

Modeling of Poly Ethylene with Natural Product Powder and Study of this Product for Wooden Plastic

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Abstract: *Organic fillers are not widely used in the plastic industry although their use is increasing. In this research we adopted Alhaji Graecrum powder as filler to modified both Hi and low-density polyethylene. The average particle size of Alhaji Graecrum was equal or less than 600 micrometers and the filler ratio was 35% by weight of the polymer matrix. Flame retardant for pure and modified polyethylene in both types Hi and low density are examined. No noticeable changes made to both the average of burning time and the burning rate due to the adding of ALHAJI GRAECORUM particles. These results were explained due the fact that both LDPE and HDPE are commonly made from highly flammable hydrocarbons that burn quite readily upon ignition. The corrosion behavior of modified low and hi-density polyethylene in NaOH, HCl and Na₂SO₄ solution were also investigated. The weight loss as a function of dipping time in this corrosive medium was calculated. The obtained results show each corrosive medium has its own effect of both Hi and low-density polyethylene, and each has its saturated value of weight loss.*

Keywords: Thermogravimetric analysis, differential scanning calorimetry, scanning electron microscope, polypropylene, high density polyethylene, coupling agent, composites.

1. Introduction

Composite materials are those that are formed by the combination of two or more materials to achieve properties that are superior to those of their constituents (1). Due to a combination of more than one material, the properties of composites are influenced by many factors such as filler characteristics, filler content, and interfacial adhesion (2-3). As well as, the need for materials unharmed to the body and yet having appropriate properties has increased due to a lack of resources and increasing environmental pollution; thus, composites prepared from recycled materials are actively being sought after (4-5).

The addition of organic fillers like cereals stems of plants, nut shells, cotton, cellulose, or wood flour, especially of the conifers can give rise to several advantages. First of all, the cost of these fillers is usually very low, the organic fillers are biodegradable contributing to an improved environmental impact and, last but not least, some mechanical and Thermo mechanical properties can be enhanced.

Organic fillers are not widely used in the plastic industry although their use is increasing. Bad dispersion into the polymer matrix at high-level content and poor adhesion with the matrix is the more important obstacles to this approach (6-7).

There are a number of studies in the literature dealing with characterization of interfaces and their influence on the mechanical properties of polymer composites (8). Kopczyńska and Ehrenstein (9) discuss the importance of interfacial tension. The challenges consist in obtaining significant improvement in the interfacial adhesion between the polymer matrix and the inorganic particles and also to achieve a homogeneous dispersion of the filler in the polymer (10)

In this area of high-performance, polymers achieved consist in obtaining a significant improvement in the adhesion between the polymer matrix and the additives and to achieve a homogeneous dispersion of the additives in the matrix (11-13).

The main advantages of products based on adding natural filler like wood flour are improved mechanical properties, increased stiffness, and waterproof behavior (compared with wood), as well as reduced material cost and appearance of natural wood (14-16).

The objective of our research is to improve the tribological properties of low and high -density polyethylene due to the adding of Solid fillers where they can be used to improve some polymer properties, e.g., to enhance flame retardant and corrosion resistance

2. Experimental Procedure

Alhaji is a genus of old World plants in the family Fabaceae. They are commonly called camelthorns or manna trees. There are three to five species. Alhaji species have proportionally the deepest root system of any plants - a 1 m high shrub may have a main root more than 15 m long; due to their deep root system alhaji species are drought-avoiding plants that utilize groundwater, adapting in that way perfectly to the hyper-arid environment. Alhaji species are used as food plants by the larvae of some Lepidoptera species including Coleophora argyrellata that feeds exclusively on A. maurorum. The genus name comes from the Arabic word for pilgrim. Table (1) shows the scientific classification of ALHAJIGRAECORUM (17).

Table 1: Scientific classification of ALHAJI GRAECORUM

Alhaji maurorum	
Scientific classification	
Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
(unranked):	Rosids
Order:	Fabales
Family:	Fabaceae
Subfamily:	Faboideae
Tribe:	Hedysareae
Genus:	Alhaji

ALHAJI GRAECORUM particles are used as a reinforcement to enhance the properties of low-density polyethylene. Additive-free LDPE (SCILEN 22004) grade is supplied from the state company for petrochemical industry (SCPI) of (MI=0.39 gm/10min.) al (density = 0.922 gm/cc). The ALHAJI GRAECORUM is obtained from marshes in Almudinah district Basrah governorate. The average ALHAJI GRAECORUM particle size used in this work is (< 600) μm. The used concentration of ALHAJIGRAECORUM is 35 wet%.

