Study of Tensile Strength and Hardness Property for PVC Reinforced with Fiber

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ABSTRACT

Study the tensile strength and hardness of poly vinyl chloride as a matrix and subsidized fiber (short fiber glass - glass fibers are woven mat - fibers, nylon-6) and attended samples fractures different size. (21%-23%-25%-27%-29%). A comparison was made of the results of the tensile tests and hardness of materials composite as tests were conducted at room temperature. (23+2 c). Results from the volumetric fraction lead to increased resistance to tensile and hardness values.Results of the materials [pvc+f(w.r+N-6)] had its highest value of the tensile strength and material [pvc+ fg(w.r)], had its highest value of hardness.

Introduction

The study of mechanical properties of the materials of the very important things. Because it determines the behavior of these materials when they are under the influence of different stresses. And under different external conditions of the pressure effect of temperature and time of stress and the speed of the stress and the nature of chemical solvents and other factors that many of the mechanical properties of composite material with the foundation polymer so affecting is the study of the mechanical properties of very complicated things, to the multiplicity of influencing each property variables [1].

Know overlapped materials as those of solid systems resulting from the involvement of two or more substances do not interact chemically but Ata sran physically so as to make new material has the perfect recipes and intended qualities ideal for strength, durability, density of low-lying, resistant to chemicals, moisture, thermal insulation and electric, the possibility of configuration, cst low-lying. [2]

Article overlapped article basically consists (Matrix) and prepreg material (Reinforcement), it is possible that the material foundation and strengthening material be composed of polymeric material or metal or ceramic. [3]

Material Matrix

Is an material that is working on the cohesion of the elements of Material composite and linking their parts together to form a system able to withstand external influences [4]

The Material base move the load hanging out and distributed to material reinforcement and maintaining reinforcement materials from external conditions and changes in temperature and oxidation, corrosion etc.

Pvc Attend the re-mediated interaction of acetylene gas with hydrochloric acid, the presence of a suitable catalyst. [5]

A rapid growth in PVC consumption has become as important in many industries, such as insulation for electrical wires, Hats flooring, and in bottles industry, the automotive industry, and use very in vitro hardwood industry, has taken PVC compete rubber in many uses because of its good

qualities in terms of higher dielectric severe Almqazemh for planing and the low moisture absorption and good elasticity. [6]

Fiber

A filamentous structures irregular in shape with good properties, working to strengthen the Material base.The fiber bear the bulk of the load hanging on Material overlapped reinforced fiber, the material properties of overlapping depends on the properties of the fiber (fiber diameter, the volumetric fraction, the length of the fiber) [7]

Fiber glass

The most common type of fiber used in the manufacture of overlapping material because of its fiber glass of good properties.

Fibers Nylon 6

Nylon fibers made of polyamides and is thermoplastic polymers prepared from amino acids or their compounds.

Nylon fibers possess good mechanical properties and good resistance to heat, and has nylon fiber tensile strength and flexibility so competently used widely in the manufacture of clothing, tires, carpets, ropes The fibers of nylon fiber low-lying transactions and high elongation, which have the ability to absorb greater energy, they also increase the durability and shock resistance [8]

Hardness is the property of the mechanical properties of the surface mission. It can measure the surface hardness measurement of frictional resistance of the material, but the most common measurement of hardness is measured diameter effect happening at the surface of the material due to the penetration of steel ball or body pyramidal shape under the influence of a certain load [9] as the depth of penetration inside the material is a measure of the viability of the article on resistance deformity.

Through the results of hardness can predict some important properties of resistance tensile strength and resistance to wear and tear [10]

Hardness is proportional to the tensile strength of a specific material as the high hardness materials have high resistance strain [11]

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Hardness of materials depends on the type of bond strength between molecules or atoms on the surface type, temperature and conditions affecting it.

The value of hardness give index of strength and structure coherence and hardness are associated with the mechanical resistance of the material, where often the material with a *hardness of low-lying yield strength and sessile [1]*

Tensile Test (Tensile Test):

For precise values for mechanical properties of engineering materials, including the overlapping material it is done by following the tension which is considered one mechanical tests task through which the test can find out a lot of information that determines the mechanical behavior of the material during use, including [12]

modulus of elasticity (Elastic Modulus),the maximum tensile strength(Ultimate Tensile Strength), Strain(Strain), undergo points(Yield Point), Ductility, durability(Toughness).

volumetric fraction (Volume Fraction):

