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Studies of The Swelling Properties of Guna Protein/ Cellulose Biocomposites

KEYWORDS Guna protein,weight loss,composition,Biodegradability and swelling.

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ABSTRACT *Biodegradation studies of Guna protein/ cellulose biocomposites was evaluated measuring the decrease in weight of samples. Both blended and unblended samples of cellulose and guna protein/cellulose were investigated. Weight loss studies revealed that compositions ratios 40/60 and 60/40 of Guna protein/cellulose showed better results of 0.03% in the first to 0.08% through 40 to 60days.Composite ratios 30/70 and 70/30 of cellulose/Guna protein blends also represented another set of good biodegradable composite showing an onset of 0.028% to 0.05% through 40 to 60days.However the composition ratio of blends was observed to have played a vital role in the biodegrading of the various ratios of composite blends that is moisture uptake or swelling increased with increase in composition.*

INTRODUCTION

The evaluation of visible changes in composites and plastic materials can be carried out in almost all Tests. These changes include the following: formation of cracks on the surface, defragmentation, formation of biomass on the surface and changes in coiour. These changes do not prove the presence or onset of any biodegrading process but may be a first indication of any microbial attack. To obtain a more convincing information, a more sophisticated method can be made using either scanning electron microscope (SEM) or Atomic force microscopy(AFM)(Ikada,1999).Analysis revealed that after initial degradation, cracks may appear on the surface of the composites. In another related investigation (Kikawaet et al 2002) used Atomic force microscopy (AFM) to investigate the surface erosion of polyhydroxybutyrate(PHB) films. Although other techniques such as Differential Scanning Calorimetry (DSC), Fourier Transformed Infra-red (FTIR) ,Nuclear Magnetic Resonance (NMR), X-ray diffraction(XRD) can be used to access the biodegradability of polymeric materials. As part of the investigation, the degradation studies or water uptake by samples subjected to soil burial test was carried out as described below

MATERIALS AND MATHODS

MATERIALS

Plain woven cotton material was obtained from Mubi main market.Sodium hydroxide, potassium hydroxide and Hydrogen peroxide were supplied by the British Drug House(BDH). Distilled water was obtained from the distiller from the laboratory of Adamawa State University, Mubi.

METHODS

COMPOSITE FORMATION

Fabrics were cut into 10cm x 10cm pieces. Fabrics pieces were slightly held under tension using masking tape. Guna protein resin (GPR) already prepared earlier will be poured over the fabric to impregnate it. Another layer of fabric will be put on top and more resin was poured on to the second layer of fabric. A total of four were used to make the composite. Then the resin coated fabrics were transferred to an air-circulating oven at 35°c and were allowed to dry for approximately 36h for proper treatment. These were conditioned for three days (ASTMD 790-02) before further characterization.

CHARACTERIZATIONS The biodegradability of the samples were measured as follows: Composite sheets were cut into rectangular shapes measuring 10cm by 5cm specimens. Biodegradability tests were then carried out in pots containing soils from the environment having Ph of 7.5-7.7 by maintaining a relative humidity of approximately 98% by sprinkling of water daily. Each specimen was buried 10cm deep in a pot of 30cm in diameter at a room temperature of 27°C.Each specimen was dug out from the soil after 10,20 30, 40,and 50days respectively and stored in polyethene bags until needed for further analysis. The swelling properties were therefore determined by weight loss or water uptake measurements. The objective of this study was therefore to evaluate the swelling properties of Guna protein/ cellulose based biocomposite through weight loss analysis.

MOISTURE CONTENT

Moisture content of the GPR was determined by the methods of Barminas et al 2007. This included a known weight of resin samples introduced into desiccators containing a saturated solution of sodium chloride. The difference between the wet and dry samples was recorded as moisture intake by the resin samples.

. The amount of water absorbed was calculated as follows;

$M_{t(\%)} = (W_t - W_o)/W_o \times 100\%$

Where W_t and W_o are the weights of the samples before and after immersion in water respectively.

