*The study of mechanical properties of the polyaniline:Alcaúlan clays nanocomposite

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Abstract:-
Intercalation composite of polyaniline and clay has been reported.The composite was prepared by in polymerization of aniline with "Alcaúlan" Clay.Were studied of the mechanical properties of polyaniline/ Alcaúlan clay.
Which was prepared in Almokhtbroandaccurate size equal to(≤ 250)μm.Mechanical properties arestuding several variables such as the coefficient Jonk, tensile strength, elongation, fracture resistance and hardness.The results showed that the hardness of PAni/clay increase with increasingPAni/clay increase with temperature. Also fracture strength increase with increasing temperature.

Keyword:-Polyaniline , clay, Mechanical properties.
Physics classification : QC 170-197

Introduction1.:

A polymer composite is made by the combination of polymer and synthetic or natural Inorganic filler. Fillers are employed to improve the desired properties of the polymer or simply reduce the cost [1].In general , the structures of polymer / claynanocomposites are classified according to the level of intercalation and exfoliation of polymer chains into the clay galleries. Various porametersinduding clay nature , organic modifier, polymer matrix and preparation method are affective on the intercalation and exfoliation level. Therefore depending on the nature and properties of clay and polymer as well aspreparation methodology of nanocomposite, different composite micro-structures can be obtained [2].In this method the clay layers are synthesized insittu in the presence of polymer chains. The polymer and clay Primary materials are dissolved in an aqueous solution.
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Typically magnesium hydroxide,silica and lithium fluoride as clay building blocks are mixed with polymer in asolvent.The nucleation and growth of clay layers are take place on the polymer chains and thepolymer chains are trapped in the clay inter layers[2,3,4].
As show in fig(1). The sample was manufactuing by using Mixer andextrnder.

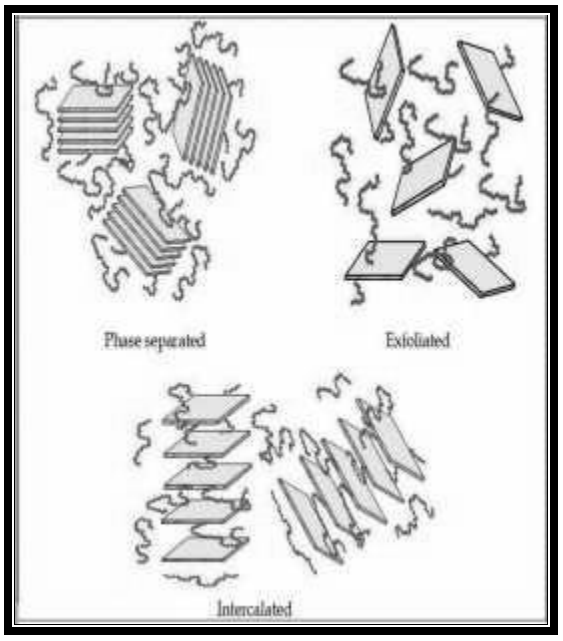


Fig. (1)Various micro-structures of polymer/clay composites.

Experimental procedure:-

2.Preparation of Composites

Walnuts shells are mixed with (PAni- clay Alcaúlan) using mixer(600) instrument attached to HaakeRehochard meter under following conditions; mixing time(15) minutes, mixing temperature (160) °C and mixing velocity(50) R.P.M., by using the cross section (mixer 400) with description(16) R.P.M,(60) °C for 10 minutes. The final mold product is introduced in a laboratory compress under(5) tons at(175) °C for(3) minutes in a square frame. The pressure then rises gradually up to(15) tons for (10) minutes and after this period the sample is cooled up to reach room temperature Samplesdumbbell in shape are prepared for measuring the mechanical properties by using ZwickRell instrument.

3. Average Time of Burning ATB

Average time of Burning (ATB) and the Burning Rate was measuring for each sample by a device the Burning Rate, according to the standard method 81 ASTM D635 - calculating the time required for combustion model to a distance of 75 mm from sample, also re-measurement three times for each sample was extracted average values.

4.Tests:-

4.1.Examine the durability and elastic modulus. :-

A universal testing machine ZwickRell was used [5]. The tensile modulus was calculated as the ratio of stress to elastic strain in tension for both caly and(PAni/ clay).The tensile properties were tested according to the American standard for testing and Minerals(ASTM) Standard D-638: Standard Test Method for Tensile Properties of clay and PAni/clay[6]. The dimensions of the dumbbell-shaped specimens are shown in Figure (2). The tensile strength was calculated Q by the following equation [7]:

$Q = F / A \ N/mm^2$ .....(1)

Where F = force (N) , and A =sample section area (2mm).

