# Effect of Nano ($Y_2O_3$) on the Mechanical Properties of the (PS:NR:PMMA) Polymer Blend Composite

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## Abstract

Study of the mechanical properties of polymer blend composite to the preparation of matrix Unsaturated Polyester resin (UPS) with natural rubber (NR) and polymethyl methacrylate (UPS:NR:PMMA) material and study influence Nano Yttrium Oxide ($Y_2O_3$) on the composite . The first group is the preparation of samples of the mixture of polyester matrix with natural rubber material in ratio certain, It was examined the mechanical properties: tensile, flexure at break, young modules, hardness and compression decreases with increases the natural Rubber ratio but Elongation test increases when increases Rubber ratio. The second group is the samples preparation of the mixture of polyester with PMMA material, test mechanical properties decreases with increases the PMMA ratio. Third group was prepared from a mixture of polymer blend composite, which consists of fixed ratios of polyester, natural rubber and PMMA. Addition of Nano material $Y_2O_3$ at ratio (0.25-1.5) wt% .result test mechanical properties increases with increases the $Y_2O_3$ ratio.

**Keywords:** Polymer Blend, polyester, natural rubber, PMMA, $Y_2O_3$, Mechanical properties.

# Effect of Nano ($Y_2O_3$) on the Mechanical Properties of the (PS:NR:PMMA) Polymer Blend Composite

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# التحقق من تأثير مادة $Y_2O_3$ النانوية على الخواص الميكانيكية (PS:NR:PMMA) لمزيج مركب بوليمري

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## الخلاصة

دراسة الخواص الميكانيكية المزيج مركب بوليمري والذي حضر من البوليستر الغير مشبع وهو مادة الاساس (UPS) مع المطاط الطبيعي (NR) ومادة البولي مثيل ميثا اكريليت (PMMA) ، ودراسة تأثير مادة الالتراليوم النانوية ($Y_2O_3$) على المركب .المجموعة الاولى حضرت بإضافة المطاط الطبيعي بنسب معينه الى مادة الاساس البولي استر وتم دراسة الخواص الميكانيكية وهي : ( الشد ، الانحناء ، ومعامل يونك ،الصلادة و الانضغاط وقد تبين من خلال الاختبار انها تقل مع زيادة نسبة المطاط في المركب . المجموعة الثانية هي إضافة مادة PMMA على المادة الاساس البولي استر وبنسب معينه ومن خلال الفحوصات الميكانيكية تبين انمها تقل مع زيادة نسبة PMMA. اما المجموعة الثالثة تم تحضير عينات من مزيج مركب بوليمري يتكون من مادة الاساس البولي استر مع تثبيت نسبة المطاط الطبيعي وتثبيت نسبة PMMA ودراسة تأثير مادة $Y_2O_3$ وبنسب تتراوح بين (1.5-0.25)% من مادة الاساس . وتبين من خلال الفحوصات الميكانيكية ان الخواص الميكانيكية اعلاه تزداد مع زيادة نسبة دقائق الالتراليوم النانوية .

**الكلمات المفتاحية :** مزيج بوليمر ،بوليستر ، مطاط طبيعي ،بولي مثيل ميثا اكلريت ، اوكسيد الالتراليوم ، الخواص الميكانيكية

## Introduction

Polymers are made of long molecules (macromolecule) composed of repeating structure units typically connected by covalent bonds, these long molecules are bonded together by weak Van der Waals and hydrogen bonds, or by these plus covalent cross – links. Polymer blends can be classified into three main categories, a) rubber-rubber blends, b) plastic-rubber blends and c) plastic-plastic blends. Plastic-rubber blends where it can be further divided into rubber-toughened plastics which are more for impact applications and thermoplastic elastomers, which can be processed like a thermoplastic but properties wise, behave more like elastomers. Polymer blend represents very important field in processing of new materials, which has better properties in comparison with the net polymers [1] . Polymer blending is an attractive route for producing new polymeric materials with tailored properties without having to synthesize totally new

materials [2].The incorporation of elastomeric particles into the bulk of thermoplastics brittle polymers are a well-known technique used to improve the toughness of the plastics. Toughness can be defined as the amount of energy that a material can absorb before breaking polymer modification is blending two or more components with different properties [3] .Polyamides are commercially important polymers amongst crystalline engineering thermoplastics; this is mainly due to their high performance characteristics such as high melting points, good mechanical strength and ductility, as well as excellent resistance to solvents, fatigue and abrasion [4]. A polymer blend or polymer mixture is a member of a class of materials in which two or more polymers are blended together to create a new material with different physical properties [5] . Blending of polymer is a technological way for providing materials with full set of desired specific properties at the lowest cost, e.g. a combination of strength and toughness, strength and solvent resistance, etc. [6] . Preliminary studies on rubber modified resin reported only modest increases in fracture toughness; however, as the technology developed, more significant increases in toughness were obtained [ 7,8 ] . In more recent years, it has been shown that the toughness can be increased by more than an order of magnitude over that of the unmodified resin [9-11] . Synthetic polymeric materials have been used in industrial materials, which are currently receiving great attention as innovative materials for industrial applications in several sectors, such as automotive, building, appliance, packaging and biomaterials. Engineering polymers are designed to give improved strength or better performance at elevated temperatures. Some of the engineering polymers can perform at temperatures as high as $300^0$C; others usually in a fibre form have specific strength that is greater than of steel . Among polymer materials, thermoplastics and elastomer- based polymer mixtures, thermoplastic elastomers are of special interest. The application of these materials can be confidently advised because they are processed as plastics preserving high elasticity as elastomers [12]. The polymer blends has been a major topic of polymer research and development for almost five decades, although noted to be of interest much earlier, the academic and industrial effort in polymer blends exponentially increased starting in the late 1960s. Although various reasons were responsible for this increased interest, one significant factor was the emergence of a major engineering

polymer blend [13].The development of new polymeric blends is an important and creative technological way of obtaining new applications for polymeric materials, decreasing costs and optimizing properties of the final products. Most of the polymers are immiscible during their mixture with other polymers and form multiphase systems [14, 15]. Modern technologies provide powerful tools to explain microstructures at different levels, and to understand the relationships between structures and properties. These new levels of understanding bring opportunities to develop materials for new applications [16]. Plastics and rubbers incorporating powdery fillers have frequently been used from the viewpoint of mechanical properties [17] . An important attribute of polymers is the ability to modify their inherent physical properties by the addition of fillers while retaining their characteristics. Polymers can be made stronger, stiffer [18-20] . Since rubber elements have the unique properties of high elongation, reversibility incompressibility, and damping. PMMA is a transparent polymeric material that poses many desirable properties such as light weight, high transmittance, chemical resistance, uncoloured, resistance to weathering corrosion and good insulating properties. Rubber toughened PMMA has been the focus of commercial and scientific interest for many years. Besides improving the fracture resistance of the polymer, modifiers for PMMA must also maintain the stiffness of the matrix as well as its clarity [21]. The matrix material must be capable of being forced around the reinforcement during some stage in the manufacture of the composite [22] . Most polymer blends obtained by mixing melted components form heterogeneous systems with an emulsion type of structure. The component with the lower volume fraction takes the form of particles dispersed in the medium of the second component. The aim of the research study of the Effect of Nano ($Y_2O_3$) on the Mechanical Properties of the (PS:NR:PMMA) Polymer Blend Composite