RESULTS

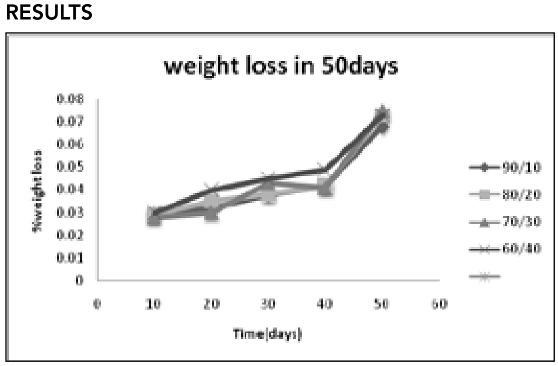

Fig4.3A: Weight loss versus Time of Guna protein/cellu-

lose at different ratios.

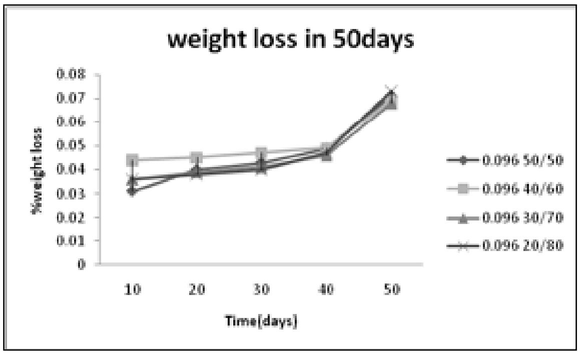

Fig4.3B: Weight loss versus Time of Guna protein/cellulose at different ratios2.

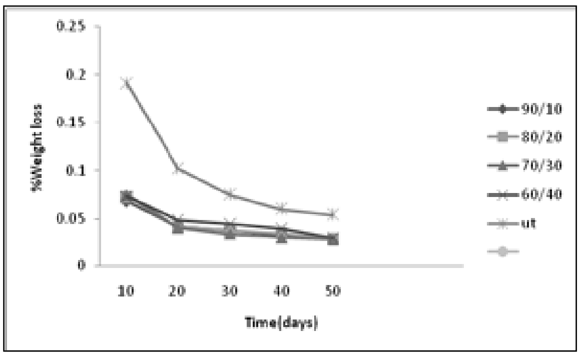

Fig4.3C:Weight loss versus Time of Guna protein/cellulose compared to untreated cellulose.

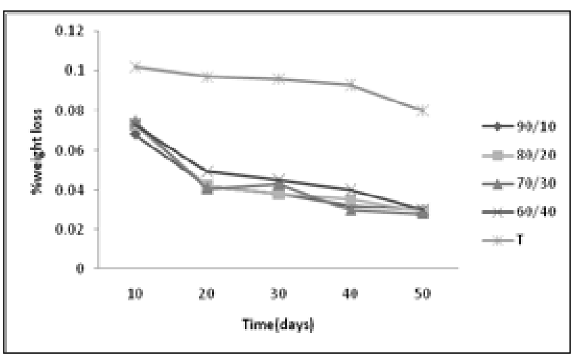

Fig4.3D; Weight loss versus Time of guna protein/cellulose compared to cellulose

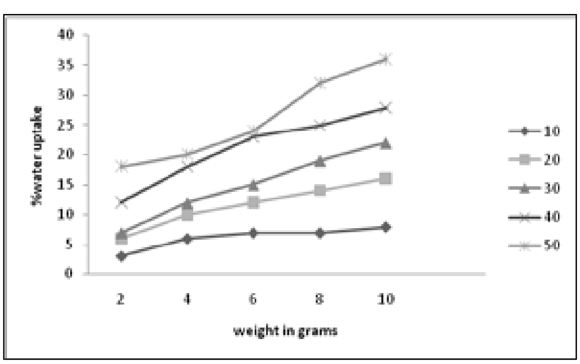

Fig4.3E: Effects of immersion weight on Guna protein loading

DISCUSSIONS

The results of the biodegradability studies carried on the samples of in terms of weight and water uptake over a period of 60days is given in Figs4.3A-D, Fig2 shows the water absorption or water uptake. However, the degradation of the material was observed to increase with increase in the time (days) and the ratio of Guna/cellulose used. The amount of cellulose present in a given material contributes tremendously in biodegrading of any material under consideration.

