THE ISSUE OF NEW HIGHLY HEAT-RESISTANT ADHESIVE COMPOSITIONS

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The important question is the improvement of thermal performance of polyurethane adhesives used by domestic industries through research of existing and development of new adhesive compositions. The purpose of this study is to examine the development of new adhesive compositions that could be used for making shoes that will be used under elevated temperature conditions. Currently there are about a hundred brands of domestic synthetic adhesives that are based on the ability to withstand more or less heat load can be divided into three groups: adhesives that can withstand prolonged exposure to temperatures around 60°C; heat-resistant adhesives that can withstand long or short-term effect of temperatures of 100°C; highly heat-resistant adhesives that can withstand short-term effect of temperature to 300°C. Firms "Bayer", "Tivolli", "Henkel", "Loctite", "Teroson" (Germany) are the worldwide leaders in adhesives and materials for their production. Lately, foreign companies produce new highly heat-resistant adhesive compositions that can withstand the heat load of about 300-500°C. However, these adhesive compositions have low flexural properties and therefore not recommended for products that are exposed to irregular separation and shock loads, i.e. for the production of shoes. Thus, there is a need to explore the creation of new adhesive compositions which would contain non-toxic natural ingredients as a modifier and at the same time increase heat resistance and would be economically beneficial and allow to reduce the shoe manufacturing process technology that would withstand high temperature stress.

Keywords: shoe, adhesive composition, thermal stability.

INTRODUCTION

Along with the growth of footwear production of glued method of fastening requirements for its quality and range also increase. The use of new artificial and synthetic materials of different chemical composition for the top and bottom of shoes, a large range of special shoes, and increased atmospheric temperature parameters during usage lead to an increase in temperature of asphalt, thus worsening the reliability of glued joints. It requires a variety of heat-resistant adhesives with a wide range of properties.

Requirements for glued attaching of synthetic materials best meet polyurethane adhesives. These adhesives should provide not only high strength adhesive-bonded joints in the initial state, but also preservation of strength parameters during usage at elevated temperatures, have the ability to harden at low temperatures and pressures, do not emit volatile products during solidification and have high physical and mechanical properties.

Many certificates have been devoted to improvement of properties and development of new polyurethane compositions (Багалова К.М. и соавторы, 1987).

THE PURPOSE OF THE GIVEN WORK

With increasing demands for quality footwear and high competitiveness of manufacturers in our market imported expensive heat-resistant compositions that require high culture of production and related equipment are used.

Domestic footwear production enterprises are not equipped with advanced technologies and conditions of ventilation are inadequate, which is the main cause of failure to use certain components to enhance the heat resistance of adhesive composition.

Thus, the issue of improving thermal performance of adhesives that are used by domestic industries through research of existing and developing new ones is urgent.

In the domestic footwear industry glues-solvents based on polyurethane rubber are mostly used. The aim of this study is to explore the possibility of modifying domestic polyurethane adhesive compositions that could be applied for making shoes, used at elevated temperature conditions and, accordingly, the development of optimum compositions for further study of physical and mechanical properties of heat resistance.

RESULTS AND DISCUSSIONS

By rational selection of urethane elastomer with doping agents that promotes adhesion, it is possible to obtain materials with good adhesive properties, and also change the physical and mechanical parameters depending on the required properties of the adhesive connection.

There are different classes of heat-resistant adhesives such as epoxy and phenol formaldehyde, element and inorganic (phosphate, ceramic, metal), adhesives based on aromatic polymers containing heterocycles, which have different applications. The term "heat-resistant adhesive" is relative and can be interpreted differently depending on the purpose of its use. For the shoe industry the term "heat-resistant adhesive" means the ability to withstand thermal loads within 100°C.

Expansion of the use of adhesive joints in various industries and increasing demands to adhesive joints led recently to a large number of brands of adhesives based on synthetic resins of different types modified with fillers and other additives.

Now there are about a hundred brands of domestic synthetic adhesives, which have different physical, mechanical and technological properties. Depending on the ability to withstand more or less thermal load adhesives can be divided into three groups (Петрова А.П., 1977):

- Adhesives that can withstand prolonged exposure to temperatures around 60°C;
- Heat-resistant adhesives that can withstand long or short-term effect of temperatures of 100°C;
- Highly heat-resistant adhesives that can withstand short-term effect of temperature up to 300°C.

