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13th Joint Conference on Chemistry (13th JCC) IOP Conf. Series: Materials Science and Engineering 509 (2019) 012080 IOP Publishing doi:10.1088/1757-899X/509/1/012080 1 Effect of alkalinization-bleaching and acid hydrolysis treatment stalk sweet sorghum waste on compatibilities in polypropylene matrix Evana Yuanita1,2,a, Anandiza Yoga Pratama1,b, Herald Kurnia1,c, Elvi Kustiyah1,3,d, Ismojo1,4,e, Mochamad Chalid1,f 1 Department of Metallurgy and Materials Engineering, Universitas Indonesia, Kampus Baru UI Depok, Depok 16424, West Java – Indonesia 2 Balai Besar Kimia dan Kemasan, Badan Penelitian dan Pengembangan Industri- Kementerian Perindustrian, Jalan Jenderal Gatot Subroto Kav.

52-53, Jakarta 12950, DKI Jakarta – Indonesia 3 Chemical Engineering, Universitas Bhayangkara Jakarta Raya 2nd Campus, Bekasi 17121, Jawa Barat – Indonesia 4 Department of Automotive Mechanical Engineering diploma III, Institute Technology Indonesia, ITI, Tangerang Selatan, Serpong, E-mail: a evana.y@kemenperin.go.id, b anandizayoga@yahoo.com, c kurnia.herald@gmail.com, d elvikustiyah@gmail.com, e ismojo72@gmail.com, f chalid@metal.ui.ac.id Abstract.

In this study, the effect of different chemical modifications of stalk sweet sorghum waste on compatibilities in polypropylene matrix has been discussed. Chemical treatments include alkalization-bleaching and alkalization-bleaching-acid hydrolysis treatments. The treatment was objective to improve the surface properties of the sorghum fibre and compatibilities in synthetic polymer matrix.

Evaluation of the effect of different chemical modifications was measured with field-emission scanning electron microscope (FE-SEM) and tensile properties. The results showed that the compatibility and tensile strength of composite fibre

alkalinization-bleaching treatment were better than untreated composites. Keywords: Polypropylene, sorghum fibre, alkalinization, bleaching, acid hydrolysis, tensile strength 1.

Inti Polymer matrix composite (PMC) with natural fibre as reinforced is rapidly growing in the last decade. Natural fibre, especially in South Asia, such as oil palm fibre, sugar palm fibre, kenaf, pineapple, ramie, bamboo etc., have been explored as a source of cellulosic fibre and more often applied as the reinforcement of composites [1-6].

Sorghum has been developed in Indonesia and can become a great potential as industrial raw such as sugar ants, amino acids, starch and the Ministry of Research and Technology put in the 4th range of their Roadmap Program in food security after rice, corn and soybean in 2011. Moreover, sorghum has higher cellulose and lower lignin content than bagasse and rice straw [7].

Based on this facts, stalk sweet sorghum waste will be abundant in supply and become cellulose resources which can be valorised as polymer reinforcement. Unfortunately, natural fibre is hydrophilic and could ingest a lot of water. The 13th Joint Conference on Chemistry (13th JCC) IOP Conf. Series: Materials Science and Engineering 509 (2019) 012080 IOP Publishing doi:10.1088/1757-899X/509/1/012080 2 water absorption would weaken the interface between natural fibre dan polymer matrix [8].

Due to this reason, natural fibre has to be treated before applied as polymer reinforcement. Some effort has been done to modify and treat stalk sweet sorghum in order to have good interface bonding between fibre and polymer [7, 9, 10]. This paper investigated the compatibilities of stalk of sweet sorghum in polypropylene matrix and more extensive study to observe the influence of chemical treatment to the fibre. 2. Experient Secton 2.1. Material Stalk of sweet sorghum was purchased from local market in Bogor.

