Nitrosoamine free preservative system for natural rubber latex

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Introduction

Natural rubber (NR) latex is the sap of *Hevea brasiliensis* tree (Blackley, 1997). It is a colloidal dispersion of rubber particles in an aqueous medium, containing usually from about 20% to about 40% w/w rubber particles (dry rubber) and about 5% w/w non-rubber compounds, including carbohydrates, proteins, phospholipids and metal salts. Since it provides an optimum environment for microbial growth, in the absence of a proper preservation, the carbohydrates which the latex contains are oxidized in to short chain volatile fatty acids due to microbial activities. These acids destabilize the latex which results the coagulation of rubber particles (Blackley, 1997). Preservatives can effectively inhibit the bacterial growth in fresh NR latex. Hence the formation of acidic compounds resulting from bacterial activity in the latex is inhibited, which in turn inhibits coagulation. Since the most widely used preservative, Tetramethyl thiurumdisulfide (TMTD) forms carcinogenic nitrosamine, present invention is mainly focused on the provision of a nitrosoamine free preservative system for latex concentrate to stabilize the latex over a period of six months. Volatile fatty acid number is an important measure of the level of deterioration and stability of the latex. Therefore the preservative activities of new developing system (NDS) for treated latex concentrate was tested based on the measurements of volatile fatty acids (VFA) number test.

Methodology

The current study was carried out at the Rubber chemistry & Technology laboratories of Rubber Research Institute, Ratmalana. Three experimental trials with different treatments of NDS were conducted during this study. The trial (I) was carried out to find out the optimum concentration of NDS in preservation of natural rubber latex. In order to compare the efficiency of NDS with the conventional preservative, the VFA number of the latex, treated with ammonia/TMTD/ZnO (TZ) system and NDS was determined respectively. In trial (II), the effect of NDS on latex preservation in combination with a co-activator was determined. The effect of ammonia on the activity of novel preservative and the appropriate combination of ammonia and NDS to preserve and stabilize the latex were evaluated in trial (III).The appropriate combination was used to prepare centrifuged latex and other properties of the concentrated latex such as total solids content (TSC), dry rubber content (DRC), pH, KOH number, Brookfield viscosity were measured according to ISO standard methods and compared with the centrifuged latex preserved by adding 0.2% ammonia (NH_3), 0.025% of 1:1 mixture of tetramethylthiuramdisulphide (TMTD) and Zinc oxide (ZnO) combination as a control sample.VFA values of trial (I) and (II) were analyzed using one way analysis of variance (ANOVA) with MINITAB statistical package 16.0 version. The Experiment trials were done using complete randomized design (CRD). Means comparison of results was done by using the least significant difference ($P<0.05$) test (LSD).

Results and Discussion

Samples prepared using NDS caused a decrease in VFA number and this reduction was consistent with 0.1% and 0.2% concentrations (Figure 1). The leveling effect with NDS resulted at lower VFA values compared to conventional preservative system. According to the ANOVA there was a significant difference ($P < 0.05$) between the VFA number of conventional preservative system and NDS. The optimum concentration of NDS in preservation of natural rubber latex was set as 0.1%.

