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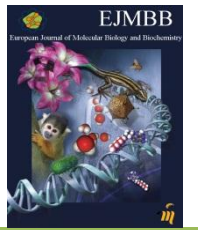

EFFECT OF DYNAMIC VULCANIZATION ON THE SWELLING AND MECHANICAL PROPERTIES OF EPDM/PVC COMPOSITES

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ABSTRACT

Composite based on Ethylene Propylene Diene Monomer (EPDM) and Poly Vinyl Chloride (PVC) has been prepared. The sorption studies were conducted with aromatic hydrocarbons and organic liquid fuels for the membrane characterization. Special attention has been given to size of penetrant and also type of vulcanization. The swelling was found to decrease with dynamic vulcanization. It was found that the sweling decreased with increase in the size of the penetrant. The mechanical properties were enhanced by dynamic vulcanization.

INTRODUCTION

Polymers are used as structural engineering materials and knowledge of the performance of polymer under the influence of external factors such as solvent, temperature etc. is essential for their successful applications. Composites are engineering materials made from two or more constituents with significantly different physical or chemical properties which remain separate and distinct on a macroscopic level within the finished structure. i.e., a composite is commonly defined as a combination of two or more distinct materials, each of which retains its own distinctive properties, to create a new material with properties that cannot be achieved by any of the components acting alone. Swelling experiments of rubber composites are important for analyzing the service performance of these composites in harsh environment.
There exist interesting reports on the molecular transport through different polymer membranes [1-7]. It has been reported that the permeation depends upon a number of factors like composition, method of formation, type of cross linking agents used, nature and size of the penetrants, temperature etc.

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MATERIALS AND METHODS

Ethylene Propylene Diene Monomer Rubber (EPDM), a terpolymer of ethylene,propylene and a non-conjugated diene, is one of the most versatile, fastest growing rubbers having both specialty and general – purpose applications [8].This choice is based on the common use as general-purpose rubber, in addition to their distinguished property [9]. Poly (vinyl chloride) is one of the most widely used polymers in many industrial applications.

EPDM was masticated for two minutes and PVC powder then added. After 4 minutes, other ingredients were added in the following order: zinc oxide, stearic acid, MBTS and sulphur. The processing time after the addition of each component added was about 2 minutes. The compounded composites were compression moulded at 170 degree for optimum cure time using a hydraulic press.

Examination of transport characteristics

For diffusion experiments, circular samples of diameter 19.6mm and 2mm thickness were punched out from the vulcanized sheets and were dried in vacuum desiccators over anhydrous $CaCl_2$ at room temperature for about 24 hours. The original mass and thickness of the samples were measured before sorption experiments. They were then immersed in about 20 ml solvents taken in closed diffusion bottles, kept at constant temperature in an air oven. The samples were removed from the bottles at periodic intervals, dried for about 5-10 seconds between filter papers to remove the excess solvent on their surfaces and weighed immediately using an electronic balance (Shimadzu, Libror AEU-210,Japan) that measured reproducibly within ± 0.0001 g. They were then placed back into the test bottles. The process was continued until equilibrium swelling was achieved (no further increase in solvent uptake was detected). Since the weighing was done within 40 seconds, the error associated with the evaporation of solvents is negligible.

Investigation of mechanical Properties

The test specimens were punched out from the molded sheets using a die. Tensile strength tests of composite samples were conducted on computerized Universal Testing Machine.

RESULTS AND DISCUSSION

Figure 1 and 2 shows the effect of the type of vulcanization techniques on the sorption behavior of EPDM/ PVC membranes, using toluene and diesel respectively as penetrant. It is observed that dynamically vulcanized samples showed a lower swelling compared to the corresponding statically vulcanized one. The dynamic vulcanization produces a fine dispersion of the rigid PVC particles in EPDM matrix [10] as can be seen from FESEM of statcally and dynamically vulcanised 100/7.5 EPDM/PC compostes in figure 3. This generates a matrix with relatively lower free volume for sorption of solvent.

Dynamic vulcanizing has enhanced the overall mechanical properties. The tensile strength of dynamically vulcanized composites is greater than the statically vulcanized samples for all the composites. For a less dispersed system, the tensile strength of the composites decreases due to the inability of the filler to support stresses transferred from matrix. The better tensile strength of dynamically vulcanized samples can be attributed to the better dispersion. Table 1 shows the effect of vulcanization technique on mechanical properties of EPDM/PVC composites.

Fig. 1: Effect of type of vulcanization techniques on the sorption behavior of 100/7.5 EPDM/PVC, using toluene as penetrant

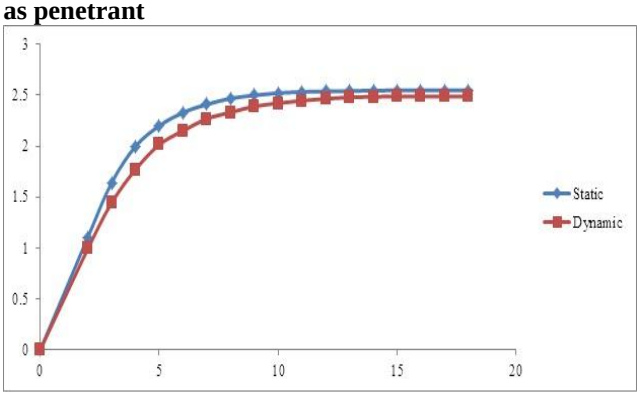


Fig.2: Effect of type of vulcanization techniques on the sorption behavior of 100/7.5 EPDM/PVC, using diesel as penetrant

