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Improving the Specifications of Floor Coating by adding nanoclay

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Improving the Specifications of Floor Coating by adding nanoclay

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Abstract: In the present study the effect of weight percentage of nanoclay with epoxy resin coating on mechanical properties (impact strength , hardness, and wear rate), Adhesion test and thermal properties (thermogravimetric analysis (TGA), thermal expansion coefficient (CTE),the weight percentage of nano clay at (0,1,3,5,7) wt% ,has been investigated.Results indicated,that when increase the weight ratio of nano clay the value of impact strength increased, hardness and decreasing wear rate up 5wt% , and at 7 wt% that the impact strength , hardness would be decreased and wear rate increase due to agglomeration of nano clay . The strength adhesion pull off of the epoxy coating was 1.76 Mpa ,when adding nano clay,improve the adhesion properties of the epoxy coating at the ratio of 5%. The improved the thermal stability of the nanoclay filled with epoxy coating. Thermal stability is very important for coating materials.

Key words: Epoxy, nano clay, Impact strength, Hardness, Wear rate, bonding strength, TGA, CTE

1. Introduction:

Clay based polymer nanocomposites include been worked in coating manufacture industries for advancing mechanical , thermal , and character activity of the product [1] . In the case of epoxy coating usually the resin is mixed with inorganic nano clay in addition to the regular reinforcement for improving the mechanical properties of the nanocomposites [2].Nano clay may be used as a filler and is able to filled of polymer and impede the free movement of epoxy chains neighboring the nano clay [3]. Nano composites are mixes in which at least single of the phases gets lengths in the nanometer range. These are great achievement components that show unusual property combinations and different design actions [4]. Another mechanical property that may be necessary to study is toughness , which is a test of a components resistance to contained ductile deformation [5]. Stable components expand when heated and contract when cooled. The sectional change in length is proportional to the heat change the constant of proportionality being the coefficient of thermal expansion [5]. On best purposes Nano reinforcement need to be area modified before incorporating them in to polymer matrices . This is because of the polarity difference between nanoreinforcement and majority of the polymer matrices [6].

The epoxy organic coating was used to protect the substrate due to their good adhesion,and thermal stability [7]. Boreum etal .,This research was used six types of epoxy used to coating underwater concrete . included the type of the coating , the thickness of the coating and the strength of the bonding [8].Seenaa I. to study Chopped Glass fibers reinforced acrylic elastomeric composites water proofing compounds .Glass fibers are excellent properties like high strength, stiffness, flexibility, and resistance to chemical material. To prepare elastomeric Acrylic polymer and acrylic with glass fibers the volume fraction (v_0, v_1, v_2, v_3, v_4) (0, 2.34, 4.69, 7.10, and 9.43)% [9].Granite ,cache, and ceramic are the types of materials used in painting the floors, and because of their exposure to breakage and lack of



resistance to environmental conditions due to the presence of salts and water. researchers to invent a new material that is cheap, lightweight, and resistant to environmental conditions, and to improve its specifications further by adding nanomaterials. Nanoclay were chosen in this paper for their availability and cheapness, and they were characterized by specifications that improved the physical and mechanical properties of the epoxy coating. The aim of the research is to prepare low cost plastic coating of epoxy resin reinforcement with nanoclays , and to improve the mechanical and thermal properties of the coating.

2. Experimental part:

2.1. Materials:

Epoxy as amatrix coating (Nit fill, EPLV with hardener from fosroc company) . Nano clay from shanghai kudu co., ltd china . Particle size 60 nm is shown in figure (1)

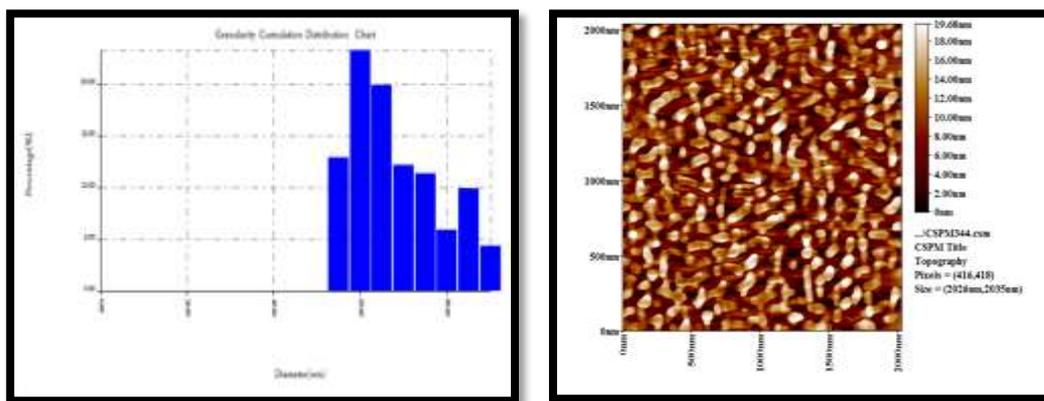


Figure 1. Granularity normal distribution chart for nano clay

2.2. preparation coating from epoxy reinforcement with nano clay:

