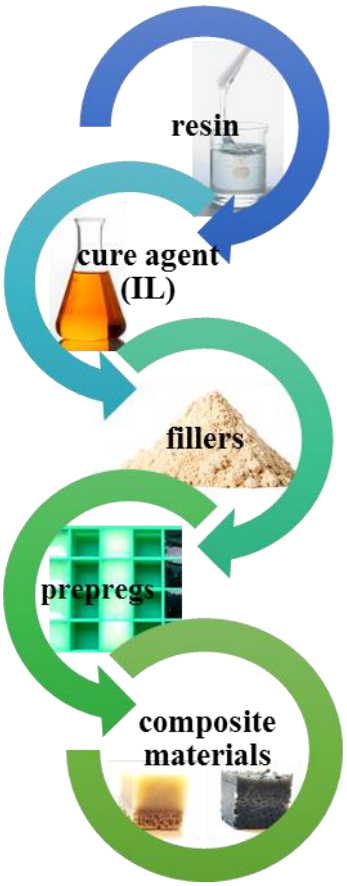
Multifunctional composite systems based on epoxy resins with ionic liquids as a crosslinking initiators

Epoxy resins for over 70 years are used in many industries, and because of their unique properties, they are considered one of the most important groups of polymers. They have chemical resistance and good mechanical and thermal properties, and have found a **number of practical applications**, such as adhesives, coating materials, paints, composites, molding materials, microelectronic materials or matrixes for fiber reinforced composites. Moreover, the ability to use a variety of fillers allows to modify the properties of the resulting composite products, depending on the desired application. In addition, the choice of an appropriate crosslinking initiator can affect the conditions and storage times of uncured epoxy resins.



Epoxy resins production is approximately 3.75 million tons per year in the United States alone, making it one of the **key polymeric materials** used in almost every industry. Despite this fact, there is still a need to modify resins to obtain composites with different fillers that affect the properties, appearance and potential for later use.

The purpose of the project is to develop and prepare innovative composites based on epoxy resin with ionic liquids as a crosslink initiators used directly or in combination with SILP materials (Supported Ionic Liquid Phase, combining both hardener and filler functions). Moreover, the aim is to use fillers such as cellulose, charcoal, silica or polyaramide fibers as modifiers for the mechanical, sorption and filtration properties of the resulting composite materials.

The main issues associated with the manufacturing of prepreg systems concerns with their storage and transport. Due to the presence of reactive functional groups in the structure of the hardeners, transport or too long and improper storage of epoxy resin composites (too high temperature), results in the initiation of the crosslinking process and these systems are therefore unsuitable for further use. Thus, the innovative element of the project will be the use of different groups of ionic liquids or their eutectic mixtures as initiators of crosslinking process. By using ILs the resin-initiator systems capable of long storage and crosslinking after suitable thermal process could be prepared, with shortened process time. Significant novelty will also be the use of SILP materials (ionic liquid adsorbed on the surface of silica), thereby combining the use of hardener and filler in one material. Another elements of novelty are (i) simultaneous use of ionic liquid as a hardening agent and the fillers affecting mechanical and sorption properties of the composite, and also (ii) preparation of a composites containing two or more filler types simultaneously to reduce/offset unwanted changes caused by the use of one filler.

Selection of fillers proposed in the project is dictated by their availability on the market, low price, and in the case of using biopolymers or polyaramide fibers the possibility of using waste materials. This will reduce the cost of producing new composites and will contribute to more efficient textile waste management, thereby reducing its negative impact on the environment.