A HEAT-BONDED FIBROUS MATERIAL FROM POLYETHYLENE

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Fibrous materials which have been prepared by the method of aerodynamic spinning from a polymer melt are finding wide application in the manufacture of goods for national consumption [1]. In particular, fibrous materials of the type of "bonded web," which have been spun from polymers having adhesion to various fabrics and a low melting point (from 393 to 433 K), are used with high efficiency for joining parts and elements of sewed items [2].

In the USSR, the raw material for heat-bonded fibrous materials (HFM) is 6/66/610 polyamide, the output of which is limited.

The small volume output of 6/66/610 copolyamide is mainly connected with the ecological "harmfulness" of the technological process for synthesizing this type of polymeric raw material. Purchases of this polymer by import are also insufficient. Therefore, at present the requirements of the sewing industry for heat-bonded materials is being satisfied only to the extent of about 1% [3]. The rapidly growing demand for highly adhesive fibrous materials, the high cost, and the limited supply of existing raw material have brought about a search for new forms of polymer, characterized by availability and low cost.

As the object of study we have selected various grades of domestic polyethylene. The investigation of the fundamental possibility of spinning HFM based on these was carried out on an experimental aerodynamic spinning assembly for fibrous materials from polymer melts (OVN-1).

Specimens of HFM from high-pressure polyethylene (HPPE) and mixtures of it with low-pressure polyethylene (LPPE) were obtained. Basic consumer properties of these specimens were determined by standard procedures. The figures for HFM which were obtained were compared with the properties of similar material from copolyamide produced under industrial conditions in the VNIIISV experimental factory.

From the data shown in Fig. 1, it is evident that HFM which has been spun from a mixture of LPPE and HPPE (curve 2) has somewhat better strength characteristics than material which has been spun from HPPE (curve 3), but is significantly inferior to material from the copolyamide (curve 1). It is to be noted that according to the requirements of consumers the minimal allowable strength of heat-bonded materials should be 6 N (in Fig. 1, denoted by the dotted line). On this basis it follows from analysis of Fig. 1 that only fibrous material prepared from mixtures of HPPE and LPPE can be used as the heat-bonding material, the surface density of this mixture being 1.5 times as large as that of traditional HFM made from the copolyamide. Another no less important characteristic of heat-bonded materials is the strength of the bonded joint. Bonding of HFM specimens with an inner layer fabric and type 234 or 134 calico according to the procedure of TsNIIShP is carried out at a temperature of 150°C and a pressure of 0.03 MPa during a period of 20 sec, subsequently holding the specimen under atmospheric conditions for 8 h. Determination of the strength or resistance to delamination of the bonded joint was carried out according to All-Union State Standard 15902.3-79. The resistance of the bonded joint to delamination after dry cleaning, which imitates treatment of the bonded materials with solvents of the perchloroethylene type for 15 min at 20°C and a drum rotation rate of 70 rpm, was determined in similar fashion.

From the data given in Fig. 2, it is evident that fibrous materials made from polyethylene have a bonding power (curve 2) which is 30% lower than the bonding power of HFM from the copolyamide (curve 1). However, both types of HFM conform to requirements with respect to bonding power since the minimum allowable value of the strength of the bonded joint in conformity to customer demands is 5 N/cm (the broken line in Fig. 2).

In addition to the indicated methods of study we carried out testing of the HFM from polyethylene and from the copolyamide for stiffness according to All-Union State Standard 8977-74. In Table 1 we give the results from tests of bonded packages for stiffness and strength of the bonded seams against delamination after dry cleaning of the bonded fabrics. It is evident
Fig. 1. Breaking strength $P$ of HFM from polymers of different composition vs. surface density $\rho$: 1) HFM from copolyamide (platamide); 2) HFM from mixture of LPPE and HPPE; 3) HFM from HPPE.

Fig. 2. Dependence of strength of bonded joints ($P_h$) of bands of type 279 calico on surface density ($\rho$) of HFM from polymers of various composition: 1) HFM from a polyamide (platamide); 2) HFM from HPPE and a mixture of LPPE and HPPE.

TABLE 1. Some Properties of HFM from Various Materials

<table>
<thead>
<tr>
<th>Starting material for HFM</th>
<th>Surface density, g/m²</th>
<th>Stiffness of the bonded package CN</th>
<th>Strength of bonded seams against delamination, N/cm after dry cleaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copolyamide (platamide)</td>
<td>30–35</td>
<td>6.0–6.6</td>
<td>1.8–2.4</td>
</tr>
<tr>
<td>Polyethylene</td>
<td>30–35</td>
<td>9.0–9.5</td>
<td>3.0–3.8</td>
</tr>
</tbody>
</table>

that the bonded packages based on HFM from polyethylene have an elevated stiffness, and the resistance of the bonded seams after dry cleaning of the fabrics which have been bonded by this material is less than the resistance of seams which have been bonded by material from the copolyamide.

Thus, in basic consumer properties, HFM from polyethylene are inferior to HFM from a copolyamide, and consequently cannot serve as an equivalent replacement for it. However, considering the acute shortage in heat-bonded materials, they can be recommended for use in the sewing industry.