PRI (%)
C1	76.5^{A}
C2	73.5^{A}
C3	68.0^{B}
C4	60.2^{C}
C5	60.1^{C}

Table 3 depicts the treatment effect on PRI value, combination of both factors; the clone and the Sodium metabisulfite level. The P value was less than significant level ($P < 0.05$) and therefore treatments have an effect on PRI value of sole crepe rubber. The highest value of PRI was shown by treatment 1 and the lowest PRI value was recorded form treatment 4. All treatments were significantly different from each other. Antioxidants present in NR latex are mainly Phospholipids, amino acid, Phenols, Tocotrienols and Betaines (Nadarajah, *et al*, 1971). In fractionation process non rubber particles such as lipid, protein, amino acid and antioxidant are removed from the latex. Therefore PRI value of rubber is reduced from fractionation process.

According to results of total number of experiment levels, higher PRI value was shown by treatment 1 for each clone. Also treatment 1 of C1 recorded the maximum PRI value. Treatment 4 of C1 recorded the lowest PRI value from all combination. Treatment 1 and treatment 2 of each clone showed a similar variation of PRI value. Treatment 4 for each clone of PRI value showed the minimum value (61.5%). When considering a particular clone the PRI value has decreased with the increase in Sodium metabisulfite level.

Table 3. Mean PRI value of particular treatment (Considering, combination of both factors)

Treatment	Mean of PRI (%)
1	73.6^{A}
2	69.9^{B}
3	65.6^{C}
4	61.5^{D}

Grading, marketing and purity of sole crepe depend on the colour of sole crepe. The lowest colour index was recorded by clone C1 and C2. It indicates that C1 and C2 clones give a good appearance in sole crepe rubber manufacture. Latex consists of both non rubber and rubber particles. If there is high latex volume, at the fractionation process more yellow fraction are

removed See table 4). As a result rubber quantity will be decreased for sole crepe manufacturing process.

Table 4. Mean value of colour index, fraction (%) and PRI value

Clone	Colour index	Fraction (%)	PRI value (%)
C1	1.5	3.8	76.5
C2	1.5	4.8	73.5
C3	1.9	5.5	68.0
C4	2.2	10.5	60.2
C5	2.7	12.3	60.1

Conclusion

Sodium metabisulfite and clone have a significant effect on plasticity of sole crepe rubber. When increasing the dosage of Sodium metabisulfite the plasticity decreases. RRIC 121 is the best clone in manufacturing sole crepe with higher plasticity retention out of the clone experimented.

References

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