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JIF = 1.500	SJIF (Morocco) = 2.031	

SOI: 1.1/TAS DOI: 10.15863/TAS

International Scientific Journal

Theoretical & Applied Science

p-ISSN: 2308-4944 (print) **e-ISSN:** 2409-0085 (online)

Year: 2018 **Issue:** 07 **Volume:** 63

Published: 23.07.2018 **http://T-Science.org**

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PLASTICIZATION OF BUTADIENE-NITRILE RUBBER WITH DICAPRYLATE ETHER OF DIPHENYLOLPROPANE

Abstract: *Dicaprylate ether of diphenylpropane DEDE derived from oil extracted from Balakhani fields was used for plasticization of butadiene-nitrile rubber. It has been revealed that the percentage of DEDE should be 10% because the strength of NBR-40 rubber is too high. In that case DEDE acts as both plasticizer and filler. But the subsequent increase in the amount of plasticizer reduces resistance to stretch and friction of the vulcanizates.*

When using 5-10% DEDE by mass in rubber mixture, breaking strength of the vulcanizates increased by 1,4-2,9 MPa; oil, acid and base resistance were 4-8% greater.

Key words: *Butadiene-nitrile rubber (NBR-40), plasticizer, vulcanizate, filler, hardness, oil-acid resistance, synthesis, physical-mechanical properties, sulfur, accelerator, modification.*

Language: *English*

Citation: Movlayev IH, Shixaliyev KS (2018) PLASTICIZATION OF BUTADIENE-NITRILE RUBBER WITH DICAPRYLATE ETHER OF DIPHENYLOLPROPANE. ISJ Theoretical & Applied Science, 07 (63): 124-126.

Soi: http://s-o-i.org/1.1/TAS-07-63-17 ***Doi***: https://dx.doi.org/10.15863/TAS.2018.07.63.17

Introduction

The main purpose of adding the plasticizer to the rubber mixture is to modify the mechanical properties of the polymer. Different plasticizers have a different effect on the plasticity of the polymer.

A number of plasticizers were used for plasticization of NBR-40 rubber. However, these plasticizers can not fully provide equal distribution and compatibility of the ingredients used in the rubber mixture based on the NBR-40 rubber, so that the purpose of this work is to synthesis a new plasticizer and overcome the above mentioned deficiency [1,c.243],[2,c.37]

For this purpose, the following scientific research has been carried out.

Composition preparation

The composition mixture was prepared on laboratory two-roll mixing mill machine. For this purpose, after heating the rolls to 90°C temperature, the ingredients were added to the mill in the following sequence. [3,c.267],[4,c.65],[5,c.57].

Synthetic and natural naphthenic acids have been used as the primary material for the synthesis of esters. Synthetic naphthenic acids have been synthesized by a direct oxidation of oil concentrates extracted from Balakhani at temperatures of 220-250^{0}C. In order to oxidize, variable valent metals (Mn and Co) were used as catalyst.

The dicaprilate ester of diphenylolpropane of naphthen and benzoic acids was used for the plasticization of NBR-40 rubber.[6,c.132],[7,c.16],[8,c.37],[9,c.88],[10,c.31]

Some properties of dicaprilate ether of the diphenylolpropane and dioctylphthalate used in the experiments are given in Table 1.

Table 1.

Properties of plasticizer

№	Indicators	DEDE
1	Ignition temperature, °C	206
2	Acid number, mq KOH/q	0.5
3	Density at 20°C, km/m^3	959.4
4	Saponification number, mq KOH/q	290-300

A rubber mixture was prepared on the laboratory two-roll mixing mill machine using the DEDE as a plasticizer and the butadiene-nitrile rubber (NBR-40) indicated on the following table (Table 2). The rubber blend was vulcanized at 155^{0}C for 20 minutes.

Table 2

Recipe of the rubber blend consists of NBR-40 and plasticizer

№	Ingredients	1	2	3	4		
1	NBR -40	100	100	100	100	100	100
2	Altax	2,0	2,0	2,0	2,0	2,0	2,0
3	Captax	2,0	2,0	2,0	2,0	2,0	2,0
4	Neozon-D	2,0	2,0	2,0	2,0	2,0	2,0
5	Zinc oxide (ZnO)	5,0	5,0	5,0	5,0	5,0	5,0
6	Dioctylphthalate	2,0	2,0	2,0	2,0	2,0	2,0
7	Dibutylphthalate	3,0	3,0	3,0	3,0	3,0	3,0
8	Sulfur	4,0	4,0	4,0	4,0	4,0	4,0
9	Technical carbon P-324	50	50	50	50	50	50
11	Dicaprylate ether of diphenylpropane	-	2,0	4.0	6,0	8,0	10

Physical-mechanical properties of vulcanizates are illustrated in Table 3.

Table 3

Physical-mechanical properties of vulcanizates of NBR-40/DEDE mixtures

Composition of the blend, m.f.						
NBR-40 DEDE	100	98 2	96 4	94 6	92 8	90 10
Properties of the vulcanizates						
Tensile strength, MPa	17,2	17,9	18,6	19,2	20,1	17,5
Conventional tension in 100% elongation, MPa	3,8	3,9	4,0	4,5	4,7	3,78
Relative extension, %	320	340	360	370	380	395
Relative residual deformation, %	13,0	13,0	13,2	13,5	14,0	15,8
Resistance to tearing, kN/m						
Elasticity, %	12,0	12,5	13	13,2	13,8	13,7
Conventional unit of hardness on TM-2	82,2	82,0	81,5	81,5	80,7	78,0
During 138 hours at 120^{0}C aging coefficients Fp εp	 0,84 0,62	 0,85 0,62	 0,80 0,63	 0,86 0,63	 0,86 0,64	 0,84 0,63
Swelling rate for 24 hours at 23^{0}C Burning time	114.0 292	115.0 300	115.0 320	117.0 390	120.0 97	139 35
Strength of metal contact, MPa	5,6	5,8	6,2	6,8	7,0	6,85

Oil-gasoline resistance of the compositions and vulcanizates have been studied. The results are indicated in Table 4.

Table 4

Resistance of vulcanizates to aggressive environment

№	Ingredients	Solving
1	Transformer oil	not dissolved
2	Crude oil	not dissolved
3	HCl	not dissolved
4	Base	not dissolved

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