

STUDY ON
ETHEPHON (2-CHLOROETHYLPHOSPHONIC ACID)
STIMULATION OF NATURAL RUBBER LATEX ON
PHYSIO-CHEMICAL AND MECHANICAL PROPERTIES
OF RUBBER

by

Anusha Priyanthi Attanayake

Ph.D

2016

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CERTIFICATION OF SUPERVISORS

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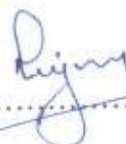
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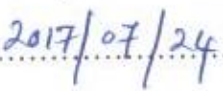
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DECLARATION

The work described in this thesis was carried out by me under the supervision of Professor L.Karunanayake of the University of Sri Jayewardenepura and Dr. A.H.L.R Nilmini, Rubber Research Institute of Sri Lanka and a report on this has not been submitted in whole or in part to any university or any institution for another Degree/Diploma.

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We certify that the above statement made by the candidate is true and that this thesis is submitted for submission to the University for the purpose of evaluation.




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Dedicated to my dear Husband

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LIST OF ABRIVATIONS

S/2 d 2	-	Half spiral cut once in two days frequency
S/2 d3	-	Half spiral cut once in three days frequency
DRC	-	Dry Rubber Content
TSC	-	Total Solid Content
NRC	-	Non rubber content
ET	-	Ethephon
NRL	-	Natural Rubber Latex
VFA	-	Volatile Fatty Acid
ISO	-	International Standard Organization
NR	-	Natural Rubber
EB%	-	Percentage elongation at break
MW	-	Molecular weight
MWD	-	Molecular weight distribution
P ₀	-	Plasticity Number
PRI	-	Plasticity Retention Index
HFA	-	Higher Fatty Acid
FTIR	-	Fourier transform Infrared spectroscopy
CLD	-	Cross link density
IPP	-	Isopentenyl pyrophosphate
SRPs	-	Small rubber particles
LRPs	-	Large rubber particles

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**Study on Ethephon (2-Chloroethylphosphonicacid) stimulation of Natural Rubber
Latex on Physio-chemical and Mechanical Properties of Rubber**

Anusha Priyanthi Attanayake

ABSTRACT

Low frequency harvesting systems were introduced as a solution for key challenges faced by the rubber industry, such as lack of skilled tappers, high cost of production and declining rubber prices in international market. So far in-depth comprehensive technological analysis on effect of ethephon concentration has not been done. Therefore, the aim of the present investigation was to identify the effect of stimulation on raw rubber and latex properties. Further, physico-mechanical properties and ultimate processability were studied. The results of the study revealed that the maximum rubber yield as well as optimum physico-mechanical properties could be achieved with 3% ethephon concentration and higher doses of stimulant did not further improve the production. Total solid content, dry rubber content and latex viscosity were reduced with the increased ethephon concentration with simultaneous increase of non-rubber content. Viable count of bacteria increased significantly; as a result of high non rubber and sugar content in more diluted latex. Packing efficiency of latex enhanced by the production of small rubber particles with the increase of ethephon concentration, which leads to superior green strength for latex casting film. Therefore, stimulated latex could be recommended for the applications such as gloves, balloons and exercise belts. Extremely high plasticity retention index value and high ageing resistance were reported with rather low Mooney viscosity

and elasticity value which would be of advantage in-terms of product manufacturer's perspective. Lovibond colour index improved up to 3% due to retardation of enzymatic discolouration by thiol compounds. However, higher doses of ethephon lead to discoloration of rubber. Stimulation enhanced the production of short polyisoprene chains, with significant reduction in plasticity number, viscosity averaged molecular weight and increased the storage hardening and gel formation. However, above properties were at an acceptable level up to 3% ethephon concentration. End to end linkage of linear polymer of relatively long chains with very short chains create highly cross linked network which can tolerate the applied stress. Outstanding properties i.e. high tear strength, percentage elongation at break and elastic modulus were attributed to the bimodality in chain length. Relatively long chains serving to retard rupture while limited extensibility of very short chains improve the elastic modulus and ultimate strength. 3% ethephon concentration could be recommended as the best in terms of cure characteristics of unfilled compound rubber with maximum scorch safety time, maximum cure time and highest cure rate index. Due to vulcanization accelerator activator effect of decomposition products of proteins stimulated rubber imparts high cure rate than the control. Latex and raw rubber properties with the application of 3% ethephon revealed that, maximum effective time was 15 days after stimulation which would be a drawback of stimulation. Application of recommended dosage may only provide the optimum properties and higher doses may deteriorate the expected results. Dynamic and Physico-mechanical properties of stimulated rubber prepared with different filler loadings and application of glutathione in latex stage to replace or reduce the dosage of bleaching agent are among the future interests.