UNIVERSITY OF PANNONIA

COURSE DATASHEET

Semester:	2015/16/1
Course:	Fundamentals of environmental chemistry lab
Code:	VEMKFTB134K
Responsible department:	Department of Physical Chemistry
Department code:	MKFK
Responsible instructor:	dr. Dezső Boda

Course objectives:

To make proficiency in experimental work and deepening knowledge in environmental chemistry by experiments.

Course content:

1. Study of a redox electrode. The characteristic properties of a redox system are determined by measuring the e.m.f. of a suitable galvanic cell. **Determination of pH by different methods.** The pH of solutions are determined via pH sensitive electrodes. (H2/Pt, quinhidrone, glass electrodes).

2. Determination of Poisson constant by Kundt"s method. The velocity of sound in a gas is determined by the measurement of wave-length via resonance method. The Poisson constant is calculated from the measured data. **Determination of the vapour pressure with isoteniscope.** The vapor pressure of a pure liquid is measured as the function of temperature by isoteniscope method. The heat of vaporization is calculated from the data.

3. Vapor-liquid equilibrium in a binary mixture. The equilibrium compositions of the vapor and liquid phases are measured in a binary mixture at constant pressure. The molar fractions are determined by refractometry. **Determination of the thickness of an AgI layer.** The thickness of a galvanic deposited AgI layer is determined by chronopotentiometry.

4. Partition of a solute between two immiscible liquids. The partition of acetic acid is investigated between two immiscible liquids (water and organic solvent). The equilibrium concentrations are determined by titration (water phase) or calculated using mass balance (organic phase). **Inversion rate of sucrose.** The rate constant of the acid-catalysed pseudo-first order reaction is determined. The reaction is followed by optical rotation measurement.

5. Conductivity of electrolyte solutions. Conductivities of a weak and a strong electrolyte are measured as a function of concentration. The dissociation constant of the weak electrolyte is calculated using the Ostwald"s dilution law. **Galvanic corrosion.** Evans-diagrams of galvanic corrosion systems are determined as function of pH by galvanostatic method. The maximum current density and potential of corrosion are determined via Evans diagrams.

6. Preparation for the laboratory course. Introducing, labour safety, requirements, introducing to the literature (books, journals), taking over laboratory devices, discussion of tasks.

7. Safety report. Analysis of functional groups: olefins, strong reducing agents, saponification of esters, alcohols,

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Course content:

carboxylic acids etc.

8. Synthesis of crystalline derivatives of carbonyl compounds, thin layer chromatography (TLC). Precipitation of the 2,4-dinitrophenylhydrazone of an unknown carbonyl compound, recrystallization of the precipitate, melting point measurement, identification of the compound on TLC plate.

9. Synthesis of aspirin by the acylation of salicylic acid. Spectroscopic characterization of the product.

10. Preparation of olefins. Synthesis of cyclohexene starting from cyclohexanol by acidic dehydration, purification of the product (extraction, washing, fractional distillation), determination of purity by measuring refractive index.

1. **Gravimetric determination of sulfite ions.** Sulfite ions will be oxidized with hydrogen peroxide, then precipitated as arium sulfate by using barium chloride **Determination of lead and bismuth by complexometric titration:** in the same sample, by application of suitable indicators, at different pH values, using calibrated EDTA solution.
2. **Photochemical degradation of methylene blue (MB) on TiO_2 semiconductor. by application of a photoactive semiconductor.** Reactive radicals formed upon UV irradiation of a photoactive semiconductor oxidize MB – its transformation can be spectrophotometrically followed in the samples taken after given periods of irradiation. **Degradation of MB by photo-Fenton reaction.** Irradiation of trioxalatoferrate(III) in the visible range produces hydroxyl gyököket radicals, the amount of which is doubled by the reaction of hydrogen peroxide present in the solution. The latter reaction is catalyzed by the iron(II) species photochemically formed in this system. The hydroxyl radicals generated totally mineralize the organic dye (MB).
3. **Determination of the critical micellar concentration (cmc) of CTAB.** The surface active cetyltrimethylammonium ions electrostatically bind the negatively charged fluorescein ions, the photoemission of which significantly ganges in the near of cmc – this phenomenon is easily followed by a spectrofuorometer. **Determination of the concentration of an anionic detergent in wastewaters.** These surface active anions form an adduct with MB, which can be extracted with chloroform. The concentration in the extract can be photometrically determined.
4. **Acid rain – absorption and determination of SO_2.** Sulfur dioxide (as one of the main components of acid rain) is produced by burning thioacetamide dissolved in methanol. The flue gas is absorbed in the solution of hydrogen peroxide – thus SO_2 is oxidized to sulfate, which forms colloidal precipitate with barium ions dropped subsequently into this solution. The concentration of the colloidal barium sulfate can be determined by measuring the light scattering, using a spectrofluorometer.
5. **Determination of the oil content of a soil sample by extraction.** The oil content is extracted by diethylether. After the removal of the solvent, the mass of the oil extracted is directly measured and compared to the total mass of the sample. **Writing an examination paper on the theoretical and practical parts of the**

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measurements.

Requirements, evaluation and grading:

The experiments have to be performed, the measurements and calculations have to be reported.
The mark of the practice is based on the total points given for the measurements and the oral or written tests about the theoretical backgrounds.

Required and recommended readings:

Liszi, J.: Fizikai kémia, Veszprém, 1993. Kézirat. Tanszéki munkaközösség: Fizikai kémiai laboratóriumi gyakorlatok, Veszprém, 2000. Kézirat. Sajó István: Komplexometria, Műszaki Könyvkiadó, Bp., 1973. A Journal of Chemical Education különböző számai Országos Szabvány, MSZ 260/47-83 (Szennyvizek vizsgálata, anionaktív detergensek meghatározása) Organikum, Szerves kémiai praktikum. Műszaki Könyvkiadó, Bp., 1967.