Use Gold Nanoparticles To product Plastic timber recycling waste plastics and Fibers palm Fronds

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Abstract: Saudi Arabia has plenty of agricultural waste products such as fiber palm fronds. Among the advantages of these fibers are: renewable, nonabrasive, cheaper, abundance and show less health and safety concern during handling and processing. Also Saudi Arabia has a lot of industrial waste such as plastic. Recently, the interest has increased to recycle plastic materials accordingly, the composite industry has begun investigating the possibility of increasing the proportion of recycled composites. This leaded to search about environment eco-friendly reinforcement and resins systems while providing the same performance as their man made counterparts**,** and if we want to enhance the performance recycled composites we can use gold nanoparticles.

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1. Introduction

The trend to add value to products and that is environmentally friend has encouraged transformation industries to work with waste recovery. Discarded post-consumer plastics are generally considered a problem due to the damage they cause to the environment. Most come from disposable food packages, which, after being discarded in landfills, pile up and increase the volume of waste and the visual pollution(1-3).

One of the alternatives to reduce the amount of material currently treated as urban solid waste is to recycle it(4).

The traditional process for producing thermoplastic materials is the mechanical one(5), involving the use of the equipment's.

Recycling plastic waste with vegetable fibers, plentiful in the middle East region, would increase its value, and this process has aroused interest in studying the production and application of such composites(6).

In general, vegetable fibers, when adequately combined with polymers, can provide better flexibility and improve mechanical resistance and toughness (7-9). However composites reinforced with natural fibers and gold nanoparticles tend to show low mechanical resistance due to poor interfacial adhesion caused by the low chemical interaction of the fibers (10)and gold Nano particles.

Dates have been a staple food of the Middle East for thousands of years.

The date palm trunks are used as beams and rafters, leaves are used as a raw material for many of the industries. Furthermore, rachis and leaves can be viewed as sources of reinforcing fibers for polymeric matrices in composite materials (11).

The valorization for fiber production of eight Saudi lignocelluloses were investigated. Fiber length, specific gravity and chemical composition: total extractives, lignin, holocellulose and ash contents of the eight lignocelluloses materials were determined. All the characteristics examined varied significantly due to the natural resource effect. The three lignocelluloses materials of date palm had higher contents of total extractives, lignin and ash; and lower holocellulose content compared to those from timber trees. Although the date palm leaflet possessed the longest fibers (1.31mm), followed by rachis (1.19mm). Their fiber manufacturing needs more chemicals and time and some problems arise upon chemical recovery process due to their chemical composition(12).

Date palm leaves were compounded with plastic and gold nanoparticles stabilizers to form composite materials. The stability of the composites in natural weathering conditions of Saudi Arabia and in accelerated weathering conditions was investigated.

The composites were found to be much more stable than Plastic under the severe natural weathering conditions of Saudi Arabia and in accelerated weathering trials. Compatibilized samples are generally less stable than uncompatibilized ones as a result of the lower stability of the plastic.

In addition to enhanced stability imparted by the presence of the fibres in the composites, enhanced interfacial adhesion resulting.

From add gold nanoparticles can be the source of retention of mechanical strength.fibers have a high potential to be used in many different area particularly as reinforcement in development of composites. Many studies have been done on isolation and characterization of fibers from various sources. fibers can be extracted from simple mechanical methods or a combination of both chemical and mechanical methods(13). This study investigated the influence of add gold nanoparticles to fiber as an element of reinforcement for post consumption package materials, using simplified and low cost methodology.

2. Experimental

Synthesis of gold nanoparticles

Add 20 mL of 1.0 mM $HAuCl_4$ to a 50 mL beaker or Erlenmeyer flask on a stirring hot plate. Add a magnetic stir bar and bring the solution to a rolling boil.To the rapidly-stirred boiling solution, quickly add 2 mL of a 1% solution of trisodium citrate dehydrate, $Na_3C_6H_5O_7.2H_2O$. The gold sol gradually forms as the citrate reduces the gold(III). Remove from heat when the solution has turned deep red .

