Thesis abstract

New antistatic coating composites based on polyurea elastomers

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The subject of this doctoral dissertation was to obtain new anti-electrostatic polyurea coatings that can be applied by airless spraying.

The literature part discusses the history of polyurethanes and polyurea, and then presents the raw materials used for their production, dividing them according to a given application and characterizing the products that can be obtained from them. The mechanisms of action of antistatic agents are also described, focusing mainly on ionic liquids and carbon-based additives. In addition, the phenomenon of static electricity and the risks associated with it are described. Documents that define the requirements for the materials used in the areas exposed to static electricity were also presented.

The experimental part was divided into two stages, devoted to screening tests and target tests.

In the first stage, antistatic additives compatible with the raw materials used in the production of hybrid coatings and pure polyurea were selected. The work began with the development of a reference recipe, which enabled laboratory scale tests to be carried out, and then it was modified using commercially available antistatic agents, of which 16 were obtained. In total, 54 samples were prepared for the demonstration tests. Measurements of surface and vertical electrical resistance were carried out on the coatings at relative air humidity of 30%, 50% and 70%. The obtained results allowed to indicate whether the used antistatic agents are effective or not. In the electrical resistance tests, the additive based mainly on 1-ethyl-3-methylimidazolium dicyanamide turned out to be the most effective modifier. The next step was to conduct tensile tests on samples containing additives, which were promising for good electrical resistance results in target tests. The FT-IR spectra of most of the coatings obtained were analyzed. No additional bands were found to interfere with the course of the reaction. Additional bands appeared in the spectra containing the most effective measures for lowering electrical resistance and they come from introduced antistatic additives. SEM images were taken for selected samples, which proved the formation of a thin layer of moisture supporting the conduction mechanism. Viscosity measurements were carried out, which showed that the liquid antistatic additives do not significantly affect the rheology of the resin

mixture, what in turn gave a possibility of using them in target recipes. Additional resistance measurements were also made (two years after spraying) on samples containing LE100LV, Catafor MST and Basionics VS03 additives. The obtained results proved that the modifiers used do not lose their properties over time.

In the second part of the work, target recipes were prepared containing the most promising antistatic additives: LE100LV, Addid 230, Catafor MST, AvanNATUR 133, Basionics VS03. Including the reference sample, 14 coatings based on pure polyurea were prepared, which were further sprayed using the industrial Gama G35-H aggregate. Measurements of surface and volume electrical resistance were carried out on the samples made at various relative air humidity (30%, 50%, 70%). The obtained results showed antistatic properties of the coatings made. In order to verify the mechanical parameters, tensile tests and Shore A and D hardness measurements were performed.

The conducted research allowed to obtain coatings that are ready for implementation in the industry, have great market potential and meet the criteria required for anti-electrostatic materials. A large number of tested and selected additives makes it possible to optimize the composition of the product for a specific application and the possibility of changing the recipe if any antistatic agent is unavailable.