From fig4.3B, the biodegrading of the composite materials with ratios 90/10,80/20,70/30 and 60/40 Guna protein/cellulose blends were observed. The biodegrading of the composite materials increased as the number of days increased. This goes to along to show that biodegradability of composites materials is also a function of time. The composition ratio that is most degraded over the period of study is shown to be the ratio 60/40 then followed by composition 70/30.This an indication that cellulose content and resin ratios play vital role in the determination of the right for efficient material properties. The ratio of 60/40(Guna protein/cellulose) blends degraded considerably from 0.03% in the first 20days to 0.08% between 40 to 60days.

Fig 4.3C represents a different set of the compositions .In the figure, compositions ratios of 50/50, 40/60, 20/80 and 30/70 of guna protein/cellulose blends were taken into consideration.

Again, the composition ratio of 40/60 degraded efficiently, showing at first a lag period of 20days that is from a percentage weight loss of 0.04% to the highest value of 0.08%between 50 to 60days.This is closely followed by the composite specimen material with a composition ratio of 30/70, which even at the first instance recorded a weight 0.035% to higher value of 0.07%.

From fig4.3C and fig4.3Ds, it can be seen that the ratios of 60/40 and70/30 as shown in fig4.3A and 40/60 and 30/70 composition of Guna protein/cellulose blends presented a complimentary results in terms of the degraded composition. This have shown higher weight loss values even in the lag period of 20days.These results showed that for effective degradation of composites the composition or right mix is central in determinations of the final properties of the fabricated material.

However, it was observed that the weight loss increased with increase in the number of days for soil burial tests for all the specimens.

This is in line with the studies of (Kumar et al., 2010), in which studies on polylactic acid reinforced with flax fibre.

In order to study the effective contributions of the cellulose, treated (chemically modified) and untreated cellulose were subjected the soil burial tests. This to advance an understanding of the compatibility between each of the fibre material as it was shown(Felix et al,1994)that alkalization has effect of enhancing yarn consolidation(especially mercerization) which in turn improves compatibility with other biopolymers.

Fig4.3C represent the weight loss of chosen compositions of 90/10, 80/20, 70/30 and 60/40 of guna protein/cellulose blends against the untreated fibre (ut) as control. From the figure, the composition ratio 60/40 still showed better degradation properties even in the first 20days of the studies with a value of 0.05% and slightly decreased to a value of 0.049% in the last 40 to 50days.This rate of degradation observed throughout the period of comparison indicated that the compositions 60/40 and70/30 of Guna protein/cellulose blends still present better sets of material especially when compared to the other two ratios of 80/20 and 90/10 blends. This is in line with the studies of Kumar (2010) which indicated that fibre composition is central to degrading of composite materials.

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Another promising feature of the composite in comparison to unmodified fibres is the similarity in terms of the degradation pattern especially in the first 20days,hovering between 0.05% to 0.052% especially on the first 20days.This may be attributed to the inherent properties of the composites materials and the unmodified fibre in this studies.

Fig4.3D represents a similar study carried on composite specimens with different compositions but in this case a treated or chemically modified fibre and blends of guna protein/cellulose were exposed to the same soil burial test. Still the compositions with ratio 60/40 showed a higher of 0.08% for especially for the first 20dys before maintaining an almost constant value of 0.07% in weight loss. Composite specimen with ratio 70/30 of Guna protein/cellulose also showed a higher weight loss value of0.069% than other composite specimens under this study. Most interestingly, the modified fibre subjected to the same biodegradability study showed an excellent value of 0.18% weight maintaining an almost constant value of 0.12% throughout the period of study. This showed clearly that chemical modification of natural fibers result in increased fibre properties as in studies of (Felix et al., 1994).

Water absorption is a very important property to study especially as regards to protein resin as one of the biopolymer used in fabricating the guna protein/ cellulose biocomposites. The water absorptivity of the material of the material is shown in fig 4.3E.

From the figure, it was observed that water absorption increases with incease in mass of guna protein used.The increase in water absorption with increase could be attributed to the hydrophilic nature of guna protein owing to its functionality. This is in line with studied of(Peechawang et al 2005).

CONCLUSION

Studies on completely green composites prepared by blended was carried out in terms of swelling or weight loss measurements. The weight loss increased with increase in the days of burial in the soil. However, the weight loss also increased with increase in fibre content. This is an indication that both Guna protein and cellulose can be utilized as functional green composite materials.

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