Oxidation Degradation Study And Use Of Phenol And Amina Antioxidant Compounds In Natural Rubber Cyclical

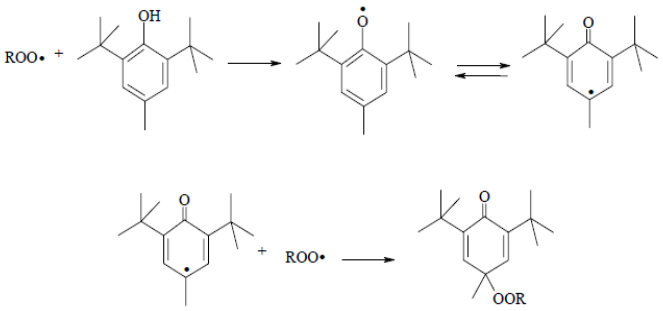
Arofah Megasari Siregar, Eddyanto, Basuki Wirjosentono, Ameilia Zuliyanti Siregar

Abstract: The research was conducted research into the use of commercial antioxidants Irganox 1010 (wingstay) to inhibit the oxidative degradation of cyclic polymers of natural rubber and polypropylene nanocomposite with commercial montmorillonite (PP / MMT-Clay). Proces mixing nanocomposit PP/MMT using commercial compatibiliser PP-g-MA (PB3200) made in an internal mixer at a temperature of 180 C for 10 minutes and 65 rpm rotor speed. Hyndered phenol antioxidant effectiveness was analyzed using Fourier Transform Infra Red (FTIR). Analysis of infrared is done by measuring the broad index absorption of the carbonyl group (>C=O) at a wavelength of 1700 cm-1 and a broad index uptake hydroxyl group at a wavelength of 3400 cm-1 before and after heated in an oven temperature of 125oC with variations in exposure time. The results indicate the use of antioxidant Irganox 1010 in nanocomposite PP / MMT with a stabilizing factor of 5.5. Further commercial antioxidants will be used to restrain the rate of oxidation degradation of the natural rubber products cyclical (CNR).

Index Terms: Antioxidant, wingstay, oxidative degradation, stabilizers, FTIR, a stabilizing factor.

1 INTRODUCTION

Polymers are widely used in everyday life. Polymers used for a variety of human needs, ranging from household appliances, auto parts, building materials up to the packaging for a variety of food and electronic components. Polymers can change their chemical structure by oxidation. The oxidation process leads to the termination of the C-C bond and free radikat arrest by oxygen [1]. Natural rubber is a natural polymer that has long been used for various purposes. Products processed natural rubber perishable and durable. The oxidation process causes natural rubber degradation and changes in physical properties that lead to reduced product quality. To prevent oxidative degradation of this, the natural rubber material added anti-degradation that are anti-oxidants. Natural rubber by antioxidants 12 times more stable to oxidative degradation [2]. The use of antioxidants with hindered phenol showed a direct correlation between the increase in the stability of natural rubber with a concentration of antioxidants [3]. The reaction mechanism of the stabilization of radicals by hindered phenol can be explained by the reaction mechanism in Figure 1.1.



Research from Muller.*et al* (2009) showed that the use of hindered phenol antioxidants can improve the stability of polypropylene for a long period of time due to its antioxidant hindered phenol remained stable during the manufacturing process and storage [4]. Research Astutiningsih*, et al* (2009) showed that the nanocomposite polypropylene with montmorillonite were synthesized by means of engineering cascade using PP-g-maleik anhydride (Maleic anhydride / MA) as pengkompatibel (compatibilizer) is unstable against thermal effect [5]. Natural rubber cyclically (cyclic natural rubber, CNR) is a modified natural rubber which became one of the flagship products downstream rubber industry. Natural rubber cyclical has considerable potential for use as an adhesive raw materials (adhesive) and the paint because it has physical properties of a typical, namely: lightweight, rigid, and resistant to abrasion (power strings) and has the adhesion was good to metal, wood , rubber, leather, textiles and paper. In the industry, the cyclical natural rubber is widely used as a resin material in the manufacture of paints, inks and as an adhesive [6]. However, this cyclical natural rubber are particularly vulnerable (vulnerable) against degradation by oxidation reaction of a compound of ozone, oxygen or utraviolet to light (UV). Therefore CNR storage in a relatively long time will lead to changes in physical and chemical properties CNR or degradation indicated by a change in color to brown, harder and affects the cyclical nature of this rubber solubility in organic solvents. This study aims to determine how the influence of the commercial antioxidants Irganox 1010 (wingstay) as inhibiting the rate of oxidative degradation of

