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ABSTRACT

The morphology and mechanical properties of nylon (copolyamide 6/66)/acrylonitrile-butadiene rubber (NBR) blends have been studied with special reference to the effect of blend ratio and crosslinking systems. Morphological investigations of the blends using scanning and transmission electron microscopies show that a uniform and finer dispersion of the elastomer phase is achieved by dynamic crosslinking. The effects of various crosslinking systems such as sulphur and dicumyl peroxide on the morphology and mechanical properties of these blends were analysed. Morphological stability of the blends upon annealing has been investigated and the mechanical properties of the blends have been discussed. Attempts have been made to correlate the morphology with the mechanical properties of the dynamically vulcanized blends. The stability of the blend morphology during annealing has been examined.

INTRODUCTION

Polymer blends have provided an effective way to meet new requirements for material properties(1-3). Because of their simple method of preparation and easy attainment of the desired physical properties, those blends, which are prepared, by the physical blending of an elastomer and thermoplastic material under high shearing action have gained considerable attention(4). Furthermore the addition

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of small quantities of crosslinking agents during the mixing operation (this is called dynamic crosslinking) imparts a marked improvement in the final properties\(^5\)\(^-\)\(^6\). The energy used during such mixing under shear, the crosslinking level thus attained in the rubber phase and the interfacial characteristics are considered to be the major contributing factors in establishing and regulating the phase structure of the soft and hard phases in the resulting blend system\(^7\). The majority of the more useful blends are immiscible, and in these systems the minor phase is mechanically dispersed in the major one. The size and shape of the dispersed phase depends on several parameters, including the interfacial properties, composition and rheology of the blends.

During the past several years, many studies have been reported on the structure and properties of various thermoplastic elastomeric blends obtained by dynamic vulcanization. Fischer\(^4\) reported on the properties of PP/EPDM thermoplastic blends prepared by partial crosslinking of the elastomer phase. The rheology, morphology and mechanical properties of many thermoplastic elastomers have been reported from this laboratory by Thomas and co-workers\(^8\)\(^-\)\(^14\). Ghosh and co-workers\(^15\) investigated the influence of the vulcanization technique on the phase morphology and on the properties of vulcanised thermoplastic elastomer blends. Kumar et al\(^16\) has reported on the morphology and mechanical properties of dynamically vulcanised thermoplastic elastomers (TPE’s) comprising thermomechanically reclaimed ground tire rubber (GTR) in blend formulations containing low density polyethylene and various types of elastomers. The report illustrates LDPE/EPDM/GTR blends crosslinked with sulfur as the best performing composition owing to the dual compatibilising nature of EPDM. Oderkerk et al\(^17\) reported on the achievement of excellent mechanical properties in dynamically crosslinked nylon6/EPDM blend that contains a higher proportion of elastomer. The authors reported on the use of maleic anhydride (MA) modified ethylene propylene diene terpolymer as a compatibiliser which ensured a finer dispersion of the EPDM phase in nylon in blend composition containing 60% of elastomer.

Dynamic crosslinking of the rubber phase during mixing can also improve the interfacial properties. This way of modifying polymers is usually initiated by the thermal decomposition of peroxides or by high energy radiation\(^18\). Sulphur vulcanization can also be used for the dynamic vulcanization of diene rubbers. Higher thermal resistance and reduced set are the major advantages of crosslinking the rubber phase. Numerous reports on thermoplastic/crosslinked elastomer blends are available elsewhere\(^19\)\(^-\)\(^24\). In these studies the crosslinking reaction generally proceeds under intense melt blending conditions to give fine particles of crosslinked rubber in a thermoplastic matrix. Fisher reported on the selective crosslinking of an elastomer phase in polymer blends\(^25\)\(^-\)\(^27\).
Blends of Nylon 6/66 and Acrylonitrile-Butadiene Rubber: Effects of Blend Ratio

The purpose of the dynamic vulcanization of elastomeric thermoplastic rubber blends is to provide compositions that have reduced permanent set, improved mechanical properties, greater resistance to attack by hot oils, greater stability of phase morphology in the melt, and more reliable thermoplastic fabricability.