To prepared sample coating from epoxy resin with different weight ratio of nano clay (0,1,3,5,7) wt. % using casting method . Then add nano clay with epoxy resin at 60 °c in 60 minutes and magnetic stirrer was employed to mix with the hardener . The sample ws left 24 hours at room temperature figure (2).



Figure 2. sample epoxy nanocomposites

2.3. Preparation concrete samples from adhesion test:

To prepared sample adhesion test from weight ratio the cement and use epoxy resin coating and best ratio of nano clay on mechanical test (1,3,5 ,and 7) wt% .

2.4. devices tests:

Impact test: Impact test used in this research is a charpy type without incision. The dimensions of the samples 55mm,10mm,2mm and The test with ASTM ISO 179 .

Hardness test: The hardness is scratch and stitch resistance .The type of hardness used the Durometer (shore D), like many other hardness test ASTM D2240 [1] .

Wear rate: the test was perform on pin-on-disc . Wear rate of samples were calculated with a total amount of weight loss during wear test in terms of grams . The experimental conditions were done under variable load within the range of (15 N) and a sliding speed within the range of (2 m/sec) and sliding time of (120 sec)

pull-off adhesion test: Adhesion test by drawing method with amannual device that contains a screen showing the amount of projected load for its adhesion to coating .

TGA: Thermo gravimetric analysis is a means in which the weight loss of a specimen is examined with raising heat. It is moved by putting the specimen in a weighing balance and heating the specimen at a controlled rate .

CTE: Coefficient of thermal expansion is a measure of changing the longitudinal or volumetric dimensions under the influence of temperature. The dimensions of the sample used are length 20mm and diameter 5mm .

3. Results and discussion :

3.1. Mechanical tests:

Impact strength:- Impact strength values increase with increaseng weight ratio of nanoclay at 1% - 5%, Because of the small size of the nanoparticle particles that spreads well within the base material of the composite , which makes it more able to resist impact shown in figure (3a) .The 5wt% showed the high value of impact strength of 96 when compared with epoxy resin of 70 but decreasing at 7% because agglomerate of nanoclay to due the weak mechanical properties and this finding agree with [8] .

Hardness and wear rate test :- hardness shore D values increasing with increase weight ratio of nano clay up 5% because of the good connection and interaction between the filler and the matrix and decreasing at 7%, it showed similar results as the impact strength which agree with [10] .But wear rate decreasing with increase weight ratio of nano clay due to the nano clay results in considerable improvement in abrasion wear resistance which agree with [11] . shows in figure (3 b & c)

Figure (3.c)As is clear,incorporation of nanoclay in epoxy resin can greatly reduce the wear rate. This means that the addition of nanoparticles was highly effective to improve tribological properties and performance of epoxy coating. These effects can be attributed to improving the stiffness of coating surface and thus increase the wear resistance through the addition of nanoclay .

