

The scientific objective of the project is to determine the possibility of using natural substances of vegetable origin, as anti-aging compounds biodegradable polymers. The application of these compounds will improve the resistance of the biodegradable polymers to external factors (solar radiation, humidity) deteriorating the properties of these materials, without negatively affecting the ability of industrial composting biodegradation.

Global consumption of plastics in the world is around 300 million tons per annum, with annual growth estimated at around 5%. Commonly used polymeric materials are produced from petroleum (approximately 4% of global petroleum production is used to produce polymers). Polymeric products made from petrochemical polymers are extremely stable in environmental conditions. After their exploitation this becomes serious problem for the environment. Most of the products made of plastic are stockpiled in landfills, and the decomposition time of such products is often several hundred years.

The solution to this problem may be the use of biodegradable polymers derived from renewable materials, undergoing a process of biodegradation. Biodegradation is a process of materials degradation caused by biological activity, in particular the activity of enzymes, leading to significant changes in the chemical structure of the material. This process takes place under conditions favorable for the development of specific groups of microorganisms, such as fungi or bacteria. The main advantage of biodegradable polymers is that they completely decomposed in a few months in proper conditions. Due to the good processing and utility properties polylactide and polycaprolactone attract considerable interest amongst biodegradable polymers.

Polylactide is biodegradable and biocompatible material which can be produced from renewable resources. It is produced from lactic acid obtained from the fermentation of corn starch or cane. This polymer is widely used for food packaging, textiles, tissue engineering, medicine and cell culture preparation.

Polycaprolactone is biodegradable polymer which easily mixes with many other polymers, and therefore is used as an additive increasing flexibility of polymeric materials and their biodegradability. It is also used in combination with starch for the production of rigid material, from which a biodegradable and disposable plates or cups are manufactured. Polycaprolactone also has many biomedical applications. By the fact that in the human body it is gradually and slowly degraded (about 2 years) it is used for the production of implants and resorbable surgical threads.

As in the case of polymers derived from petroleum it is necessary to provide biodegradable polymers suitable resistance to external factors during use. For many years various studies to improve the stability of polymers, their resistance to weather conditions, chemicals and high temperatures have been carried out. The most common method to improve the stability of polymer materials is the use of specific chemicals (anti-aging compounds), which added to the polymer matrix improve the resistance of these materials to heat at an elevated temperature, solar radiation or chemical substances.

The aging of materials is a universal phenomenon, occurring in all areas of life, in particular relating to the technical objects. The universality of this phenomenon makes it the main subject of numerous research projects, both from the point of view of the knowledge of the aging mechanisms and to evaluate its effect on the properties of materials. Increasing demand for polymeric materials, that often are indispensable in the construction of machines, equipment and products of daily use are the reason that research work is focused on the explanation of the complex mechanisms of the aging process. Many research have carried out to determine its effect on the properties of materials as well as assessing the impact of processing conditions on the progress of this phenomenon

An innovative approach, proposed in this application, is the use of natural substances of plant origin (coffee, cocoa and cinnamon), containing natural polyphenols as anti-aging compounds of biodegradable polymers.

Polyphenols are compounds which form a large group of natural substances present in many plants. These organic compounds are very common in the plant organisms. They can be found in fruits, vegetables, vegetable drinks, spices and plant origin drugs. Rich sources of these compounds are fruits such as chokeberry, blueberries, grapes and vegetables, especially cabbage and garlic. Also grain, nuts and legumes contain many polyphenols. Amongst drinks green tea, red wine, coffee, cocoa have significant polyphenol content.

The project realization will extend the application of studied biodegradable polymers. Increasing the use of biodegradable materials, may lead to the elimination of polymers derived from petroleum from many production processes. This will reduce the use of these polymers, petroleum and reduce the environmental pollution by waste from these polymers. Increased use of biodegradable polymers will also decrease their prices, thereby increasing their competitiveness compared to polymers derived from petroleum.