The purpose of the project described here was to develop crosslinked nylon-NBR blend systems, and to investigate their morphology and mechanical properties. The effects of various crosslinking systems on the morphology, stability, and properties of the blend systems have been analysed. Crosslinking agents such as dicumyl peroxide and sulphur were used for interfacial modification.

EXPERIMENTAL

Materials used

The nylon used was a copolymer of nylon 6 and nylon 6,6 supplied by Sri Ram Fibres Ltd., Chennai, India. The nitrile rubber (Aparene N-553 –S) used in this work contained 34% w/w bound acrylonitrile. It was supplied by Gujarat Apar India Ltd., Mumbai, India. The characteristics of the materials are given in Table 1.

Table 1. Characteristics of the component polymers

<table>
<thead>
<tr>
<th>Materials</th>
<th>Characteristics</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nylon (copolyamide 6/66)</td>
<td>Density (g/cm³): 1.11</td>
<td>SRF Ltd., (Chennai, India)</td>
</tr>
<tr>
<td></td>
<td>Melting range (°C): 165-175</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water absorption (%) at 23 °C: 10-12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moisture regain (%): 2.5-3.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relative viscosity: 2.5-2.7</td>
<td></td>
</tr>
<tr>
<td>Nitrile rubber (NBR)</td>
<td>Density (g/cm³): 0.98</td>
<td>Gujarat Apar Polymers Ltd.</td>
</tr>
<tr>
<td></td>
<td>Volatile matter (%): 0.13</td>
<td>(Mumbai, India)</td>
</tr>
<tr>
<td></td>
<td>Antioxidant (%): 1.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water absorption (%) at 25 °C: 7.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Organic acid (%): 0.25</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soap (%): 0.004</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bound acrylonitrile (%): 34</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mooney viscosity, ML₁+₄ 100 °C: 40</td>
<td></td>
</tr>
<tr>
<td>Dicumyl peroxide (DCP)</td>
<td>40% active</td>
<td>Kishore Rubber Products Pvt. Ltd., Pune, India</td>
</tr>
</tbody>
</table>
Sample preparation

The blends are designated by N0, N20, N50, N70, and N100. The subscripts denote the weight percentage of nylon in the blend. Blends of nylon and NBR were prepared in a Rheocord-90 Internal mixer with a rotor speed of 60 rpm and a total mixing time of 10 min. Curatives were added and the mixing continued for 8 min. The sheeted blends were compression moulded (150 x 150 x 1.5 mm³) at 180 °C.

Preparation of samples for scanning electron microscopy (SEM) and transmission electron microscopy (TEM)

In order to study the morphology of the samples by SEM, the NBR phase was preferentially extracted from uncrosslinked blends using toluene at 25 °C. Nylon was extracted from dicumyl peroxide crosslinked samples with formic acid at 25 °C. NBR and nylon were extracted from the annealed samples using toluene and formic acid respectively. Transmission Electron Microscope (JEOL JEM 2010) was used to observe the internal morphology of the specimens after osmium tetroxide (OsO₄) staining of the NBR phase. Thin slices of the samples were cut using a cryocutter.

Measurement of mechanical properties

The tensile testing of sample was carried out at 25 ± 2 °C according to ASTM D41-80 using dumb-bell shaped test specimens at a cross head speed of 500 mm/min. The tension set after failure was tested according to ASTM D412-80. The tear strength was determined as per ASTM D-624-81 using unnicked 90° angle specimens.

RESULTS AND DISCUSSION

Morphology of unvulcanized blends

The important physical factors that decide the morphology of the blends are the blend component ratio, the intrinsic melt viscosity, the rate of shear during mixing and the presence of other ingredients. Danesi and Porter(28) have shown that, for blends with the same processing history, the morphology is decided by the melt viscosity ratio and composition. Generally the least viscous component was observed to form the continuous phase over a large composition range(29).

The scanning electron micrographs of the fracture surfaces of N70, N50 and N30, from which the NBR phase was preferentially extracted using toluene,
are shown in Figures 1a-c. In Figures 1a and 1b, the holes indicate the NBR phase that has been extracted. The morphology of the unmodified blends of nylon/NBR indicates a phase structure in which NBR was dispersed as domains in the continuous nylon phase at its lower composition, but as the proportion of rubber increased beyond 40%, this component was also found to exist as a continuous phase.

