CHOICE JUSTIFICATION OF THE POLYMER COMPONENT FOR HYBRID RADIO-ABSORBING COMPOSITES

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The composition of the matrix in hybrid radio-absorbing composites critically affects their electromagnetic properties. Therefore, its selection should be based on an analysis of dielectric characteristics ($\varepsilon = 4–10$, $tg\delta > 0.05$), mechanical properties, thermal stability, resistance to atmospheric influences, as well as application process ability, cost, and availability. The matrix of a composite radio-absorbing paint must support the dielectric and magnetic losses of the fillers, ensure uniform distribution of microspheres, and possess high strength and thermal resistance.

Potential polymer matrices considered included polyurethane, polyvinyl chloride, as well as epoxy, phenol-formaldehyde, and silicone resins. The methodology for assessing the feasibility of using specific polymers consisted of several stages:

- Evaluation of the compatibility between cenospheres and the polymer matrix based on adhesion indicators and dispersion stability;
- Assessment of the absorption efficiency of coatings obtained using different polymer compositions and microspheres containing maghemite, hematite, and hercynite as fillers were carried out using the impedance matching formula**.**

As a result of the research, it was concluded that epoxy resin and polyurethane-based matrices are compatible with ferromagnetic and conductive fillers, enable the production of highly filled composites (~50 %), and are easy to mix, apply, and cure. At the same time, the polyurethane-based matrix is electrically neutral ($\varepsilon \sim 3.0–3.5$, $tg\delta \sim 0.01$), which does not reduce the effectiveness of dielectric, magnetic, and conductive filler losses. Polyurethane provides the matrix with high elasticity, strength, and resistance to moisture, UV radiation, and oxidation. Given the compatibility requirements with fillers, the modification of the polyurethane composition should focus on increasing adhesion to graphene, which can be achieved by adding silane compounds.

In turn, the epoxy resin matrix, with similar dielectric characteristics ($\varepsilon \sim 3.5–4.0$, $tg\delta \sim 0.02$), exhibits greater strength but moderate elasticity. Epoxies ensure strong bonding with oxide compounds due to the chemical interaction between the resin's hydroxyl groups and the microsphere surfaces. To improve adhesion to graphene, surface silanization is advisable.

Thus, polyurethane is more suitable for producing elastic coatings intended for the protection of flexible surfaces. Meanwhile, epoxy resin represents a compromise between mechanical properties and electromagnetic performance.

The obtained data have been verified through the study of coating properties and validated in practical use within composite coatings for the aerospace industry.