Fibre preparation

Branches obtained from palm trees were cut intopieces about 8 inches long. Thereafter, they were air dried for 48 hrs at room temperature. The material brought to room temperature and specimens were prepared and tested according to ASTM standards (Specific Gravity, ASTM D792-91.Water Absorption, ASTM D570-95).

Preparation of Waste palm leaves and fiber material

The pieces of branches were then granulated to a small size using a Granulator (Rapid Granulator Inc., USA, Type 79-C,No. 201544). The fibers were then size separated by using a sieving machine. Only the large fraction of fibers was used in this study. The fibers size distribution was characterized using a digital vernier caliper. The average length of the fibers was 6.2 mm with a standard deviation of 2.8 mm and an aspect ratio of 10.8. The fibers obtained were then cleaned to remove the volatile organic compounds. The chemicals used for cleaning were ethanol and toluene in the ratio of 1:2 (V/V). The mixture of these two chemicals was prepared in a large container. The fibers were soaked in the mixture for 24hrs. The fibers were then washed with water and dried in a vacuum oven (Blue M Electric Company, Model OV-490A-2) at 105 °C for 24 hrs to remove residual moisture, and stored in suitable bags at dry place.

Preparation of plastic wastes

A random collection of different mixed plastic waste was shredded followed by washing with detergent and rinsed twice and excess of water was drained allowed for complete dry in open air. The clean and dry bits of mixed plastics were fractionated in to different size particles by passing through size selective meshes and stored in containers.

Composite sample

Fiber material + Waste Plastic + gold nanoparticles + PVC= new Composite

3. Results and Discussion

Characterization of gold nanoparticles

The UV–visible spectra of the samples were recorded for the wavelength 520 nm at 25 °C. Figure (1) on a Hewlett-Packard 8452A diode array spectrophotometer.

The gold nanoparticles obtained were characterized by atomic force microscope (AFM). Transmission electron microscopy (TEM). Figures (2,3)

Characteristics of composite samples

The composite samples (A) with gold nanoparticles prepared in this project have properties comparable with those of the same composite(B) with out gold nanoparticles. It noted that most of the characteristics of composite samples (A),could be enhanced by putting gold nanoparticles to increase the density, by increasing the compression before the material solidification in the mold. Surface modification leaf material/fibers with chemical reagent and gold nanoparticles in order to develop strong adhesiveness between plastic, leaf fiber materials as it is one of the important step in the process for the improvement of mechanical properties of composites. The properties of composites depend on the matrix, the fibers and their interfacial compatibility. Natural fibers because of hydrophilic nature reduce their compatibility with polymer matrix. Surface modification of fibers and their compatibility development is considered to be a challenging area of research for the development of composites.

Density

The density of prepared composite samples with gold nanoparticles(A), (1.A.6; 1.A.8; 1.A.10; 1.A.12 and 1.A.14), were recoded, it was ranged between 1.29 and 1.99 with an average of 1.59 g/cm^3 in comparison to composite sample without gold nanoparticles(B) where its density recorded 1.1g/cm^3.(Figure 4). Density is a crucial factor for wood-plastic composites or fiber reinforced plastic composites with gold nanoparticles, which primarily depend on the specific gravities of its ingredients and their proportional formulation. Moisture in natural cellulose fibers create steam and vapor during processing due to plastic decomposition produces volatile organic compound at hot melt temperatures, hence, porosity. To overcome this constraint using gold nanoparticles to vented extruder is the best option in terms of removing the trace gases and steam which subsequently decreasing porosity and bring the density close to the maximum one.