## Materials and Preparation

### 1. Matrix of the material

a. (Unsaturated Polyester resin) (UPS) as the basis of the Company , with Saudi Arabia in the form of a transparent viscous liquid at room temperature, one of the types of polymers thermally hardened (Thermosets) density (1200Kg / $m^3$) turns to solid state when adding tempered

(Hardener) factory production company (SIR), which Saudi Arabia (MEKP) (Methyl- Ethyl Keton Peroxide) on the transparent liquid form and is added to the polycarbonate resin ester is saturated by (1 g) of each tempered (100g) of polycarbonate resin unsaturated ester at room temperature required materials ready in the my search .

b. polymethyl methacrylate (PMMA) cold curing , type (Castavaria) made by (Vertex – Dental Company), Vertex™ Castavaria is a multifunctional self-polymerizing acrylic which is perfectly useable as a pouring, relining, rebasing and as a repair acrylic.

c. Natural rubber, made by Malaysia, which is melted by Tlowin .

d. Powder material Nano particle Yttrium oxide ( $Y_2O_3$) ,made by Chendgu Haoxuan Technology Co,. Radius (30-80) nm, shape spherical, Assay 99.999% MW=225.82 , china .

**2. Preparation of casting mold samples** :

2.1 Samples were prepared according to the rates in Table (1) .

**Table (1) represent ratio samples polymer blend composite**

| Groups | Ratio metal polymer blend composite |
|---|---|
| First group | UPS(100%) |
| | UPS(95%)+NR(5%) |
| | UPS(90%)+NR(10%) |
| | UPS(85%)+NR(15%) |
| | UPS(80%)+NR(20%) |
| Second group | UPS(95%)+PMMA(5%) |
| | UPS(90%)+PMMA(10%) |
| | UPS(85%)+PMMA(15%) |
| | UPS(80%)+PMMA(20%) |
| Third group | UPS(79.75%)+(10%NR)+(10%)PMMA+0.25%)$Y_2O_3$ |
| | UPS(79.5%)+(10%NR)+(10%)PMMA+(0.5%)$Y_2O_3$ |
| | UPS(79.25%)+(10%NR)+(10)PMMA+(0.75%)$Y_2O_3$ |
| | UPS(79%)+(10%NR)+(10%)PMMA+(1%)$Y_2O_3$ |
| | UPS(78.5%)+(10%NR)+(10%)PMMA+(1.5%)$Y_2O_3$ |

2.2 After 24 hours flying the sample from the mold and is inserted into the electric furnace temperature ( 55 $^oC$) so as to make the treatment process and keep the sample in the oven

for (50-60) min this is the stage necessary to obtain the best interlock and to remove the stresses generated by the manufacturing process [23].

2.3 These samples are cut by the (CNC) Computer Numerical Control machine depending on the devices that have been testing the specifications as well as the quality of the examination, by formats as required in the examination, and described in the International standards and devices used in the examination, .

## 3 Mechanical Properties Testing :

### 3.1 Tensile test

Samples were cut according to (American society for testing materials) (ASTM D) specimen. The machine used for the testing of tensile properties is micro computer controlled electronic universal testing machine (model WDW 200 E) made in China The test was conducted at velocity of (1 mm/min) at ambient temperature, tensile stress was applied till the failure of the sample and stress-strain curve was obtained.

### 3.2 Flexural strength

bending behaviour of the prepared sample was tested using a three point test instrument, (model WDW 200 E) made in China, at room temperature and after fixing the ends of the sample on the supports of the instrument, the weights were increased gradually on at the middle of the sample with velocity (5mm/min) until the failure of the specimen occurred.

### 3.3 Impact test

It is considered one of the most important mechanical tests that give the absorption of energy that is required for fracture of the sample which is given directly from the device, furthermore impact strength (I.S). The impact test instrument model XJU-22 . The sample was placed vertically; the testing method of this instrument includes lifting of pendulum to its maximum height and fixing it firmly where its potential energy would be changed to kinetic energy.

### 3.4 Hardness test

Shore D has been used to measure the hardness of the samples, which must have smooth, plain surface with thickness at least more than (3mm) and must not be exposed to mechanical vibrations so that the prepared sample has (8×8×5) $mm^3$. These dimensions were taken according to ASTM-D570, Shore instrument is similar to compass containing needle placed in a position perpendicular to the sample and it takes waiting (0.5 min) to read the value and to have some accuracy an average of ten readings have to be taken in different locations and at different points for each sample

### 3.5 Compression test

The sample for this test was prepared according to ASTM with dimensions (2×1×1) $mm^3$, depending on thickness of the sample.. The test was conducted at velocity of (0.5mm/min) at ambient temperature. The machine for the testing of compression was made in China and it is model (WDW200E). The load was applied gradually to the longitudinally fixed sample, the increasing of the load continued until the failure of the specimen occurred,

## Result and Discussion

The practical size distribution of this powder was carried out by atomic force microscopic (AFM) using scanning probe microscopy (SPM) the result of practical size distribution of $Y_2O_3$ as rang (28-100) shown in table (2) and figure (3-1) where average value of diameter was (68.91nm ) .

