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Effects of Polyvinyl Chloride Addition on Swelling Resistance of Nitril Rubber

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Abstract

A research aim to improving the swelling resistance of Nitril rubber NBR by insertion a various amounts of Polyvinyl chloride PVC,(30% ,50% and 70%) respectively, at curing condition (temperature 170 ºC, pressure 90 bar during 20 min) that leads to create a new polymer morphology of polymer blend. Swelling resistance in the oil and distilled water exponentially improved with increasing PVC content in blend, weather resistance and thermal stability of NBR is also developed with PVC addition due to PVC have higher glass transition temperature which 87 ºC than NBR which is -15 ºC.

Keywords: Nitril rubber, Polyvinyl chloride, swelling resistance.

Introduction

Composites have been developed to meet several industrial requirements, such as the need for easier processing and broadening the range of properties, either by varying the type, relative content or the morphology of each component[1]. Nowadays, considerable research interest is focused on new polymeric materials obtained by blending two or more polymers. The major feature of such process is that the intermediate properties are in some cases better than those exhibited by either of the single components[2].

In addition, some modifications in terms of processing characteristics, durability and cost can be achieved via polymer blending[3]. Typical ingredients include crosslinking agents (also called curatives), reinforcements, anti-degradants, process aids, extenders, and specialty additives, such as tackifiers, blowing agents, and colorants[4]. Blends have been developed to meet several industrial requirements such as the need for easier pro the properties range, either by varying the type, relative amounts or morphology of each component[5]. These materials can be prepared so as, for example, to combine their high mechanical strength to a better dimensional stability and thermal resistance[6].

In recent years, the blends of acrylonitrile-butadiene rubber (NBR) and poly (vinyl chloride) (PVC) have been widely used in industry. Major applications of these blends include conveyor belt covers, cable jackets, hose cover linings, gaskets, footwear and cellular products. It is worth noting that NBR acts as a permanent plasticizer for PVC in applications such as wire and cable insulation in which PVC improves the chemical resistance, thermal ageing and abrasion resistance of NBR[7].

Material and Methods

Materials: Nitril rubber**,** of Polyvinyl chloride PVC.

The Batch: The batch was prepared from Nitril rubber with addition of some of materials (such as zinc oxide, stearic acid, sulfur, Antioxidant, Carbon black. etc), Polyvinyl chloride PVC with as a weight percentages (30 ,50 and 70)%wt. Percentages of materials shown in Table-1.

Table-1
the materials content in the master batch

Materials	The content pphr %
PVC	0 , 30 , 50 , 70
NBR	100 , 70 , 50 , 30
Carbon black 660	40
MBTS	0.7
Sulfur	1.5
Zinc oxide	3
Stearic acid	1

Swelling test: The test conducted according to ASTM D 471-98, there are many applications of PVC/NBR blend specially in seals, gaskets, hoses and others. so that performing of swelling test is very essential to specified changing of material performance in a various chemical liquids. This test including immersion PVC/NBR blend specimens in engine oil and distilled water at room temperature then measuring the change in volume, weight and hardness weekly during one month . This test include immersion of PVC/NBR blend specimens in 80 ml of engine oil and distilled water then observed the changing in volume, Hardness and weight.

Results and Discussion

Figure -1 and figure -2 indicate to the changing in volume that increased at first and second weeks, the increase was higher than at third and fourth weeks, that result due to reaching to saturation level. Swelling occurrence was not instantaneous. It is caused by the diffusion/absorption of liquid hydrocarbon or

water, or both, into the specimens. The time of swelling depended upon oil viscosity, element thickness, temperature and salinity[8]. Figure-3 and figure-4 showed increasing in the weight during immersion period which due to entry of hydrocarbon and water molecules in the sample that caused swelling occurrence. By increasing PVC content in NBR the swelling rate was decreased that due to decreasing in Carbon black which presents in NBR that attracts Hydrocarbon and water molecules and cause changing in volume and weight. As the results showed that the addition of 70% PVC caused less value of swelling rate than other addition percentage of PVC [9]. The results of swelling rate for immersion in engine oil are higher than in distiller water because of Hydrocarbons chemical nature assist to increasing swelling rate.

