Summer School
Chemical Engineering

Vienna University of Technology
Institute of Chemical Engineering

http://www.tuwien.ac.at
http://www.vt.tuwien.ac.at/summerschool
Program Outline

- **Experimentally oriented program** with a focus on unit operations in thermal/mechanical/chemical process engineering
- **Experiments with existing apparatuses/equipment** selected from the following processes or unit operations:
  - **Thermal process engineering**
    - distillation / rectification
    - absorption
    - extraction
    - column design (pressure drop, mass transfer)
    - membrane technology (gas permeation, reverse osmosis or ultrafiltration)
    - humidification / dehumidification (spray dryer + cyclone)
    - Adsorption (fluidized bed adsorption / -desorption)
  - **Mechanical process engineering**
    - particle size distribution analysis
    - mixing / stirring
    - centrifugation / filtration
  - **Chemical process engineering**
    - reaction engineering I (ideal reactors)
    - reaction engineering II (real reactors)
Scheduling

- **Duration:** 4 weeks / 5 days a week
- **Schedule:** Typically begin in 1st week of July
  - Course (short lectures, laboratory work):
    - Mon, Tue, Thu, Fri 09:00 a.m. - 05:00 p.m.
  - Company visits / excursions:
    - Wed 09:00 a.m. - 05:00 p.m.
- **Language:** English (German possible, if desired)
Participants

- **Potential Participants:**
  - Students of "Chemical Engineering" (3rd/4th year)
  - Pre-requisites include mass transfer/separations (CH E 307 and 330 at Clemson)
Some course details ...

**General aspects:**
- groups of two students
- one or two-day experiments
- introductory lectures by teaching staff for each experiment
- course manual (finalized in accordance with visiting faculty/staff)
- excursion program (company visits: OMV AG, ...)
- Grading: ”reports” and oral presentations
- Additional short lectures (e.g. experimental data analysis/statistics, scientific report writing & oral presentations, ...)
- general presentation of departmental research
Experiments

- Reaction engineering
  - residence time, mixing in stirred tank and tubular reactors
  - analysis of response of pH change
  - ideal / real reactors
  - dimensionless numbers (Re, Sh, Bo)
Experiments

- Particle technology
  - change of particle size distribution after milling
  - analysis by sieving
  - hardness of materials
Experiments

- Gas permeation
  - fluxes of pure components ($O_2$, $N_2$) through polymeric membranes
  - variation of process conditions
  - calculation of permeabilities, selectivity
  - dependence of $P$ on $T$ (Arrhenius)
Experiments

- Extraction
  - hold-up of dispersed phase in columns
  - variation of process conditions (stirrer speed, feed rates of organic and aqueous phase)
  - analysis by dimensionless numbers
Experiments

- Reactive absorption
  - oxidation of NaHSO$_3$ by oxygen from air
  - modelling of mass transfer in packed bed columns
  - variation of process conditions
Experiments

- **Distillation**
  - separation of a binary mixture of ethanol and 2-butanol
  - concentration measurement via refractive index
  - variation of reboiler duty, reflux ratio and feed rates
Experiments

Distillation (cont.)
- McCabe-Thiele analysis
- Overall heat balance from temperature and flow measurements
Experiments

- **Columns**
  - pressure drop as a function of gas and liquid flow for tray and packed (Sulzer, Mellapak, Raschig rings) columns
  - flooding of columns
  - modelling and prediction of pressure drops
Experiments

- Centrifuge
  - solid-liquid separation of suspensions
  - variation of process conditions
  - modelling
Experiments

- Adsorption
  - fluidized bed / fixed bed adsorption / desorption of CO₂ from air onto zeolites
  - breakthrough of CO₂
  - adsorption modelling (isotherms, ...)

![Diagram](image.png)
Living, Etc.

- Dorm accommodations
  - Single room in city
  - Public transit (or walk!) to campus
- TU-Vienna representative will meet upon arrival & guide to dorm (by arrangement)