**Table (2) practical size distribution of $Y_2O_3$ , where average value of diameter .**

| Diameter(nm)< | Volume(%) | Cumulation(%) | Diameter(nm)< | Volume(%) | Cumulation(%) | Diameter(nm)< | Volume(%) | Cumulation(%) |
|---|---|---|---|---|---|---|---|---|
| 30.00 | 0.81 | 0.81 | 55.00 | 9.68 | 23.39 | 80.00 | 7.26 | 66.13 |
| 35.00 | 0.81 | 1.61 | 60.00 | 8.87 | 32.26 | 85.00 | 14.52 | 80.65 |
| 40.00 | 2.42 | 4.03 | 65.00 | 9.68 | 41.94 | 90.00 | 13.71 | 94.35 |
| 45.00 | 1.61 | 5.65 | 70.00 | 8.06 | 50.00 | 95.00 | 5.65 | 100.00 |
| 50.00 | 8.06 | 13.71 | 75.00 | 8.87 | 58.87 | | | |

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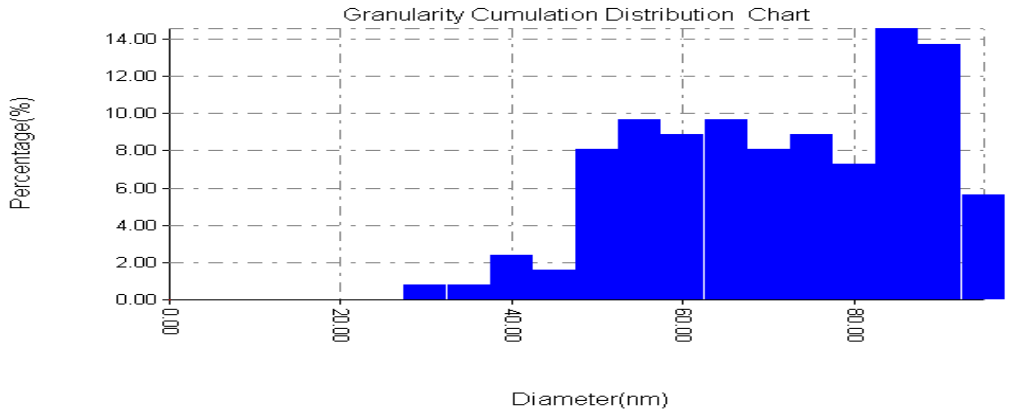


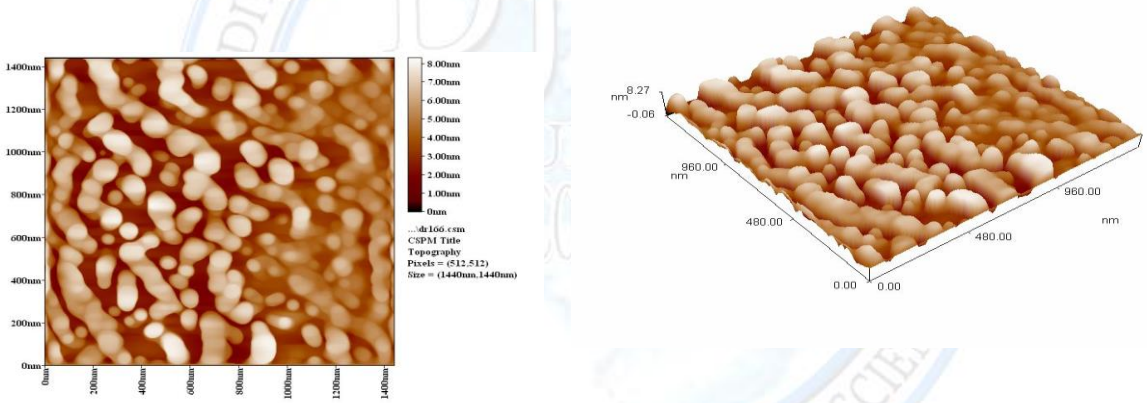




**Figure (3-1) AFM test of Nano $Y_2O_3$**

By table (1) the ratio the metal at make polymer blend composite to study of the research;

**Tensile test result:**

Fig.(3-2) show the stress-strain curves of first group of polymer blend (UPS:NR) as a function of NR . it was found from the figure that the stress value decreases with increases of NR to

UPS , the reason to effect the rubber to the polymer blend composite metal gained plasticity property .

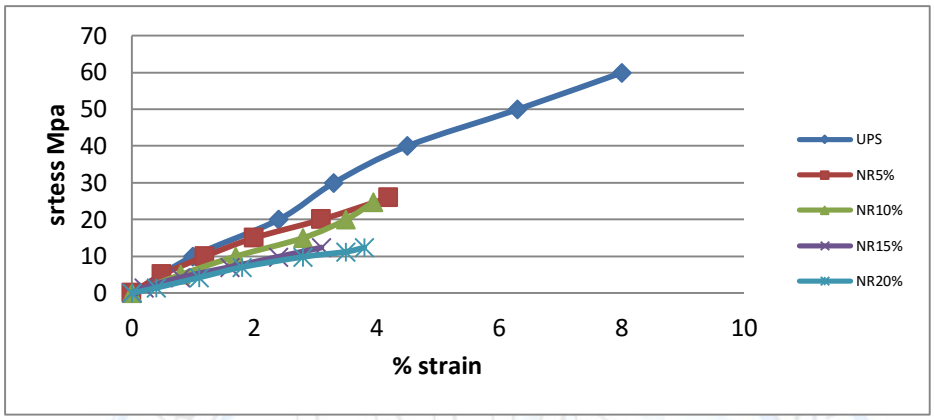
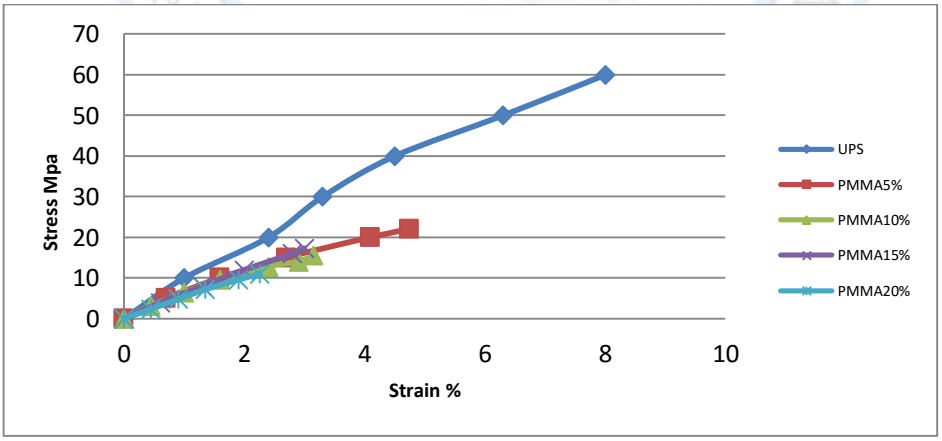



**Fig. (3-2): Stress-strain curves of the polymer blend (UPS:NR) as a function of NR content in composite**

Fig.(3-3) show the stress-strain curves of second group of polymer blend (UPS: PMMA) as a function of PMMA , observed value stress decreases when increases the ratio PMMA, and reason to effect the PMMA to the polymer blend composite gained character delicacy .