Dependent properties of the material overlapped mainly on the nature of components, based on the mixing base, as it found that the resistant material overlapped to withstand the stresses depends mainly on the modulus of elasticity and resistance to fiber reinforcement so it can get the best resistance depending on the fracture volumetric fiber reinforcement [13], and when the pregnancy is hanging considered Article overlapped is the lamb of Cheddar and toward fiber. in this case the emotion quotient will be equal for each of the material foundation and fiber material overlapped, and since that article overlapped consists of a material foundation and fiber, then it is based and is based on emotion breakage (fracture strain) for each of the material foundation and fiber [60]

Experimental Work

The use of pvc of matrix material for (density 0.90g/cm^3) [15] , also three types of fibers were used for reinforcing the pvc Glass chopped standard mat type (E-glass) with surface density of, (0.277 Kg/m^3). Woven raven with angle of $(0^0\text{-}90^0)$ continuous direction with surface density (0.5 Kg/m^3), nylon-6 with surface density of (1.4 Kg/m^3).

was used to prepare sheets of PVC composites reinforced with three of glass fibers (random, woven raven and sandwich).[pVC+ f.g Random ,pVC+ f.g woven raven, pVC+ f.N_6, pVC+sandwich (f.g w-r+N-6)], for different volume fraction. (22%, 24%, 26%, 28%, 30%).

The tensile strength of a fiber reinforced composite (Tsc) depends on the bonding between the fibers and the matrix.

$$\rho c = V_m \rho m + V_f \rho_f \dots\dots (1)$$
$$V_m = 1 - V_f \dots\dots\dots\dots\dots (2)$$
$$V_f = \cfrac{1}{1+\cfrac{1-\varphi_\rho f}{\varphi_\rho m}} \dots\dots (3)$$

where

ρc : density of the composite

ρm: density of the matrix

ρ_f : density of the fibers

V_m: volume fraction of the matrix.

V_f : volume fraction of the fibers

: weight fraction of the fibers.

from equation (4) can calculate the tensile strength

Tsc =Vfδf +Vmδm……… (4)

where: -

Tsc: tensile strength of the composite.

δf : stress of the fibers.

δm : stress of the matrix.

[16],

The brinell hardness test was used in this study, the law used to calculate brinell hardness was:-

$$H.Br = \frac{2F}{\pi D(D+\sqrt{D^2-d^2})} \dots\dots \quad (5)$$

where:

F: applied load equal .

D: diameter of the spherical indenter equal to (5mm).

d: diameter of the residual impression.

Result and Discussion

The results in Discuss tensile

Shapes (1,2,3,4,5) show that the tensile strength of polymeric materials overlapped fiber reinforced resistance increases with the volumetric fraction. The highest value for the tensile strength of the material supported by two types of fiber This explains that Alalv nylon 6 characterized by strongly tightening and durability replay, and that the fiber orientation parallel to the direction of pregnancy leads to an increase in the carrying hanging over Material overlapped force. Because the volumetric fraction plays a key role in the mechanical behavior of materials overlapped in addition to the fiber it has a significant role in increasing Qiao tensile strength because the length and direction of the fibers leads to distribute the load along the overlapped article [17]

From the results the value of the tensile strength of the material overlapped reinforced fibers of short glass less valuable compared with other materials because The reason is when a Material overlapped reinforced fiber short to stress strain, these fibers will suffer strained as a result of shear stresses user interface that works on the surfaces of fiber and shear stresses this will be of great value when the ends of the fiber, which suffer strained biggest spat values stresses the closer to the center of the fiber and tensile stresses are zero at the end of the fiber [18] , the fiber concentrated load at the end of short-fiber and is distributed in the alignment of short fibers in the material foundation that works to transfer load from the material foundation to fiber through the surface area interconnection [19] that the pressure in the material foundation and events spaces at the ends of fiber and some small cracks along the fiber material this leads to the formation of easy paths for cracks and speed of deployment [20]

The results in Discuss hardness

That most of the hardness tests depends on the resistance of the Material breakthroughs at the outer surface

I have used the hardness Brinell to determine the hardness and the results of found that there is a noticeable change in the hardness of the material in fiber reinforced overlapped as in formats (6,7,8,9,10), any increase hardness values increase the volumetric fraction of each material overlapped and probably is due to the fact the hardness of the surface of the property so this expected.

