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The Effect of Different Types of Carbon Black on Thermal Characteristics of Shape Memory Natural Rubber Vulcanizate

Pengaruh Berbagai Jenis Karbon Hitam pada Karakteristik Termal Memori Bentuk Vulkanisat Karet Alam

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In this research, thermal characteristics of shape memory natural rubber (SMNR) vulcanizate with different types of carbon black filler (N220, N330, N550) were investigated to specify the appropriate type of carbon black for the desired characteristic of the vulcanizate. SMNR vulcanizate prepared by swelling the vulcanizate with stearic acid at 70 °C. The thermogravimetric method was analyzed in a flowing nitrogen atmosphere at a heating rate of 20 °C min⁻¹. It was found that the initial degradation temperature of the blank vulcanizate (357.37–386.13 °C) was higher than SMNR vulcanizate swollen stearic acid (327.65–359.95 °C) meaning decreased thermal stability of SMNR vulcanizate. The weight loss of the blank vulcanizate at any type of carbon black is lower than SMNR vulcanizate.

Dalam penelitian ini, karakteristik termal dari vulkanisat karet alam pengingat bentuk (SMNR) dengan berbagai jenis pengisi karbon hitam *filler* (N220, N330, N550) diinvestigasi untuk menentukan jenis karbon hitam yang sesuai untuk karakteristik vulkanisat yang diinginkan. Vulkanisat SMNR dibuat dengan merendam vulkanisat dalam larutan asam stearat pada suhu 70 °C. Metode termogravimetri dianalisis dalam atmosfer nitrogen yang mengalir pada tingkat pemanasan sebesar 20 °C menit⁻¹. Ditemukan bahwa suhu degradasi awal vulkanisat blanko (357,37–386,13 °C) lebih tinggi dari vulkanisat SMNR yang telah direndam asam stearat (327,65–359,95 °C) yang berarti terjadi penurunan stabilitas termal vulkanisat SMNR. Penurunan berat dari vulkanisat blanko pada semua jenis karbon hitam lebih rendah dari vulkanisat SMNR.

Keywords: *Carbon black, natural rubber, shape memory, thermal characteristic, thermogravimetric.*

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The Role of Partially Hydrolyzed Polyvinyl Alcohol to the Enhancement of the Electrical Conductivity of Conductive Polymer

Peran Polivinil Alkohol Terhidrolisis Sebagian untuk Peningkatan Konduktivitas Listrik dari Polimer Konduktif

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This is the report of preliminary studies on the properties of polymerization solution containing 1, 5, and 10% polyvinyl alcohol (PVA). The degree of polymerization was divided into three categories of respectively low, medium, and high. The pH value of all solutions was found almost similar, which approximately in the range 5.0–6.5. While the viscosity exhibited values in the range 1.20–1985 mPa s depends on the concentration and the degree of polymerization. The lower solid content evaluation indicated a faster dissolution rate of PVA when compared with those of medium and high. The PVA dissolves completely in less than 10, 180, and 220 minutes for 1, 5, and 10% of the solution, respectively. The solid content, which is the indicator of the solubility property of solution has resulted in a deviation of less than 0.1% between that of experimental and theoretical for each concentration. This report also discusses thin film properties, including the electrical conductivity value of each PVA solution against time during the dissolving process.

Penelitian ini merupakan studi pendahuluan tentang sifat-sifat larutan polimer yang mengandung 1, 5 dan 10% polivinil alkohol (PVA). Tingkat polimerisasi dibagi menjadi tiga kategori masing-masing rendah, sedang dan tinggi. Nilai pH dari semua larutan ditemukan hampir serupa, yaitu kisaran 5,0–6,5. Sementara viskositas menunjukkan nilai dengan kisaran 1,20–1985 mPa s tergantung pada konsentrasi dan tingkat polimerisasi. Hasil analisis kandungan padatan yang rendah menunjukkan laju penguraian PVA yang lebih cepat jika dibandingkan dengan yang sedang dan tinggi. PVA larut seluruhnya dalam waktu kurang dari 10, 180 dan 220 menit masing-masing untuk 1, 5 dan 10% dari larutan. Kandungan padat, yang merupakan indikator sifat kelarutan, telah menghasilkan penyimpangan kurang dari 0,1% antara eksperimental dan teoritis untuk setiap konsentrasi. Penelitian ini juga membahas sifat-sifat film tipis, termasuk nilai konduktivitas listrik dari setiap larutan PVA terhadap waktu selama proses pelarutan.

