Thesis topics, 2025/26/2nd semester

Dr. Attila Bényei:

Polymorphism of pharmaceutically active compounds: powder and single crystal diffraction studies (Chemistry or chemical engineer BSc/MSc, 1 person, 0 free)

Polymorphism is a very important phenomena especially in pharmaceutical industry. Co-crystals of pharmaceutically active compounds (APIs) and their polymorphism is a novel direction of the research. The main method in these studies are powder and single crystal X-ray diffraction. The purpose of the thesis is to prepare new polymorphs and co-crystals of an API and their characterization with powder XRD. If single crystals could be grown that the determination of their complete structure in the solid state.

Dr. Eszter Mária Papp-Kovács

Investigation of Competitive sorption of Rare Earth Ions on Bentonite and Zeolite: Thermodynamic, Kinetic, and Mechanistic Approach (no free place)

Rare earth elements are essential in modern technology and often occur with radioactive elements. This work studies competitive sorption of rare earth ions on bentonite and zeolite under different chemical conditions, applying isotherm and kinetic models. The results will support understanding REE environmental behavior.

Investigation of Parameters Affecting the Adsorption of Radioactive Contaminants on Clay-LDH Sorbent Systems (Chemistry or chemical engineer BSc/MSc, 1 person, 1 free place)

The aim of this thesis is to synthesize clay–layered double hydroxide (LDH) composite sorbents and investigate the factors affecting the binding of radioactive contaminant ions. The sorbents will be characterized using structural and surface-chemical techniques (XRD, SEM, BET, FTIR). Adsorption of radioactive ions will be measured under varying pH, ionic strength, and temperature using gamma spectrometry, and kinetic and isotherm models will be applied to evaluate adsorption processes. The study aims to develop an efficient and stable sorbent for reducing environmental radioactive contamination.

Radioanalytical Study of the Regenerability and Stability of Clay-LDH Sorbents (Chemistry or chemical engineer BSc/MSc, 1 person, 1 free place)

The aim of this thesis is to investigate the regenerability and long-term stability of clay–LDH composite sorbents in experiments with radioactive isotope adsorption. Structural characterization of the sorbents will be performed using XRD, FTIR, and SEM, and surface properties will be analyzed using BET measurements. By evaluating the adsorption of radioactive ions over multiple cycles, the regenerability of the sorbents and their suitability for immobilizing radioactive contaminants will be assessed. The research contributes to the development of environmentally friendly, reusable technologies for radioactive waste management.

Surface Modification and Structural Analysis of Bentonite and Zeolite for Selective Rare Earth Ion sorption (Chemistry or chemical engineer BSc/MSc, 1 person, 1 free place)

Bentonite and zeolite are inexpensive natural sorbents that can be improved by surface modification for REE removal. This study prepares modified samples (acid-activated, pillared, phosphate-treated), characterizes them, and tests their sorption performance. The goal is to link structure to sorption behavior.

Dr. Gyula Tircsó

Design, synthesis and characterization of new ligands for the complexation of metal ions of biomedical importance (Chemistry or chemical engineer BSc/MSc, 1 person, 1 free)

Complexes of the lanthanide ions (Ln^{3+}) have been utilized in medical applications due to their widespread magnetic, photophysical, and nuclear properties. Owing to their toxicity the Ln^{3+} ions are must be chelated using multidentate ligands. Beside the traditional pendant arms, the picolinate metal binding moiety is explored more extensively nowadays. The proposed project therefore aims at the development and synthesis of a monopicolinate based chelator derived from the 2,2'-oxybis(ethylamine) diamine possessing three acetate pendant arms (OBE3APA). The research will focus on the synthesis of the ligand and characterization (stability, formation and dissociation kinetics) of their complexes formed with metal ions of biomedical relevance (Bi^{3+}, Gd^{3+}, Sc^{3+} etc.).