GRAFTING OF OPMF VIA EXTRUSION

NABILAH SYAHEERA BINTI JUMAHADI, MADAM SUHAIZAH BINTI HANIPAH

Faculty of Chemical Engineering, Universiti Teknologi Mara, 40450 Shah Alam, Selangor

***Abstract*— Experimental investigation was conducted to study to study the mechanical properties of grafted Oil Palm Mesocarp Fiber (OPMF) and employ grafting extrusion. To improve the interfacial Oil Palm Mesocarp Fiber (OPMF) were grafted using peroxide and anhydride. The extrusion are done using twin screw extruder was proposed with Di-cumyl Peroxide as initiator and Maleic Anhydride. The mechanical test such as Flexural Test and Tensile test are done using Universal Testing Machine while chemical bonds are identified using Fourier Transform Infrared Spectroscopy (FTIR) .**

Keywords*— *Extrusion, Oil Palm Mesocarp Fiber, Grafting, Natural Fiber

I. Introduction

What is Fiber? Fiber is material made from two or more constituent materials with significantly different physical or chemical properties that is called composite, when combined, produce a material with characteristics different from the individual components. The individual components remain separate and distinct within the finished structure. (Pickering, Efendy et al. 2016)

Oil Palm Mesocarp Fiber (OPMF) usually used as biomass fuel for a steam boiler due to its porous nature. Company also can reduce their cost and reduce the toxic emissions compare to fossil fuel as a fuel. Oil Palm Mesocarp Fiber also non-toxic because oil pam extraction does not use any chemical at all. Oil palm extraction only involve physical process. (Teh, Neoh et al. 2014)

A graft copolymer consists of a polymeric backbone with covalently linked polymeric side chains. In principle, both the backbone and side chains could be homopolymers or copolymers. Grafting can be carried out with properties of the side chains can be added to those of the substrate polymer without changing the latter. (Pickering, Efendy et al. 2016)

But with other types of grafting, the crystalline nature of the cellulose, for example, can be largely destroyed. This releases the natural absorbency of cellulose as well as adding that of the hydrophobic side chains leading to very high water absorbency.

This work is an attempt to modify OPMF with a good chemical reagents and simple technique which is grafting for use as a good reinforcement in developing lightweight and low cost. The aim of this work is to rationalize the effects of grafting on the mechanical and chemical properties of polymer-grafted oil palm fibers.

II. METHODOLOGY

A. Materials

Oil palm mesocarp fibers were collected from Jugra Palm Oil Mill, Banting, Malaysia. All chemical were used without further purification. All equipment used in experiment are from Polymer Laboratory (UiTM Shah Alam). The fibers were kept in an environmentally controlled condition of -20 ^{o}C to avoid the growth of fungus.

Linear low-density polyethylene is a linear polymer (polyethylene) with significant short number of chain. LLDPE is made by copolymerization of ethylene with longer chain olefins with lower operating temperature and pressure compare to production of LDPE (low-density polyethylene). LLDPE has low molecular weight with different rheological (qualitative and quantitative between deformation and stress).

Last but not least, the other chemicals are involved are Dicumyl peroxide and Maleic Anhydride. Dicumyl peroxide IUPAC name or also known as 2-(2-phenylpropan-2-ylperoxy)propan-2-ylbenzene. Usually it's exists in white powder with unique smell form. And it's also got high boiling point compare to water which is 130^{0}C and 39^{0}C respectively.

While Maleic Anhydride is an organic compound or known as Furan-2,5-dione. Maleic Anhydride physical properties also similar like Dicumyl Peroxide, usually in forms of white powder with strog unique smell. Usually it is produced in ndustrial scale for application in coatings and polymers.

Oil palm mesocarp fiber washed thoroughly and put inside the oven for 24 hours to make sure it's completely dry. After that oil palm mesocarp fiber mixed with the anhydride and peroxide. After that, that mixing will be grafted using twin screw extruder and compressed it using hot press with suitable condition.