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commercial montmorillonite nanocomposite polypropylene (PP/MMT-Clay) and find out how the oxidation process in CNR.

RESEARCH METHODOLOGY

The raw materials used are: polypropylene (PP), Motmorilonit (MTT), Polypropylene tergrafting maleik acid (PP-g-MA), Irganox 1010 (wingstay). Cyclic natural rubber (CNR). Manufacture of nano composites PP/MMT-Clay with antioxidants is done by inserting 35 g PP522H (100 phr) into the container torg rheometer then processed at a temperature of 180 ° C for 2 minutes with a rotor speed of 65 rpm. MMT is added as much as 2.5 phr, PP-g-MA 2.5 phr and Irganox1010 1phr. The process is continued for 8 minutes at 180 ° C with a rotor speed of 65 rpm. After 10 minutes the process is terminated. Material removed from the container and put in a container refrigeration. The cooling process is performed with N_2 gas. The resulting material pulverized to 100 mesh. The resulting powder is printed to form the film. The film, produced in part directly analyzed by FTIR, partially processed at 180^{o}C 10 min and expose to Wallace Oven. Every 24 hours FTIR analysis of the film until there is a marked change in the results of comparative analysis FTIR.Sebagai made of PP/MMT-Clay.

RESULTS AND DISCUSSIONS

The results of FTIR analysis of nanocomposite PP / MMT-Clay with Irganox 1010 as in Figure 2.1

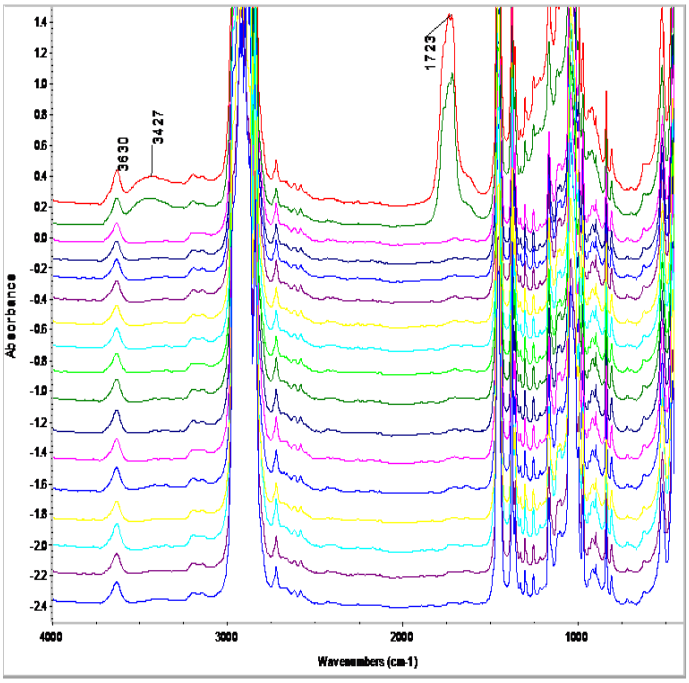
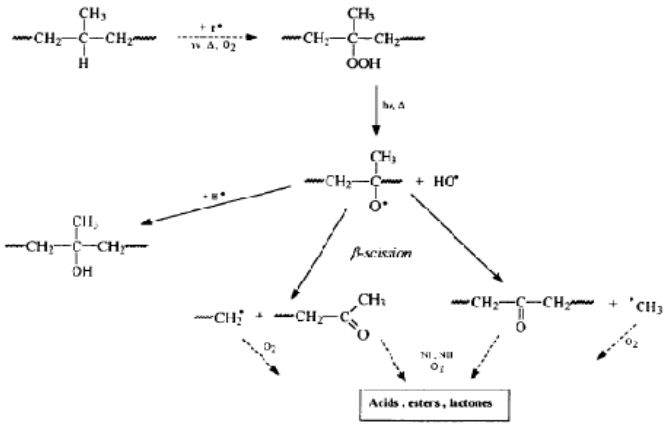


