

## **“Development of composites based on waste polystyrene films”**

Mzhachikh Ivan Evgenyevich

**The relevance of the topic.** Today, the largest sector of plastics application is packaging, which accounts for almost 40% of the total demand. With the constant growth of global plastics production, waste management has become a big problem.

Recycling of plastic waste solves several problems: it significantly reduces the energy and material costs, and improves the environmental situation. For example, when thermoforming packaging containers for food, waste accumulates about 30%.

Polystyrene (PS) is one of the widely used polymers used, among other things, for the production of food packaging, during the production of which a large amount of waste is generated. However, the fragility and low temperature of thermal deformation limit the use of secondary polystyrene. To eliminate the disadvantages, secondary polystyrene is modified by adding various modifiers and fillers.

**The purpose of the work.** The study of technological, physico-mechanical properties of secondary polystyrene formed after thermoforming of food packaging, selection of modifying additives, production of modified compositions with improved properties, study of structural characteristics, physico-chemical and mechanical properties of compositions modified with thermoplastics and nanoadditives of montmorillonite based on secondary polystyrene.

**Tasks of the work.** To achieve this goal, it is necessary to solve the following main tasks:

1. To investigate the effect of styrene-ethylene butylene-styrene thermoplastics on the physical and mechanical characteristics of secondary polystyrene.
2. To determine the effect of the montmorillonite nanofill on the physical, mechanical and technological properties of secondary polystyrene.
3. To study temperature transitions and structural and morphological characteristics of modified and filled compositions based on secondary polystyrene.
4. To investigate the rheological properties of modified compositions based on recycled polystyrene in order to improve their processing.
5. To determine the prospects for further development and use of composites based on modified and filled secondary polystyrene

### **Scientific novelty.**

- it is revealed that the use of physico-chemical methods of modification of secondary polystyrene using thermoplastics allows to obtain composite materials with improved physical and mechanical characteristics;

- the influence of the structure on the change in the strength characteristics of the secondary PS modified by block copolymers is shown, while a morphology with a high dispersion of the elastomeric phase is formed, which affects the increase in fluidity and improvement of the rheological properties of composites;
- the possibility of effective regulation of the physico-mechanical and technological properties of PS waste with the production of hybrid composites containing styrene-ethylene butylene-styrene modifiers is shown.;
- a synergistic effect of increasing the impact strength of composites was found with the combined introduction of maleinated styrene-ethylene butylene styrene and a montmorillonite nanoadditive;
- it is shown that the combined introduction of montmorillonite and maleinated styrene-ethylene butylene-styrene into a composition based on secondary PS makes it possible, due to the formation of morphology with a mixed intercalation-exfoliated structure, to obtain compositions with an optimal balance of stiffness and toughness while maintaining the elongation value under tension.

**Theoretical and practical significance.** Based on the obtained scientific results and the conducted research, a complex task has been solved, including the development of methods for obtaining composite materials based on PS waste, evaluating their technological and operational properties. The resulting composite material based on a secondary PS modified with a maleinated thermoplastic with an organogline nanofill has a wide range of strength and deformation characteristics. The introduction of 3 to 5% thermoplastics into the secondary PS leads to a significant increase in impact strength and elongation during tension. The introduction of maleinated styrene-ethylene butylene-styrene as a compatibilizer to ensure good adhesion of the components of the composition made it possible to develop a material with both sufficient strength and improved toughness. Extended tests of PS waste modified with thermoplastics and montmorillonite showed changes in the fluidity, rheological properties of composites and their morphology.

**Defense Provisions:**

1. conducting a comprehensive study of the physico-chemical, technological, operational and physico-mechanical properties of secondary polystyrene formed after thermoforming food packaging;
2. development of composite materials based on secondary PS with improved physical and mechanical properties;
3. identification of the effect of modifying additives on the physico-mechanical and structural characteristics of compositions modified with thermoplastic elastomers based on secondary PS.