Grafted oil palm mesocarp fiber characterized using a Fourier Transform Infrafed (FTIR) analysis where the spectra was recorded in range 500-4000 cm

On the other hand, tensile strength was measured using Tinius Olsen H50KT universal tester machine. One sample was repeatedly five times to get a constant result. Flexural test also done using the same equipment and method.

III. RESULTS AND DISCUSSION

A. Composition and FTIR test

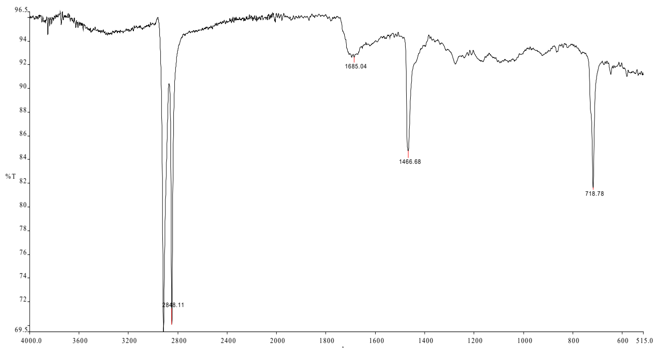

Fig. 1: Sample 1 (OPMF 10% LLDPE 80%)

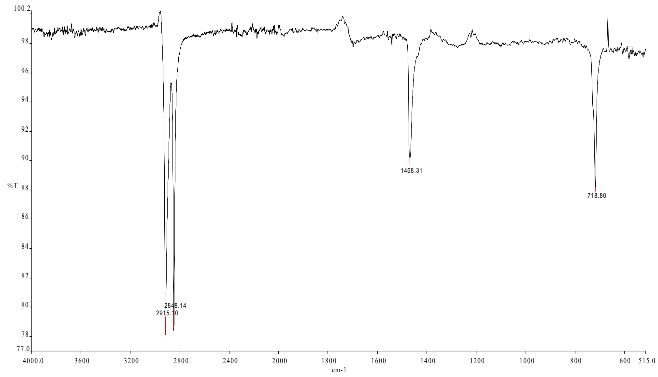

Fig. 2: Sample 2 (OPMF 20% LLDPE 70%)

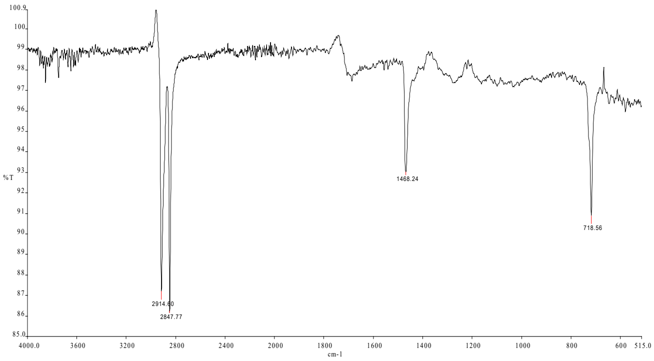

Fig. 3: Sample 3 (OPMF 30% LLDPE 60%)

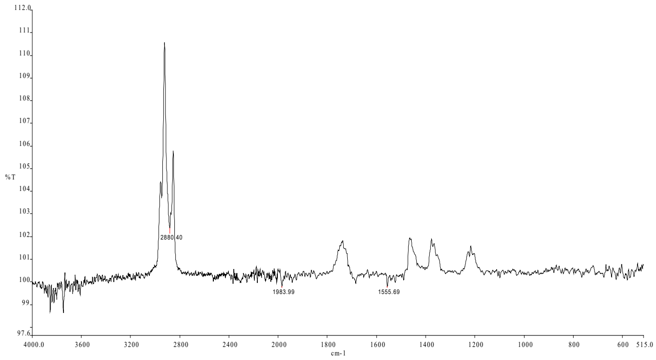

Fig. 4: Sample 4 (OPMF 40% LLDPE 50%)

