OPTIMISATION OF RECYCLED POLYPROPYLENE REINFORCED WITH OIL PALM EMPTY FRUIT BUNCH (OPEFB) AND FLY ASH FOR ENHANCEMENT OF THERMAL AND FLAME-RETARDANT PROPERTIES

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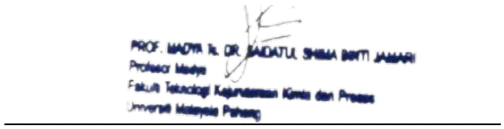

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ABSTRAK

Kesedaran terhadap penjagaan alam sekitar dengan menggunakan bahan mesra alam telah meningkat diseluruh dunia. Perkara ini disebabkan oleh sumber minyak yang tidak kekal lama untuk menghasilkan produk berasaskan sintetik / petroleum untuk digunakan untuk jangka masa panjang. Di samping itu,sisa buangan yang tidak dikitar semula hasil dari polipropilena (RPP), abu terbang (FA), tandan buah kosong kelapa sawit (OPEFB) telah menyebabkan masalah besar bagi alam sekitar. Oleh itu, menghasilkan produk mesra alam dari sisa buangan ini adalah sesuatu yang baru untuk mengatasi masalah kekurangan sumber asli. Kebarangkalian untuk mendapatkan nisbah campuran yang betul telah diselidiki dalam kajian ini. Komposit. Penyelidikan ini dimulakan dengan melakukan pra-rawatan terhadap OPEFB dan FA. Pra-rawatan alkali dilakukan dengan menggunakan natrium hidroksida dengan kepekatan 1,2,3,4 dan 5 wt / v% pada OPEFB dan 5,10,15 dan 20 wt / wt% untuk FA. Masa rendaman yang digunakan untuk merawat gentian ialah (99 minit), dengan nisbah gentian kepada larutan 1:20 (5g dalam 100ml) dengan menggunakan mandian ultrabunyi (CREST-Ultrasonics) pada 80°C. Abu terbang itu direndam dalam larutan NaOH pada suhu bilik (27°C) dan dikacau selama kira-kira 30 minit pada 750 rpm menggunakan Plat Panas Kacau KEGEMARAN (HS0707V2). Nisbah abu terbang kepada natrium hidroksida yang digunakan ialah 1:1.2. (untuk pengaktifan abu terbang). Rawatan alkali dilakukan pada OPEFB untuk membuat perubahan permukaan gentian dan penghapusan silika untuk pembesaran liang. Sementara itu, perubahan permukaan FA seperti luas permukaan, diameter pori dan isipadu pori diukur untuk pengubahsuaian FA. Polipropilena cantuman anhidrida maleik (MAPP) digunakan sebagai agen gandingan polibond untuk pertambahbaikan ikatan antara gentian dan matrik. Beberapa analisis seperti Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy-Energy Dispersion X-Ray (SEM-EDX), Barret-Joyner-Halenda (BJH) dan Brunauer-Emmett-teller (BET) telah digunakan untuk menentukan isipadu kepekatan alkali yang optimum dalam pengubahsuaian permukaan gentian. Seterusnya, komposit dikompaun dan dibentuk dengan menggunakan mesin penyemprot, mesin tekan panas dan sejuk. Komposit ini disediakan dengan pelbagai nisbah RPP, FA, OPEFB dan MAPP dengan menggunakan perisian Design of Experiment (DOE). Beberapa analisis seperti Scanning Electron Microscopy-Energy Dispersion X-Ray (SEM-EDX), Thermogravimetric Analysis (TGA), kekuatan tegangan (ASTM D3039), Indeks Oksigen Terhad (ASTM D2863) dan ujian Pembakaran Mendatar (UL94HB) akan digunakan untuk dapatkan sifat terma, mekanikal dan nyalaan. Rumusan optimum gentian tambahan yang telah dipilih untuk membuat komposit adalah 5wt/v% OPEFB dan 20wt/wt% FA. Rumusan campuran optimum komposit ini didasarkan pada tindak balas analisis termal dengan menggunakan perisian Design of Experiment (DOE) yang OPEFB: RPP: FA: MAPP (1.24:59.79:32.00:7.00). Sifat mekanikal telah dipertingkatkan dengan tegasan maksimum 20.53MPa, kepekaan daya pecah 2026.73N, kekuatan tegangan 2.48Mpa, kepekaan daya pecah 349.83N. Manakala bagi ujian kemudahbakaran, komposit dikelaskan sebagai bahan pemadam sendiri dengan ujian UL94HB.Formulasi polipropilena kitar semula dengan tambahan gentian seperti OPEFB dan FA dipercayai mempunyai potensi dalam mengantikan gentian sintetik untuk penghasilan penebat bangunan yang kalis api.