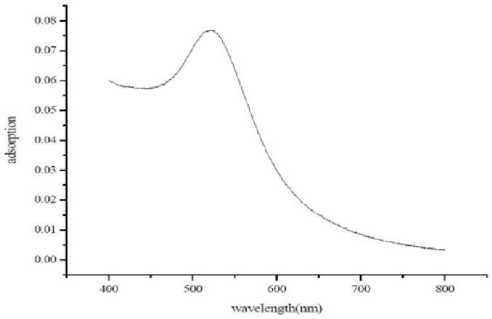
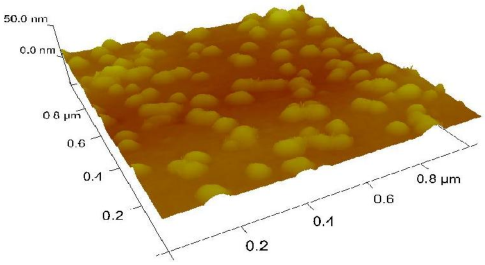
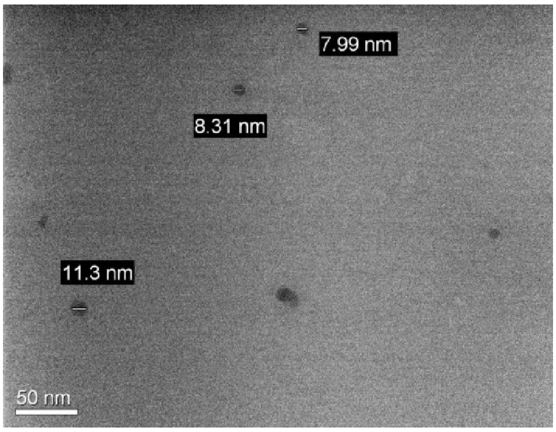


Figure (1) UV-vis spectroscopy of colloids gold nanoparticels



Figure(2)atomic force microscope (AFM)



Figure(3)(TEM) images of gold nanoparticles

Table 1. Density and Water Absorption of some prepared wood composites

samples	**Density(g\cm3)**	**Water Absorption %**
1.A.6	1.29	5.4
1.A.8	1.44	6.6
1.A.10	1.55	4.5
1.A.12	1.71	3.06
1.A.14	1.99	2.2
2B	1.1	8.47

Table 2.Tensile properties of some prepared wood composites

samples	**Modulus of Elasticity at yielding point (MPa)**	**Strain at yielding point**	**Stress at Max. load)MPa(**
1.A.6	576.2	0.0023	1.89
1.A.8	690.8	0.0025	3.25
1.A.10	599.1	0.0009	3.5
1.A.12	773.4	0.0004	3.2
1.A.14	918.8	0.0034	3.9
Mean	711.66	0.0019	3.18

Water Absorption

Water uptake or swelling ratio of a sample is determined by measuring the change of weight percent due to water absorption within certain period of time. The prepared samples with gold nanoparticles(A), in addition to a sample without gold nanoparticles(B) were immersed in water, for 24 hours, and then reweighed after surface drying. The change of mass due to swelling (water absorption) is determined.(Figure 4) shows the swelling ratio of different samples(A,B). It is, clearly, indicated that swelling ratio is inversely proportional to the sample(A) density as compared to the sample(B). Least swelling was recorded in sample number 1- A -14, which has density 1.99 g/cm^3.(Table 1).

Ability of water absorption by the composites containing natural fiber and plastic polymer mixture with gold nanoparticles (A)depends on their porosity, amount of fiber content and their availability to incoming water. Composite materials are typically porous, and their degree of porosity is determined by moisture of the incoming raw materials, as well as, processing conditions, mainly heat treatment. The water uptake ability of composite depends on the level of moisture content in the initial formulation leading to develop elevated value of porosity during the processing and lowers the density of composite sample consequently, higher the water absorption (8).

Tensile property

The tensile property in terms of modulus of elasticity at yielding point of prepared composite samples tested. Stress at maximum load ranging from 1.89 to 3.9 with an average of 3.18MPa and corresponding modulus elasticity at yielding point were recorded 576.2; 690.8; 599.1; 773.4;918.8 and711.66MPa for samples 1.A.6; 1.A.8; 1.A.10; 1.A.12; 1.A.14 respectively (Table 2). The average value for all samples were recorded 643.48 MPa. The variations in elasticity at yielding point attributed to modifications of conditions to improve the quality of composites such as proportional mixing of raw materials, heat treatments, compression and addition of gold nanoparticles etc. Further improvements in the strength of composites are in progress.

