Pengaruh lama proses milling dan jenis hardener terhadap distribusi sifat-sifat pelat bipolar PEMFC berbasis komposit grafit/epoksi = The influence of milling process and variation of epoxy hardener on the distribution of properties of bipolar plate PEMFC based on graphite/epoxy

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Abstrak

ABSTRAK
Penelitian ini membahas tentang pengaruh lama proses milling dan penggunaan jenis hardener yang berbeda pada distribusi konduktivitas listrik dan sifat mekanis komposit pelat bipolar Grafit/Epoksi untuk aplikasi PEMFC. Komposisi material yaitu 75 wt% grafit sintetis (Merck®) dan 5 wt% carbon black (CB) hasil karbonisasi serat kelapa dan 20 wt% epoksi resin (bisphenol A ® + Polyamino Amide dan bisphenol A ® + Cycloaliphatic amine) sebagai binder. Pelat bipolar dipreparasi menggunakan milling dengan media air menggunakan ball mill lalu dicetak menggunakan proses cetak panas. Proses milling dilakukan selama 1, 2, 3 dan 4 hari. Proses pencetakan dilakukan menggunakan mesin single stroke compression molding. Tekanan, suhu proses, dan waktu berturut-turut ialah 55 MPa, 100oC, dan 4 jam. Hasil menunjukkan kekuatan fleksural tertinggi terdapat pada sampel hasil milling 4 hari sebesar 44.8 MPa sementara densitas dan prositasnya ialah 3.012 gr/cm3 dan 0.665 %. Konduktivitas listrik material tertinggi terdapat pada formula F4 (milling 4 hari) yaitu sebesar 8.13 S/cm. Proses milling diketahui merupakan faktor utama yang mempengaruhi sifat pelat bipolar. Hal ini dikarenakan air meningkatkan distribusi grafit dan CB serta mampu mencegah terbentuknya aglomerasi. Pengaruh penggunaan hardener yang berbeda viskositasnya diketahui mampu meningkatkan konduktivitas listrik material pelat bipolar sebesar 15 S/cm pada sampel FX5 (100% hardener viskositas rendah). Sebaliknya, penambahan hardener viskositas rendah pada sistem komposit pelat bipolar menurunkan kekuatan mekanis material dari 44.75 MPa (0% hardener viskositas rendah) menjadi 29.5 MPa (100% hardener viskositas rendah) sementara densitas dan porositasnya ialah 2.962 g/cm3 dan 0.670 % untuk formula 0% hardener viskositas rendah, 2.548 g/cm3 dan 0.988 % untuk formula 100% hardener viskositas rendah.
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ABSTRACT
An investigation is made of influences of milling time and different types of hardener to the distribution of electrical and mechanical properties of Carbon/Epoxy composites as bipolar plate in proton-exchange membrane fuel cells (PEMFC). The material composition of bipolar plate was 75 wt% synthetic graphite (Merck®) and 5 wt% carbon black (CB) from carbonization of palm oil fibers with epoxy resin (bisphenol A ® + Polyamino Amide and bisphenol A ® + Cycloaliphatic amine) as binder in the amount of 20 wt%. Bipolar plate were prepared by compounding using water as grinding media in ball mill and followed by compression molding. Ball milling is performed both for

mixing and milling process, this process was carried out for 1, 2, 3 and 4 days. The compounding method was conducted using single stroke compression molding machine. The process parameters, such as pressure and temperature, were set respectively 55 MPa for 4 hours at 100oC. The results indicate that there is an optimum range of milling time (3-4 days) with respect to the distribution profile of electrical conductivity and mechanical properties of bipolar plate. The highest flexural strength was 44.8 MPa whilst the density and porosity of the bipolar plate respectively were measured 3.012 gr/cm3 and 0.665 %. Bipolar plate have resulted relatively low electrical conductivity up to 8.13 S.cm−1 but it shows good distribution in all area along the plate. The grinding process was found as one major factor affecting the properties of bipolar plate. Since water acts as grinding media to increase uniformity and distribution of graphite and CB during grinding process and also act as an agent to prevent agglomeration. The effect of using different types of hardener was found can improve the conductivity up to 15 S/cm. On the other hand, the flexural strength and % deflection were reduced in the presence of low viscosity hardener, from 44.75 MPa (0%wt low viscosity hardener) to 29.5 MPa (100%wt low viscosity hardener) whilst the density and porosity of the bipolar plate respectively were measure 2.962 g/cm3 and 0.670 % for formula 0%wt low viscosity hardener, 2.548 g/cm3 and 0.988 % formula 100%wt low viscosity hardener.