ÉCOLE SUPÉRIEURE
DE CHIMIE PHYSIQUE ÉLECTRONIQUE
DE LYON

IPL INTERNATIONAL SUMMER SCHOOL

Practical work at CPE Lyon

11 June to 17 July 2010

The CPE Lyon part of the IPL International Summer School (brochure enclosed) includes a 5-week programme of practical classes in chemistry and/or chemical engineering (40 hours) in addition to taking the French language classes (30 hours) and the industrial and cultural visits.
The practical classes are designed to allow students from the United States and Canada to transfer credits for the study to their home university.
The practical work programme is flexible. Experiments are offered in Chemical Engineering, Analytical Chemistry, and Organic Chemistry. Some experiments will be open-ended allowing students to go deeper into the particular aspect of the subject concerned. A programme oriented towards chemistry students and a programme oriented towards chemical engineering students is provided.
All students will have free access to the Internet.
Accommodation is provided for the five weeks of the Summer School.

The total cost to students is 1700 Euros. This covers all tuition costs, the costs of the industrial and cultural visits, and accommodation for the five weeks in a student residence, and lunches from Monday to Friday. The cost of other meals and local transport is not included.

This is a tremendous opportunity to gain an international experience, to improve your scientific knowledge and practical skills, and to learn the French language. Only a very basic prior knowledge of French is necessary. The practical classes will be given in English when necessary, and, for the language study, students will be divided into groups depending on their ability. A class for beginners will be available.

The laboratory experiments offered are given on the following pages.

Any students interested in this course are invited to contact Marie-Jeanne Feucht (Feucht@cpe.fr) if further information is required.

Applications should be made using the IPL International Summer School form which is found on the website www.ipl.fr/summerschool .
The content of this course for each individual student will be adapted to their particular requirements (requirements of their home institution, their previous experience, or their own wishes). This can be negotiated on an individual basis after the application has been received.
Please respect the deadline (15 February 2010) for applications if possible.
Later applications will be considered but a place cannot be guaranteed.

Practical experiments for chemical engineering students

Course on “Chemical risk”, labeling, MSDS, toxicity and safety behavior in the laboratory

Experiment 1. To determine the general expression for pressure drop in a linear tube.
Objective: To determine the general expression for pressure drop in tubing.

- measure the pressure drop in smooth linear tubes of different diameters using the appropriate manometers for different flow rates
- determine the two non-dimensional numbers, Reynolds number and pressure drop coefficient, characteristic of fluid flow
- put the data obtained on a Moody chart. What conclusions can be made?
- carry out the same study using a rough sided tube. What is the quality of the tubing tested? Can the roughness be estimated?

Experiment 2. Stirring. The determination of the relationship between the power number N_p and the Reynolds number Re.
Objective: The measurements carried out on this pilot stirrer allow the relationship linking the power number N_p to the Reynolds number Re to be determined.
It can be deduced that certain impellers are much more ‘energy consuming’ than others and that, depending on the phenomenon that one wishes to favorize, it is better to choose one type of impeller rather than another. This also allows one to optimize energy consumption.

- establish a protocol that will enable the measurement of the power number N_p to be made as a function of the Reynolds number.
- choose two sizes from the large groups of impellers provided (Rushton turbine or marine propeller). For each impeller, observe the behaviour of the fluid within the stirred tank for different values of speed. Measure the different values of power, speed and torque to determine the two non-dimensional numbers (Reynolds number and power number Np). What conclusions can you make?

Experiment 3. Ebulliometry. Liquid-vapor equilibrium.
Objective: This experiment will allow you to demonstrate a liquid-vapor equilibrium. From your experimental results, together with data to be found in the literature, you will also be able to adjust the parameters of Wilson’s excess model and verify its validity for the binary system considered.

- study the liquid-vapor equilibrium of the binary water-methanol mixture at atmospheric pressure
- adjust the parameters of Wilson’s excess model
- verify its validity for the binary system considered
- calculate the theoretical values of the activity coefficients and compare these values with the experimental values. Is Wilson’s excess model valid?

Experiment 4. Distillation of the binary water-methanol mixture at atmospheric pressure

- how to start the column and to choose parameters ?
- determination of the number of trays in total reflux
- material and thermal balance
- distillation of the binary mixture, respecting the specifications.

Experiment 5. Precipitation and filtration of adipic acid

- prepare an aqueous solution of adipic acid
- precipitation by adding sulphuric acid
- put the mixture in a filtration cell
- perform the filtration at a constant pressure
- determine the resistance of the cake and of the support using the filtration law and experimental values.

Experiment 6. Kinetics
This practical involves 2 days in the laboratory for practical work and calculations:

1st day: t-butyl-chloride hydrolysis: acid quantification as kinetics measurement tool and its use to prove that the reaction is 1st order.
2^{nd} day: Heck arylation of but-3-en-2-ol catalyzed by palladium: Use of quantitative GC analysis of the reaction medium to follow the conversion, to control the global order of the reaction, to prove that the two observed reactions are parallel, initiation to TON concept.

Experiment 7. Chemical analysis of water for quality control.
Experiment A: determination of main parameters in drinking water: alkalinity, hardness, pH, conductivity, other anions and cations by ion chromatography. Synthesis of all results: ionic balance, mineralization.

Experiment B: titration of nitrogen by Kjeldahl method. This is a method much used for quality control in environmental analysis and in water treatment stations.

Experiments focused on water quality control, for example on effluents.

Practical experiments for chemistry students

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Experiment 2. Quantification of polyaromatic hydrocarbons by UV spectroscopy
Spectrum, calibration curve, dilution of the sample. Sensitivity of the method. Results expressed in different units.

Experiment 3. Demonstration of GC/MS.

Experiment 4. Organic synthesis.
Experiment A: Synthesis of two ketones by Heck arylation of but-3-en-2-ol catalyzed by palladium. A study of the kinetics of the reaction, purification and analysis of the products. Use of quantitative GC analysis of the reaction medium to follow the conversion, to determine the overall order of the reaction, to prove that the two reactions are parallel; initiation to the TON concept.
Calculation of the kinetics of the reaction.
Extraction, purification on silica and basic analyses of the products.

Experiment B: Synthesis of butylacetate. Conversion performed by heteroazeotropic distillation, extraction, purification by distillation and basic analyses of the product.

Experiment C. NMR analysis (^{1}H and ^{13}C) of samples prepared in the previous experiments. Spectrum accumulation and analysis; isomer ratio calculation for the two ketones obtained by the Heck reaction.

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