**Fig(3- 3): Stress-strain curves of the polymer blend (UPS:PMMA) as a function of PMMA content in composite**

Through curves (stress - strain) the observe it's consists of the deformation zone flexible of linear relationship between stress and strain, and this region has been the flexibility coefficient, which represents a slope straight line. suffer material polymer within the boundaries of this region distorted flexible due to tensile and elongation of the chains of polymeric for without breaking the bonds. then this curve deviates from linear behavior is a result generate crack inside the polymeric material, these cracks grow and accumulate with increasing stress composed cracks larger and continues to grow with a stress until it's gets in the fracture sample. In other cases, the fracture starts at the outer surfaces of the positions deformation or defects such as for scratches bond or internal cracks and working zones of concentration of stresses that lead to the high value of the stress to exceed the limits of the force of internal bonds , thus break happens [23].

Fig.(3-4) show the flexural strength values for the polymer blend (UPS:NR ) as a Relative to NR . it was found from this figure that the fracture strength decreases with function NR to UPS .and (UPS:PMMA) as a Relative to PMMA . Observed the value fracture strength decreases with increases the ratio the PMMA in to polymer blend composite because the PMMA it's brittle .

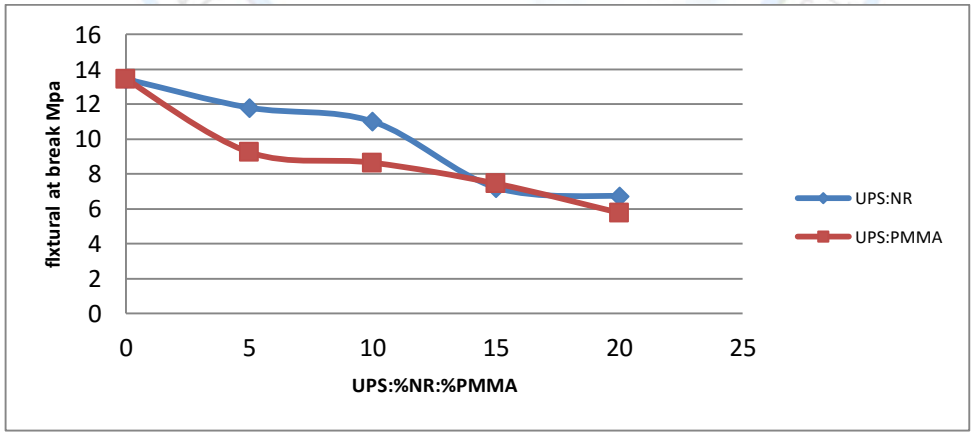



**Fig.(3-4) Fracture strength of the polymer blend (UPS:NR) as a function of NR content in composite and Flexure strength of polymer blend (PS:PMMA) as a function of PMMA content in composite**

Bending resistance significantly affected as strongly linked to the base material and reinforcement material. this is due to the presence of metal within the base material, which do not facilitates the penetration of the base material process between the reinforced material which decreases the moist which is in the liquid state, and this leads to decreased interoperability bonding area between the material matrix and materials reinforced which It decreases the bonding strength after hardening and ultimately decrease the flexibility bending transactions [24].Fig.3-5 show curves of first group of polymer blend (UPS:NR) as function of NR , observed value Young modules decreases with increases the ratio the NR in to polymer blend . (UPS:PMMA) as a function of PMMA . Observed the value Yong modules decreases with increases the ration PMMA in to polymer blend For the same reason above .

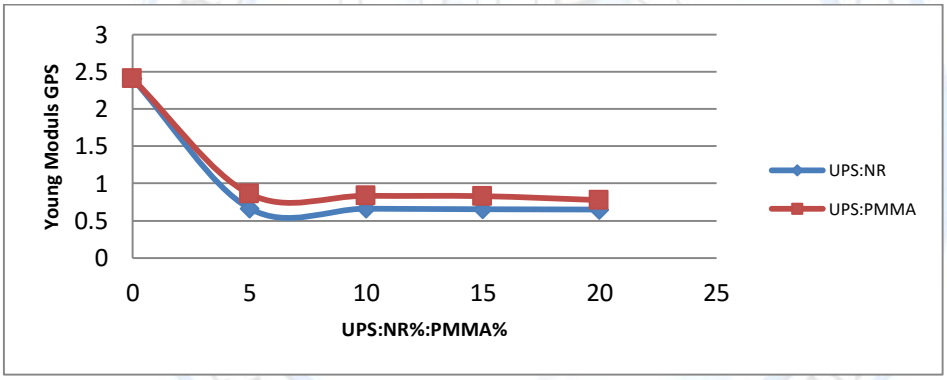



**Fig.(3-5) Young modulus of the polymer blend (UPS:NR%) as a function of NR content in composite and polymer blend (UPS:PMMA) as a function of PMMA content in composite**

From Fig.3-6 show curve the first group (UPS:NR) as a function of NR, Observed the value Elongation increases with increases the ratio of NR in to polymer blend because to Acquire the status of ductility from the metal NR .( UPS:PMMA) as a function of PMMA observed the value Elongation decreases with increases the ration PMMA in to polymer blend because brittle metal PMMA .

