

Investigation on Physical and Mechanical Properties of WPC from Corn stalk (Lignocellulosic Fiber) and HDPE

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Summary: This study has tried to use HDPE and the coupling agent consistent MAPP and cornstalk fibers, create wood plastic composite material and its physical and mechanical properties such as tensile modulus, flexural modulus and humidity absorption is measured. After determining the percentage of 20, 30 and 40% of corn stalk fibers in the product and the use of two longitudinal mesh levels of 40 and 80 of them and using the 5% MAPP coupling agent testing was done and it was shown that increasing fiber length and percent increase in product humidity is absorbed. This is while the declines by increasing the fiber length changes of samples were during the tensile tests. In the bending test also increased fiber length and flexural modulus was increased.

Keywords: cornstalk; physical and mechanical properties; wood plastic composite

Introduction

Structural products are generally categories in 3 groups: 1. Particulate-Composites 2. Fiber-Composite and 3. Network-Composites. Composite properties influenced the properties of components, their distribution and interaction between them. Therefore, composites described as a system, must be defined phase diagram amplifier. In general, the overall properties of composite additives are creating at the two types of changes: 1. Change causes physical and mechanical properties are the main material. 2. Change cause process making sense is original material properties. Wood plastic composites (WPCs), which are defined as composite materials containing wood (in various forms such as wood flour and fiber, kenaf fiber, hemp etc) and thermoplastic materials (e.g. polyethylene, polypropylene

etc.), are a relatively new family of composite materials. WPCs are becoming more and more commonplace and are also gaining considerable popularity in the world.^[4]

Material and Methods

In this study, high density polyethylene (HDPE) 0.96 g/cm³ and melt flow indices 18 g/10 min (MFI) as granules were prepared. Cornstalk flour, corn fields as well as farm research and to reform the institution as a filler seeds from Karaj province corn farms, between the two phases of consistent visitors maleic anhydride (MA) to 5 percent of amount weight as granules. The samples tests based on 40 and 80 mesh then 20, 30 and 40 weight percentages were classified. Pit parenchyma tissue of the corn stalk fibers separating manually to become a much smaller number were used laboratory mill. While the hydroxyl groups of fibers existence the material is wet, it should be dried at 85 °C for 24 h. After draying material weighted on a digital scale, built mixed presented treatments by an internal

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Table 1.

Analysis of variance of independent variables and length of fiber.

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square
FACTOR (20%, 30%, 40% Fibers in WPC)	Tensile Modulus, MPa	198292.111	2	99146.056**
BFACTOR (Mesh 40, Mesh 80 of fibers in WPC)	Tensile Modulus, MPa	4050.000	1	4050.000 ^{ns}

**In the 1% level, are different (Treatments with 99% made different).^{ns}In the 5% level, are different (Treatments with 95% made different).

mixer with 50 g tank capacity with 180 °C temperature for 8 minutes with 60 rpm of the twin rotors. The samples pressed by a heat press at 180 °C for 2 minutes and 6 MPa pressure. Impression pressing took by hand to form the samples for tensile and flexion tests. After completing the mechanical tests, humidity absorption as well as three long immersion in water for 2, 24 hours and also aligned for 432 hours at climatization chamber with 25 °C and humidity 60% measured. Finally to clarify the quality and amount of mineral materials and ash was survived Thermo gravimetric analysis test paid to the analysis result. The results were studied with variance analysis test followed by Duncan test.