Figure 2 indicates the morphology of various rubber/NBR blends. The minor component appeared as the dispersed phase, and its domain size increased with increasing concentration. The particle size distribution curves (Figure 3) for the unmodified blends were drawn by measuring the size of about 300 particles from the micrographs. The broad distributions of N70 and N30 were attributed to the agglomeration of the nylon and NBR domains respectively because of their higher concentrations. We also estimated the interfacial area per unit volume of each blend composition. This is presented in Table 2.

It is interesting to note that the interfacial area per unit volume decreased when the NBR concentration increased. This is associated with the phenomenon of

![Figure 1. SEM of the blend morphology of (a) 70/30, (b) 50/50 and (c) 30/70 nylon/NBR blends](image)
coalescence. Although N_{40}, N_{50}, and N_{60} exhibited a co-continuous morphology, dispersed particles also could be seen in the blends, indicating a non-uniform morphology. The size of the NBR domains measured from the SEM can be expressed in different ways, as given by the equations:

Figure 2. Effect of blend composition on the dispersed particle size

Table 2. Interfacial area per unit volume of uncrosslinked blends

<table>
<thead>
<tr>
<th>Sample</th>
<th>Interfacial area per unit volume (μm⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N_{80}</td>
<td>0.3810</td>
</tr>
<tr>
<td>N_{70}</td>
<td>0.1339</td>
</tr>
<tr>
<td>N_{30}</td>
<td>0.1320</td>
</tr>
<tr>
<td>N_{20}</td>
<td>-</td>
</tr>
</tbody>
</table>
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\[ D_n = \frac{\sum NiDi}{\sum Ni} \]  
\[ D_v = \frac{\sum NiDi^4}{\sum NiDi^3} \]  
\[ D_w = \frac{\sum NiDi^2}{\sum NiDi} \]  

Figure 3. Particle size distribution curves (normal and cumulative) of samples containing various amounts of NBR

where \( Ni \) is the number of domains having diameter \( Di \); \( \bar{D}_n \), the number average diameter, \( \bar{D}_v \), the weight average diameter and \( \bar{D}_w \), the volume average diameter. Table 3 shows the results of these measurements.
Table 3. Average diameter of dispersed phase in various nylon/NBR blends

<table>
<thead>
<tr>
<th>Sample</th>
<th>Dn (μm)</th>
<th>Dw (μm)</th>
<th>Dv (μm)</th>
<th>PDI values</th>
</tr>
</thead>
<tbody>
<tr>
<td>N70</td>
<td>7.3</td>
<td>12.19</td>
<td>14.13</td>
<td>1.67</td>
</tr>
<tr>
<td>N30</td>
<td>6.1</td>
<td>10.04</td>
<td>12.32</td>
<td>1.63</td>
</tr>
<tr>
<td>N20</td>
<td>3.7</td>
<td>5.28</td>
<td>6.98</td>
<td>1.41</td>
</tr>
</tbody>
</table>

The increase in domain size at higher concentrations of the dispersed phase is due to the coalescence of the domains at higher concentrations. The above observations are further supported by the TEM studies (Figures 4a-d). It is possible to see the NBR dispersion in Figure 4a.

Furthermore, in the TEM of N70 (Figure 4a) it is possible to observe nylon inclusions in the dispersed rubber phase. They are formed during the mixing process. Similar results have already been reported in PA/EPR blends compatibilized with EPR-g-PA(31). In that case the rubber domains were found to contain nylon sub-inclusions, amounting to about 40% of the domains. The non-uniform morphology of N50 (Figures 4b and 4c) is clear from the TEM,

Figure 4. TEM photographs of (a) 70/30, (b)&(c) 50/50 and (d) 30/70 nylon/NBR blends (Magnification x 5000)
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where both dispersed (Figures 4b) as well as elongated phases (Figure 4c) can be seen. The TEM of N_{30} confirms the dispersed nature of the nylon in the continuous nitrile rubber matrix (Figure 4d).

**Dynamic vulcanization**

**Morphology of dynamically vulcanized systems**

The vulcanization of the rubber phase during mixing has been investigated as a way to improve the physical properties of several thermoplastic elastomers based on rubber/plastic blends. Dynamic vulcanization leads to the formation of a finely and uniformly distributed crosslinked rubber in the plastic matrix, and gives also a stable morphology. The purpose of the dynamic vulcanization of elastomeric thermoplastic rubber blend is to improve permanent set and ultimate mechanical properties, and provide greater resistance to attack by hot oils, greater stability of phase morphology in the melt.