(Young's modulus) Y = stress/strain .....(2)

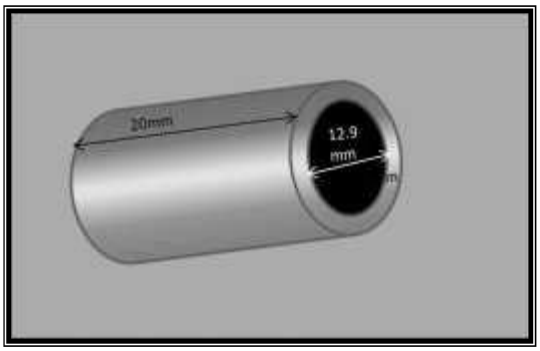


Figure (2) tensile specimen coupon dimensions centimeters

The screening process that breaks the sample into two or more and recorded the amount of durability sample and compressive strength is calculated by the Brazilian way of equation (3)[8].

$\sigma_s = 2P/\pi Dh$..... (3)

:That's where

σ_s = breaking strength (MPa).

P = highest power are kept has got to break ceramic sample (N).

D = width ceramic sample (mm).

h = thickness of ceramic sample (mm).

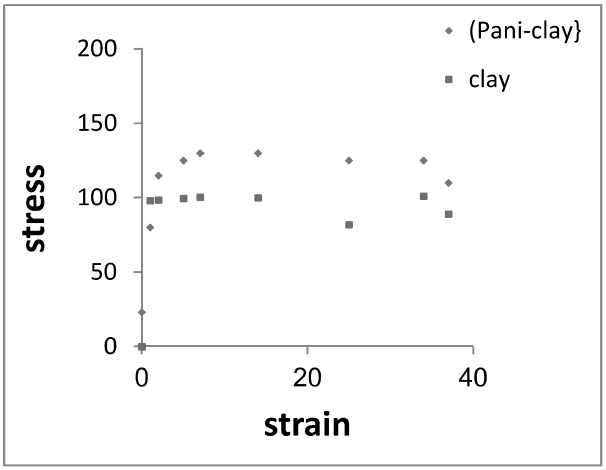
4-Results and Discussions:-

The mechanical properties of PAni/clay are shown in Figure(3), where the stress - strain curves of polymer composite and clay. Hardness value can be evaluated from the area under the curve. Tough break: was reached by the deformation of a large break after the maximum in the plot of stress and emotion, and there is a large amount of yield, before the sample at the end. This is due to the rearrangement of the molecular polymer yield large response to the applied stress. It can distinguish three zones; first is the linear region; second is the area yield; third area is the elongation up to the end of the first half. In the firstarea, (the linear region), where deformation is not too large, and obeyed Hooke's law, which distinguishes the instantaneous deformation and recovery associated with the bending and stretching interatomic bonds between atoms of the polymer. There is also a permanent displacement of the particles relative to others. Referred to the extent commensurate with the highest stress that

can be applied to Hooke's law. As shown in fig(4).The table(1(a,b))test results Showshardnessby Moh scale of salad. Samplesscorched temperature (Moh's Scale of Hardness) (100,300,500,700,900)^{0}C can be seen by the results that the hardness values of the samples increases with increasing temperature incineration is due to the occurrence of the sintering process the presence of the liquid phase at high temperatures, which is working on linking the granules with each other and lead to the closure of pores between the grains, which leads to increased hardness values and this is consistent with what was said [9],that the strength of the body are affected by the growth of crystals and the chemical composition of the metal, and also due to the differing percentage Moleight in the

Firing Temperatuer (^{0}C)	100	300	500	700	900
Fractuer Strength MPa	3.1	3.59	3.71	4.78	5.01

samples produced as increased hardness values with increasing content Moleight in samples producer. In the case of the mixture results showed a higher hardness than in the case of the mud and this is due to the same reason, which interpreted the property of flexibility. As shown in figshows(5).The table (2(a,b)),(100,300,500,700,900)^{0}C. can be seen from the result that the values shown the results of examination of resistance to breakage by the way Brazilian samples scorched-temperature fracture resistance of the samples increases with increasing temperature incineration this is due to the occurrence of the sintering process the existence of the liquid phase (Liquid Sintering) at high temperatures, which works to reduce the pores and bridged thus, a more cohesive granules with each as intertwined shapes needle for Molaat which gives strength to the body and thus increasing the values of fracture resistance and this corresponds to the mentioned [10] that increase the body's resistance increases with increasing temperature sintering. shown in the table(3) explains that the modulus of elasticity (coefficient Jonk), which is defined as the percentage of elongation Alajhadaly solids only, illustrated by the table (4) that demonstrates Ankhvaz coefficient AmahoJonk in the mud of the clay and(PAni-clay), has high hardness, flexibility and low-lying reverse if the mud[11].



