LABORATORY PLANNING GUIDE

L56 v3 Chemical Reaction Engineering Laboratory

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**Covered subjects according to the curriculum**

Major topics of learning content:

- conversion of substances depending on
  - reactor type
  - residence time in the reactor
  - temperature
- fundamentals of a saponification reaction
- fundamentals of chemical catalysis
- fundamentals of enzymatic catalysis
- continuous stirred tank reactor
- discontinuous stirred tank reactor
- stirred tanks in series
- tubular reactor
- plug-flow reactor
- laminar-flow reactor
- use of a photometric analyser
- using the flow injection analysis (FIA)
- heterogeneous catalysis in the fixed bed
- corrosion behaviour of different metallic materials (rust / passivation)
  - influence of pH value of the electrolyte solution
  - influence of salt concentration in the electrolyte solution
  - oxygen corrosion
  - corrosion protection by external voltage, sacrificial anodes and protective layers
- gas absorption
  - investigation of the absorption process when separating gas mixtures in a packed column
  - investigation of the variables influencing the effectiveness of absorption
- continuous adsorptive air drying
  - fundamental principle of adsorption and desorption
  - investigation of the variables influencing adsorption and desorption
- adsorption
  - determining the mass transfer zone
  - an absorber’s mass balance and efficiency
  - predicting breakthrough curves
  - detection of the influencing factors contact time, temperature and mode of operation
- fundamentals of diffusion: Fick’s law
- determination of the diffusion coefficient for the mass transport in gas and in liquid
- advanced oxidation with hydrogen peroxide and UV light
- fundamental principle of reverse osmosis
  - Van’t Hoff’s law
  - permeate flow rate and retention dependent on pressure, salt concentration in raw water and yield
  - assembly, cleaning and conservation of membrane modules
Main concept
The laboratory is designed for accommodation of 24 students + 2 laboratory staff:
- 2 - 4 students form a team and work together at a workstation / training system
- 11 different workstations
- All workstations are floor standing or on a laboratory table
- 3 of the workstations are equipped with a PC
- Each workstation is equipped with a manual containing technical information, basic theory, experiment instructions, evaluation help and safety advice.
- Student teams are scheduled to change workstations from lab session to lab session in order to perform the entire range of experiments within the course duration.
- Average time per experiment: 90 to 120 minutes.
- 2 workstations for laboratory staff (with PC and internet access)
- 1 printer for common use
- 1 cupboard for small parts, consumables, tools, paper etc.

Initial training provided for laboratory personnel
To be conducted immediately after installation and commissioning of the equipment.
General topics to be covered for any of the educational systems:
- Basic familiarization with the system.
- Functions and components.
- Overall system configuration aspects.
- Start-up and operational aspects.
- Conduction experiments, including evaluation and calculation.
- Using the system with and without the software (where applicable).
- Trouble shooting and maintenance aspects.
- Hands-on, practical familiarization aspects.
- Seminar participants with the delivered system.
- Details of the manuals.
- Safe operation and preventive maintenance.

Requirements / Utilities
Power supply:
- 230 V / 50 Hz / 1 phase – at least 20 power sockets
Water:
- 4 x cold water
- 4 x drain
Others:
- CO₂
Laboratory computer network:
- 2 internet connections for staff
- 2 internet connections for students
Location:
- Laboratory space min 72 m²
- This laboratory could be installed on any floor (e.g. ground floor or 1st floor)
### Schedule of requirements

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1</td>
<td>Supply unit for chemical reactors</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 1.1</td>
<td>Continuous stirred tank reactor</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 1.2</td>
<td>Tubular reactor</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 1.3</td>
<td>Stirred tanks in series</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 1.4</td>
<td>Discontinuous stirred tank reactor</td>
<td>1 pcs.</td>
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<tr>
<td>Item 1.5</td>
<td>Plug-flow reactor</td>
<td>1 pcs.</td>
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<tr>
<td>Item 1.6</td>
<td>Laminar-flow reactor</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 2</td>
<td>Fixed bed catalysis</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 2.1</td>
<td>Flow injection analysis</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 3</td>
<td>Corrosion experimental unit</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 4</td>
<td>Gas absorption</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 5</td>
<td>Adsorptive air drying</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 6</td>
<td>Adsorption</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 7</td>
<td>Diffusion in liquids and gases</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 8</td>
<td>Tubular reactor</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 9</td>
<td>Advanced oxidation</td>
<td>1 pcs.</td>
</tr>
<tr>
<td>Item 10</td>
<td>Reverse osmosis</td>
<td>1 pcs.</td>
</tr>
</tbody>
</table>

### Laboratory drawing

![Laboratory drawing](image_url)