Article overlapped subsidized short-fiber had a lower value for the hardness while Article overlapped subsidized showed woven glass fiber mat is the highest value for hardness,

The concept of hardness can be counted to measure the plastic deformation that can be experienced by the article under the influence of external stress, the addition of fiber to the polymer leading to high hardness materials as a result of increased resistance to deform plastically [21]

Conclusion

From the results in the present work, it was found that value of tensile depends on the reinforced phase and volume fraction, Increase volume fraction of composite materials increasingly each of the tensile strength and hardness values. The maximum value of tensile strength was poly vinyl chloride reinforced with fibers sandwich (woven raven + N-6) in compare with the other types of composites. The maximum value of Brinell hardness was poly vinyl chloride reinforced with glass fibers woven raven in compare with the other types of composites.
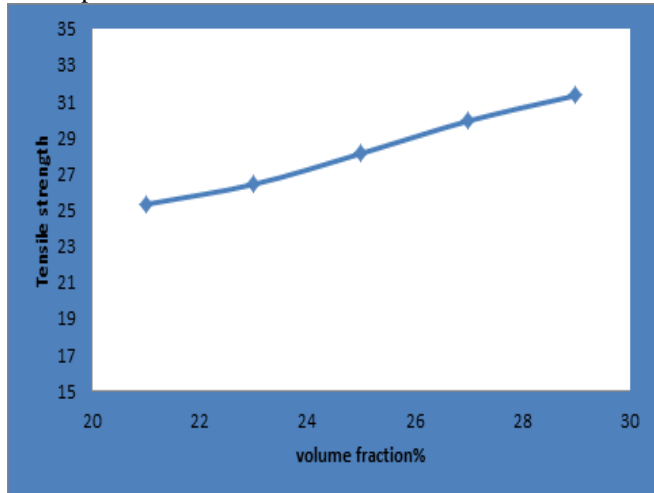
Figure 1. Variation in the tensile strength with the volume fraction to pvc+F.N-6.
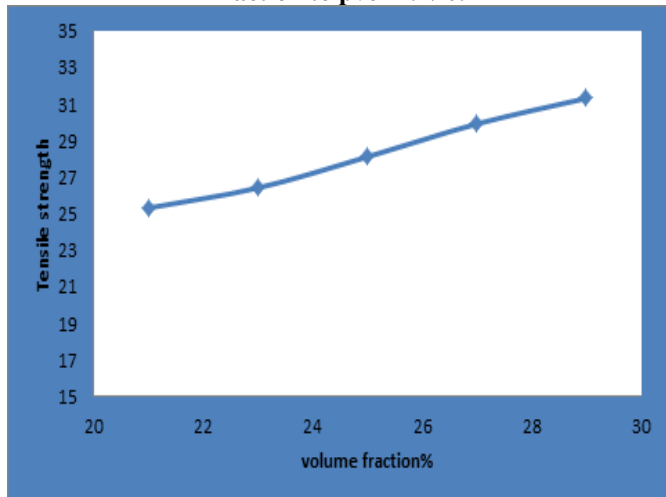
Figure 2. Variation in the tensile strength with the volume fraction pvc+F.G(w-r+N-6).
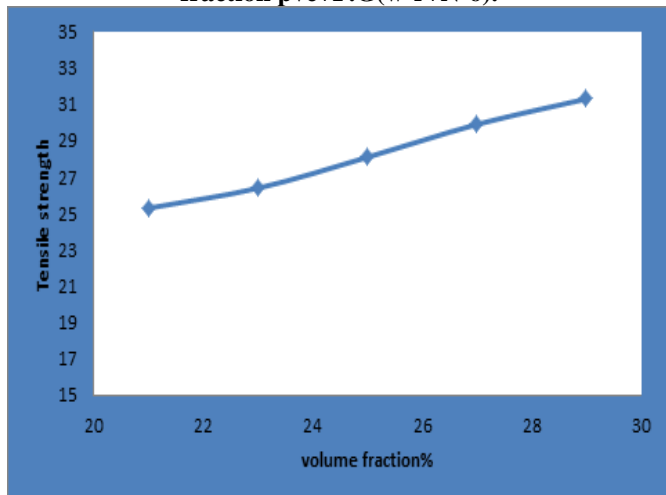
Figure 3. Variation in the tensile strength with the volume fraction to Pvc+F.G(r).
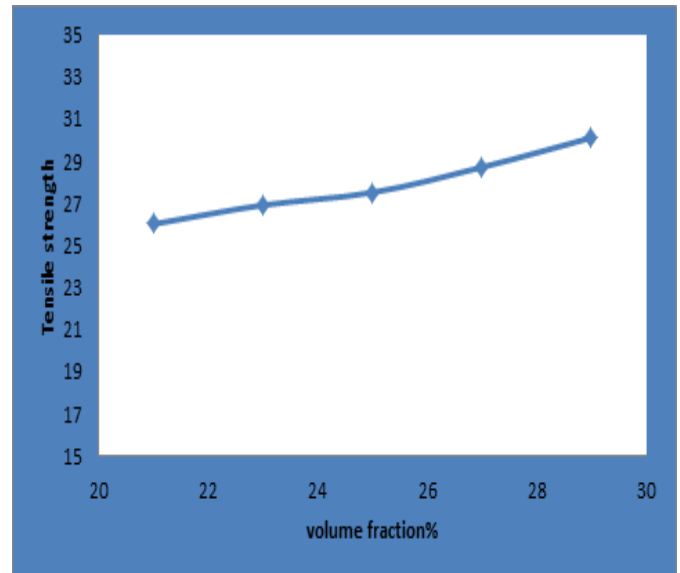

