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Preparation of composites from Nano clays with Epoxy resin and development some of their Mechanical properties

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ABSTRACT

The present research includes improvement of Iraq clay to get nano structures composition and use them as reinforcement materials with Epoxy resin with weight fractions (**%1 ,%3 , %5**),and samples of research where prepared by manual molding method. Mechanical tests were carried out (Tensile, Impact ,Hardness, Compression and Bending). The results showed significant improvements in the properties of the prepared Nano composites.

Introduction:

In response to the requirements of development and industrial renaissance that a non-move toward improving the performance of products from design and manufacture, may be suitability for use in a specific and non-suitability of the area for use in another area, where much of the technology and modern industries need to substances that have a combination of properties unusual (Impact and high durability, low weight, resistance to various environmental conditions and uncontaminated) so that they are economic, health, suitable for industrial and engineering applications to were find composite materials.

Moreover require space field of low weight and good performance materials in order to resist the weather conditions of outer space.[1].

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Polymer compositions are still a solution to the problems caused by the use of homogeneous polymers alone, which suffer from a decline and deterioration in stress resistance and weather effects during fields use or through equipment, household use. To reduce environmental pollution and produce biodegradable composite materials, Natural organic materials are environmentally friendly such as Clays, rather than reinforced with environmentally friendly industrial and hydrocarbon materials such as glass fibers, nylon fibers, and metal wires. [2][3].

Epoxy is a thermoses polymer that forms a strong rigidly cross linked network of polymer chains.

Epoxy has been widely used in commercial applications with Fiber glass, graphite, and aromatic fibers. Applications include: Aircraft components, Pressure vessels, Rocket motor cases, and Car bodies.[4]

Experimental Part

The use of Epoxy resin matrix material manufactured from acompany (SIka) of America to form a viscous liquid transparent at room temperature,

one of the types of polymers (Thermoses') density (1200Kg/m^3) turn into a solid state when adding Hardener of the production company (Sika)of America, It is a liquid with moderate viscosity which can be cured to the solid state by adding a hardener, The percentage of the hardener to the resin is (1:2),that forms a strong rigidly cross linked network of polymer chains.

Epoxy has been widely used in commercial applications with fiber glass, graphite, and aromatic fibers. Applications include:

Aircraft components, Pressure vessels, Rocket motor cases, and Car bodies at room temperature Used the three types of reinforcement materials purpose of strengthening the material basis of three types of clays Iraqi nano particles (kaoline, Attoplugas, and bentonite) ,reinforced the resin material in the form of powder average of diameter (50-90) nm were prepared in the laboratory.

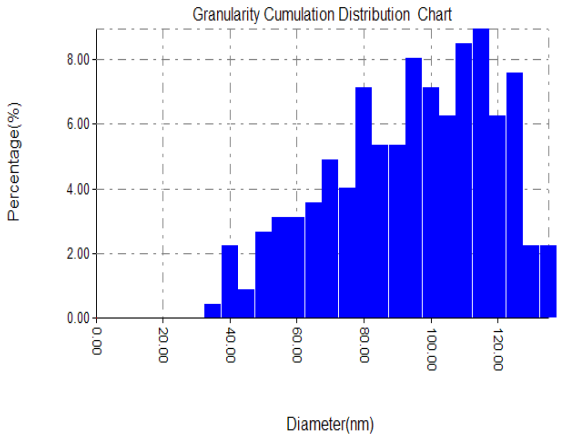
Table (1) Chemical analysis of Clays

Constituents	Wt% Bentonite	Wt% Attoplugus	Wt % Kaoline
SiO2	56.7	31.04	48.57
Al2O3	15.42	7.113	35.05
CaO	4.48	20.65	0.6
MgO	3.42	2.993	0. 77
K2O		0.231	0.08
Fe2O3	5,12	4.266	1.34
TiO2		0.7511	1.19
Na_2O	1.11		
Moisture			0.08
L.O.I			12