The morphological transformation produced by dynamic crosslinking is shown schematically in Figure 5. In compositions where the rubber phase is dispersed in a plastic matrix, dynamic cross-linking causes a considerable reduction of the size of the rubber domains. It is most effective in highly crosslinked systems, i.e., where the crosslink density of the rubber is high. In a co-continuous morphology wherein both phases are continuous, a high degree of dynamic crosslinking disperses the rubber phase in the plastic phase. At low levels of crosslinking the original co-continuous morphology can be retained. But in compositions where the plastic phase is dispersed in a continuous rubber phase, dynamic cross-linking will lead to phase inversion. However, a very low degree of crosslinking can retain the original morphology of the uncrosslinked blend.

Figure 6a shows an SEM of the cryogenically fractured surface of dynamically crosslinked (2 phr DCP) nylon/NBR 70/30 blends in which the nylon constitutes the continuous phase. Compared to unvulcanized compositions (Figure 1a; N_{70}) there is a uniform morphology. From this morphology it is clear that the size of NBR particles, which constitute the dispersed phase in the unvulcanized compositions, has been decreased considerably in dynamically crosslinked compositions. This can be correlated very well with the tremendous improvement in the mechanical properties, which will be discussed later.

Figure 6b shows the morphology of dynamically crosslinked 50/50 blends using DCP. In this sample the nylon phase has been extracted using formic acid. As we discussed earlier, the unvulcanized 50/50 blend showed a co-continuous
The morphology of 50/50 blends crosslinked with 2 phr DCP (Figure 6b) showed the tendency of NBR to form a dispersed phase rather than to be continuous. This supports the view that the rubber is dispersed as domains in vulcanized systems. Severe break-up of the rubber domains is absent because of the low degree of crosslinking. Figure 6c shows the morphology of dynamically crosslinked 30/70 (nylon 30) with 2 phr DCP, from which the nylon phase has been extracted. Compared to unvulcanized N30, in the dynamically crosslinked system, because of the higher viscosity of the rubber phase, the continuous nature of NBR phase is diminished.

Figure 5. Speculative model for the morphology of crosslinked systems
particle size distribution curves for unvulcanised N\textsubscript{30} and N\textsubscript{70} are broad, because of coalescence of the dispersed nylon and NBR respectively\textsuperscript{(30)}. But the compositions that are dynamically crosslinked show a uniform morphology; furthermore the dispersed domain size has been decreased considerably. This can be attributed to the fact that the rubber particle size is reduced as a result of crosslinking with DCP.

As a result of dynamic vulcanization the vulcanized rubber domains are very effective in preventing agglomeration. This process forces the un-crosslinked plastic phase to be continuous. Since the ultimate properties are very dependent on the properties of the continuous phase, and the strength of the plastic phase is generally greater than that of the rubbery one, dynamic vulcanization greatly improves the ultimate properties of the rubber-plastic blends.

Furthermore crosslinking increases the viscosity of the NBR phase. This increased viscosity implies increased stresses at a given speed of mixing. These increased stresses in turn would be expected to break up the dispersed phase.

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Dao\textsuperscript{(35-36)} reported that rubber particle growth is inhibited and stabilized at a certain crosslinking density.

The stabilizing effect of crosslinking is not appreciable for nylon rich blends. The NBR domains are more spherical and uniform in the crosslinked blends. The effect of DCP crosslinking on the morphology (Figure 6c) of 30/70, nylon/NBR where 70\% of NBR was crosslinked with 2 phr DCP was different from that shown in Figure 6a (70/30, nylon/NBR blend crosslinked with 2 phr DCP). When NBR is dispersed in the nylon phase, stabilization of the morphology by crosslinking is dominant.

It is very clear from Figure 6b that crosslinking caused the NBR phase to be dispersed in the nylon matrix. The above aspects of the morphology are reflected in the mechanical properties of the blends. Because of the stable morphology (uniform, spherical and small domains) of dynamically vulcanized N\textsubscript{70} (Figure 6a), this material showed almost 160\% improvement in its tensile strength. This is discussed in the coming section of the manuscript.

