THE POTENTIAL OF ALKANOLAMIDE AS A NEW ADDITIVE IN NATURAL AND SYNTHETIC RUBBER COMPOUNDS

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THE POTENTIAL OF ALKANOLAMIDE AS A NEW ADDITIVE IN NATURAL AND SYNTHETIC RUBBER COMPOUNDS

by

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DEDICATION

This work is dedicated to the persons who I love very much;

My beloved parents, Almarhumah Roslaini Nasution

Muhammmad Akram Dalimunthe

My beloved wife, Yulia Kalsum

My dearest children Ikhwan Indrawan Dalimunthe (Iwa)

Annisa' Riftah Andreani Dalimunthe (Ica)

Muhammad Khatami Dalmunthe (Khatami)

Nurul Izza Dalimunthe (Lala)

Naufal Hariri Dalimunthe (Ari)

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LIST OF ABREVIATIONS

Abbreviation	Description
NR	Natural Rubber
CB	Carbon Black
MFA	Multifunctional Additive
POFA	Palm Oil Fatty Acid
SMR L	L Grade Standard Malaysian Rubber
MgO	Magnesium Oxide
ZnO	Zinc Oxide
ETU	Ethylene thiourea
CR	Polychloroprene Rubber
ALK	Alkanolamide
RBDPS	Refined Bleached Deodorized Palm Stearin
SBR	Styrene-butadiene Rubber
CV	Conventional Vulcanizing System
EV	Efficient Vulcanizing System
Semi-EV	Semi-efficient Vulcanizing System
NBR	Acrylonitrile Butadiene Rubber
ENR	Epoxidised Natural Rubber
PPD	Paraphenyllediamines
HMMM	Hexamethoxymethymelamine
MRPRA	Malaysian Rubber Producers Association
phr	Part per hundred rubber
TS	Tensile Strength

Abbreviation	Description
EB	Elongation at Break
M100	Moduli at 100% elongation
M300	Moduli at 300% elongation
RRIM	Rubber Research Institute Malaysia
TBBS	N-tert-butyl-2-benzothiazyl-sulfonamide
CBS	N-cyclohexyl-benzothiazyl-sulfenamide
TMTD	Tetramethylthiuram disulfide
MBT	2-mercaptobenzothiazol
ASTM	American Society for Testing and Materials
SRF	Semi Reinforcing Furnace
GPF	(General Purpose Furnace)
IPPD	N-isopropyl-N'-phenyl-p-phenylenediamine
FF	(Fine Furnace)
HAF	(High Abrasion Furnace)
ISAF	(Intermediate Super Abrasion Furnace)
SAF	(Super Abrasion Furnace)
APTES	Aminopropyltriethoxy Silane
MBTS	Mercapto Benzothiazolyl disulfide
ENB	Ethylidene Norbornene
DCP	Dicumyl Peroxide
MDR	Moving Die Rheometer
N330	N330 Grade Carbon Black
SEM	Scanning Electron Miscroscopy
FTIR	Fourier Transform Infrared Spectroscopy

LIST OF SYMBOLS

Symbol	Description
kJ	Kilojoule
kg	Kilogram
kcal	Kilocalori
g/s	Gram per second
^{o}C	Centigrade
T_g	Glass Transition Temperature
C-C	Carbon to Carbon Bond
S-S	Sulfur to Sulfur Bond
$-S_x-$	Sulfidic Cross-link
C-S	Carbon to Sulfur Bond
ML 1 + 4 @	M = Mooney Viscosity Value
$100^{o}C$	L = Large rotor (for small replace it with 'S')
	1 = Pre-heat time in minutes.
	4 = Time in minutes after starting the motor at which the reading is taken.
	100°C = Test temperature.
g/cm^3	Gram per cubic centimeter
$S'M_L$	Elastic minimum torque
$S'M_H$	Elastic maximum torque
$S'(M_H - M_L)$	Elastic torque difference
ts_2	Scorch time
tc_{90}	Curing time

Symbol	Description
CRI	Cure rate index
W_1	The initial mass of specimen (g)
W_2	The mass of specimen (g) after immersion in toluene.
M_c	The molecular weight between cross-links
ρ	The density of the rubber
V_s	The molar volume of the toluene
V_r	The volume fraction of the polymer in the swollen specimen
Q_m	The weight increase of the blends in toluene
χ	The interaction parameter of the rubber network-solvent
V_c	Cross-link Density
cm^{-1}	Wave Number
α	The fractional mass loss at time *t*
t	Specific time
T	Absolute Temperature (^oK)

POTENSI ALKANOLAMIDA SEBAGAI BAHAN TAMBAH BARU DI DALAM SEBATIAN GETAH ASLI DAN SEBATIAN GETAH SINTETIK

ABSTRAK

Potensi Alkanolamida (ALK) sebagai bahan tambah baru di dalam sebatian getah asli dan sebatian getah sintetik telah dikaji. ALK disediakan dengan melakukan tindak balas antara *Refined Bleached Deodorised Palm Stearin (RBDPS)* dengan diethanolamina. Sebatian-sebatian getah asli dan getah polikloroprena tak berpengisi, getah asli berpengisi silika dan berpengisi hitam karbon, dan juga getah asli terepoksida (ENR-25) dan getah stirena-butadiena berpengisi hitam karbon telah dipilih sebagai sebatian-sebatian getah yang akan dikaji. Dalam kajian ini, ALK dengan pembebanan yang berbeza ditambahkan ke dalam sebatian-sebatian getah, kemudian dimatangkan dengan menggunakan sistem pemvulkanan sulfur terpecut.

Objektif utama dari kajian adalah untuk menyelidik kesan pembebanan ALK terhadap sifat-sifat daripada sebatian-sebatian getah yang berbeza. Telah didapati bahawa ALK boleh digunakan bukan sahaja sebagai bahan tambah kuratif, tetapi juga sebagai bahan pemplastik dalaman bagi sebatian-sebatian getah. ALK boleh meningkatkan ciri-ciri pematangan sebatian-sebatian getah manakala kadar pematangan dan perbezaan tork meningkat. Masa skorj dan pematangan optimum sebatian-sebatian getah asli tak berpengisi dan berpengisi silika, serta getah asli, getah ENR-25 dan getah stirena-butadiena berpengisi hitam karbon semakin pendek dengan peningkatan pembebanan ALK. Perbezaan nilai tork adalah meningkat sehingga pembebanan ALK yang optimum bagi sebatian-sebatian getah.