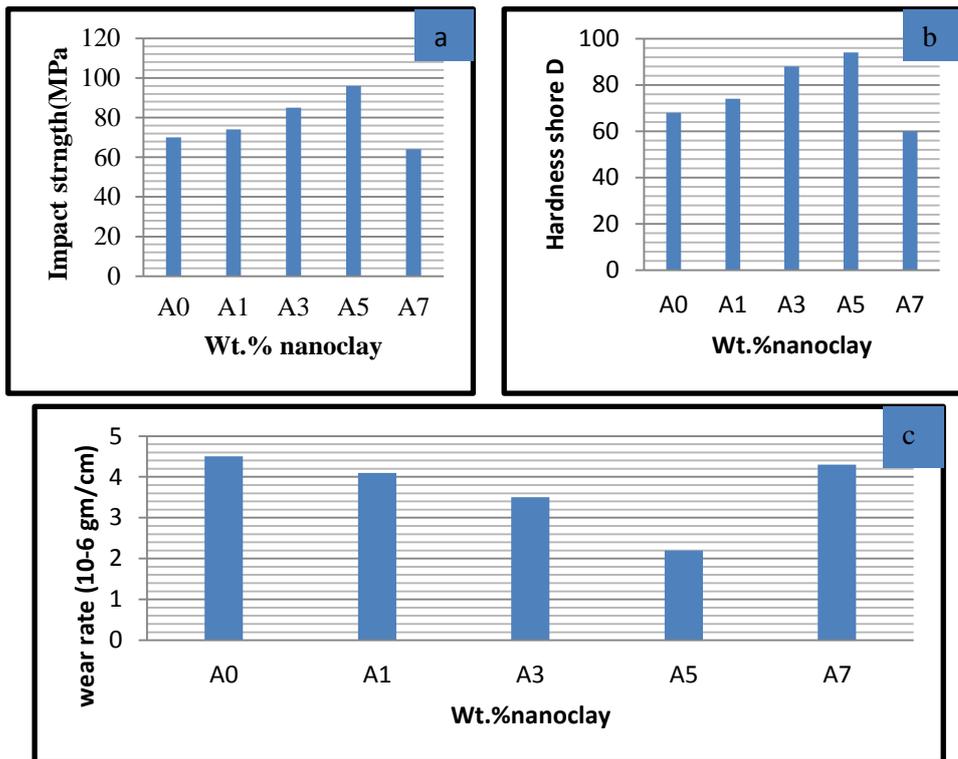


Figure 3. a-Impact strength ,b- Hardness shore D , and c- wear rate as function of weight ratio of nanoclay

3.2. Adhesion strength test:

The adhesion strength of the epoxy coating to substrate concrete was determined using a pull-off test. Figure (4) indicates the pull-off test results of concrete bonded with an epoxy coating containing varying weight ratio of nano clay. The cross-linking density decreased as the nano clay addition increased. The decrease in cross-linking density makes the cured product less brittle, i.e., the bonding strength is increased. The quality of the interface and the strength of the adhesion at the interface determine load transfer between the matrix and the nanofillers [12]. The bond strength of the epoxy coating was 1.76 MPa ,when adding nano clay did make a significant improvement of bond strength of the epoxy nanocomposites at 5% . An increase in particle loading due to an increase in weight fraction leads to a uniform and continuous interface that may create a strong polymer network improving the mechanical properties.