Figure 4. Variation in the tensile strength with the volume fraction to Pvc+F.G(w-r).
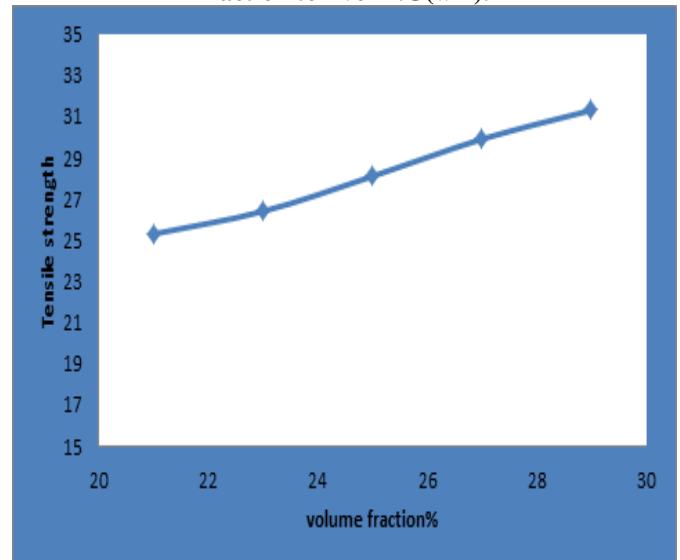

Figure 5. Variation in the tensile strength with the volume fraction to Pvc+F.G(w-r+r).
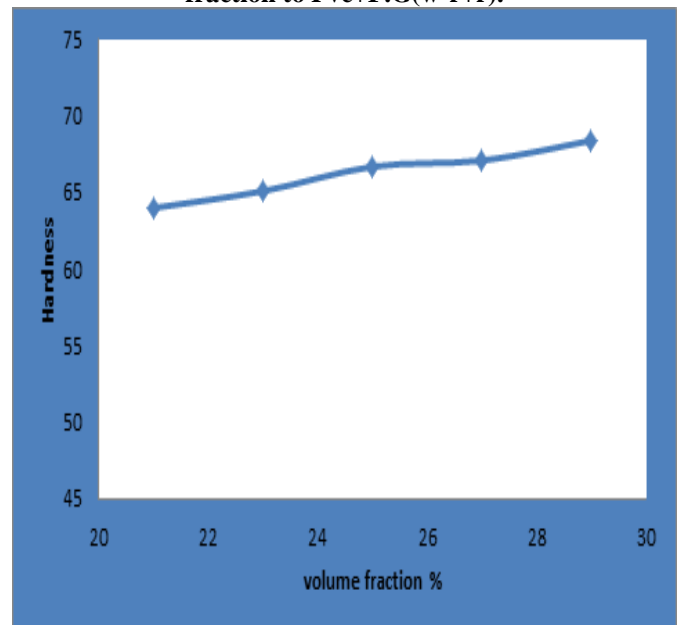

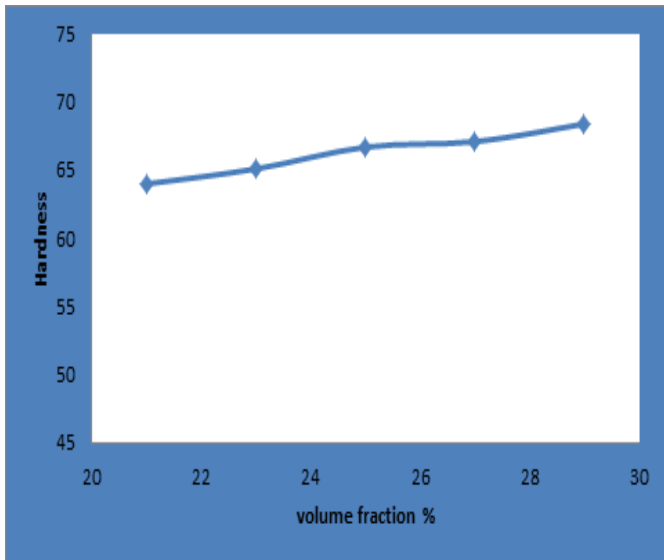**Figure 6. Variation in the hardness with the volume fraction to pvc+F. (w-r+ n-6).**

