

DESCRIPTION FOR THE GENERAL PUBLIC

The overall objective of the project is to carry out the research on the development of the new technique for mixture separation of chemical substances, particularly biologically active ones, using stationary phase (adsorbent) layer, through which a mobile phase solution flows under the influence of an external pressure (hydrodynamic flow) and an parallel electric field to the hydrodynamic flow is exerted. The technique is named as high-performance layer electrochromatography (HPLEC). The technique is new, and its name is preliminary proposed for use in this project.

The objective of the project is multi-faceted, covers the following topics: developing a new design and production of prototype equipment for high-performance layer electrochromatography, research on influence of construction, kinetic and thermodynamic factors influencing efficiency and quality of separation of various substance mixtures, particularly of biological activity, in terms of knowledge of the mechanisms governing separation process, knowledge of rules that can be used to optimize the conditions of analytical separation (that could be applied to analysis of biomedical, pharmaceutical, environmental samples).

In the range of the project the research on constructional variants of equipment for HPLEC technique will be carried out. The research will be used to select the most appropriate constructional variants of the device for this technique in respect of separation efficiency of substance mixtures under optimal conditions. It mainly concerns the minimum dispersion of solute zones caused by device elements and reproducible results in long-term, iterative, parallel separation process of several samples simultaneously. A key feature is a layer of the stationary phase (adsorbent), which stands for a kind of flat column, known in the form of a porous rod/column in liquid column chromatography and capillary electrochromatography. In view of the unknown optimal thickness of the adsorbent layer in HPLEC system, a very important issue is to optimize the dead volumes of the device, related to the off-line and on-line sample injection and solute band detection with respect to parallel and simultaneous separation of several samples. The influence of physicochemical factors, including the size of electric field, the hydrodynamic flow velocity of the mobile phase, its qualitative and quantitative composition, temperature, etc., will be investigated in respect of quality of analytical separation of substance mixtures. These results will allow to elaborate rules for optimization of separation conditions with HPLEC technique.

This project is a logical consequence of the research work carried out by the applicant in the framework of two previous NCN grants that involved techniques of pressurized planar electrochromatography and orthogonal pressurized planar electrochromatography. The first of the completed projects involved the separation of substances on thin-layer chromatographic plates with the application of an electric field only to induce the migration of the mobile phase (the electroosmotic effect). The second study was also concerned with substance separation on thin-layer chromatographic plates, however, the mobile phase movement was induced by external pressure and electric field was perpendicularly applied to this flow.

The subject of the project concerns research into the new technique for separation of substances that is proposed by the applicant. The research project, apart from the aspects of basic research, has an innovative character. For this reason, it stands for very promising potential exploitation of basic research in both laboratory and industrial practice.