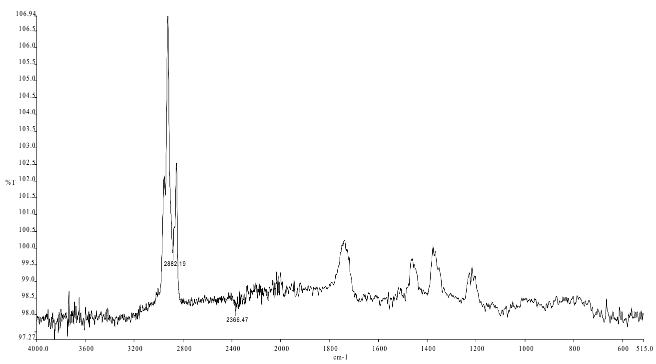

Fig. 5: Sample 5 (OPMF 10% LLDPE 78%)

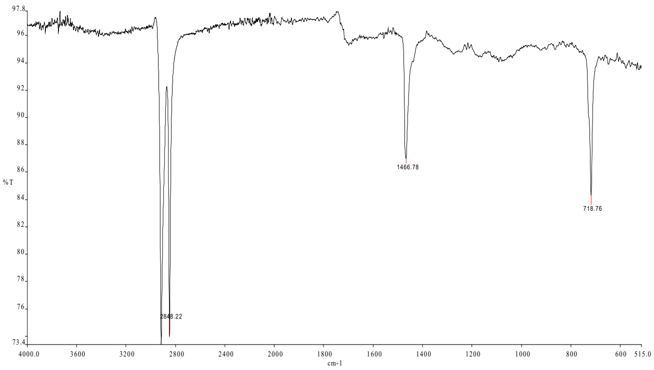

Fig. 6: Sample 6 (OPMF 20% LLDPE 68%)

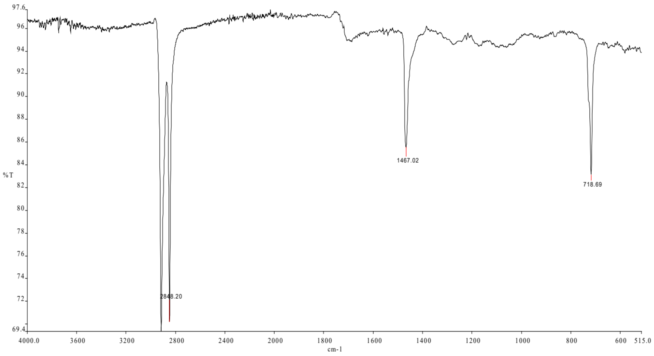

Fig. 7: Sample 7 (OPMF 30% LLDPE 58%)

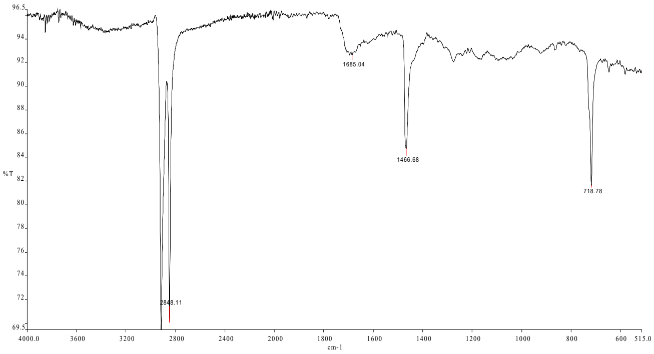

Fig. 8: Sample 8 (OPMF 40% LLDPE 48%)

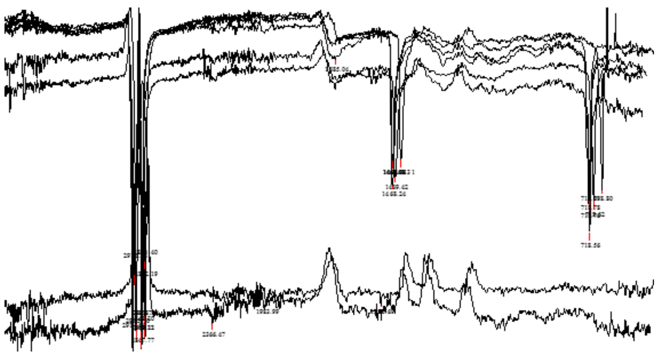

Fig. 9: All sample combined

The FTIR spectra for the grafter OPMF is represented by figure 1 to figure 8, where the peaks curves at the bend 2880.40 - 2882 cm^{-1} are attributed to aldehyde and ketone such maleic anhydride.