Figure 2.1. *The results of FTIR analysis of nanocomposite PP / MMT-Clay-Irganox 1010 after warmer at a temperature of 180°C for 10 min and expose to Wallace Oven on 0-518 hours.*

Durasi ekspose (jam)	Luas Absorbansi			Indeks Hidroksil	Indeks Carbonil
	Gugus -OH	Carbonil	Reference 2700		
0	10.49	2.90	3.26	3.21	0.89
48	10.40	3.01	3.34	3.11	0.90
72	9.98	2.64	3.31	3.01	0.88
96	10.18	2.60	3.35	3.04	0.79
125	10.72	3.27	3.41	3.14	0.96
145	10.24	2.59	3.34	3.07	0.78
168	10.16	2.54	3.35	3.03	0.76
192	10.29	2.62	3.35	3.05	0.78
230	10.21	2.54	3.37	3.03	0.75
254	10.32	2.88	3.35	3.08	0.86
278	9.99	2.64	3.31	3.02	0.80
302	10.15	2.76	3.33	3.05	0.83
325	9.98	2.63	3.32	3.02	0.79
350	10.40	3.20	3.32	3.13	0.97
398	10.03	2.77	3.35	3.12	0.87
470	**39.28**	**112.78**	**2.74**	**14.33**	**33.66**
516	**32.9**	**125.65**	**2.69**	**12.23**	**46.71**

Spike seen in Figure 2.1 at a wavelength of 1723 and 3427 which occurred on the hour to 470. This indicates an increase in the content of carbonyl and hydroxyl hydroxyl groups. Changes in the content of carbonyl and hydroxyl groups are also illustrated also in Table 2.1. Based on these data it is known that the stability can be maintained up to 398 hours. Increased content of carbonyl and hydroxyl indicates there has been a degradation of the polymer. PP degradation mechanism as in Figure 2.2.

Table 2.1. *Improved broad absorbance OH groups and carbonyl on FTIR analysis Nanocomposite PP / MMT-Clay-Irganox 1010*



Durasi ekspose (jam)	Luas Absorbansi			Indeks Hidroksil	Indeks Carbonil
	Gugus -OH	Carbonil	Reference 2700		
0	6.4	2.0	2,93	2,18	0,68
48	6,7	2,3	3,01	2,22	0,76
72	6,8	2,3	2,98	2,28	0,77
96	32,9	68,8	2,5	13,16	27,52

Figure 2.2. *Polypropylene degradation reaction mechanism [7].The results of FTIR analysis of nanocomposite PP / MMT-Clay without antioxidants such as in Figure 2.3.*