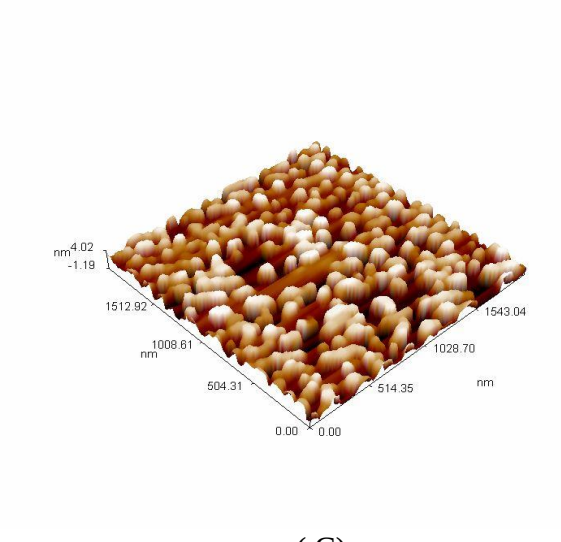
Preparation of Nano particles:

The abrasives (Attoplugus, Caoline and Bentonite) were washed with distilled water twice and dried by a drying Furnace at a temperature of(70-80) ° C, then grinded and sown with a 53 µm sieve. Preparation is done first by adding 2.7 g of German-made alkali ammonium salt (CTAB) into a glass flask with 75 ml of distilled water twice as well as 3 ml of Hcl acid 4M. Add 53 µm with the solution and then expose the mixture to the laser 50 mJ for half an hour. and then the mixture is filtered and the solid is taken for the AFM test as in Figure (1).

(A)



(B)



(C)

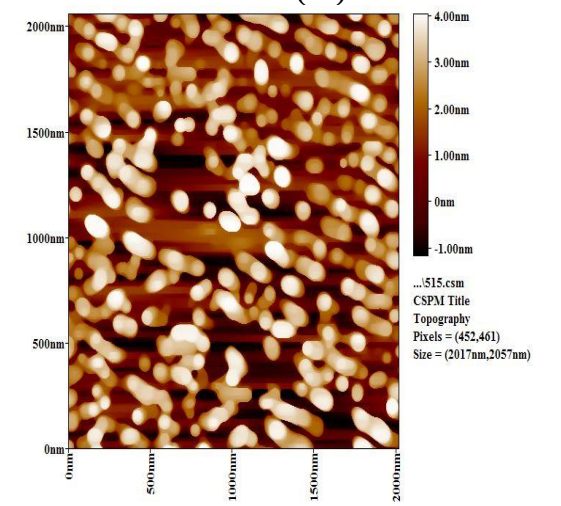


Fig.(1) Atomic Force Microscopic Analysis

Preparation of specimens

The samples were prepared by hand molding using a glass mold and then to make a homogeneous mixture of epoxy material with clays types. And add the hardner with 1: 2 of epoxy to help harden the material and then leave the material for 24 hours and putted them in furnace (50-60) ° C then be cut by a small electric saw and then softened by the device and the samples were in accordance with ASTM.

Classification of samples:

Samples were divided into three groups and according to weight fractions (1%, 3% and 5%) of the Clays

