Abstract

Polyoxymethylene belongs to the group of engineering materials, and due to its excellent mechanical and electrical properties and high chemical resistance, it is used in many industrial sectors. Advances in polymer functionalization have made plastics crucial in the medical industry. There is market demand for high-quality plastics that offer repeatable processing and quality at an affordable price. Antibacterial composites are an important group of materials in biomedicine because they can be more effective than traditional antibiotics due to their large surface area and reactivity. Mechanical properties and chemical resistance are also important in plastics used in the medical industry, as they can affect the competitiveness of the product and effectively extend its life cycle. The doctoral thesis examined the modification of polyoxymethylene to increase its anti-adhesive and biocidal properties and resistance to aging.

In the first stage of the work, composites were produced on a polyoxymethylene matrix with the addition of metal particles and metal oxides, such as silver and titanium, zinc, and copper oxides, to test their antibacterial effectiveness. Titanium (IV) oxide showed the highest biocidal activity, completely eliminating Escherichia coli (100%) and reducing the Staphylococcus aureus population by 96%. The other additives had significantly lower effectiveness. The mechanical properties of the composites were only slightly impaired.

The effect of additives such as silicone and aramid fibers on an antibacterial composite with 2% TiO2 by weight was investigated. A composite based on impact-reinforced polyoxymethylene (Hostaform C2521). The results showed that the addition of silicone increased hydrophobicity and deteriorated strength properties, which was caused by the lack of compatibility between the polymer matrix and the elastomeric phase of the additive. Composites with aramid fibers had increased surface wettability. A deterioration in strength was observed due to agglomeration and fiber pull-out from the matrix. The developed Hostaform C2521 composite with 2% by weight TiO_2 showed the best resistance to dynamic loads and a hydrophobic surface.

The next stage of research concerned the selection of an anti-aging additive. Four additives were selected and dosed at 2% by weight. Accelerated aging of the composites confirmed the anti-photooxidative effect of the modifiers used. Titanium (IV) oxide acted as a UV absorber, limiting degradation. UV stabilizers increased water absorption, and after hydrolytic degradation, tensile strength and elongation at break increased, while the modulus

of elasticity decreased. Photodegradation lowered the melting point and degree of crystallinity, with the greatest decrease in unmodified materials.

The final stage of research confirmed the possibility of synergistic action of modifiers, which allowed for the creation of an innovative composite with antibacterial and hydrophobic properties, increased impact resistance, and resistance to photo-oxidative aging, thus fulfilling the purpose of the doctoral thesis.