ALHAJI GRAECORUM as a fine powder is mixed with LDPE using mixer 600 instruments attached to Haake Rehochard meter under following conditions; mixing time 15 min., mixing temperature 160C and mixing velocity 32 RPM. After that the final mold product is introduced in a laboratory compress under 5 ton at 1750C for 3 minutes in a square frame where the pressure rises gradually up to 15 ton for a (6) minutes and after this period the sample sheet is cooled up to reach room temperature . This sheet of final product is used to prepare Samples dumbbell in shape for measuring the mechanical properties and melt index by using Instron instrument model 1193 with following conditions ;chart speed (10) mm/min., crosshead speed 50 mm/min. The test specimen is positioned vertically in the grips of device then the grips are tightened evenly and firmly to prevent any slippage. The relationship between elongation and load is obtained directly from the instrument. All measurements are made according to[ASTM D638 1977], and time of burning,and burning rate were measured according to [ASTM D635 -81] (8).

For corrosion analysis, we took a small piece of 5 gm weight for each pure and modified polyethylene and immersed in 5% HCL corrosive solution.After a period we evaluated the chemical degradation by weight changes before and after dipping in a corrosive medium. We repeated the same procure for 1, 3, 7, 14, 21, 28, 38 and 50 days. The same steps were followed in 5% NaOH and 30% Na₂SO₄

3. Results and Discussion

The burning or combustion process of any type of fuel source, either wood or polymer constitutes a cycle with three steps that need to occur in this order: 1. heating of the fuel source. 2. Decomposition of the fuel source into combustible and non-combustible materials. 3. Ignition of the combustible fuel and air mixture to produce a flame (18)

Flame retardant for pure and modified polyethylene in both type Hi and low density are listed in theTable (2).No noticeable changes made to both the average of burning time and the burning rate due to the adding ofALHAJI GRAECORUM particles due to the fact that LDPE and HDPE are commonly made from highly flammable hydrocarbons that burn quite readily upon ignition.

Table 2: Flame retardant modified polyethylene

Polyethylene type	Burning time average sec.	Burning rate cm/sec.
Pure-LDPE	102	13.6
Pure -HDPE	130	17.333
Modified-LDPE	144	19.2
Modified-HDPE	104	13.866

For degradation analysis,we used three types of corrosive mediumsHCl, NaOH and Na₂SO₄, which are acidic, basic and salty corrosive medium respectively.

Figure (1) showed the variation of weight of both modified LDPE and modified HDPE as a function of immersion time in HCl. A partial degradation is obtained due the immersion in 5%HCl.It is very obvious that both hi and low-density polyethylene have the same degradation behavior. No noticeable changes in weight after 7 days of immersion

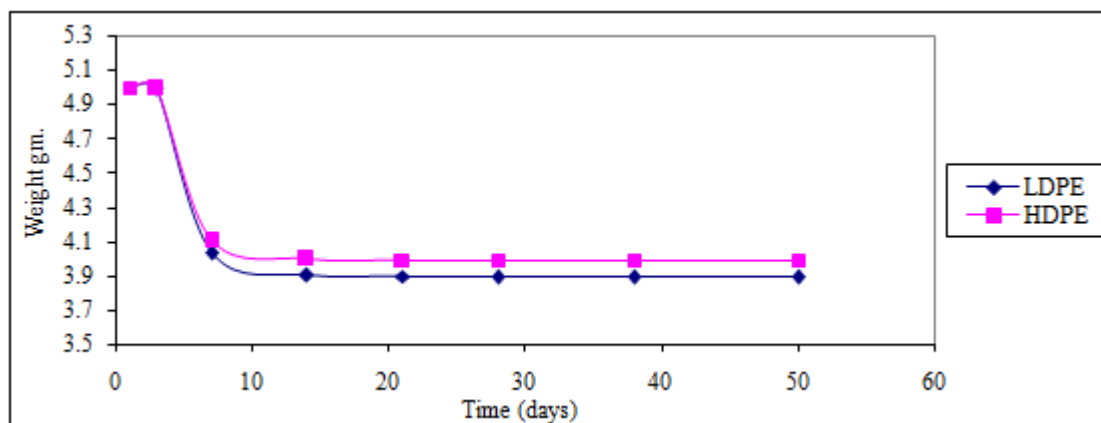


Figure 1: The variation of weight as a function of immersion time in HCl.