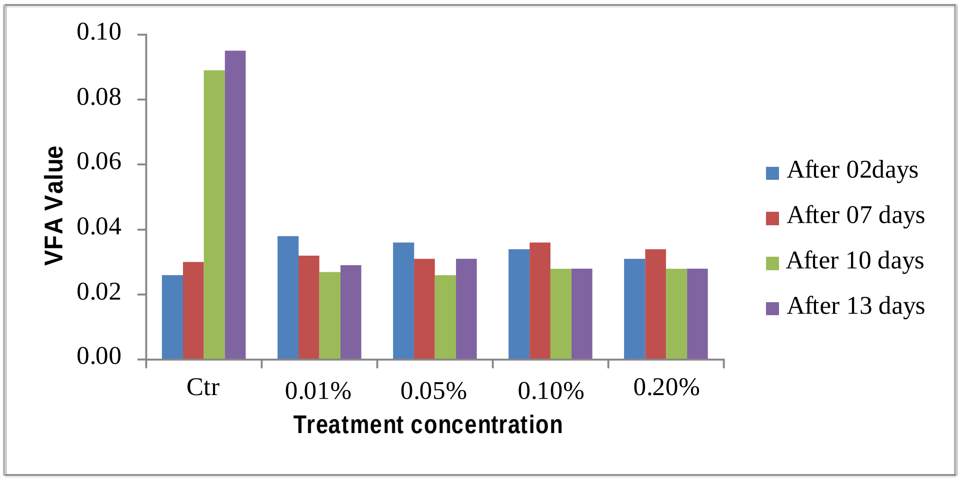

Figure 1. Comparison of VFA number of the latex treated with ammonia/TZ and NDS

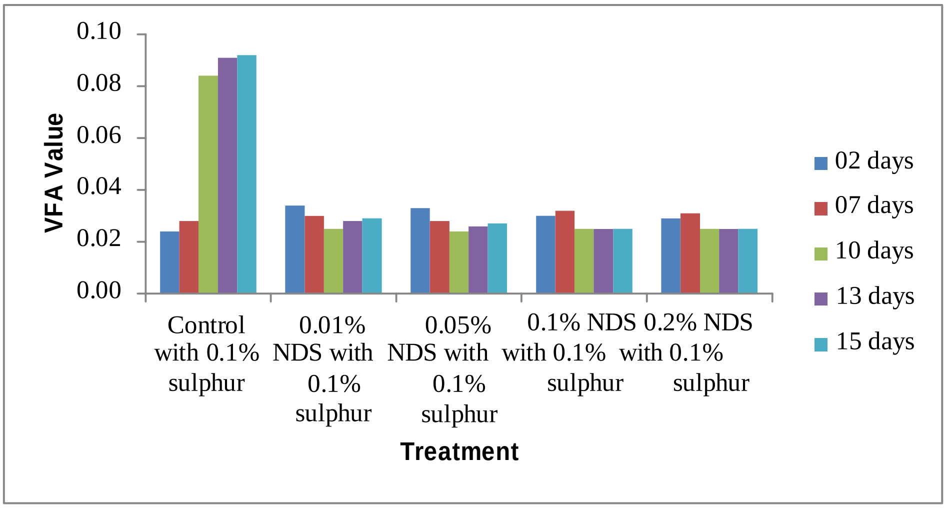

Figure 2. The effect of sulfur in combination with the activity of new developing system.

According to the ANOVA in the presence of a co-activator there was a significant difference ($P < 0.05$) between the VFA number of conventional preservative system and NDS. The positive effect of sulfur is remarkable with NDS system compared to conventional TZ system (Figure 2). The increase of the VFA value has slow down with 0.1% and 0.2% of NDS. Decrease amount of the VFA value is much significant in the presence of sulfur resembling synergistic effect with NDS.

The results of the trial (III) indicated that the NDS alone was not enough to replace the role of ammonia in preservation. The optimum combination of ammonia and NDS to preserve and stabilize the latex could be 0.2% and 0.1% respectively.

Table 1. Variation of VFA number of latexes preserved using 0.1% NDS with different ammonia concentrations

	VFA after				
	02 days	07 days	10 days	13 days	15 days
Control with 0.2% ammonia	0.018	0.029	0.081	0.093	0.094
0.1% NDS with no ammonia	coagulated				
0.1% NDS with 0.5% ammonia	coagulated				
0.1% NDS with 0.1% ammonia	Partially coagulated	coagulated			
0.1% NDS with 0.2% ammonia	0.029	0.033	0.029	0.028	0.028

VFA number was within the acceptable limits for both preservative systems.VFA development was low with NDS compared to control system indicating efficiency of the novel chemical in suppression of bacterial activities.

Conclusions

New developing system (NDS) can cause a remarkable decrease in VFA number compared to the conventional system. In the presence of sulfur, NDS shows significant results than conventional system. The novel chemical alone is not enough to replace the role of ammonia in preservation of latex. The best combination of the chemicals to preserve field latex were 0.2% NH_3 with 0.1% NDS.

References

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