EFFECT OF MODIFICATION ON THE STRUCTURE AND MECHANICAL PROPERTIES OF CHLOROSULFONATED POLYETHYLENE FILMS


Structure formation in chlorosulfonated polyethylene films is described. Modification with phenol-formaldehyde resin leads to a change in the supermolecular structures, which are stabilized by introducing 1% aluminum diisobutoxymonoacetate into the system. It is shown that modifying the chlorosulfonated polyethylene leads to the formation of stable supermolecular structures and a considerable improvement in the mechanical properties of the films.

Coatings based on chlorosulfonated polyethylene have recently attracted considerable attention because of their excellent adhesion and anticorrosion properties [1]. However, it has not been possible to make much use of chlorosulfonated polyethylene in the paint industry because of the softness and low strength of the film.

Our object was to investigate the processes of structure formation in chlorosulfonated polyethylene and obtain films with good physicomechanical properties by controlling the supermolecular structures. We investigated chlorosulfonated polyethylene (CSPE) containing 25% chlorine and 1.5% sulfur. The films, obtained from a 10% solution of CSPE in xylene, were cured for 30 min at 100°C.

The supermolecular structure was studied with a MBI-6 polarizing microscope as described in [2]. The films were aged in a solar radiation chamber [3]. Photomicrographs of a CSPE film are presented in Fig. 1a, b, c. In the starting film (Fig. 1a) supermolecular structures in the form of individual two-dimensional formations of various shapes and sizes, imbedded in the structureless region of the polymer, are distinctly visible. With aging the process of structure formation continues (Fig. 1b, c). A study of the adhesion of CSPE film showed that it falls sharply during the first hours of aging, which is evidently associated with structural transformations of the film (Fig. 2, curve 1'). An investigation of the mechanical properties of CSPE films revealed that the coating has very low strength and negligible hardness: the tensile strength of the film is only 10 kgf/kgf/cm², and the hardness 0.27. Accordingly, the problem was primarily to obtain a film with stable supermolecular structures organized to ensure improved mechanical properties. From research conducted at the State Scientific-Research Institute of the Paint Industry it is known that introducing 5-10% ester gum (abietic acid ester) into CSPE considerably increases the hardness of the film (from 0.27 to 0.40). However, a study of the process of structure formation in CSPE containing ester gum shows that the supermolecular structure characteristic of CSPE is more or less preserved, only the shape of the supermolecular formations being slightly modified, while new structural elements in the form of very short individual bands are distributed all over the field of view (Fig. 1d).

It might be supposed that structures of this type, little different from the supermolecular structures of the starting CSPE, would not lead to any marked improvement in the physicomechanical properties of the


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Fig. 1. Photomicrograph of CSPE film: a) starting film; b) after aging for 60 h; c) after aging for 200 h; d) modified with ester gum, starting film; e) Modified with phenol-formaldehyde resin 101, starting film; f) modified with resin 101 and aluminum monochelate, starting film; g) the same, after aging for 200 h.