

Is a world without plastic possible? It is tough to imagine such a scenario, especially since plastic accompanies us everywhere. Plastics are not harmful materials; they are durable, inexpensive, and have unlimited application possibilities. Unfortunately, most plastics come from fossil fuels, the extraction of which causes massive CO<sub>2</sub> emissions into the atmosphere, which in turn drives climate change. Another problem with plastics is its overproduction and waste management, leading to pollution. The end-of-life (EOL) process for plastics is still very immature and most plastic products are in landfills. Therefore, new solutions are urgently needed to support the EOL process. One such method is upcycling, which differs from recycling in that it means processing waste into products with a higher value than their original value.

Therefore, this project will investigate the possibility of using plastic waste as a basis for creating new functional polymer composites.

Surprisingly, the topic is still in a very nascent phase and more research needs to be done, especially on plastic waste other than packaging. Therefore, as part of this project, the following waste groups will be tested:

- Nylon from fishing nets and old clothes,
- Car parts made of ABS,
- Building insulation elements and their derivatives made of polystyrene,
- One of the popular types of waste made of PP or HDPE, or similar.

Plastic waste will be supplemented with fillers such as graphene and its derivatives, hexagonal boron nitride (h-BN) and BN nanotubes, and other ceramic nanoparticles such as corundum.

The popular 3D printing and extrusion were chosen as the main production methods. It is planned to conduct thorough research on the processability of this type of materials and examine the properties of the composites created, focusing in particular on the study of thermal and mechanical properties, structural properties, degradation, phase transformation properties, etc.

The research will significantly complement current knowledge. It may be the basis for potential future applications based on plastic waste.