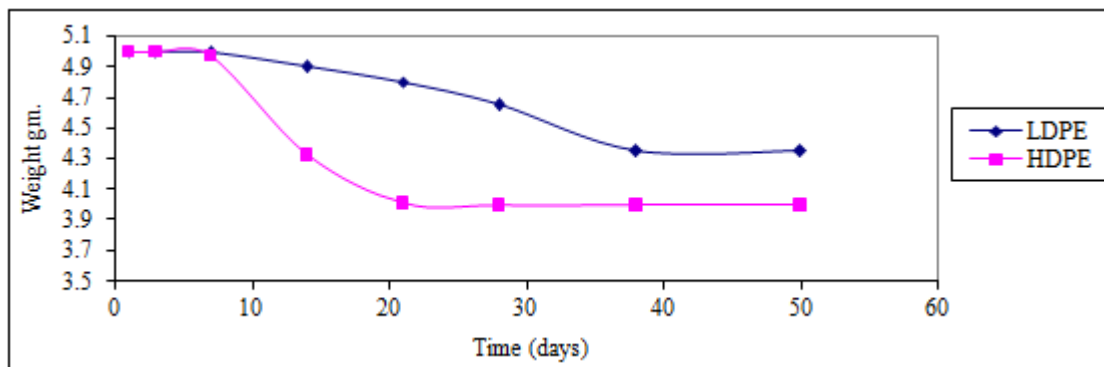


Figure 2: The variation of weight as a function of immersion time in NaOH

The degradation behavior in NaOH corrosive media is shown in Figure (2). Hi-density polyethylene is much sensitive toward immersion in NaOH where its degradation is continues till 38 days comparing to 21 days for LDPE.

The same weight changes are obtained in 10 days of immersing in NaOH corrosive medium. Between (7-38days) LDPE weight loss is higher than that of HDPE

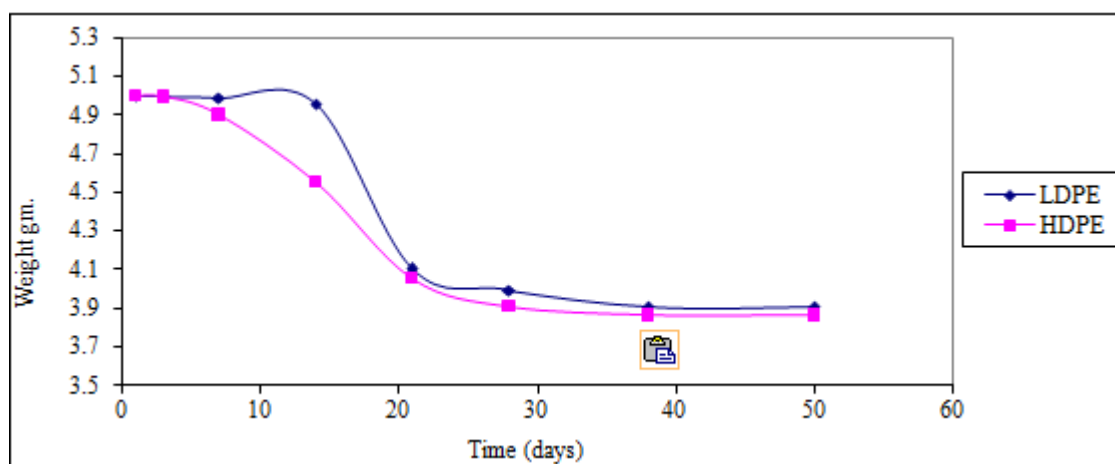
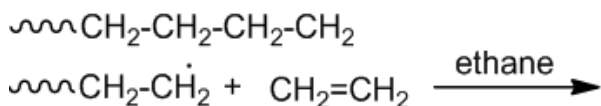


Figure 3: The variation of weight as a function of immersion time in Na2SO4

Figure (3) shows the effect of 30% Na₂SO₄ on HDPE and LDPE where a rapid loss of weight (degradation) is occurring at (7-14days). A noticeable result is that time of higher degradation is different from corrosive medium to another where it is less in both Acidic and basic corrosive medium than salty one. The above results can be explained according to the decomposition of polyethylene which is a combination of a number of elementary reactions proceeding through the free radical mechanisms:

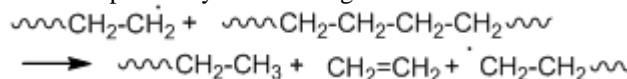
1) Initiation-Formation of macroradicals due to the polymeric-chain scission under the action of corrosion conditions

2) Chain reaction followed by a detachment of monomer from the end macroradicals.



where the product of ethane is vaporized and causing weight losing.

3) Monomolecular chain transfer caused by the detachment of hydrogen macroradicals from other macromolecules accompanied by the breaking of C-C bond.



4. Conclusion

The using of organic fillers is increasing where the addition of organic fillers to polyethylene has several advantages. Economical where the cost of these fillers is very low, the organic fillers are biodegradable contributing to an improved environmental impact and, some mechanical and Thermo mechanical properties can be enhanced. Both LDPE and HDPE are commonly made from highly flammable hydrocarbons that burn quite readily upon ignition where no noticeable changes due to the addition of Alhaji Graecrum. The amount of degradation is different according to the type of corrosive medium, but each has its own saturation value indicating a partial degradation of both HDPE and LDPE in acidic, basic and salted corrosive medium.

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