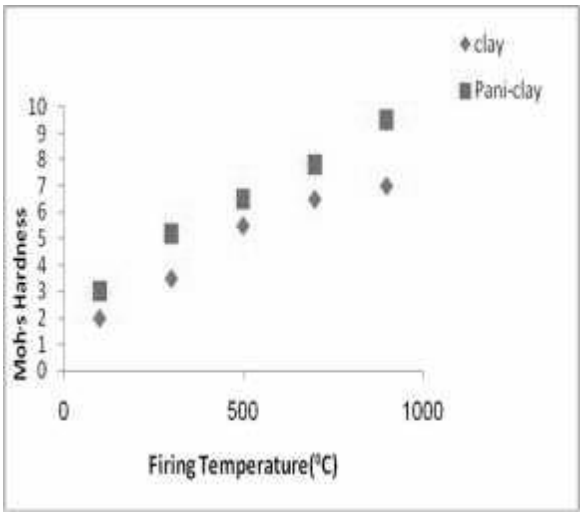
Fig(3).The stress-strain variations

Table (1-a) shows the results of the hardness of the clay through the Moh scale of hardnes

Table (1-b) shows the results of the hardness of the mixture(PAni-clay) through the Moh scale of hardness.

Firing Temperature(^{0}C)	100	300	500	700	900
Moh's Hardness	3	5.2	6.5	7.8	9.5

Firing Temperature(^{0}C)	100	300	500	700	900
Moh's Hardness	2	3.5	5.5	6.5	7

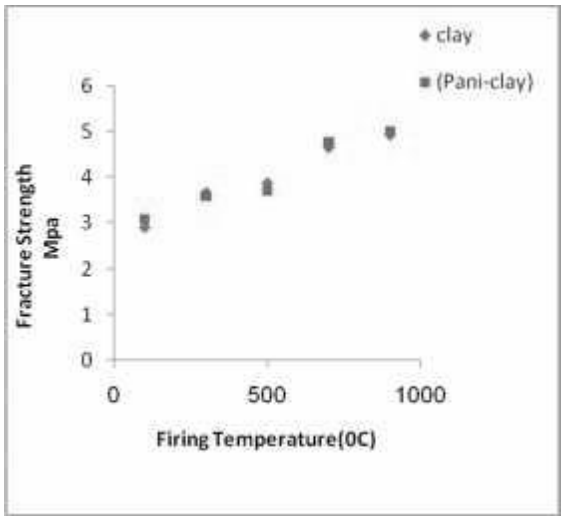


Form(4) the results of the hardness by Moh's scale of hardness

Table (2-a) shows the results of the fracture resistance of the clay by the Brazilian way with burning Tgerdrjh

Firing Temperatuer (^{0}C)	100	300	500	700	900
Fractuer Strength MPa	2.9	3.66	3.87	4.64	4.92

Table (2-b) shows the results of the fracture resistance of the mixture (PAni-clay) Hspaltrivh Brazilian change with arson



Form (5) measurement results Alexrelltin resistance by the Brazilian way with the change of temperature incineration

Table (3) shows the mechanical properties of the clay and the mixture (PAni- clay).

PAni-clay) (	Iraqi clay Alcaúlan	Mechanical tests
0.41	0.27	**Modulus of elasticity**
11.3	11.8	**Plasticity**
4.81	3.08	**Stress**

Conclusion:- 5-

Clays Alcaúlan used as a binding agent contained ratios of oxides good position to use as a binding agent and annealed after the addition of sodium silicate liquid to mix . Showed the results of tests of physical samples produced high-temperature varies depending on the temperature of the burn, as it increasingly shrinking longitudinal and bulk density with increasing temperature incineration and that the loss of water in the composition of crystalline and sintering liquid at high temperatures, which works to reduce the size of pores and bridged thereby increasing longitudinal shrinkage and bulk density and porosity decrease virtual water absorption when the temperature increase due to the metal with a specific weight. By the results of mechanical tests of the samples show that the values of hardness and fracture resistance of all the samples increases withincreasing temperature incineration so as to increase the convergence of the granules

with each other as a result of the increased amount of liquid phase.

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*دراسة الخواص الميكانيكية (لبولي انيلين/ طين الكاؤولين) المتناهي في الصغر

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الخلاصة :
تمت عملية اقحام مركب مكون من البولي انيلين وطين الكاؤولين بوساطة عملية البلمرة , وقد اجريت دراسة الخواص الميكانيكية للبولي انيلين / طين الكاؤولين العراقي من خلال اعداده بالطريقة الميكانوكيميائية وبحجم حبيبي دقيق يساوي ($\leq 250\mu m$) , ولغرض تطوير المادة تم دراسة الخواص الميكانيكية لعدة متغيرات مثل (معامل يونك , قوة الشد, الاستطالة , الصلادة , مقاومة الكسر) , حيث اظهرت النتائج ان الصلادة ومقاومة الكسر لطين الكاؤولين والمركب تزداد بزيادة درجات الحرارة .

الكلمات المفتاحية :- بولي انيلين , طين الكاؤولين , الخواص الميكانيكية .
* البحث مستل من رسالة ماجستير للباحث الثاني .