ABSTRACT

The rapid growth of environmental awareness in using environmentally friendly materials has been increased worldwide. This matter is triggered by the unsustainability of petroleum sources to produce synthetic/petroleum-based products for prolonged use. In addition, the disposal, recyclable, and non-utilised of the wastes generated by polypropylene (RPP), fly ash (FA), oil palm empty fruit bunch (OPEFB) have caused the major problem for the environment. Hence, making eco-friendly products from these wastes is a new platform to produce sustainable products for the future. The possibility of mixing the right ratio to make a good flame-retardant composite was studied in this research work. This research was conducted by performing the pre-treatment of the fillers, which are OPEFB fibre and FA. The alkaline pre-treatments were performed by using sodium hydroxide with concentrations of 1,2,3,4 and 5 wt/v% on OPEFB and 5,10,15 and 20 wt/wt% for FA. The soaking time used to treat fiber were (99 minutes), with fiber to solution ratio 1:20 (5g in 100ml) by using ultrasound bath (CREST-Ultrasonics) at 80℃. The fly ash was submerged in NaOH solution at room temperature (27°C) and stirred for about 30 minutes at 750 rpm using FAVORITE Stirring Hotplate (HS0707V2). The fly ash to sodium hydroxide ratio utilised was 1:1.2. (for fly ash activation). The alkaline treatments were conducted for OPEFB fibre to make the changes on the fibre surface and elimination of silica for pore enlargement. In the meantime, FA changes were monitored for alteration of the FA surface, such as the surface area, pore diameter, and pore volume. The maleic anhydride grafted polypropylene (MAPP) was employed to enhance the interfacial connection between the fillers and the matrix as a combined poly bond agent. A few analyses were used to determine the ideal results of the alkaline concentration used to modify the fillers of the surfaces, such as Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy-Energy Dispersion X-Ray (SEM-EDX), Barret-Joyner-Halenda (BJH), and Brunauer-Emmett-teller (BET). Next, the composite preparation was compounded and moulded by using extruder, hot and cold press machines. The composites were prepared with various ratios of RPP, FA, OPEFB, and MAPP by using Design of Experiment (DOE) software. Few analyses such as Scanning Electron Microscopy-Energy Dispersion X-Ray (SEM-EDX), Thermogravimetric Analysis (TGA), tensile strength (ASTM D3039), Limited Oxygen Index (ASTM D2863), and Horizontal Burning test (UL94HB) were used to obtain the thermal, mechanical and flame properties. The optimum result of fillers selected for composite preparation was 5w/v% of OPEFB and 20w/w% of FA. The optimum blend formulation of this composite was based on the thermal analysis response by using Design of Experiment (DOE) software which was OPEFB:RPP:FA: MAPP (1.24:59.79:32.00:7.00). The mechanical properties were improved with maximum stress 20.53MPa, break force sensitivity 2026.73N, tensile strength 2.48Mpa, break force sensitivity 349.83N. Meanwhile for the flammability test, the composite was classified as self-extinguishing material with UL94HB test. Formulation of compatibilised recycled polypropylene reinforced with OPEFB and FA on thermal and flame-retardant is thought to have the potential to replace synthetic fibre in building insulation.

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