**Effect of Nano ($Y_2O_3$) on the Mechanical Properties of the (PS:NR:PMMA) Polymer Blend Composite**

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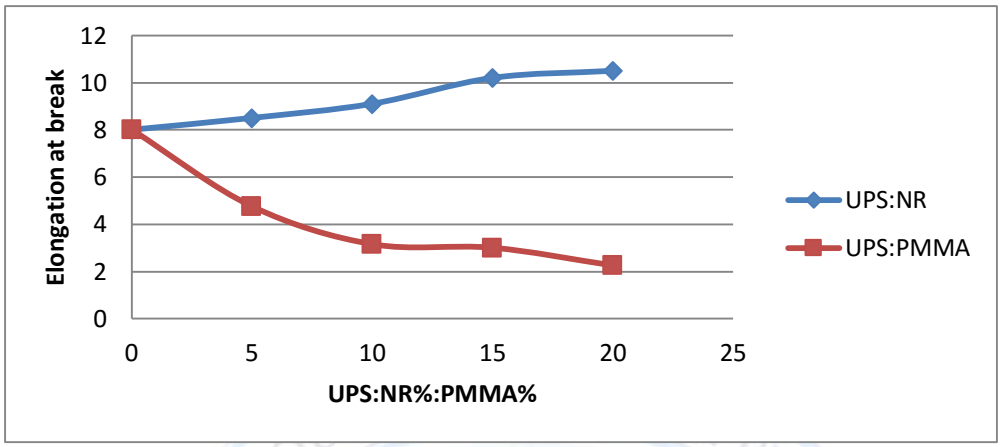


**Fig.(3-6) Elongation at break of polymer blend (PS:NR) as a function of NR content in composite**

Fig.(3-7) show the stress-strain curves of third group of polymer blend composites (UPS:NR:PMMA:$Y_2O_3$) as a function of $Y_2O_3$, observed stress value to polymer blend composite increases when increases the ratio $Y_2O_3$ .

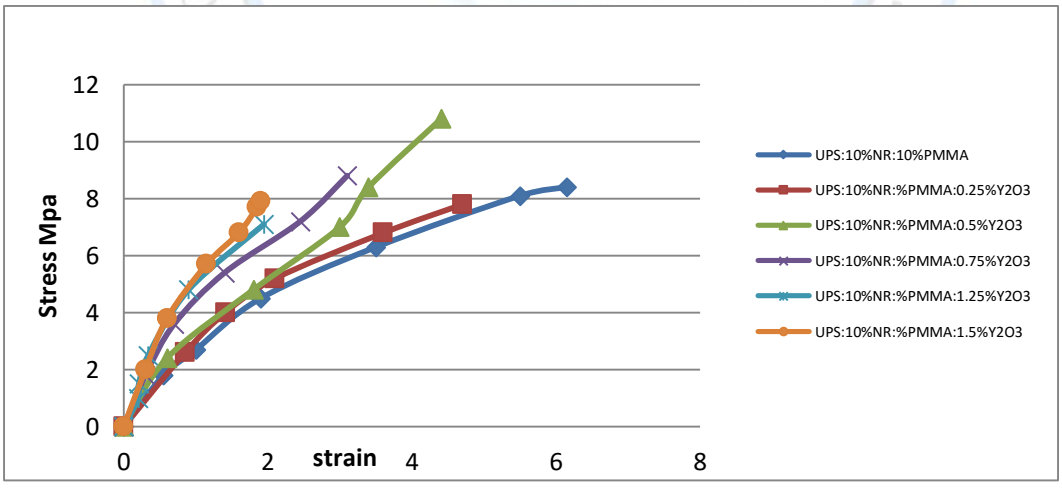


**Fig.( 3-7): Stress-strain curve of the polymer blend composite UPS:(20%NR):(15%)PMMA :%$Y_2O_3$) as a function of $Y_2O_3$ content in composite**

It was also observed that the tensile strength of the samples reinforced particles atrium oxide Nano , The reason to attributed to the strong correlation between partials of atrium oxide and material basis , as the strong bonds will does not allow the formation of internal defects (cracks) is fast, small particles into the Interfaces space within the reinforced metal network , do not work any defects inside the material composition itself . This increases the ability of the middle and moistening reinforced materials in an integrated areas, and then, increasing the contact interface area between the reinforcement material and matrix material , therefore increasing the strength of the connections between the components of material overlapped. As well as the reinforcement materials have higher than the base material flexibility [25].

Fig.3-8 show curve the third group of polymer blend composites (UPS:NR:PMMA:$Y_2O_3$) as a function of $Y_2O_3$ , observed the value fracture strength increases when increases the ratio $Y_2O_3$ in to polymer blend composite

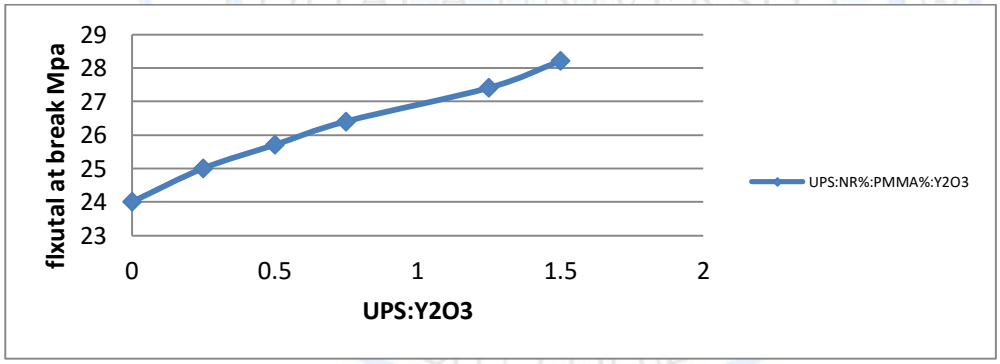


**Fig.(3-8) Fracture strength of polymer blend composite UPS:(20%NR):(15%)PMMA :%$Y_2O_3$) as a function of $Y_2O_3$ content in composite**

Bending resistance significantly affected as strongly linked to the base material and reinforcement material. this is due to the presence of metal within the base material, which facilitates the penetration of the base material process between the reinforced particles which increases the moist which is in the liquid state, and this leads to increased interoperability bonding area between the material matrix and materials reinforced which

It increases the bonding strength after hardening and ultimately increase the flexibility bending transactions .

Fig.3-9 show curve the third group of polymer blend composites and which consists to matrix polyester (UPS:NR:PMMA:$Y_2O_3$) as a function of $Y_2O_3$ , observed the value Yong modules increases when increases ratio $Y_2O_3$ in to polymer blend composite .