Transmission electron microscopy has also been used to follow the domain size of dynamically crosslinked system as it is difficult to make a quantitative measurement from SEM. Figure 7a-c shows a TEM of dynamically crosslinked 70/30 nylon/NBR blends, using 0.2 phr sulfur. A drastic reduction in rubber size as a result of crosslinking is evident in Figure 7a. Compared to uncrosslinked system, the minor NBR phase has undergone severe breakdown and the domains have been broken down into smaller units. The dispersed NBR domains attained a size of 1.3 \textmu m (Dn) in the sulfur cured 70/30-nylon/NBR-blend and the size was 7.3 \textmu m (Dn) in the uncrosslinked state. This clearly indicates that there was a considerable reduction in particle size as a result of dynamic crosslinking. It is possible to observe the co-continuity of the phases in the 50/50 crosslinked system (Figure 7b). Figure 7c shows a TEM of the 30/70 dynamically crosslinked nylon /NBR blend, in which the continuous nature of the rubber phase has diminished considerably. Disintegration of the particles as a result of crosslinking is more visible in Figure 7c. Some crosslink density values calculated using the Flory-Rehner equation are given in Table 4. The DCP system gave a higher crosslink density than the sulfur types. These observations are consistent with the phase inversions occurring in N\textsubscript{30} as a result of dynamic crosslinking.

The nature of the crosslinks formed by sulfur differs from those created by DCP. Sulfur vulcanization provides predominantly S-S linkages whereas peroxide systems give only C-C linkages. The crosslink networks formed in these cases can be represented as in Figure 8.
Morphology stability

We also monitored the stability of the morphology of unmodified, dynamically crosslinked blends and of those uncrosslinked ones that had been subjected to annealing. Figure 9a-c shows the morphology of the uncrosslinked nylon/NBR blend annealed at 175 °C for various periods of time (1, 2 and 4 h). As the blend is annealed, a significant coarsening is observed with increasing annealing time. The holes in the morphology indicate the portions from where the NBR has been extracted using toluene. As annealing progresses, the NBR phase undergoes a great deal of coarsening. The sizes of the holes show a substantial increase on annealing, which demonstrates the morphological instability of...
Figure 8. Schematic representation showing the nature of crosslinks in various crosslinking systems: (a) DCP and (b) sulfur

Figure 9. SEM photographs showing the morphology of 70/30 nylon/NBR blends annealed for (a) 1 h, (b) 2 h and (c) 4 h

Figure 9. SEM photographs showing the morphology of 70/30 nylon/NBR blends annealed for (a) 1 h, (b) 2 h and (c) 4 h
uncrosslinked nylon/NBR blends. However, no phase inversion, i.e., no change from dispersed phase to continuous phase was seen during annealing. Even though the original dispersed nature of the NBR was maintained, its tendency to coarsen with annealing became evident.

From the above observations, it can be concluded that the phase morphology of this polymer blend (unmodified) coarsens as a result of coalescence of the dispersed drops. The extensive coalescence seen in this case is associated with the high interfacial mobility caused by the lack of rigidity of the interface. This coalescence significantly degrades the properties of polymer blends.

The rate of coalescence is generally proportional to the interfacial tension, and inversely proportional to the viscous resistance of the medium. Various researchers(37) have reported phase coarsening and coalescence phenomena in polymer blends. The flow-induced coalescence behaviour of Newtonian liquid drops can be shown to occur by a three-step mechanism (Figure 10)(38). It is proposed that when two drops approach each other, they rotate in the shear field, then the film of the matrix phase between the two drops drains, the film thins to a critical value and rupture of the interface occurs, resulting in coalescence. Elmendorp and Van der Vegt(39) found that polymers have a high coalescing probability during mixing because of the fully mobile nature of the interface. For polymers unlike a Newtonian matrix, the mechanism of drop collision and film drainage is different from that of Newtonian models shown earlier, because of the different rheological behaviour of polymeric liquids. Elastic recoil is expected to cause polymer drops to separate during the initial collision step. However, Roland and Bohm(40) found that increasing the shear rate would increase the amount of coalescence. So the extensive coalescence seen during the annealing of unmodified blends indicates that polymers have a high interfacial mobility. The coalescence of dispersed particles leads to an unstable morphology and poor mechanical properties.

