

## GLOBAL TRENDS IN BIODEGRADABLE POLYMERS

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### Introduction

It is considered promising to develop technologies for biodegradable polymer hybrid compositions (BGC) and products based on them [4-6]. One of the promising directions for the creation of BGK is the use of thermoplastic starch (TPS), as the main component for their base [7]. To obtain TPK, native starch is mixed with heating with various plasticizers [8]. It is known today that the use of TPK as a filler in polyolefin compositions instead of native starch is preferred due to better processability and higher thermal stability. In this case, the content of TPS in the compositions can reach 40-60 wt.% [9, 10]. Therefore, the purpose of this work is to improve the technology for creating biodegradable film compositions intended for use as packaging materials and to draw up a basic technological scheme for the production of biodegradable hybrid compositions (BGC).

### Materials and Methods

The materials used were: high grade corn starch (GOST 32159-2013); corn amylopectin starch according to GOST 32159-2013, wheat starch according to GOST 31935-2012.; pea starch (certificate of conformity, ROQUETTE, France); rice starch (LLC Vinh Thuan Trading Import-Export Co. Ltd (Vietnam), (JSC Bioprogress, Moscow, Russia); distilled glycerin grade PK-94 (GOST 6824-96); crystalline sorbitol; low density polyethylene (high pressure) grade 11503-070 produced by Kazanorgsintez PJSC (Russia); dry vermicompost according to GOST R 56004-2014; TU 9818-001-47294670-2015 glycerin, sorbitol.

Organoleptic evaluation of polymer films according to the norms of SanPiN 42-123-4240-86, GN 2.1.6.695-98, SanPiN 2.1.4.559-96. The breaking stress in tension and the relative elongation at break of the films from the compositions were determined at a temperature of  $23 \pm 2$  °C, a relative humidity of  $50 \pm 5\%$ , and a speed of expansion of the clamps of the testing machine in accordance with GOST 14236-81. The experiment was carried out on a tensile testing machine RM-50. The limit of the permissible value of the load measurement error did not exceed  $\pm 1\%$ . Determination of vapor permeability according to GOST 33355-2015 (ISO 7783: 2011). Evaluation of biodegradation according to the modified Sturm method GOST 32433-2013. Water absorption was calculated according to where  $m$ ,  $m_1$  are the mass of the dried sample and the mass of the sample after exposure in water, respectively, g, using an analytical electronic balance ViBRA AF-R220E (ViBRA SHINKO) according to GOST 24104-88.

### As a Result of Research

The All-Russian Research Institute of Starch Products is conducting research on the use of starch to obtain biodegradable polymer products. The process of modification of various types of starches by the extrusion method in the presence of plasticizing agents has been investigated. The parameters of the technological regime for obtaining thermoplastic starch (TPK) have been developed. Mathematical models of optimal compositions of biohybrid compositions (BHC) based on polyethylene and TPK have been created, depending on the technological modes of film production. The physical and mechanical characteristics of BGC and the film were investigated at various ratios of components and the effect of ultrasonic treatment (US), considering the standard values of the maximum stress and elongation at break. During storage of BGK and films in biohumus, physical and mechanical properties were determined, indicating the accelerated decomposition of products. The microstructure of polyethylene-starch compositions obtained at different temperatures has been studied, an improvement in consumer and operational characteristics when exposed to ultrasonic treatment of the composition due to a more uniform distribution of components in the polymer matrix has been established.

The use of montmorillonite in the production of biodegradable film materials imparts hydrophobicity and makes it possible to significantly improve the physical and mechanical characteristics of film and other materials and allows to reduce the proportion of polyethylene by 2 times or more, which increases the biodegradability of polymer products.

A comprehensive study of the effect of the type of packaging on the processes of moisture migration, changes in lipase activity and microbiological indicators was carried out. It is shown that a new type of biodegradable packaging based on thermoplastic starch has similar barrier properties in comparison with classical polypropylene packaging, while the quality of the packaged products is guaranteed by the example of jelly marmalade glazed with confectionery glaze.

### Conclusion

The main essence of the studies studied is the fact that every year the study and development of biodegradable polymers becomes an important and necessary trend.