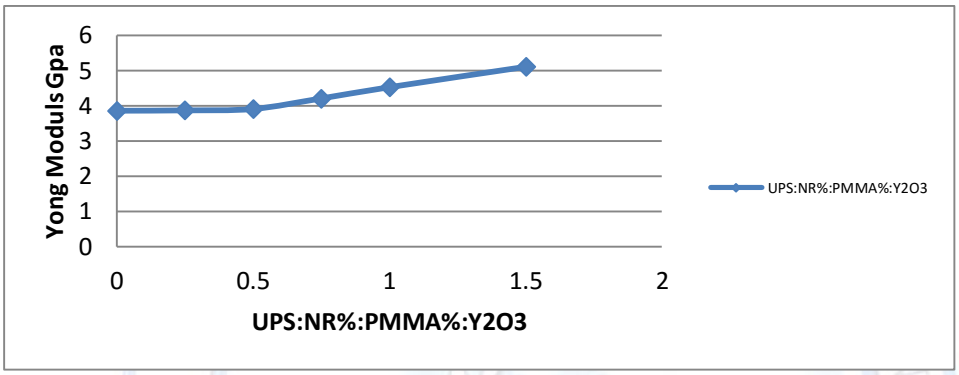


**Fig.(3-9) Young modulus of polymer blend composite UPS:(20%NR):(15%)PMMA :%$Y_2O_3$) as a function of $Y_2O_3$ content in composite**

From Fig.3-10 show the curve of the third group of polymer blend composites and which consists to matrix polyester (UPS: NR: PMMA: $Y_2O_3$) as a function of $Y_2O_3$ content, and observed the value Elongation decreases when increases the ratio of %$Y_2O_3$ in to polymer blend composite .

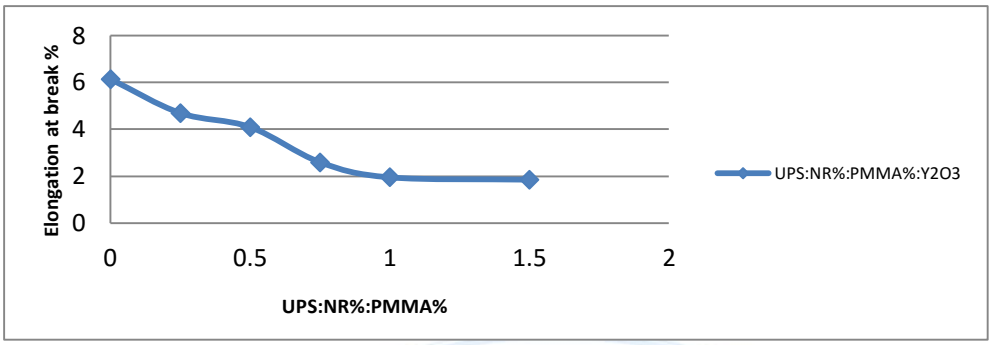


**Fig.(3-10) Elongation at break of polymer blend composite UPS:(20%NR):(15%)PMMA :%$Y_2O_3$) as a function of $Y_2O_3$ content in composite**

**Impact test**

Fig.3-11 shows the curve of the first group (UPS:NR) as a function of NR , observed that the value Impact decreases in the increases the ratio NR of the polymer blend composite . (UPS:PMMA) as a function of PMMA observed the value Impact decreases with increases the ratio the PMMA in to polymer blend composite .

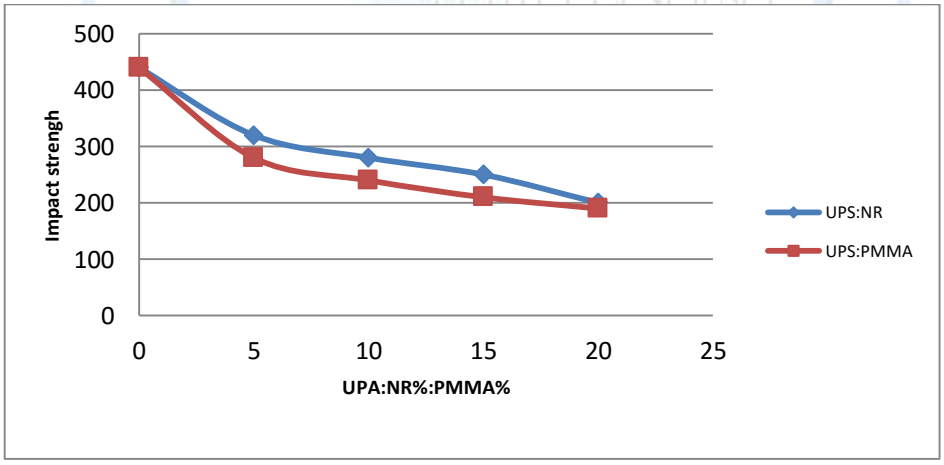


**Fig.3-11 Effect of polymer blend (UPS:NR) as a function of NR content in the blend polymer blend (UPS:PMMA) as a function of PMMA content in the blend**

The case of Impact decreases value , because of metals are working to create a lot of defects , which serve as centers of concentration of stresses and reduces needed to break the power and thus reduces the Impact values Impact decreases value because the metals are working to create a lot of defects , which serve as centers of concentration of stresses and reduces needed to break the power and thus reduces the Impact values. As well as a result of the reinforced material does not act as a barrier to developing cracks through the material overlapped any do not work on disability cracks growth and this will lead to change part of its shape and direction leading to its transformation into cracks core group. This change in the form of slit and direction led to reduce the surface area of the break and the energy expended and all these factors led to the decrease of the resistance Impact of the samples [26].

Fig.3-12 show curve the third group of polymer blend composites and which consists to matrix polyester (UPS: NR: PMMA: $Y_2O_3$) as a function of $Y_2O_3$ observed that the Impact value increases when increases the ratio of $Y_2O_3$ in to polymer blend composite.

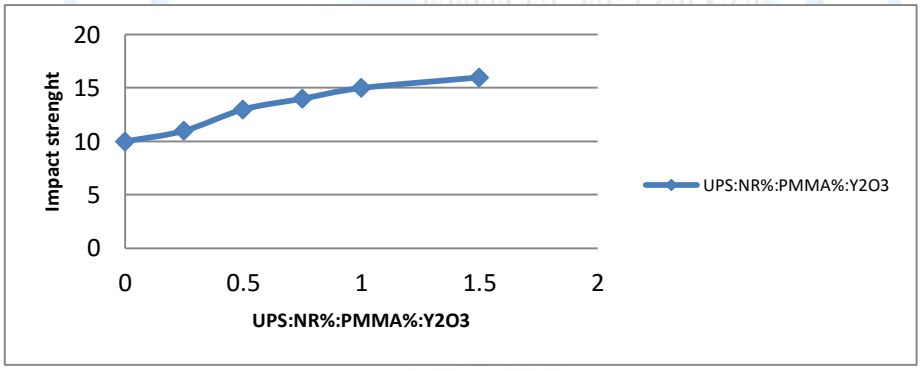


**Fig.3-12 show the effect of polymer blend composite UPS:(20%NR):(15%)PMMA :%$Y_2O_3$) as a function of $Y_2O_3$ content in composite**

Fig.3-13 show the curve of the first group (UPS: NR) as a function of NR observed the value fracture toughness decreases with increases NR of the polymer blend composite. group (UPS:PMMA) as a function of PMMA , observed the fracture toughness value decreases with increasing the ratio of the PMMA in to polymer blend composite .

