Influence of wood minutes (reed) on some physical and mechanical characteristics for (EP+W) composites.

Raya Ali Abeda), AbdulhameedRaheem Al-sarrafand, Mohammed Al-maamori
Department of Physics, College of Education for Pure Science IbnAlhaithm, University of Baghdad, Baghdad Iraq
a)rayaali_88@yahoo.com, b)hamidalsarraf7@gmail.com, c)mhalmaamori1959@yahoo.com

Abstract
By using agricultural wastes, the epoxy composites were prepared with reed minutes and with a fixed weight fraction of all samples (30%) and a particle size (212) µm. Preparation of samples carried out by using the casting method. Some mechanical properties have been investigated were included (tensile strength, bending, creep) and the results showed improvement of all properties through increased bending resistance and elasticity increased with epoxy reinforcement with wood particles. The intent of this research is to enhance the mechanical properties by adding agricultural wastes that represented by (reed).

Key word: physical and mechanical characteristics, Epoxy resins, reed.

Introduction
Agricultural wastes have a high economic value, mostly in countries that have a few forests; Iraq produces millions of tons of agricultural crops, which include vegetables, grains, and others. Erroneous use of this waste represented by cutting poses a clear danger to the environment that is one of the most popular factors leading to desertification. [1] However, there is a development in technology that has emerged through exploiting that waste, like wood or plastic, to carried a manufacturing process of products that can be used and of high performance[2].

Where polymers have an essential role in the daily uses of peoples as a result of their unique properties and inexpensive price. It is utilized in industrial sectors for example as adhesives, paper, fibers, cloths, and others [3]

Polymer science is the most common branch of material science that joins between chemistry, chemical engineering, materials, and other sciences. Chemically, polymers
defined as molecules with long chains and describe as high molecular weight, so when we refer to polymers we called (large molecules)

previously, its chemical composition was referred to as resins, but polymers at the onset of the twentieth century appeared as natural products like cotton, starch, wool ... etc. while the synthetic polymers have been made such as Bakelite, nylon, and others. [4]

The epoxies group characteristic by good mechanical properties, constant dimensions, resistance to corrosion, have excellent electrical properties. Epoxies have more applications such as the moldings of electricity as adhesive materials and others. [5]

Thermoplastic and thermoset polymers can be reinforced by using types of fillings, including clay, talc, and wood, these proses reduces costs of resin and improves its treatment capacity [6].

**Experimental work**

In this research, the reed utilized as a reinforcing material. Initially, the wood (reed) was prepared in several steps before starting the mixing process.

The reed is collected and washed well to get rid of the existing pollutants and impurities then dry them well through exposure to sunlight, then we grind the reed well until we get the reed minutes using an electric mill after that we start with chemical treatment by using a solution of sodium chloride and drying it then grinding and sifting it using a sieve with 212 µm. The second step consist of preparing the epoxy resin which is used as matrix material, the samples have been prepared by using casting method with weight fraction 30% and 212 µm for all samples, and by using CNC the samples have been get according to ASTM to be ready for tests such as (Tensile test, Bending, Creep, bulk density) as explained in followed:

-Tensile test

It is considered one of the important mechanical tests. A device manufactured according to (ASTM D638) was used. Which is placed between the handles of the device and subject to a specific load, From the following relations can calculate stress and strain:[7]

\[ \sigma = \frac{P}{A} \] \hspace{1cm} \text{(1)}

\[ \varepsilon = \frac{\Delta L}{L_0} \] \hspace{1cm} \text{(2)}

Where, \( \sigma \) = Stress , \( \varepsilon \) = Strain, \( P \) = applied force, \( A \) = cross section area

\( \Delta L \) = the amount of change in length, \( L_0 \) = origin length
-Bending test

It is one of the important tests by which the elasticity of the material can be measured, especially fragile materials. There are factors that have an effect on this test, which includes the distance between the two bearers, the loading rate and the cross-section dimensions of the sample. The curvature test is divided into two three-point test and four-point test.