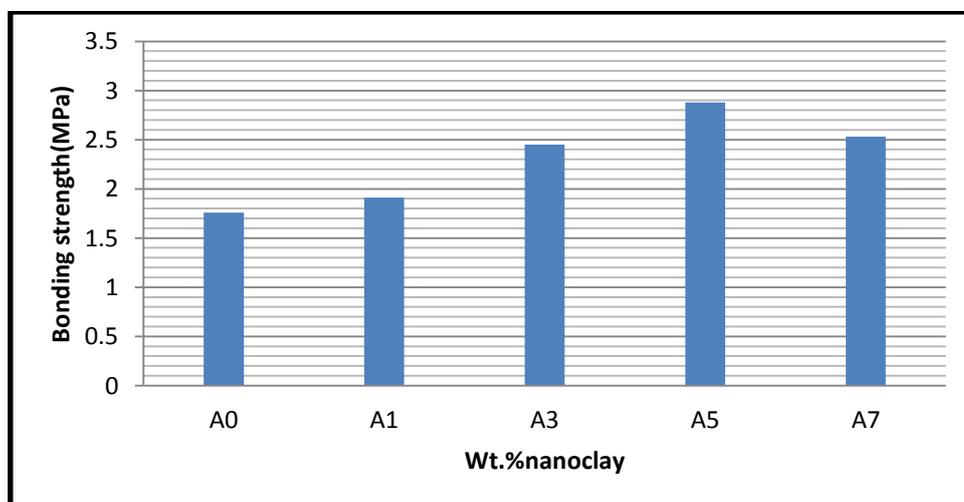
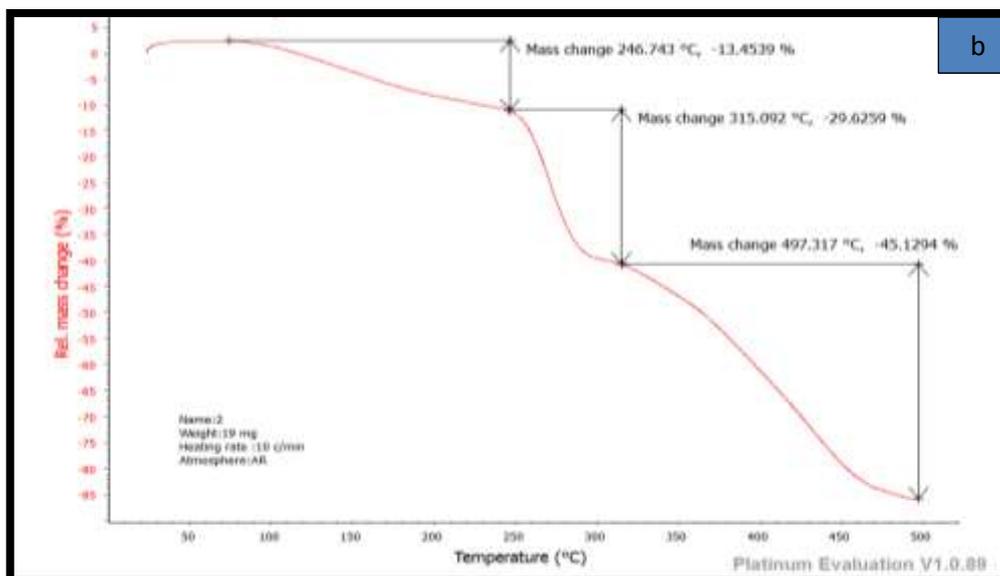
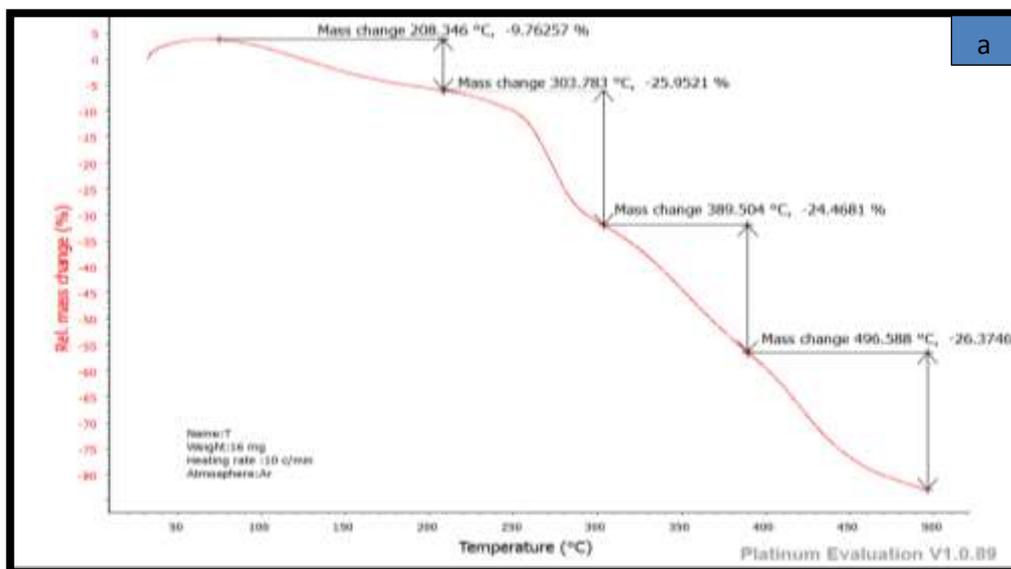


Figure 4. Adhesion strength as function of nanoclay

3.3. Thermal test:

Thermal stability of the nano clay/epoxy coating nanocomposites has been investigated by TGA . Thermal gravimetric analysis (TGA) explain to the effect of the nano clay on the thermal properties of the nanocomposites,where a shift upward of the decompositions temperature is attributed to the improved thermal stability of the nano clay filled with epoxy coating. Thermal stability is very important for coating materials. Thermosetting resins(epoxy) are 3-dimensional of cross-linking. The groups of oxirane, result from the interaction between the resin and the hardener [13]. Shows in figure (5). A thermal expansion coefficient (CTE) desired to achieve dimensional [14] . The CTE and dimensional change curves for the epoxy coating with 1, and 7 wt % of the nano clay are shown in figure (6).Dimensional length for the nanocomposites were smaller than epoxy resin .The polymers generally have a rapid loss of small molecules, such as (H₂O, HCL),at the start of heating. At the same time, the unfinished net- work structures are integrated or the free radicals used are interconnected as a result of the disintegration of some bonds with each other forming new covalent bonds that increase the stability of the compound Which prevents the separation of other molecules and thus reduces the loss and reaches the weight percentage of the semi-stable state.



