Study on the Blending Modification of High Density Polyethylene and Low Density Polyethylene

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Abstract: In this experiment, we use low density polyethylene (LDPE) and high density polyethylene (HDPE) as raw material, and then respectively use the double screw extrusion and injection molding machine through blending, extruding and production spline, according to the different proportion. We concluded that both physical properties change after testing the impact experiment and tensile experiment of the blending. The results show that: a small amount of HDPE has obvious improved the tensile strength of LDPE and the impact strength of HDPE of LDPE has greatly improved. Finally, the performance is best when HDPE accounted for 60%.

Introduction

Low density polyethylene has some advantages such as good toughness, high rigidity, impact resistance, high chemical stability, resistant to most acid and base corrosion, generally insoluble in ordinary solvents and good insulation. Compared with high density polyethylene, low density polyethylene is relatively cheap, with poor heat resistance, easy photooxidation and ozone decomposition.

High density polyethylene is widely used in agriculture, daily necessities, automobile industry, packaging and so on, but it is difficult to print[1].

The composite material is a new material, which is formed by two or more than two kinds of material or artificial synthesis. The two main types of materials can be classified into functional composite materials and structural composite materials. Composite materials commonly used have a variety of fiber, metal wire and inorganic rigid particles, etc. Blending modification can improve the physical and mechanical properties, transparency, coloring, antistatic property, and can reduce the production cost[2-4].

In this paper, LDPE was modified to improve the mechanical properties of HDPE. We tried to get a best blended proportion of LDPE and HPPE through investigation on the impact strength and the tensile strength of the LDPE/HDPE composite materials with different ratios.

Experimental section

1 Kg of blended materials of HDPE/LDPE were accurately weighed and the ratio of mass fraction of HDPE is 0%, 20%, 40%, 60%, 80% and 100%, respectively. Table 1 lists the material used in the experiment and their specifications. The blended particles were processed in the injection molding machine and five of impact and tensile splines of each group which meet the standard of GBT/T 1043.1-2008 were prepared. Tensile and impact tests were carried out with the electronic universal...
mechanical testing machine and impact test machine. Then the impact strength was calculated by formula 1.1.

Table 1 Materials and their specifications

<table>
<thead>
<tr>
<th>Materials</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDPE</td>
<td>Q/SHMMYX700</td>
</tr>
<tr>
<td>LDPE</td>
<td>Q/SH3060</td>
</tr>
</tbody>
</table>

\[ a_n = \frac{A_u}{t \times b_n} \times 10^3 \]  

formula(1.1)

In formula:  
\( A_u \): Impact energy absorbed by sample, J;  
\( a_n \): Impact strength, KJ/m²;  
\( t \): Sample width, mm;  
\( b_n \): Test notch bottom width, mm;

Results and discussion

Through the blending modification experiment, we found that the different proportion of HDPE has great influence on the mechanical properties of the blends. Table 2 exhibits the total data of the effect of content of HDPE on the mechanical properties of LDPE/LDPE composites materials.

Table 2 The total data of the effect of HDPE content on the mechanical properties

<table>
<thead>
<tr>
<th>Content (%)</th>
<th>0</th>
<th>20</th>
<th>40</th>
<th>60</th>
<th>80</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact strength (au kJ/m²)</td>
<td>11.5</td>
<td>45.95</td>
<td>62.9</td>
<td>106</td>
<td>97.05</td>
<td>54.15</td>
</tr>
</tbody>
</table>
Figure 1 Effect of the content of HDPE on the notched impact strength of HDPE/LDPE composites

Seeing from figure 1, with the increase of the content HDPE, the notched impact of HDPE/LDPE is greatly improved. When the content of LDPE was 60%, the notched impact strength of HDPE/LDPE was 106KJ/m$^2$ and is the maximum. It can be seen that the impact strength of the blends decreased after adding more HDPE into LDPE and the blending effect is not very ideal.

Figure 2 Effect of the content of HDPE on the tensile strength of HDPE/LDPE composites

Seeing from figure 2, when the content of LDPE was 60%, the tensile strength of the blend is the maximum, and high to 22.998Mpa. When the content of HDPE is added from 60% to 100%, but the tensile strength is a sharp decrease and low to 14.614Mpa when the content of HDPE is 100%.
Conclusions

Through analysis of the data of the tensile test and impact mechanics experiment of HDPE/LDPE, we found the impact strength of the blends and the tensile strength were improved when the content of HDPE is 60% and then declined when the content of HDPE is improved. So when the content of HDPE is 60%, the comprehensive properties of the blends the best.

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References