B. *Tensile Test*

Tensile test on biocomposite pellet were performed in room temperature using Tinius Olsen H50KT Universal testing machine at a cross head speed of 5 mm/min. Several specimes were tested for standard deviation.

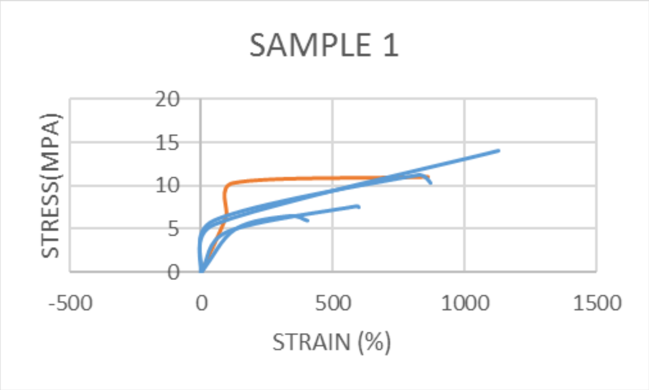

Fig. 10: Sample 1 (OPMF 10% LLDPE 80%)

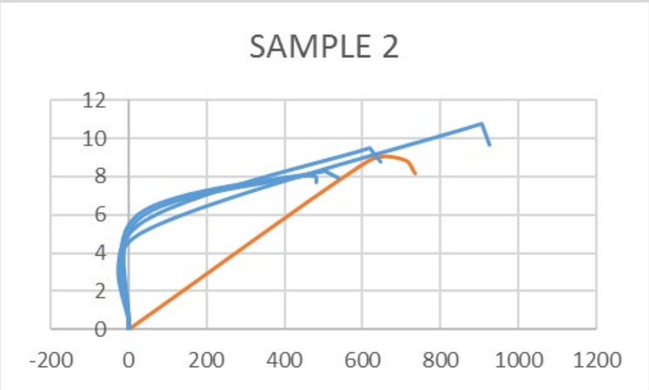

Fig. 11: Sample 2 (OPMF 20% LLDPE 70%)

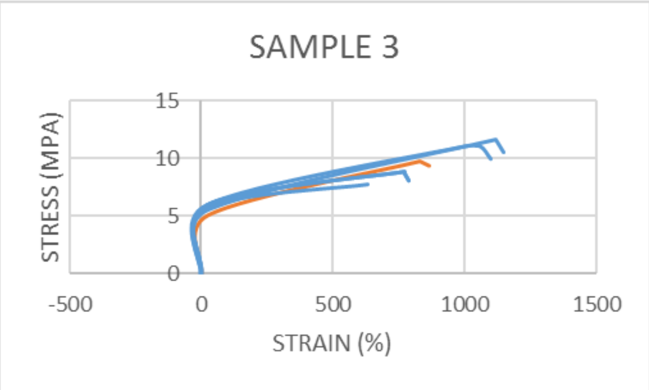

Fig. 12: Sample 3 (OPMF 30% LLDPE 60%)

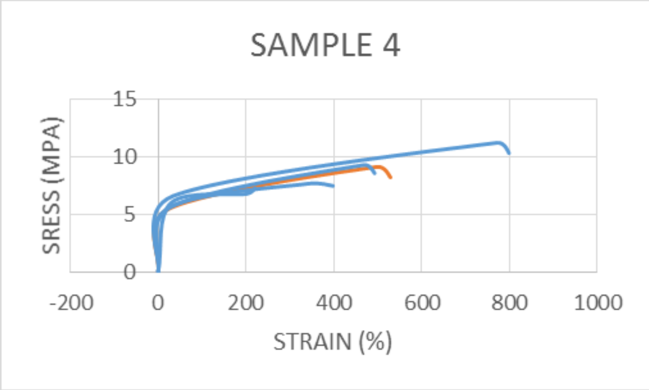

Fig. 13: Sample 4 (OPMF 40% LLDPE 50%)