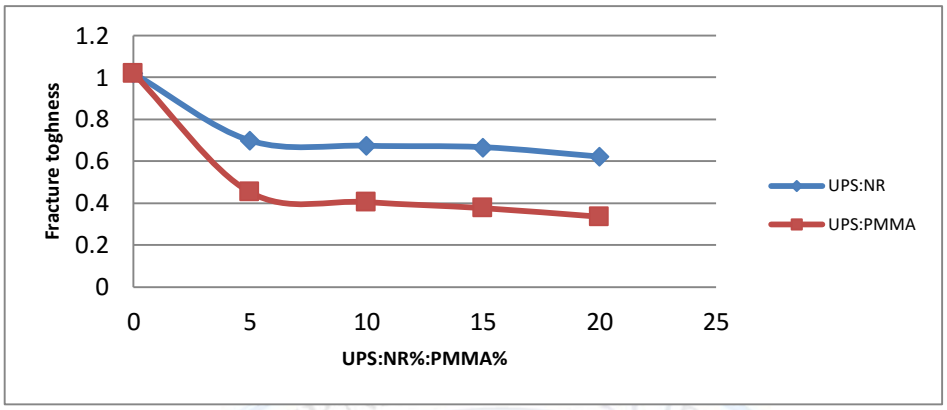


**Fig.3-13 show fracture toughness of polymer blend (UPS:NR) as a function of NR content in the blend and polymer blend (PS:NR:PMMA)**

It shows that the fracture toughness decreases values with increased , because to create a lot of defect , which serve as centers of concentration of stresses and reduces needed to break the power and thus reduces the fracture tightness values. As well as a result of the NR:PMMA material composite does not act as a barrier to developing cracks through the material and do not work on disability crake growth and this will lead to change part of its shape and direction leading to its transformation into cracks core group. This change in the form of slit and direction led to reduce the surface area of the break and the energy expended and all these factors led to the decrease of the fracture toughness resistance of the samples [26].

Fig.3-14 show the curve of the third group of polymer blend composites and which consists (UPS: NR: PMMA: $Y_2O_3$) as a function of $Y_2O_3$ observed the fracture toughness value with increases $Y_2O_3$ in to polymer blend composite.

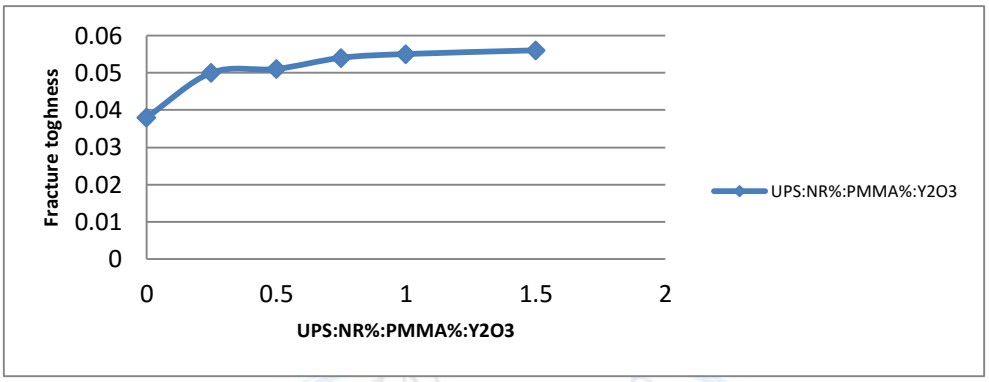


**Fig.3-14 fracture toughness of polymer blend composite UPS :( 20%NR) :( 15%) PMMA: %$Y_2O_3$) as a function of $Y_2O_3$ content in composite**

the fracture toughness increases values with increased particle atrium Nano , because to decreases defect , and work to increase force needed to break , and thus increases the fracture tightness values. Atrium Nano particle act as a barrier to developing cracks through the material and do work on disability crake growth

**Hardness test**

Fig.3-15 show curve the first group (UPS:NR) as a function of NR and observed the value hardness decreases with increases the NR ratio for the polymer blend composite . (UPS:PMMA) as a function PMMA , observed the Hardness value decreases with increases the ratio the PMMA in to polymer blend composite because the quality the metal brittle PMMA .

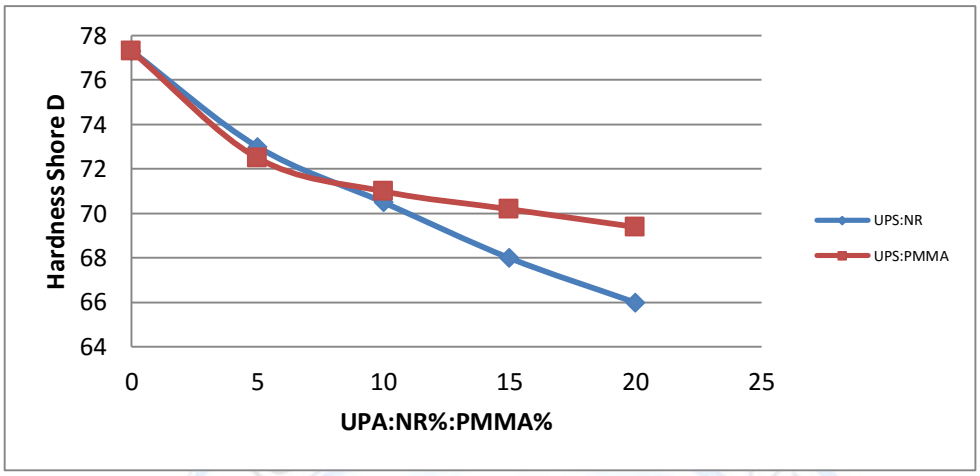


**Fig.3-15 Hardness of polymer blend (UPS:NR) as a function of NR content in composite polymer blend (UPS:PMMA) as a function of PMMA content in composite**

Fig.3-16 show curve the third group of polymer blend composites (UPS:NR:PMMA: $Y_2O_3$) as a function of $Y_2O_3$ content , observed the Hardness value increases at increases ratio $Y_2O_3$ in to polymer blend composite .