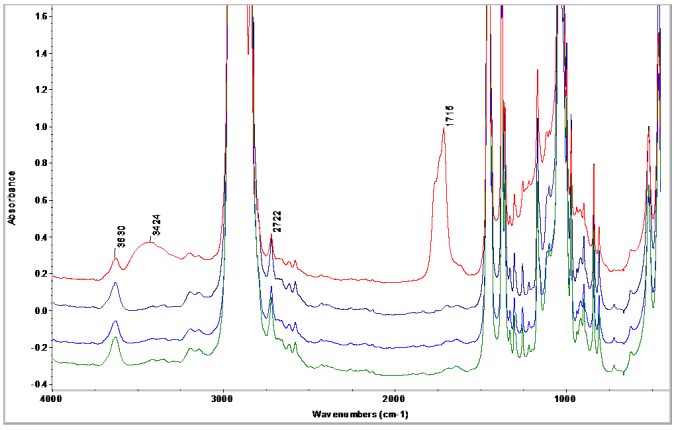
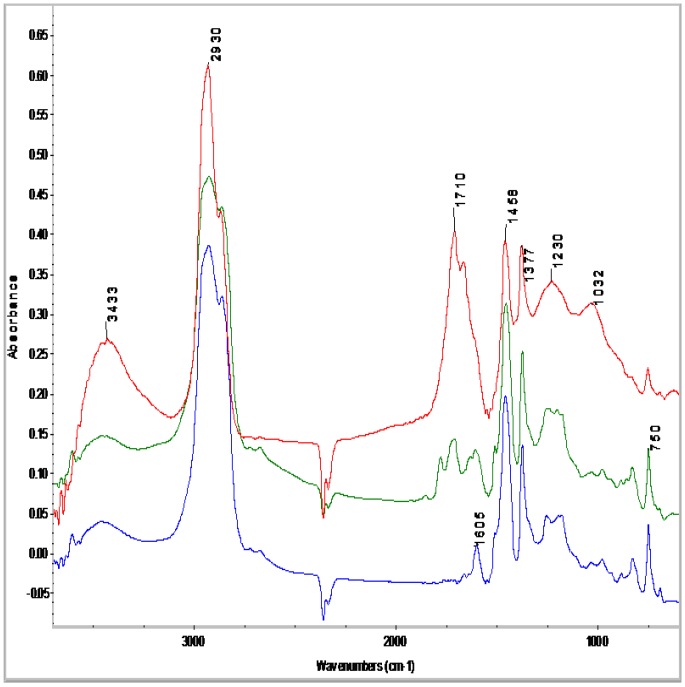


Figure 2.3. *The results of FTIR analysis of nanocomposite PP / MMT-Clay without antioxidants*



In Figure 2.3 it appears that after exposure for 96 hours degradation nanokoposit PP /MMT-Clay. In other words kestabilann only be maintained up to 96 hours only. When compared to the stability of the nanocomposite PP/MMT-clay-containing antioxidant containing no antioxidants then obtained a stabilizing factor of 5.5 (398 hours/72 hours= 5.5). The presence of antioxidants can inhibit the degradation rate of the nanocomposite PP / MMT-Clay because free radicals are formed will beeaksi with hindred phenol antioxidants with stabilizing mechanism as in Figure 1.1. FTIR analysis results cycliced natural rubber (cyclic natural rubber, CNR) gives a chromatogram as in Figure 2.4.

Figure 2.4. *The results of FTIR analysis CNR after 2 years of storage (1), after the process at a temperature of 180oC for 10 minutes (2), and CNR newly synthesized (3).*

Sampel	Luas Absorbansi		
	Gugus –OH	Carbonil	-C=C-
3	27,1	0,42	3,4
2	33,9	15,3	2,8
1	52,4	32,0	0,2

From Figure 2.4 it showed an increase of carbonyl and hydroxyl on the CNR that had been treated warming 180oC for 10 minutes and the CNR that has been stored for 2 years. The increase in the carbonyl and hydroxyl groups, indicating that the CNR degradation. FTIR analysis of the results of the nanocomposite PP/MMT-clay-Irganox 1010, PP/ MMT-clay, and CNR are mengasilkan carbonyl compounds and hydroxyl estimated their kesamaam degradation reaction mechanism of the polymers. With the same mechanism of degradation reactions of the treatment can be used to prevent degradation reactions of course almost the same. For this study will continue to see the effect of antioxidant Irganox 1010 in the stability of the CNR. From the results eksperiemn made some conclusions can be drawn: (1) degradation of nanocomposite PP/MMT-clay results in an increase of carbonyl and hydroxyl compounds. (2) Addition of hindered phenol antioxidants in nanocomposite PP/MMT-clay can improve the stability of up to five comma times. (3) The degradation of CNR generate an increasing amount kabonil and hydroxyl compounds.

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