



LABORATORY PLANNING GUIDE

Mechanical Process Engineering Laboratory

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Covered subjects according to the curriculum

Major topics of learning content:

- fundamental principle of wind sifting (gas flow classification)
 - * sorting: coarse and fine material fraction
 - * classifying: fraction balance, separation function, separation size and sharpness of separation
 - * pressure losses of sifter and cyclone
- fundamentals of sedimentation
 - * determination and comparison of the settling velocities of solids in suspensions dependent on the solid density and concentration and the liquid density and viscosity
 - * influence of coagulants on the settling velocity
- solid separation from gases with a cyclone
 - * influence of solid content and volumetric air flow rate
- fundamentals of filtration: Darcy's equation
- depth filtration with different bulk solids and suspensions
- cake filtration with different suspensions
- identification of characteristic filtration values
- fundamental principle and method of operation of a plate and frame filter press
- production of a suspension
- learning the fundamentals of flow through fixed beds and fluidised beds (Darcy)
 - * observation of the fluidisation process
 - * pressure loss dependent on the flow rate, type, particle size and height of the bulk solid
 - * verification of Carman-Kozeny equation
 - * determination of the fluidisation velocity and comparison with theoretically calculated values (Ergun equation)
- basic principle and method of operation of a Nutsche pressure filter
- basic principle and method of operation of a Nutsche vacuum filter
- basic principle and method of operation of a drum cell filter
- outflow of bulk solids from silos with wedge-shaped discharge hoppers
 - * influence of wall material and angle of inclination of hopper wall on flow profile (mass/funnel flow) and outflow time
 - * segregation processes
 - * arching
- flow properties of bulk solids
 - * recording the shear force characteristics of bulk solids
 - * determination of the optimum hopper geometry of a bulk solids silo
- comminution of solids with a ball mill
 - * cascade and cataract motion, critical speed
 - * theoretical and actual power demand
 - * influence of milling time, rotation speed, ball diameter, ball filling, material to be milled
- investigation of mixing processes during stirring
 - * power demand, mixing time, mix quality dependent on stirrer type, speed, materials used (density, viscosity) and insertion of flow impellers
 - * influence of mixing processes on heat transfer
- fundamentals of diffusion: Fick's law
- determination of the diffusion coefficient for the mass transport in gas and liquid

- fundamental principle and method of operation of a pneumatic conveyor system
 - * observation of different transport states dependent on solid content and air velocity
 - * determination of the velocity and of the solid content of the flow
 - * pressure loss dependent on solid content and air velocity
- fundamental principle and the method of operation of a hydrocyclone
 - * solid mass flow rate in feed, top and bottom flow
 - * liquid mass flow rate in feed, top and bottom flow
 - * characteristic values for sharpness of separation
 - * pressure loss at the cyclone dependent on the feed flow rate
 - * influence of solids density on characteristic values and pressure loss

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
- 17 different workstations
- All workstations are floor standing or on a laboratory table
- 1 of the workstations is 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

Trainer: Specialized engineer of G.U.N.T. Gerätebau GmbH, Germany.

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
- 400 V / 50 Hz / 3 phases – at least 3 power sockets

Water:

- 7 x cold water
- 7 x drain

Others:

- Compressed air
- Vacuum

Laboratory computer network:

- 2 internet connections for staff
- 7 internet connections for students

Location:

- Laboratory space min 108 m²
- This laboratory could be installed on any floor (e.g. ground floor or 1st floor)

Schedule of requirements

Item No.	Description	Quantity
Item 1	Gas flow classification	1 pcs.
Item 1.1	Screening machine	1 pcs.
Item 2	Fundamentals of sedimentation	1 pcs.
Item 3	Gas cyclone	1 pcs.
Item 4	Cake and depth filtration	1 pcs.
Item 4.1	Precision balance 10100g / 0,1g	1 pcs.
Item 5	Plate and frame filter press	1 pcs.
Item 6	Flow through particle layers	1 pcs.
Item 7	Nutsche pressure filter	1 pcs.
Item 8	Nutsche vacuum filter	1 pcs.
Item 9	Drum cell filter	1 pcs.
for items 7,8,9	Suspension production unit	1 pcs.
Item 10	Flow of bulk solids from silos	1 pcs.
Item 11	Flow properties of bulk solids	1 pcs.
Item 12	Ball mill	1 pcs.
Item 13	Stirring	1 pcs.
Item 14	Diffusion in liquids and gases	1 pcs.
Item 15	Pneumatic transport	1 pcs.
Item 16	Fluidised bed formation	1 pcs.
Item 17	Hydrocyclone	1 pcs.

Laboratory drawing