Sodium hydroxide (NaOH) in pellet form, acetic acid (CH3COOH), sodium chlorite (NaClO2) and sulphuric acid (H2SO4) was purchased from Merck. 2.2. Methods 2.2.1. Fibre Preparation. The stalk of sweet sorghum was firstly cut, crushed and then sieved until passing 40 mesh size screen. Secondly, alkalinisation process was prepared by immersed sorghum fibre in 10% NaOH solution for 2 hours. Thirdly, the bleaching process was carried out with a 1.7% NaClO2 solution and CH3COOH as buffer for 4 hours and then the acid hydrolysis treatment was processed with 25% H2SO4 solution for 1 hour.

Finally, the fibre was dried at room temperature and prior to composite preparation.

2.2.2. Composite Preparation. Composite preparation was performed by adding fibre 5% volume to matrix by hot melt mixing method. The mixing used double screw rheomix (Haake Polylab System) at 100 rpm, 165°C for 20 minutes.

And then, the composite was ready to be characterized by FESEM (FEI INSPECT F50) and universal tensile machine (UTM), respectively. 3. 3.1. Composite morphology Stalk of sweet sorghum without and with two different chemical treatments was selected with the aim to study the effect of alkalinization-acid bleaching and hydrolysis treatment on compatibilities in polypropylene (PP) matrix.

The investigation was performed by observing morphology on the PP- untreated sorghum fibre (SV), PP-sorghum alkalinization-bleaching (AB) and PP-sorghum alkalinization-bleaching-acid hydrolysis (ABH) as shown on Fig. 1. Fig. 1a shows poor adhesion between PP and untreated sorghum implying low compatibility between them. Untreated sorghum fibre (SV) still had impurities on the fibre surface, cannot wet each other which cause incompatibility with polymer matrix as demonstrated at previous research [11-14]. Better adhesion can be seen on Fig. 1b and 1c.

Chemical treatment has reduced the amount of hydrophilic component in fibre, matrix and fibre had better wetting characteristic because the compatibility between PP and treated sorghum was improved. To observe in detail, the different effect between AB and ABH, which one the more effective and give better effect to the compatibility, PP-sorghum alkalinization acid bleaching (AB) and PP- sorghum alkalinization acid bleaching hydrolysis (ABH) are subjected to mechanical properties testing.

Mechanical behaviour which was associated with polymer matrix and natural fibre compatibility has been studied by [13, 15]. 13th Joint Conference on Chemistry (13th JCC) IOP Conf. Series: Materials Science and Engineering 509 (2019) 012080 IOP Publishing doi:10.1088/1757-899X/509/1/012080 3 Figure 1. FESEM image of morphology on PP matrix with a) SV, b) AB, and c) ABH. 3.2.

Mechanical Properties Further study was needed to investigate the effect of chemical treatment and compared the treatment between alkalinization acid bleaching and alkalinization acid bleaching hydrolysis. Tensile strength testing was expected could explain which the chemical treatment gave better adhesion. Fig. 2 implies that PP-sorghum AB has higher tensile strength than the others.

It can be inferred that sorghum with alkalinization acid bleaching more effective to treat the fibre not only more compatible but also give reinforcement effect to the composite. It possible to explain that AB treatment is adequate to modify fibre surface.

Alkalinization treatment has function to remove impurities especially wax on fibre surface, the binding materials such as pectin, lignin, and hemicellulose have been released from the fibre [7, 14]. And then, bleaching has removed lignin and hemicellulose more effective by oxidation as confirmed by [7, 11].

Unfortunately, hydrolysis treatment has given unfavourable result. PP with fibre which was treated by hydrolysis after acid bleaching gave worse mechanical properties than PP with fibre was treated by alkalinization followed by acid bleaching. It can be explained that hydrolysis treatment has attacked the cellulose chains.

Hydronium ion from sulphuric acid cause hydrolytic cleavage of glycoside bond [16]. Figure 2. Tensile strength of PP-sorghum. 4. In this study, the effect of different chemical modifications of stalk sweet sorghum waste on compatibilities in polypropylene matrix has been investigated. Morphology and mechanical testing showed that fibre with alkalinization followed by bleaching treatment more effective to give reinforcement effect to the polymer matrix. We appreciate and thank for the support from DRPM UI through its program PIT9-2019 Grant Scheme which makes this research possible.

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