Results and Discussion

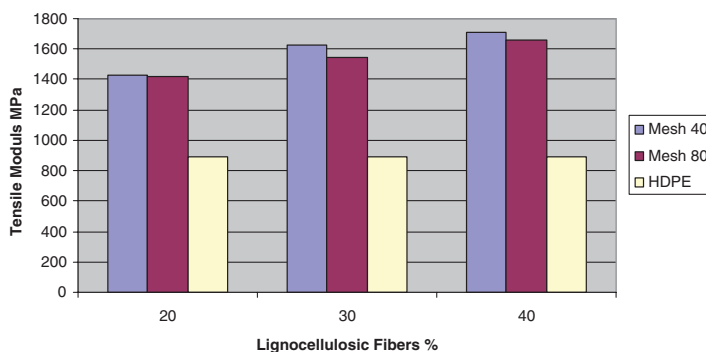
Tensile Test

The results indicate a significant effect on the fiber tensile modulus changed, but the fiber length of 40 to 80 mesh did not change significantly (Table 1).

Flexural Test

Flexural test results indicate flexural modulus increased with increasing fibers length and amount of fibers. These changes in unrelative mode are significant (Table 2).

On the other hand this effect will not be significant when the interaction variables such as length and the percentage of flexural modulus of elasticity are applied, (Figure 2).

**Figure 1.**

The interaction of fiber length and tensile modulus.

Table 2.

Independent effects of fiber length and the flexural modulus.

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square
A FACTOR(20, 30 and 40% Fibers in WPC)	Flexural modules MPa	524465.373	2	262232.687**
B FACTOR(Mesh 40, Mesh 80 of fibers in WPC)	Flexural modules MPa	158409.442	1	158409.442**

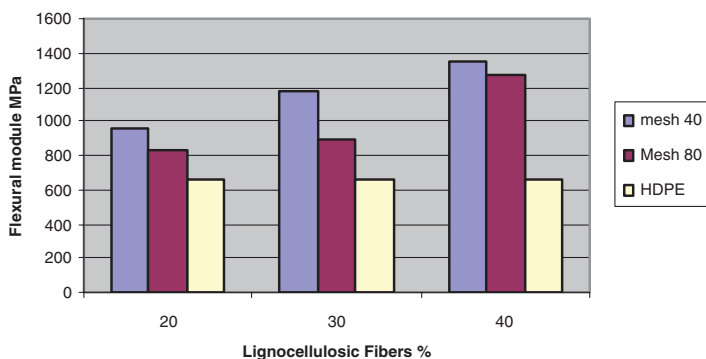


Figure 2.

The interaction of length and fiber on the flexural modulus.

Humidity Absorption Test

The variance analysis of humidity absorption test in two hours floating shows a significant effect of percentage and fiber length independently but have meaningless interaction mode. The effect of fiber length and percentage of humidity absorption at 24 hours floating in the independent states and interaction effect is statistically significant. after testing the samples for 432 hours at the chamber conditions at 25 °C, with 60% moisture, when, aligned the samples in the chamber to 416 hours, increasing moisture content of samples observed, but has remained constant after absorbing moisture from the environment and stop the moisture content of samples (Figure 3 and 4).

Thermo Gravimetric Analysis

After aligned the fibers in the machine chamber calorimeter and applied the heat, the results shown; up to 160 °C, weight loss is insignificant and it's related to active ingredient in the fiber, then with a relatively steep, the weight of sample to be reduced rapidly until the temperature reached the border of 350 °C and then garlic weight loss finds a more gentle slope (Figure 5). Final make up weight of the fiber at the remaining amount of the ash, is 25.35% of initial.

Conclusion

In similar studies, increasing the amount of corn stalk fibers, increase tensile resistance.

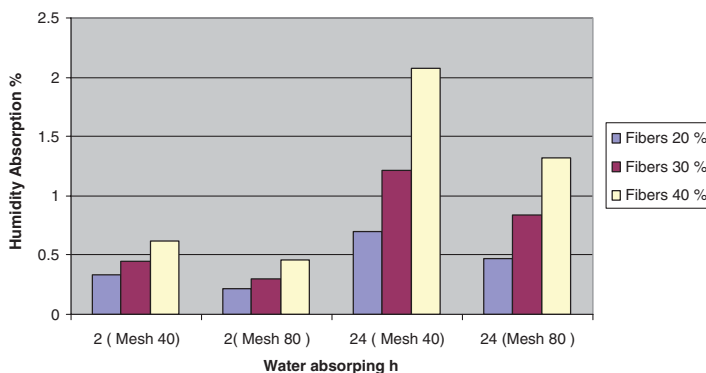


Figure 3.

