Analysis of the process of biodegradation of geotextiles from plant fibres and additives supporting plant growth used in environmental engineering

Geotextiles have become a popular solution that is successfully used in environmental engineering. The growing interest in these materials results from their numerous benefits and a wide range of applications. Geotextiles may perform several functions that include, among others, drainage, filtration, strengthening, reinforcement, anti-erosion protection, separation, and reclamation. In recent years, they have also been used in agriculture and horticulture as a substitute for fertilizers or materials that improve retention. As far as practical applications are concerned, geotextiles are applied, among others, in construction, in the reinforcement of embankments, shores of water reservoirs, high and steep earth walls, in the construction of landfills and the drainage of roads and squares.

Currently, most geotextiles are manufactured from plastic products, which are not biodegradable and thus pose a serious threat to the environment. According to estimations, nearly half of plastic products are used for a period shorter than one month, and for materials used in agriculture and environmental engineering, the period of exploitation is usually limited to one vegetation season. The main recipients of geosynthetics are environmental engineering and agriculture. As a result, they largely contribute to environmental pollution. Due to that, these sectors should accept the reuse of waste materials being, for example, the by-products of the textile industry, breeding animals or cultivating crops.

One of the ways to limit the consumption of non-renewable resources and environmental pollution is to search for natural equivalents of petrol-based materials, which will be characterised by the appropriate properties and, first of all, will comply with the principles of sustainable development. These solutions include geotextiles prepared based on waste plant and animal fibres, such as wool, jute, and linen. These materials are characterised by sufficient mechanical properties, low production costs, and, first of all, they decompose into elements that do not cause any problems for the environment and in most cases constitute a source of fertilizing substances for plants. An interesting solution in this respect may be the application of a combination of geotextiles with other sustainable additives, such as biochar and fungi from the genus Trichoderma. Biochar has become one of the most promising solutions that mitigate the problem of climate change and degradation of soil. On the other hand, Trichoderma is a biocontrol measure against numerous phytopathogens that also stimulates plant growth.

The plan of the project involves tests aimed at the determination of the properties of biodegradable geotextiles and their equivalents enriched with biochar or Trichoderma. These analyses will include the determination of the time and degree of biodegradation of geotextiles made from natural resources and applied in actual field conditions. The experiments scheduled for two years will analyse the influence of additives in form of biochar and Trichoderma on the course of the geotextile biodegradation process. The key phase will consist in the determination of the type of biodegradation products released to the environment and the determination of the influence of biodegradable geotextiles and their equivalents enriched with additives on the vegetation of selected species of grass. Selected research tasks will be carried out as part of international cooperation with the Polytechnic University of Madrid.

The planned research will be conducted in compliance with the principles of circular economy and it will indicate the possible ways to manage textile waste in widely understood environmental engineering. The potential of biodegradable geotextiles and their equivalents enriched with biochar will be evaluated in terms of improving soil properties and plant vegetation conditions, event in very hostile environmental conditions. The realisation of the objectives of the project will contribute to the evaluation of the effectiveness of solutions that are essential in terms of limiting the consumption of non-renewable resources, reducing environmental pollution, reducing the use of fertilizers, and providing reasonable support for plant vegetation. All of them are fundamental for the sustainable development of environmental engineering.