The most famous flameproofing initiator, which is recommended for the manufacturing of shoe adhesive compositions to give flameproofing or ability to self extinguish is pentabromftorbenzol. It is used alone or in combination with other compounds, o,o-di(2,3-dibromopropyl)methyl-phosphonic acid of general formula $CH_3R(O)(OCH_2CHBrCH_2Br)_2$, quaternary amine chelate complexes with metals $[Co(NH_3)_6]C1$, $[Co(NH_3)_5C1]C1_2$; $Co(NH_3)_6Br_3$; $[Cr(NH_3)C1]C1_2$; $Zn(NH_3)_4(BF_4)_2$; $Ni(NH_3)_6(BF_4)_2$. Zinc borate type 2335, antimony trioxide Sb_2O_3 (Лисицина И.И. и соавторы, 1978 is nontoxic, fire retardant.

The most well-known companies abroad that produce adhesive compositions and their components are “Bayer”, “Tivolli”, “Henkel”, “Loctite”, “Teroson” (Germany).

Firms Henkel, Loctite, Teroson are the worldwide leaders in production of adhesives and raw materials. Leading experts of group Henkel have developed such brands of industrial adhesives as SHEMOSIL, CUVERTIN, FLOCKIL, MELONIL, TEROSTAT.

The firm "Bayer" produces adhesives that are used in the domestic market, a mixture of polyurethane rubber type Desmokol and isocyanates containing vulcanizing mixture Desmodur. However, the adhesive includes scarce and toxic components and does not provide high strength adhesive connection.

To improve the initial strength and heat resistance of one-component shoe adhesives firm "Bayer" has developed special grade of urethane rubber - Desmokol 530 and Desmokol 540 (Багалова К.М. и соавторы, 1987). Adhesives based on Desmokol 530, 540 possess more strength and crystallization communications, better adhesion to many materials and higher hydrolytic stability than urethane rubber Desmokol 400 which is widely used in shoe industry. Comparative performance characteristics of the original strength and softening temperature is shown in Figures 1 and 2.

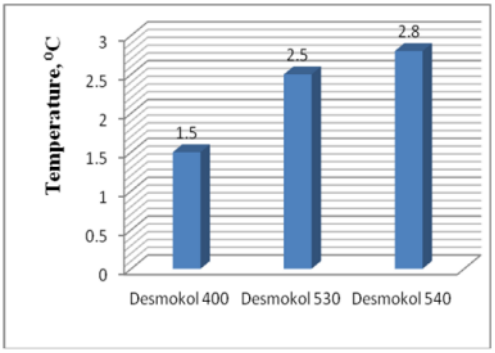

Figure 1. Softening temperature of polyurethane rubber type Desmokol marks 400, 530, 540 (0.18 MPa shear force)

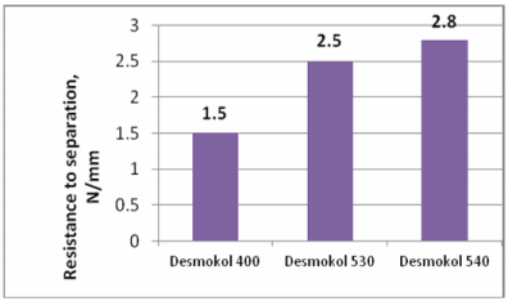

Figure 2. Comparative performance characteristics of the initial strength of urethane rubber type Desmokol 400, 530, 540

Foreign companies develop new highly heat resistant adhesive compositions that can withstand the heat load of about 300-500°C. They are:

- phenolic epoxy adhesives and their modifications, adhesives FPL-878 and FPL-881;
- nitrile-phenolic adhesives AF-31, Metlbond 4021 and Metlbond 304;
- polyamide-phenolic adhesives Hidaks 967 and Hidaks 1033;
- polyurethane Desmokol 530, modified with trioxide antimony Sb_2O_3 (Kiev National University of Technology and Design, Ukraine).

According to information from the foreign press (Techn. Informationsblatter, 1998), ceramic and inorganic adhesives based on boron hydroxide, fluoride phosphate, oxychloride, silicon dioxide and other oxides of elements of group VI are used for gluing highly heat resistant materials.

However, these adhesive compositions are not flexible enough and therefore not recommended for compounds that are affected by the uneven separation and shock, for products that have contact with the human body, i.e. for the production of shoes.

CONCLUSION

Thus, there is a need to explore the creation of new adhesive compositions which would as modifiers contain natural, environmentally friendly components to increase thermal stability and make them economically profitable and allow to reduce the duration of the technological process. The authors consider that it is appropriate to continue developing heat-resistant materials that are used and the possible modifiers polyurethane adhesive compositions to produce special footwear that would withstand high temperature stresses.

The development of technological manufacturing process of a special fire resistant boots using new modified adhesive compositions requires additional studies.

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