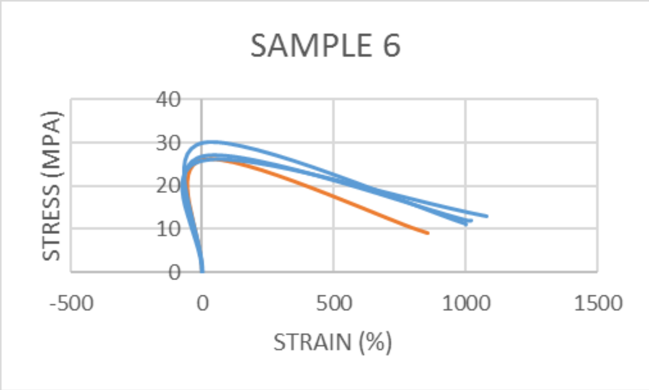

Fig. 14: Sample 6 (OPMF 20% LLDPE 68%)

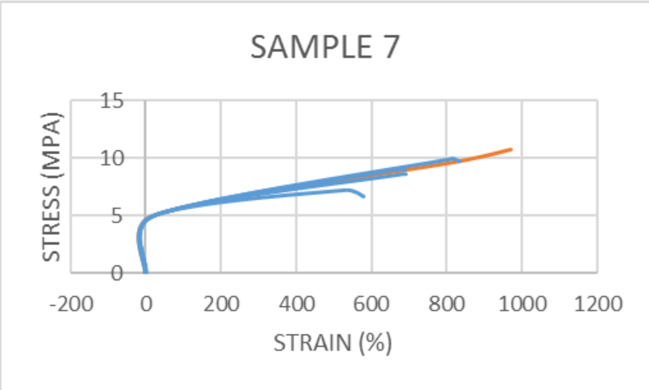

Fig. 15: Sample 7 (OPMF 30% LLDPE 58%)

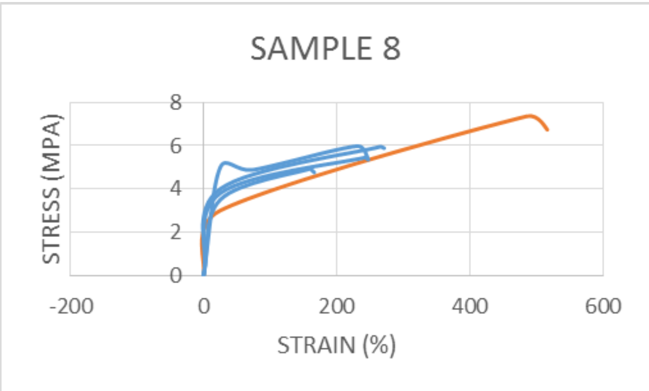

Fig. 16: Sample 8 (OPMF 40% LLDPE 48%)

We can say that when we increasing the OPMF and decrease the LLDPE

IV. Conclusion

Grafting of Oil Palm Mesocarp Fiber was successfully conducted and also can be characterized using mechanical behavior (Tensile strength) and chemical bonds. Fourier Transform Infrared (FTIR) showed anhydride bodies on the surface and cell wall structure within the cross section of the fiber.

FTIR spectra of OPMF, LLDPE, Maleic Anhydride and Dicumyl Peroxide by extrusion method are presented in Fig. 9. The grafted fiber shows an additional peak at 2880.40 - 2882 cm^{-1} due anhydride group of the grafted maleic anhydride indicating that the poly (AN) chains are chemically bonded to the Oil Palm Mesocarp Fiber.

The amount of fiber and LLDPE is one of the most important factors affecting the mechanical properties of Grafted Oil Palm Mesocarp Fiber. For example, the mechanical strength of grafted OPMF can reach 10 MPa with OPMF 10% LLDPE 80% however, at OPMF 40% LLDPE 50%, the tensile strength may be below 6 MPa

Acknowledgment

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