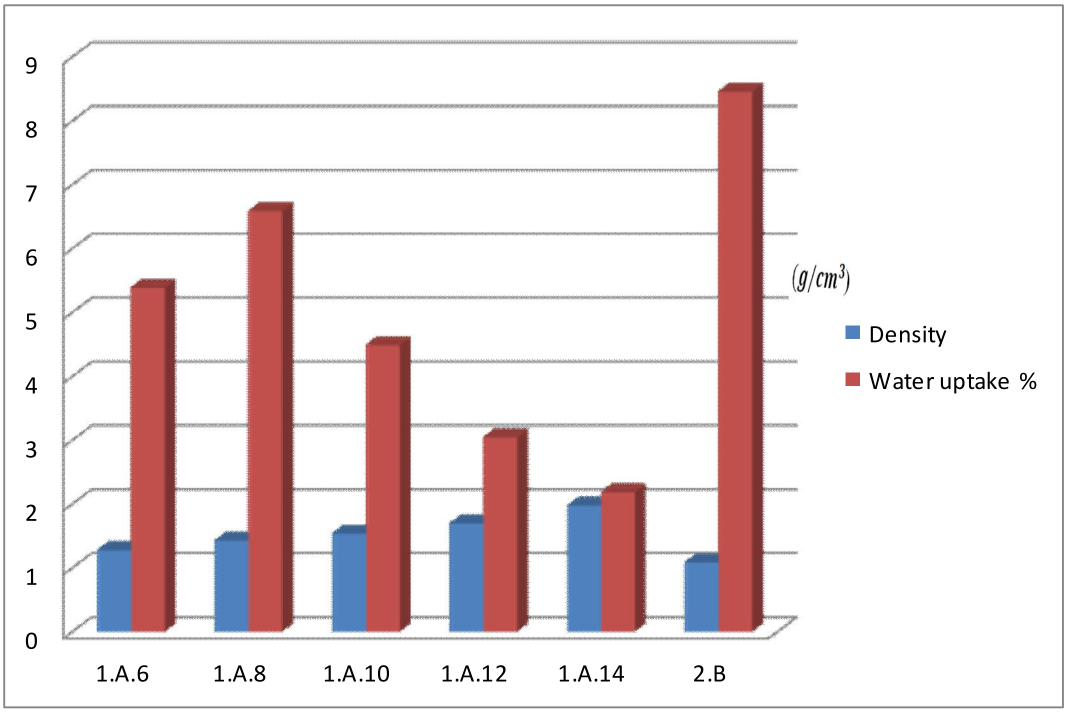


Figure 4. Comparison of Density and Water Absorption of composite

Conclusion

Recycling of plastic wastes is scientifically good practical solution for plastic disposal. This research work aims to use Gold Nanoparticles to enhance performance composites from plastic wastes and fibers obtained from waste date palm leaves as wood alternative. It is an approach of vital interest, which provides the solution for two environmental problems. From the economic point of view, date palm leaf fiber plastic composite have many benefits: They use low cost and plentiful raw materials like plastic palm leaves waste become assists instead of liabilities. They are competitively priced and are competitive with traditional materials such as timber and MDF. They are true hybrid materials, and combine the best properties of both wood and plastics and can be produced in a broad range of finishes and appearances, also easily recycled after their useful life. They are environmentally friendly contains no toxic or volatile organic components. These composites are suitable for many indoors and outdoors applications. Also, they are not suitable as insect's shelter. Therefore, the industrial production and further development of such composites are an excellent solution to get rid of a waste of agricultural origin and plastics from solid municipal waste. The waste recycling issues considered in this research project is the problem of waste palm leaves, which localized, together with the problem of plastic wastes, which is international one. This approach can be followed in other countries, middle-east countries in particular, using the available wastes as renewable resource for the production of value added building material as wood alternative, which in turn save forests and green zones contribute to environmental sustainability.

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