Keywords: *Partially hydrolyzed of Polyvinyl alcohol, polyvinyl alcohol, solid content, thin film, viscosity.*

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Effect of Solvents in the Performance of Cellulose Acetate/Poly(1,4-butylene succinate) Membrane Prepared by Using Phase Inversion Method

Pengaruh Pelarut dalam Kinerja Membran Selulosa Asetat/Poli(1,4-butilena suksinat) yang Dipreparasi dengan Menggunakan Metode Inversi Fasa

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Most of the cellulose acetate (CA) membrane for desalination process was prepared by using the phase inversion method. In this study, CA was modified by poly(1,4-butylene succinate) (PBS) with the addition of PBS was 0–40 wt% of the total material used (CA and PBS). CA/PBS membranes have been prepared by using the phase inversion method with the variation of solvents used. The membrane of CA/PBS was prepared by using dimethylformamide (DMF), N-methyl-2-pyrrolidone (NMP), and tetrahydrofuran (THF), respectively of which each of the solvents was mixed with acetone in the ratio of 50:50. The hydrophilicity of membranes was characterized by using Fourier Transform Infra-Red (FTIR) and water content. Scanning Electron Microscope (SEM) was used to observe the morphology of the membranes. Salt rejection and permeate flux was analyzed to observe membrane performance. The experiment results show no tendency was shown from the results either in its hydrophilicity or permeate flux. The morphology of membranes shows finger-like and sponge-like structures. For all variables of solvents used, salt rejection of membranes increased with the addition of PBS, of which the highest order was obtained from acetone, acetone/NMP, acetone/DMF, and acetone/THF. The best performance of membrane was prepared in acetone CA/PBS 90/10 with the salt rejection of 75% and permeate flux of 1956.52 L/m² h.

Sebagian besar membran selulosa asetat (CA) untuk proses desalinasi dibuat dengan menggunakan metode inversi fasa. Dalam penelitian ini, CA dimodifikasi oleh poli(1,4-butilena suksinat) (PBS) dengan penambahan PBS 0–40% berat dari total bahan yang digunakan (CA dan PBS). Membran CA/PBS dipreparasi menggunakan metode inversi fasa dengan variasi pelarut yang digunakan. Membran CA/PBS dibuat dengan menggunakan dimethylformamide (DMF), N-methyl-2-pyrrolidone (NMP), dan tetrahydrofuran (THF), dimana masing-masing pelarut dicampur dengan aseton dengan perbandingan 50:50. Hidrofilisitas membran dikarakterisasi dengan menggunakan *Fourier Transform Infra-Red* (FTIR) dan uji kadar air. *Scanning Electron Microscope* (SEM) digunakan untuk mengamati morfologi membran. *Salt rejection* dan *permeate flux* dianalisis untuk mengamati kinerja membran. Hasil percobaan tidak menunjukkan kecenderungan baik dalam hidrofilisitas maupun *permeate flux*. Morfologi membran menunjukkan struktur seperti jari dan seperti spons. Untuk semua variabel pelarut yang digunakan, *salt rejection* terhadap membran meningkat dengan penambahan PBS, dimana urutan tertinggi diperoleh dari aseton, aseton/NMP, aseton/DMF, dan aseton/THF. Kinerja membran terbaik didapat dengan preparasi dalam aseton CA/PBS 90/10 dengan *salt rejection* 75% dan *permeate flux* 1956,52 L/m² h.

Keywords: *Cellulose acetate, desalination, membrane, PBS, phase inversion.*

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Modified of Cellulose Acetate/Polyethylene Glycol Membrane by the Addition of Graphene Oxide

Modifikasi Membran Selulosa Asetat/Polietilen Glikol dengan Penambahan Grafena Oksida

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Cellulose acetate (CA) has been known as a polymeric membrane for desalination membrane. Many studies have been attempted to increase its performance. In this study, CA has been blended with polyethylene glycol (PEG) with graphene oxide (GO) was then added into the blended CA-PEG as many as 0, 0.0025, 0.0050, 0.0075, 0.0100, 0.0125 wt.% based on solvent. The hydrophilicity of membranes was analyzed by using Fourier Transformed Infra-Red (FTIR), whereas its morphology was analyzed using Scanning Electron Microscope (SEM). The mechanical property was analyzed by Dynamic Mechanical Analysis (DMA). Membrane's performances were analyzed from their salt rejection, permeate flux, and permeability. The analysis in the area of –OH functional group from FTIR results and water content shows that hydrophilicity of membrane increases with the addition of GO. The morphology of membranes shows a finger-like, and sponge-like structure with the smallest pore size is 0.02 micron, which was achieved from the addition of GO of 0.0050 wt.%. Salt rejection of membrane increases with the addition of GO up to 0.0050 wt.% and further decreased with the increase of GO. The optimal membrane performance was achieved by the addition of GO 0.0050 % with the salt rejection of 82%, permeate flux 626.743 L/m² h, and membrane also exhibits the mechanical property of 180.2 kPa.