Figure 7. Variation in the hardness with the volume fraction to pvc+F(n-6).
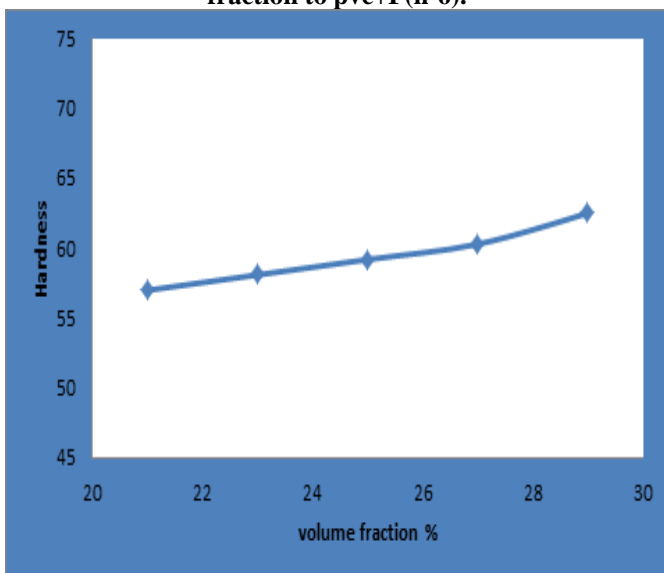

Figure 8. Variation in the hardness with the volume fraction to Pvc+F.G(r).
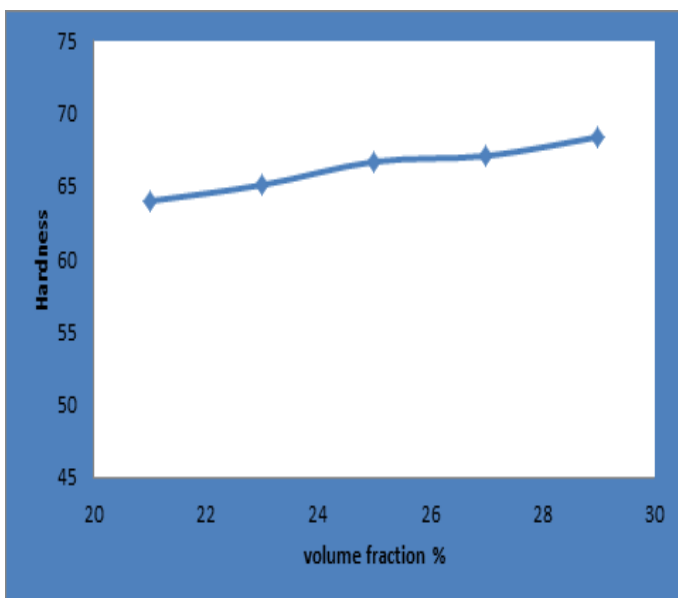

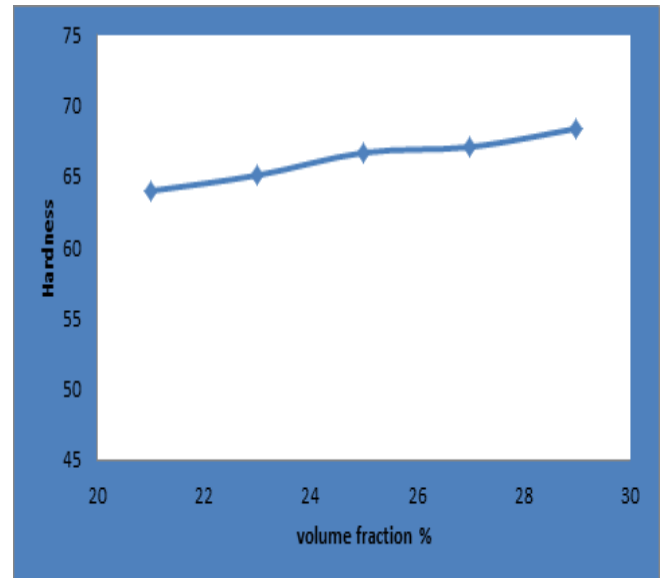**Figure 9. Variation in the hardness with the volume fraction to Pvc+F.G(w-r).**

Figure 10 Variation in the hardness with the volume fraction to Pvc+F.G(w-r +r).

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