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Opinion

Theory and Practice of UV-Rejection Technology Application

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The theoretical basis for the creation of UV-curable materials is the postulates about the nature of the physical and phase States of polymers [1]. The curing principle itself is based on the ability of ultraviolet rays (UV rays) to initiate the polymerization reaction of unsaturated compounds, and the principle of compounding UV-cured materials is based on the selection of oligomers and monomers that can copolymerize to form a single polymer network (matrix). Depending on the functional purpose of the material, the composition may contain reinforcing additives, pigments and fillers that should not inhibit the polymerization process and at the same time ensure the performance properties of coatings and products obtained during the curing of the liquid composition. Thus, the matrix must be filled with functional additives to the extent that it provides the necessary and sufficient properties of the product without compromising the efficiency of the polymerization process in the volume of the composition [2,3]. It is worth mentioning that the introduction of functional additives into the UV-cured composition is not the only way to control the properties of the resulting coatings and products. The geometry of film-forming molecules, primarily the method of packaging the resulting macromolecules (fibrillar, globular), also makes an important contribution to the formation of the properties of products obtained by UV–curing technology. In particular, the packing density will determine such properties of coatings as vapor permeability, water and moisture absorption [4-6]. When compounding pigmented systems, the selection of a mixture of film-forming agents is carried out, including taking into account the functionality of the molecules and the nature of the side substituents, which will determine the degree of regularity of macromolecules and the structure of the matrix, which should ensure, on the one hand, the strength characteristics of the coating, on the other, the stability of the system filled with pigment [3,7].

An important factor determining the coating technology is the viscosity of the UV-cured composition, which is additively determined by the intrinsic viscosity of the film-forming agents present in the mixture – and, in fact, by their molecular weight and molecular structure. Viscosity is also a determining factor in the preparation of UV-reinforced curable systems since full wettability of the filler with the composition must be ensured [8]. Based on the formulated regularities for compounding UV-curable compositions, practical recommendations for the use of UV-curable materials in various fields are presented: protective coatings (anti-corrosion, fire-resistant, hydrophobic, vandal-proof); decorative coatings (pigmented, with the effect of mother-of-pearl, with a textured surface); functional coatings and products (medical, industrial marking (for optical fibers), with the function of radiation protection, etc.) and guidelines for the organization of the technological process of applying and curing liquid UV-polymerizing compositions.

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