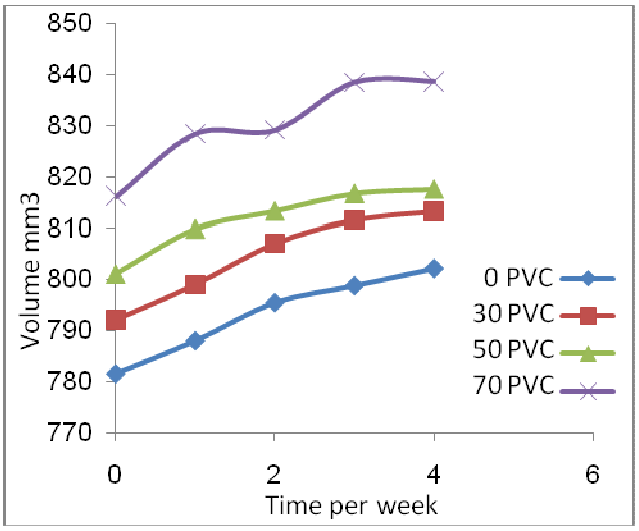

Figure-1
Changing in volume during the immersion in engine oil

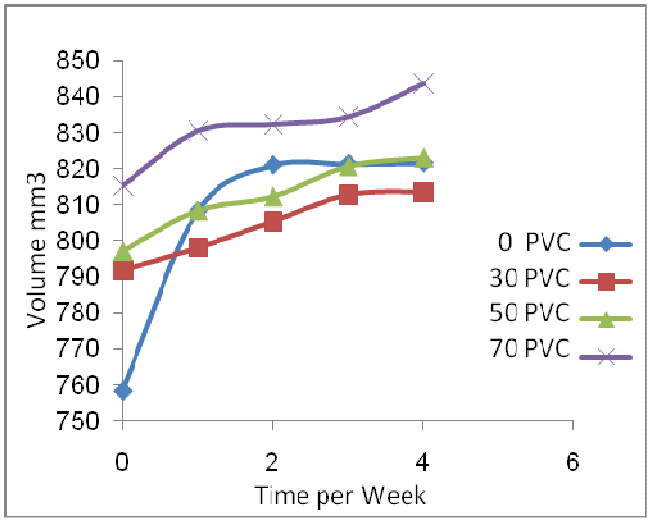

Figure-2
Changing in volume during immersion in distiller water

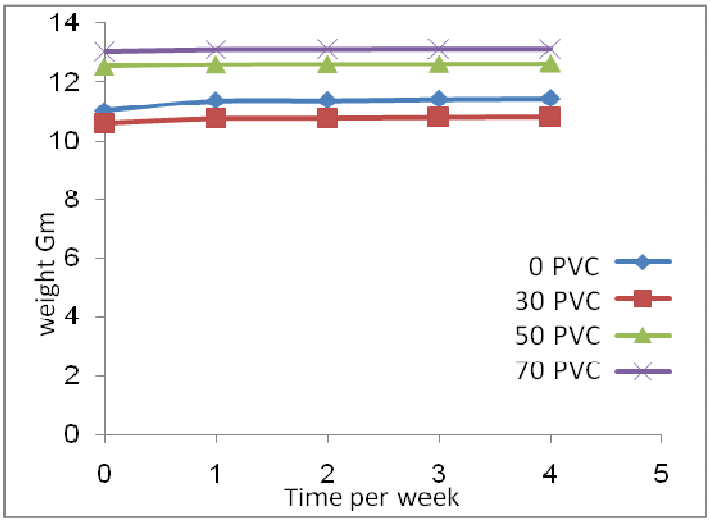

Figure-3
Changing in weight weekly during immersion in engine oil

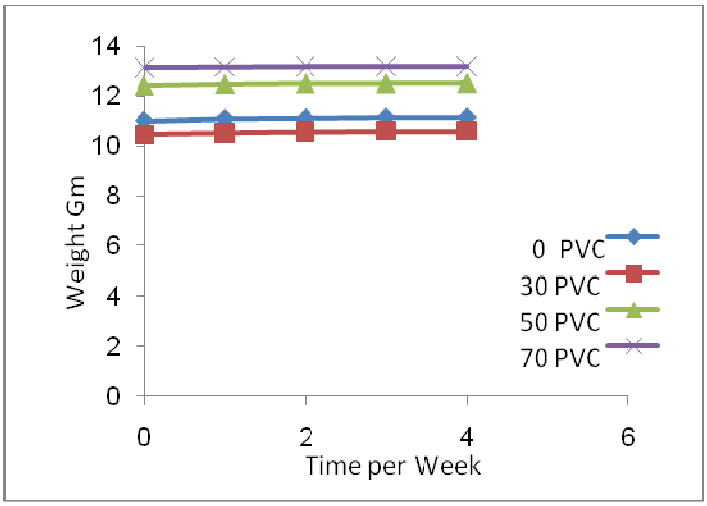

Figure-4
Changing in weight weekly during immersion in distilled water

Conclusion

The blend with 50% and 70 % PVC content have a stiffer structure than the blend with 30% and 0% PVC content. The blend with the higher amount of PVC is more suitable and resist to attack of oil and distilled water in swelling test .

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