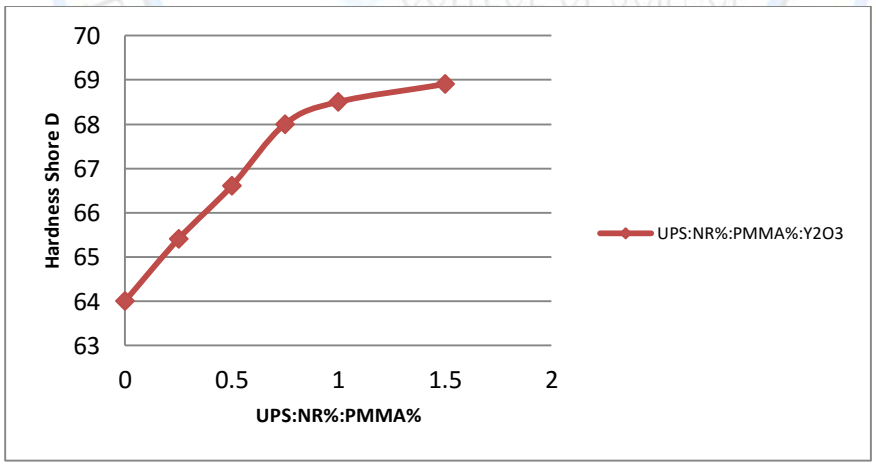


**Fig.3-16 show Harness of polymer blend composite UPS :( 20%NR) :( 15%) PMMA: %$Y_2O_3$) as a function of $Y_2O_3$ content in composite**

It is noted that the hardness values for samples of atrium oxide Nano is higher than the USP:PMMA:NR for samples of .This is due to low viscosity gained material prepared at increased fracture volumetric powder atrium oxide Nan into the material composite which is in the liquid state, causing ease of penetration material composite to space interfaces and pores interfaces , therefore resulting in a reduction of gaps inside the material . [27,28].

**Compression test**

Figure (3-17) show the compression curves of the first group (UPS:NR) as a function of NR and observed the compression value decreases with increases the ratio NR of the polymer blend composite . the reason to the polymer blend composite metal Gained plasticity property (UPS:PMMA) as a function PMMA , observed the compression value decreases with increases the ratio the PMMA in to polymer blend composite .

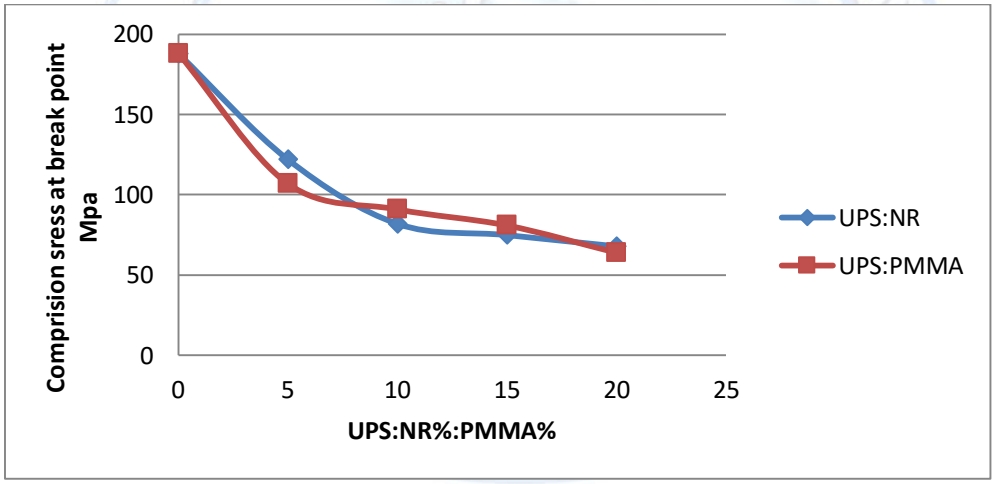


**Fig. 3-17 The compressive strength of polymer blend (UPS: NR) as a function of NR content in the blend polymer blend (UPS: PMMA) as a function of PMMA content in composite**

Fig.(3-18) show the compression curves of third group of polymer blend composites (UPS:NR:PMMA: $Y_2O_3$) as a function of $Y_2O_3$ , observed the Hardness increases at increases value ratio $Y_2O_3$ in to polymer blend composite.

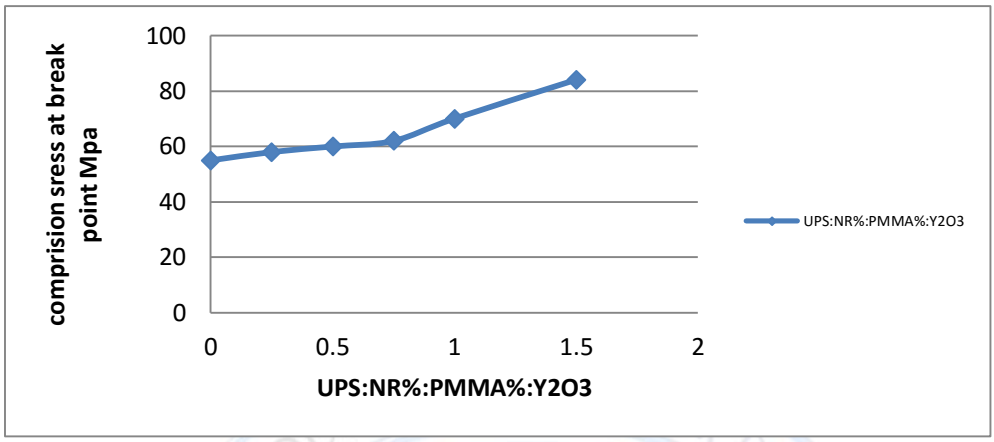


**Fig. 3-18 The compressive strength of polymer blend composite UPS:(20%NR):(15%)PMMA :%$Y_2O_3$) as a function of $Y_2O_3$ content in composite**

because of its reinforced material to resist high compression compared to the material basis on polymeric addition, and as previously stated easier penetration of atrium particle Nano into the space area interfaces between the polymeric chains lead to a reduction in the vacancy inside the base material and thus increase the compressive strength [29].

## Conclusion

1. Natural Rubber when to addition to polyester, Elongation value increases when increases NR value and the best value at 20%NR .
2. Nano $Y_2O_3$ when addition to the polymer composite blend UPS: NR: PMMA) the value of mechanical properties increases when increases ratio of Nano $Y_2O_3$ and the best value at 1.5%$Y_2O_3$ .

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