Selulosa asetat (CA) telah dikenal sebagai membran polimer untuk membran desalinasi. Banyak penelitian telah dilakukan untuk meningkatkan kinerja membran tersebut. Dalam penelitian ini, CA telah dicampur dengan polietilen glikol (PEG) dengan graphene oxide (GO) kemudian ditambahkan ke dalam campuran CA-PEG sebanyak 0; 0,0025; 0,0050; 0,0075; 0,0075; 0,0100; 0,0125 wt.%. Hidrofilisitas membran dianalisis dengan menggunakan Fourier Transformed Infra-Red (FTIR), sedangkan morfologinya dianalisis menggunakan Scanning Electron Microscope (SEM). Properti mekanik dianalisis oleh Dynamic Mechanical Analysis (DMA). Kinerja membran dianalisis dari salt

rejection, permeate flux, dan permeabilitas. Analisis di bidang gugus fungsi –OH dari hasil FTIR dan kadar air menunjukkan bahwa hidrofilisitas membran meningkat dengan penambahan GO. Morfologi membran menunjukkan struktur seperti jari, dan seperti spons dengan ukuran pori terkecil adalah 0,02 mikron, yang dicapai dari penambahan GO sebesar 0,0050% berat. Salt rejection terhadap membran meningkat dengan penambahan GO hingga 0,0050% berat dan semakin menurun dengan meningkatnya GO. Kinerja membran optimal dicapai dengan penambahan GO 0,0050% dengan salt rejection 82%, permeate flux 626,743 L/m² h, dan membran juga menunjukkan sifat mekanis sebesar 180,2 kPa.

Keywords: *Cellulose acetate, desalination, grafting, graphene oxide, membrane.*

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Degradasi Lignin dan Selulosa dari Jerami Padi dengan Proses Ozonasi*Degradation of Lignin and Cellulose from Rice Straw using Ozonation Process**Indonesian Polymer Journal 22 (2) 2019: 21–25*

Limbah jerami padi merupakan produk samping hasil pertanian yang jumlahnya sangat besar dan belum dimanfaatkan secara optimal di Indonesia. Beberapa penelitian telah mempelajari proses degradasi biomassa untuk menjadi bahan yang lebih berguna dengan berbagai metode. Salah satu metode yang dapat digunakan untuk mendegradasi biomassa adalah dengan proses ozonasi karena proses yang ramah lingkungan. Penelitian ini bertujuan untuk mendegradasi kandungan lignin dan selulosa yang terdapat pada jerami padi untuk menghasilkan produk turunan yang memiliki banyak aplikasi dan bernilai ekonomis baik di bidang pangan maupun farmasi. Penelitian dilakukan di dalam reaktor *semi-batch* berpengaduk dengan mencampur jerami padi dan larutan asam dan mengalirkan ozon ke dalam campuran selama waktu dan suhu tertentu dengan proses pengambilan sampel setiap 30 menit. Hasil penelitian menunjukkan bahwa jumlah lignin menurun dengan semakin lamanya waktu reaksi. Kecenderungan hasil tersebut berkebalikan untuk variabel suhu reaksi. Penurunan suhu reaksi ozonasi justru menurunkan jumlah lignin di jerami padi karena proses degradasi yang semakin baik. Hal yang sama juga dialami oleh selulosa pada jerami padi. Jumlah selulosa menurun dengan lamanya proses ozonasi pada suhu yang rendah. Penurunan jumlah lignin dan selulosa dalam jerami padi optimum terjadi pada suhu ozonasi 20 °C baik untuk pH 4 maupun pH 9. Produk degradasi yang dapat diperoleh dan dianalisa pada proses ozonasi jerami padi antara lain produk glukosa, fruktosa dan sukrosa.

Rice straw waste is an agricultural by-product in large quantities and has not been optimally utilized in Indonesia. Several research has studied the biomass degradation process to produce a more valuable product through various methods. One of the degradation methods that can be used to degrade biomass is the ozonation process because of the environmentally friendly process. This research aims to degrade the lignin and cellulose content in rice straw to produce valuable products that have many applications both in the food and pharmaceutical industries. The research was carried out in a stirred semi-batch reactor by reacting rice straw fiber on the acid solution with ozone during a period of time and a certain temperature. The results showed that the amount of lignin and cellulose decreased in line with prolonged time. The decrease in ozonation temperature was also reducing the amount of lignin and cellulose in rice straw because of the better degradation process. The decrease in lignin and cellulose content was achieved at 20 °C for both pH 4 and pH 9 of the system. The degradation products that can be obtained and analyzed in the process of rice straw ozonation were including glucose, fructose, and sucrose.

Keywords: Degradasi, jerami padi, lignin, ozonasi, selulosa.