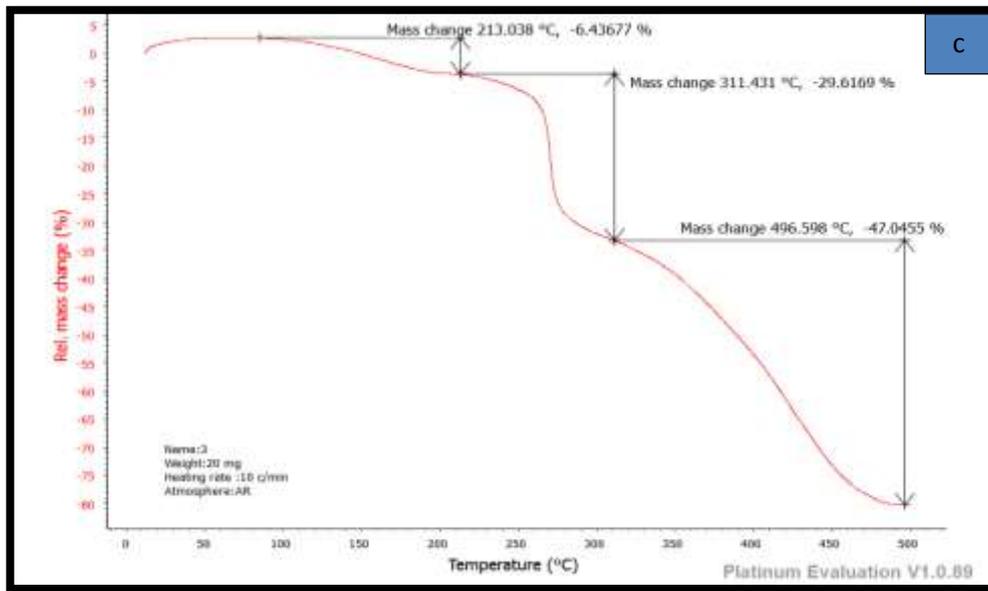
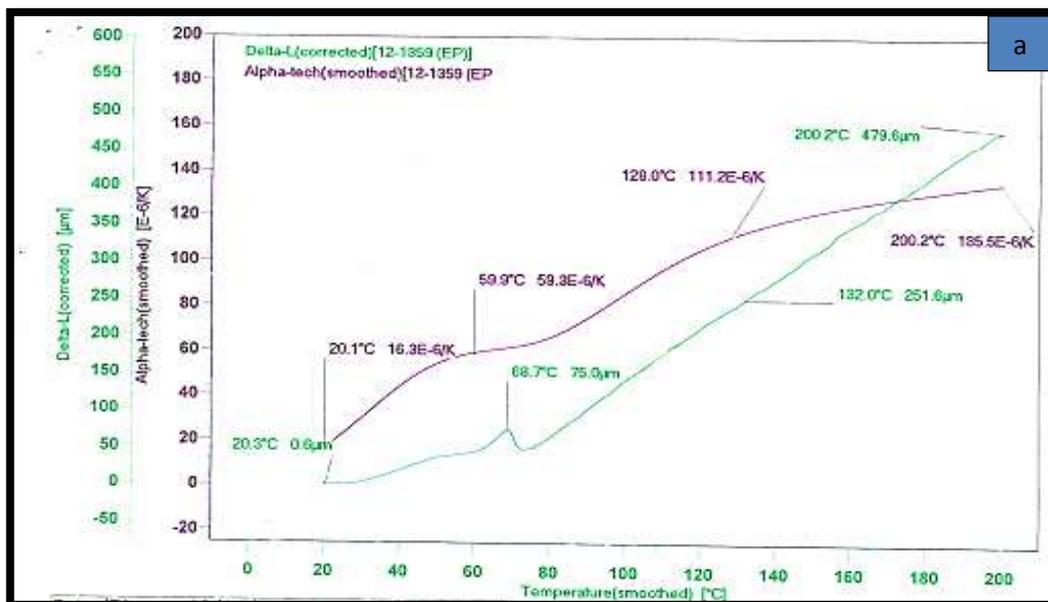


Figure 5. TGA analysis of nanocomposites a- epoxy coating b- epoxy with 1% nanoclay c- epoxy with 7% nanoclay