Effect of fiber length and time of immersion in water, humidity absorption.

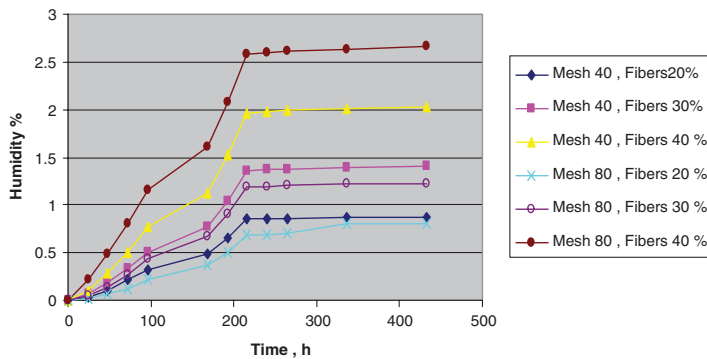


Figure 4.

432 hours in the moisture absorption curve aligned chamber climatization.

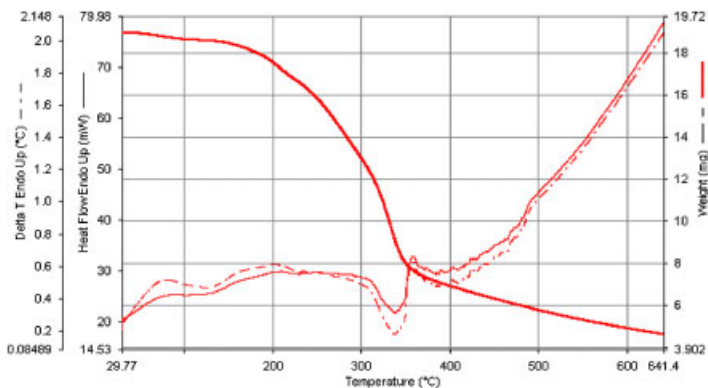


Figure 5.

Weight loss lignocellulosic fiber curve of calorimeter apparatus.

We see it, at the highest level while the peak reaches 40%. Although it is possible to reach greater tensile strength if the level is 50 or 60% or even higher than reached levels, according to Silva's (2003) research on hemp fibers, the amount of 85% at peak appears, so the use of this long fiber lignocellulosic material, as a wood plastic composite materials has been reported.^[5]

The boiler results in two linear of 40 and 80 mesh, shown no significant difference between the issue seemed strange, because it has been reported in most cases and contrary to research this issue. It may be brittle to a personality trait lignocellulosic corn stalk fibers and grinding stages, separated by vibrating sieve and mixing in internal mixer considered opinion, However, it was seems to be able to

investigate this case more good reason¹.^[3]

In the flexural test, increases flexural strength with increasing length of the corn stalk fiber as a lignocellulosic material, because the tangled fibers go to higher levels and thus create stronger ties, such as a network within the field of bridge HDPE is the problem correctly is similar with other research done in this area².^[7] The results of humidity absorption as well as showed samples produced completely normal and similar to other research, with increasing fiber length and the amount of humidity absorption and thus reduce weight and increase mechanical strength are high, this issue related to Hydroxyl groups and thus

¹Kuruilla et al., 1993.

²Yin et al., 1999.

increase the moisture absorbent position considered, although results was in less than good point polypropylene composites, This is a structural difference of these two branches of plastic and polymer side chain is related too ³.^[5]

Finally, it seems that in the climate of Iran and the other countries which has poor forest resources, the use of non-wood fiber plants (crops), especially agricultural residues such as corn stalks, can be a suitable solution to consider.

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