K =EP+ 1% Kaoline

K3 =EP+ 3% Kaoline

K5 =EP+ 5% Kaoline

A1 = EP+ 1% Attoplugus

A3 = EP+ 3% Attoplugus

A5 = EP+ 5% Attoplugus

B1 = EP+ 1% Bentonite

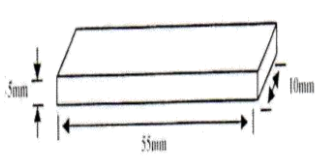
B3 = EP+ 3% Bentonite

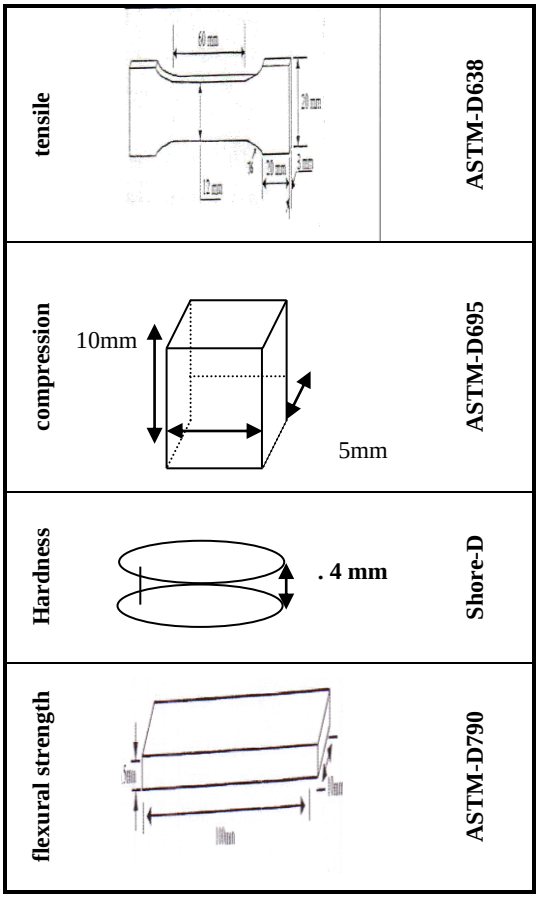
B5 = EP+ 5% Bentonite

Instrument test:

American standard for Testing Material (ASTM) has been used for both(tensile, Impact, hardness, compression and Flexural strength)[5], a laser source, and Japanese furnace.

Table (2) the standard dimensions of the samples used in the research

Test	*Sample's dimensions*	*Standard Specifications*
impact		**Charp-TMI 43-1**



Results and Discussion:

The addition of the Clays leads to their homogenous because of their hydrophilic properties, in addition to adhesion and epoxy interlock. The composites Preparation were homogeneous, with soft texture, high hardness, and regular form.[6]

Mechanical tests were carried out according to the American standard for Testing Materials.

Tensile strength of fracture was calculated by increasing the weight fraction of the prepared nanoparticles added to epoxy, especially at the weighted fraction (3%). The increase is then close to tensile stress due to the contribution of clay to the matrix material in the bearing of force [7] As in Figure (2).

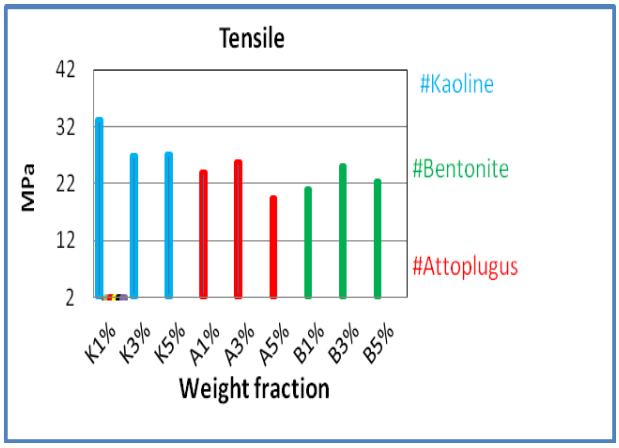


Fig. (3) Tensile of the samples as a function of weight fraction

The impact test of the important dynamic mechanical tests in which the material is subjected to a very rapid motor load, the samples were tested the Charp test. It was noted that the material Impact strength showed a significant increase when reinforced with nanoClays at the weighted fracture (3%), Mechanical bonding between the reinforcing material and the matrix material requires additional energy to dissipate the reinforced material from the matrix material [8] .as in Figure (3).

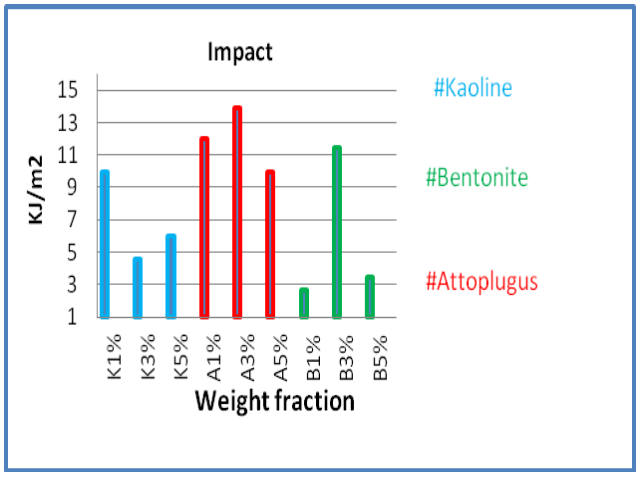


Fig. (4) Impact of the samples as a function of weight fraction

The most hardness tests were depends on the material resistance of penetrations at the outer surface. The Shore D was used, The composites reinforced in Clays give a positive increase in its strength to increase the filling of the holes within the body of the polymer and to absorb the polymer body into the surface of the clay [9] [10] Shows hardness values.