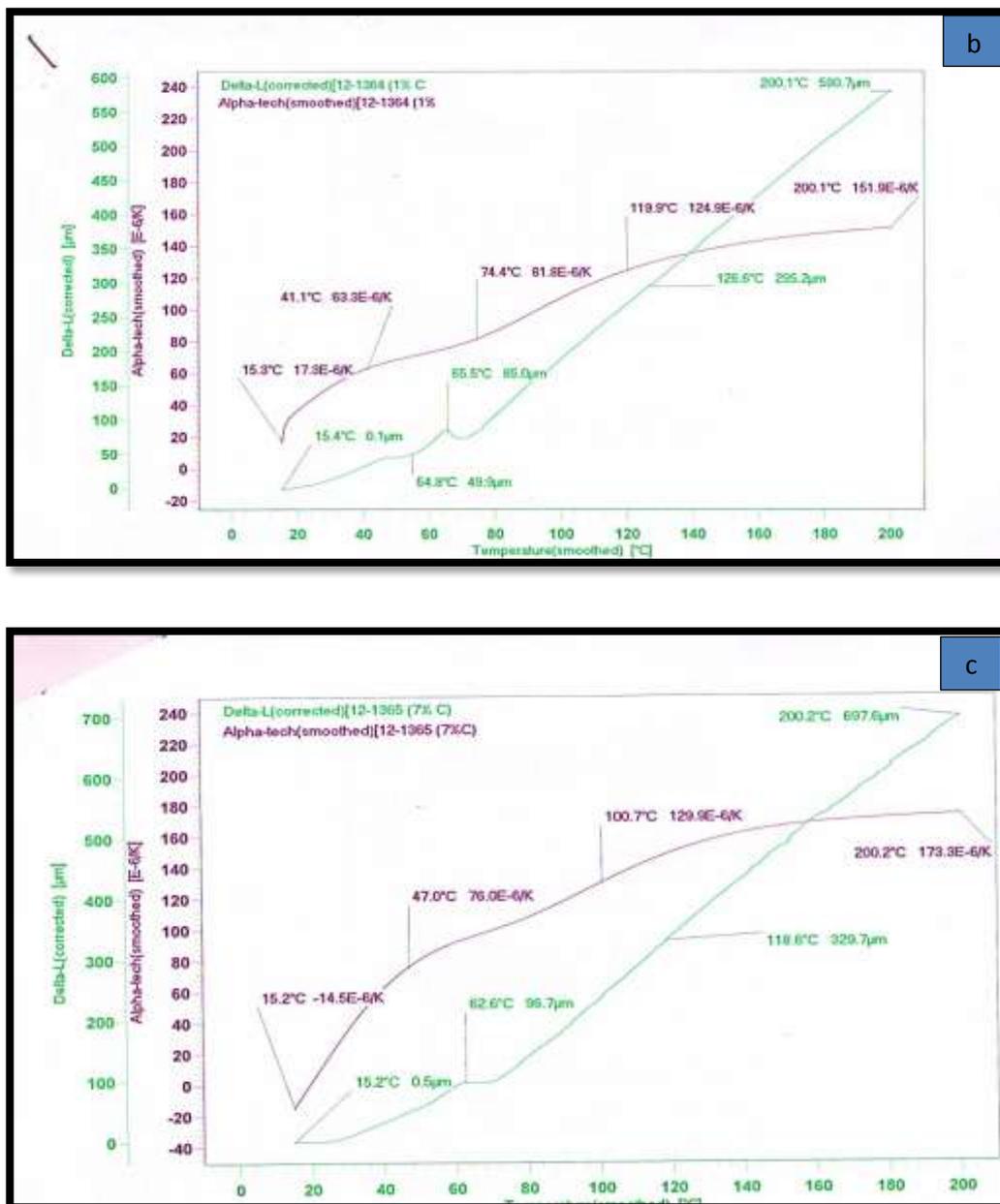


Figure 6.CTE of nanocomposites a- epoxy coating b- epoxy with 1% nanoclay c- epoxy with 7% nanoclay

4. Conclusion :-

- 1.To preparation plastic coating low cost for high mechanical properties and higher thermal stability .
- 2.Impact strength and hardness increase with increasing weight ratio of zirconium dioxide , the best ratio of 5% .
- 3.Wear rate decrease with increasing weight ratio of zirconium dioxide , the best ratio of 5%.
- 4.Pull off adhesion increase with increasing weight ratio and chose the ratio 1,3,5,7 % , best ratio of 5%.
- 5.Thermal stability is better for nanocomposites compared to the resin.

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