Figures 11a and b show the morphology of the 70/30 nylon/NBR (dynamically vulcanized with 2 phr DCP) annealed for 1 and 2 h respectively. Nylon has

Figure 10. Speculative model showing the mechanism of domain coarsening during annealing

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been preferentially extracted from this sample using formic acid. No change in the morphology was observed. This clearly shows the remarkable effect of DCP as crosslinking agent on the morphological stability of the nylon/NBR blends. This is due to the fact that crosslinking reduces the mobility of elastomeric chains.

Mechanical properties of dynamically crosslinked blends

Figure 12 shows the stress-strain behaviour of dynamically crosslinked (2 phr DCP) and uncrosslinked nylon/NBR blends. Dynamic crosslinking of samples containing higher proportions of NBR changes the deformation of the samples from plastic to elastic. The stress–strain behaviour of all uncrosslinked samples show yielding without necking (especially N70 and N50). It is possible to see the change of deformation from plastic to elastic as a result of dynamic crosslinking. In the case of uncrosslinked N30 the stress increases marginally up to 100% elongation and then decreases slowly until failure occurs. But the corresponding dynamically vulcanized sample shows elastic deformation.

Figure 13 shows the effect of the weight percentage of nylon on the maximum tensile strength of NBR-nylon blends. Nylon itself shows the highest tensile strength and increasing the rubber content decreases the tensile strength of uncrosslinked blends. This can be attributed to the decrease in crystallinity of the blend as a result of the addition of NBR.

But the mechanical properties of the dynamically crosslinked blends are increased significantly. The sample N70 showed about 160% improvement in tensile strength on dynamic vulcanization with DCP. Similarly N50 and N30 also showed considerable improvement in tensile strength due to dynamic
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Crosslinking of the NBR phase using DCP. In the case of the uncrosslinked blends, the tensile strength shows a negative deviation because of poor interfacial adhesion. But in the case of dynamically crosslinked blends, the graph is closer to the additivity line. This indicates improved adhesion between the two phases.

The poor interfacial adhesion of N70 (uncrosslinked) was clear from the large voids on the fracture surfaces and the smooth surfaces from where the rubber particles were separated from the matrix (Figure 1a). The tensile strength of dynamically crosslinked blends with 0.2 phr sulfur also showed improvement, but not as significant as in the case of DCP systems. The improvement in tensile strength of nylon rich blends is more pronounced as a result of DCP crosslinking. This can be attributed to some kind of peroxide induced mechanochemical reinforcement.

The plots of Young’s modulus of 2-phr DCP crosslinked blend systems given in Figure 14. The Figure shows a drastic improvement in modulus values of
Figure 13. Variation of maximum tensile strength of various dynamic crosslinked and uncrosslinked blend compositions

Figure 14. Variation of Young’s modulus of various dynamic crosslinked and uncrosslinked blend compositions
the blends as a result of crosslinking. The improvement in modulus values was more noticeable for nylon rich blends than it was with uncrosslinked blends, and the modulus curve showed a positive deviation.

The effect of percentage nylon on the elongation at break (EB) is shown in Figure 15. The EB increased marginally at higher proportions of nylon. However the EB of dynamically crosslinked (DCP) blends improved considerably, especially for higher concentrations of nylon.

CONCLUSIONS

The morphology and mechanical properties of thermoplastic elastomeric blends of nylon and nitrile rubber have been studied with special reference to the effect of dynamic crosslinking. The morphology of nylon/NBR blends showed a two-phase structure in which NBR was dispersed in a continuous nylon phase at lower proportions, but as the proportion of rubber increased beyond 40%, this component also existed as a continuous phase. The minor components, which were in the dispersed phase, showed an increase in domain size with increase of concentration.

![Figure 15. Variation of elongation at break (EB) of various dynamic crosslinked and uncrosslinked nylon/NBR blends](image-url)

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Dynamic crosslinking reduced the domain size of the dispersed phase. The blend morphology became stable on dynamic crosslinking and provided more spherical and uniform domains. Dynamic vulcanization also improved the mechanical properties of the blends. The 70/30-system showed 160% improvement in tensile strength values as a result of dynamic vulcanization, and dynamic vulcanizates showed a stable morphology during annealing.

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