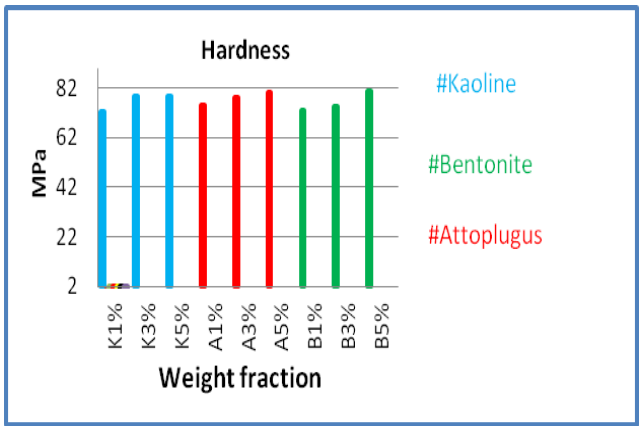


Fig. (5) Hardness of the samples as a function of weight fraction

The bending test differs from the Impact test with the stress rate. The sample is subjected to tensile strength and compression. The bending strength of the composites was calculated. There was a slight increase in bending resistance for composites reinforced Clays, especially kaolin[11]. Compression at the Crushing Point showed that reinforced in Clays did not significantly affect compressive stress resistance, because of cohesive between Epoxy and clays [12][13].

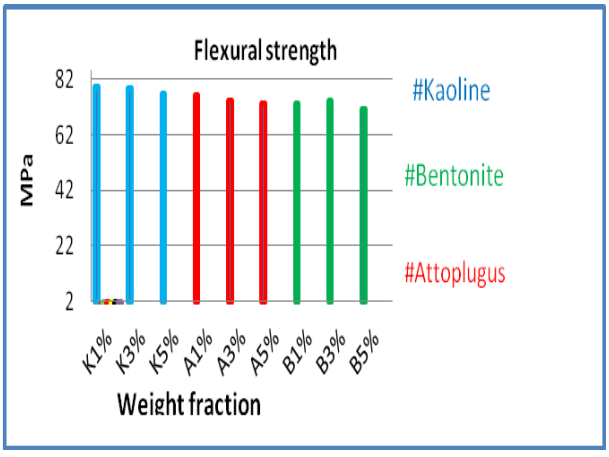


Fig. (6) Flexural strength of the samples as a function of weight fraction

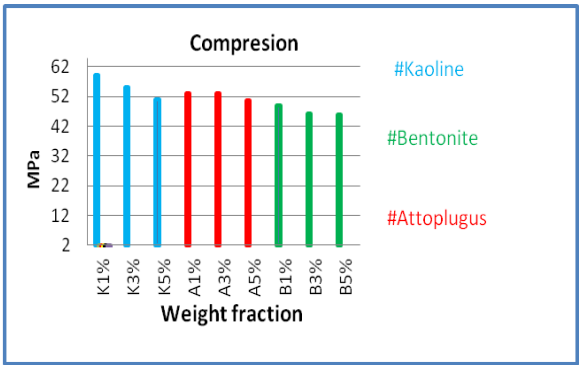


Fig. (7) Compression of the samples as a function of weight fraction

Conclusion

We conclude from the research that use the clays increases their synergy and improves mechanical properties. The use of Nanoparticles increases the properties of the composites for the better and becomes more resistant to the conditions of stress .Non-polluting and environmentally friendly composites and minimizing the use of industrial reinforce materials contaminants that affect environmental on organisms such as(glass fiber, nylon, and metals)

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تحضير متراكبات من الأطيان النانوية مع راتنج الايبوكسي وتحسين بعض خواصهما الميكانيكية .

خالد محمد خليفة بلقيس محمد ضياء طارق عبد الجليل منديل

الخلاصة :

شمل البحث الحالي تحسين الأطيان العراقية للحصول على جسيمات نانوية التركيب واستخدامها كمواد للتدعيم مع الايبوكسي وحسب الكسور الحجمية (**5%, 3%, 1%**) وحضرت عينات الدراسة بطريقة القولبة اليدوية. اجريت الاختبارات الميكانيكية (الشد, متانة الصدمة, الصلادة, متانة الانحناء, وإجهاد الانضغاطية) فأعطت نتائج البحث تحسنا كبيرا في خواص المتراكبات النانويه المحضرة.