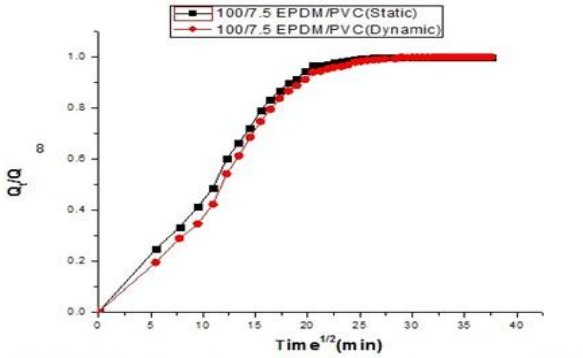
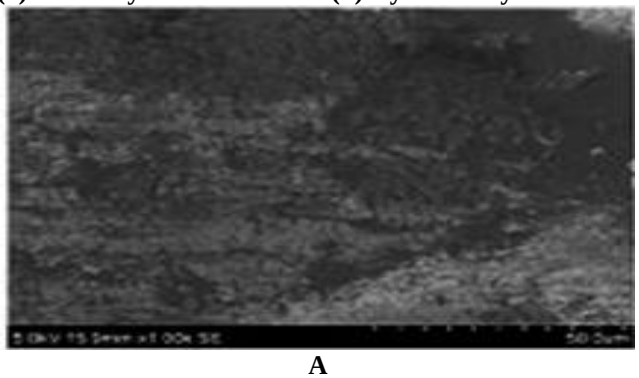
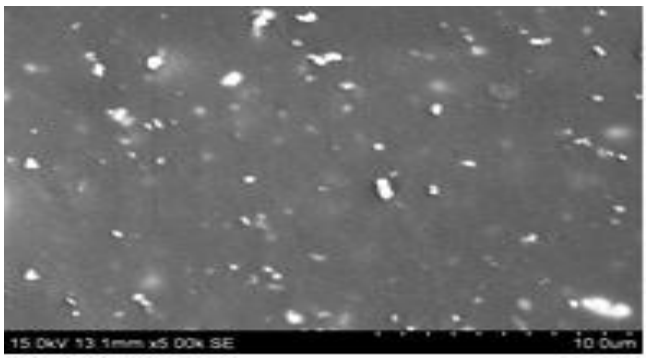


Fig.3. Scanning Electron Micrographs of Dynamically Vulcanized Sulphur Cured 100/7.5 EPDM/PVC Composites (a) Statically Vulcanized and (b) Dynamically Vulcanized



A



B

Table 1.Effect of Type of Vulcanization on Mechanical Properties of EPDM/PVC Composites

EPDM/PVC	Tensile Strength (MPa)		Modulus 100%(MPa)	
	Static	Dynamic	Static	Dynamic
100/2.5	1.45	1.76	0.92	1.13
100/5	1.4	1.96	0.94	1.15
100/7.5	1.48	1.93	0.94	0.94
100/10	1.20	1.79	0.97	1.1

CONCLUSION

Ethylene Propylene Diene Monomer (EPDM) / Poly Vinyl Chloride (PVC) composite have been prepared. The sorption studies were conducted with aromatic hydrocarbons and organic liquid fuels for the membrane characterization. Special attention has been given to size of penetrant and also type of vulcanization. The swelling property was found to decrease with dynamic vulcanization. It was found that the swelling decreased with increase in the size of the penetrant. The mechanical properties were found to enhance by dynamic vulcanization.

REFERENCES

1. Zhu M, Vesely D. (2007). The effect of *polymer* swelling and resistance to flow on solvent diffusion and permeability. *EurPolym J*, 43(10), 4503-4515.
2. Kallio KJ, Nageye AS, Hedenqvist MS. (2010). *Ageing properties of car fuel-lines accelerated testing* in, close-to-real, and service conditions.*Polym Test*, 2(1), 41-48.
3. Renzulli A, De Candia F, Gargani L. (2003). Transport Properties of Filled Elastomeric Networks. *J ApplPolymSci*, 41(5-6), 955-964.
4. Nunez GR, Padilla HD, Keeand D, Favis BD. (2001). Barrier Properties of Polyamide-6/High Density Polyethylene Blends. *Polym Bullet*, 46(4), 323-330.
5. Villaluenga JPG, Barragan VM, Seoane B, Ruiz-Bauza C. (2006). Sorption and permeation of solutions of chloride salts Water and Methanol in a Nafion Membrane. *Electrochimicaacta*, 51(28), 6297-6303.
6. Majumber PS, Bhowmick AK, Manjali AB, Ticku, VK. (2000). Barrier properties of electron beam modified EPDM rubber, *J applPolymSci*, 75, 784-793.
7. Ball IJ, Shu-chuan H, Wolf RA, Shimano JY, Richard B K, Pervaporation studies with polyaniline Membrane and Blends.*J. Membr. Sci*. 2000, 174,161-176.
8. Younan AF, Abd-El-Messieh SL, Gasser AA, (1998). Electrical and mechanical properties of ethylene propylene diene monomer–chloroprene rubber blend loaded with white and black fillers. *J ApplPolymSci*, 70, 2061-2068.
9. Stern SA, Frisch HL. (1981). The selective permeation of gases through polymers.*Ann Rev Mater Sci*, 11, 523-550.
10. Shyla George, Prajitha Kumari, Unnikrishnan G. (2010). Influence of static and dynamic crosslinking techniques on the transport properties of ethylene propylene diene monomer rubber/poly (ethylene-co-vinyl acetate) blends. *J Polym Res*, 17, 161-169.