- The creep test

The creep test is used to measure the amount of deformation in the material for a period of time, the sample required for this examination is specified in dimensions according to ASTM where the test is carried out under the influence of a specific load, the device consists of a long arm that loads are suspended on the right side which is equal to 10 N and on the left side the sample is placed

-Bulk density

Bulk density can be calculated by determining the mass of material using an electronic balance and measuring the dimensions of the sample for all composites, that are (circular cylinder) shape. The bulk density can be measured by using the following equations: [8]

\[ B.D = \frac{m}{v} \] \hspace{1cm} (3)

\[ B.D = \frac{m}{\pi r^2 h} \] \hspace{1cm} (4)

m: the mass of sample (gm)

v: size of the sample (cm³)

r: the radius with unite (cm)

h: the height of sample (cm)
3- Results and discussion

It can be measured the force required to elongate a sample to the breakdown point and the properties of materials, many performance parameters, can be determined using a tensile test [9,10] From the strain-strain curve, we can measure the maximum stress, the maximum strain, the elastic modulus, or the young’s modulus for composite. Figure (1) illustrates the stress-strain curve of (EP + W) composite. The results showed that the minimum stress and the maximum stress of the (EP + W) range about 2.27Mpa to 18.8 Mpa this values explained that increasing the elasticity when reinforcement the epoxy by wood minutes (reed) This compatible with results of the researchers (Lee and Ohkita) [11] The increase in the elasticity modulus arises as a result of that the particles of wood are connected with each other, and the formation of a crust of the matrix material surrounded by rows of minutes, and this is consistent with researchers results have (Ishai and Cohen)[12,13]

![Figure (1): shows the stress-strain curve of an (EP + W) composite](image)

The creep test determined by the relation of the strain values with the time under the load of 10 N.

Figure (2) illustrate the relation between strain and time of the (EP+W) composite, the results explained that the value of strain at the instantaneous time increasing until the 8 min it ranges from (0.23 to 0.51).
The epoxy resin represents a thermosetting material, where the elastic modulus in polymeric materials variation with time, which deferent from other materials such as ceramic and metals materials that are considered stable materials.

![Graph of Ep+w](image)

Figure (2) shows the change between strain and time of the (EP+W) composite Bending test utilized to determine the linear behavior of the material under the effect of the applied load.

Where the bending test gives notification about the behavior of composites and their effect by the applied load for a period of time where the stress applied within the limit of elasticity.

The wood-plastic composites explain a response to the variation in dimensions that leads to failure.[14][15]

Figure (3) the relation between deformation and the applied load on the specimen of (EP + W) composite. It shows from the figure the increase in the amount of elongation and the rise in deformation at the moment of the applied load, this means the amount of elongation is proportional to the applied load, where the material returns to its original shape if remove the applied load.
Figure (3) shown the relation between deformation and the applied load on the sample of (EP + W) composite

Where, cellulose and lignin are the main component of wood used, and it has properties like a linear orientation, high degree of polymerization, and the texture of chemical adhesion between the polymer and cellulose present in the wood, this increases the transferring of the stress from the matrix material to the reinforcement material, thus an increase in mechanical properties [16].

This apparent decrease is attributed to the surfaces formed between the polymeric material and the wood powder, which reduces the formed void and does not allow the formation of internal defects. This explains the role of the reinforcement material in improving mechanical properties. This is compatible with the work of the researcher (Mazatusziha Ahmed). [17]

One of the important physical tests is the bulk density which is possible to know the distances inside the particles of matter to be used in many applications.

Figure (4) shown that the bulk density value for the epoxy is 0.214 g / cm3 before reinforcing by the wood minutes (reed), its value has changed and it has become 0.22 g / cm3 when reinforcing by wood minutes this result indicates an enhancing in the density of composites after the reinforcing the epoxy with wood minutes (reed), attributing to filling in the blanks Inside the epoxy which improved the bulk density.
The reason for this is to fill in the existing voids, which are very tiny, which are formed during the preparation of samples with wood minutes, where they work to spread within the structure of the composites material, so the volume and voids are decreases and the joining between the matrix material with the reinforcement material increases, hence material cohesion and hardness increases, therefore the bulk density increases which is consistent with the researcher (Qasem).[18]

**Conclusions**

The current study demonstrated that adding wood minutes (reeds) to epoxy resins worked to improve the mechanical and physical properties that represent by tensile strength, bending strength, creep, and bulk density.

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