

In the past few decades, environmental pollution caused by automobile exhaust gas containing sulfur oxides is becoming more serious. Combustion products of diesel fuel with high sulfur content are rich in their oxides, which greatly pollutes the air, and consequently adversely affect human health.

Production of fuel with reduced sulfur content is a challenge for refineries and many scientific laboratories in the world. In view of the strong constraint rules secretion oxides SO_x to the atmosphere looking for new, effective and energy-efficient technology evolution of these compounds from fuel. The conventional method of efficiently removing sulfur compounds, including thiols, thioethers, and disulfides of fuel used on an industrial scale is hydrodesulfurization (HDS). This process requires a high temperature of 300 - 400 ° C and a high pressure (20 -100 psi H₂), further reduces the octane rating of the fuel, above all, is ineffective for the removal of aromatic sulfur compounds, which account for over 55% of the total sulfur content, such as: benzothiophene, dibenzothiophene, and derivatives thereof, especially 4,6-dimethyl-dibenzothiophene. Stringent conditions for conducting conventional hydrodesulfurization process fuels that generate high costs and limitations of the method mentioned contributed to the fact that looking for alternative methods of deep desulphurization of fuels that would allow for the efficient release of sulfur compounds in moderate conditions. In recent times, special attention is paid to alternative technologies such as desulfurization oxidative desulfurization (ODS) combined with extraction using ionic liquids. In the process of the ODS aromatic sulfur compounds under moderate reaction conditions be oxidized to the corresponding sulfoxides and sulfones. The oxidized products are then removed in the liquid-liquid extraction using ionic liquids that are primarily due to the low volatility are an alternative to flammable and volatile organic compounds.

This project focuses on basic research physicochemical, thermodynamic and kinetic systems with ionic liquids and deep eutectic solvent (DES). The subject matter is taken very timely and has a close relationship the possibilities of new technological applications of ionic liquids and eutectic systems in oxidation desulfurization of liquid fuels. The main objective of this project is to search for ionic liquids and eutectic systems for possible use in the oxidation desulfurization. This applies in particular to such compounds as benzothiophene, dibenzothiophene, and derivatives thereof, wherein the separation by commonly used on an industrial scale of the desulphurisation process is impossible. In order to increase the selectivity of separation of these compounds it is proposed to add to the oxidizing agent.

Ionic liquids are seen as an important class of novel compounds characterized by specific properties. In particular, low volatility and high value of selectivity, shown in earlier work is supported by the use of ionic liquids as alternative solvents in many sectors of the chemical industry, including extraction and purification technologies.

In the opened literature, it was shown that ILs exhibit high values of selectivity in separation of aromatic sulfur compounds (thiophene) from aliphatic hydrocarbons (fuel) compared to conventional organic solvents used on an industrial scale (NMP, or sulfolane), which in combination with negligible vapor pressure, it offers hope to the possibility of using this type of compounds for separating sulfur compounds from fuel on an industrial scale for a traditional volatile organic solvents. A significant number of publications in this field comes from our laboratory. In order to increase the efficiency of removal of sulfur from the fuel (over 90%) proposes a desulphurization with the addition of an oxidizing agent, which is the main subject of this project. The novelty of this research project will be a series of studies on the possibility of using deep eutectic solvents (DES) in oxidation desulfurization. Available world literature devotes little attention to the possibility of the use of DES in fuel desulphurization processes, but research is not yet addressed the possibility of the use of DES for desulfurization of liquid fuels in oxidative desulfurization.

The possibility of use ILs and DES in the technological process of extraction of sulfur compounds from fuels will be determined based on the planned basic measurements of thermodynamic phase equilibrium (liquid + solid), (liquid + liquid) and (liquid + vapor) in binary systems, and extraction of aromatics sulfur (thiophene, methylthiophene, benzothiophene, dibenzothiophene, 4,6 - dimetylodibenzotiofen) in a model fuel. From the point of view of designing technological processes on an industrial scale, an important role is played by measurements of physicochemical properties. A valuable supplement to studies of ionic liquids extraction capabilities for determining the density and viscosity of pure ionic liquids and DES as a function of temperature and composition. Furthermore, it plans to make measurements which allow to determine the influence of many factors, including: the construction of ionic liquids, DES, temperature, amount of and the type of the oxidizing agent and the impact of the extraction time of extraction cycles on the ability of ionic liquids extraction and eutectic systems. The results will undoubtedly be a considerate contribution to the discipline in Poland and in the world.