



Parc Científic de Barcelona
Baldiri Reixac, 10
08028 Barcelona - Spain

Course Description

This course will provide concepts, methods and advice on how to scale-up or translate a process or model to larger sizes. Emphasis throughout the course will be on proper designs, modeling and processing. The importance of the process geometry will be emphasized.

The course will cover the different scale-up methods and how to establish viable process objectives. A general scale-up method is presented and a number of examples are worked as illustrations. Scale-up traps and pitfalls are reviewed as well as ways to avoid these. The importance of process objectives will be emphasized. Basic concepts of importance are reviewed using different areas as examples. Power analysis will be presented as a useful tool in scale-up. Examples will show how to use the power analysis in applications and to establish the controlling mechanisms. Detailed suggestions for pilot studies will be given. Scale-up in the mixing and contacting area is reviewed. Equipment, operating conditions, optimum designs and processing conditions will be discussed.

Methods to perform process translation in mixing will be developed and examined as to their practicality. Correlations and data use will be reviewed for process accuracy and use in pilot studies. Pitfalls and the use of analogies in solving processing problems will be discussed.

PILOT PLANT AND SCALE-UP STUDIES

Process Development and Scale-Up Methods:
How to Perform Pilot Plant Studies
and Process Translation

9 - 11 May 2011

Who Should Attend

Engineers and scientists who are involved with process development, process translation, scale-up and pilot plant studies will benefit from this course. This includes those in:

- Pilot plant operations
- Specialty chemical production
- Food processing
- Chemical reactor design
- Waste processing
- Pharmaceutical production
- Process and Project design
- Composite material manufacturing
- Biotechnology and fermentation

Learning Objectives

Upon completion of this course, you will be able to:

- Identify management considerations in scale-up
- Use different approaches for process scale-up
- Perform process scale-up using a systematic general approach for different processes
- Avoid the classical mistakes and traps made in process scale-up
- Perform a power analysis and understand flow regimes basic to scale-up
- Outline important considerations when doing scale-up research
- Carry out successful process translations from the laboratory to the plant
- Explain different concepts of scale-up in mixing and contacting

Course Director

Dr. Gary B. Tatterson is a recognized leader in the areas of process scale-up, mixing and process design for industry. He brings to this program fourteen years of teaching a highly successful scale-up course in the US and Europe as well as thirtytwo years of research and industrial experience in mixing, multiphase processing, plant design and scale-up. As a consultant, he has worked on design problems for numerous companies, including Mead Paper Co., Wilson Great Batch, Akzo Coatings America, B.J. Services, Raytheon, Texaco, E.I. du Pont, Rohm & Haas and Colgate. Dr. Tatterson has written extensively in the area of scale-up, mixing and contacting. With over thirty-eight publications in mixing and contacting, Dr. Tatterson emphasizes a fundamental and practical approach to scale-up issues. He has written three texts:

- 1) Fluid mixing and gas dispersion in agitated tanks
- 2) Scale-up and design of industrial mixing processes
- 3) Process scale-up and design

The latter two texts form the basis for this course. Currently, Dr. Tatterson is developing a text in the general area of unit operations in chemical engineering, which will cover areas such as atomization, filtration, flotation, size reduction, paste and powder processing.

Dr. Tatterson is a Professor of Chemical Engineering at the North Carolina A&T State University, where he teaches thermal sciences, plant design, solids handling, food processing, mixing and process scale-up courses. His courses follow the philosophy of fundamental and practical understanding that is basic to good processing and engineering practice.



FIRST DAY

8:00 - 8:30 **Registration**

9:00 - 17:30

Session 1: Why? Management Considerations

- Time Lines
- Facilities and Personnel
- Safety and the Environment
- Equipment and Process Reliability Development

Session 2: Methods for Scale-Up

- Repeating Designs
- Regular Design Methods
- Rules of Thumb

Session 3: A Systematic Method for Scale-Up

- Needs Matching
- Process and Geometric Similarity
- A Simple Process
- Energy, Power and Their Importance
- Geometry and Its Importance
- Working Volume

The General Scale-Up Method

- Examples for Each of the Following: Burning Problem; Flow Regime Change; Agglomerator Scale-Up; Atomization; Metal Processing; Spray Dryer

Dual Approach: Vendor and Pilot Plant Studies

- The KIS Principle
- Scaledown
- Process Understanding

Session 4: Scale-Up Traps and Overcoming Traps

- Traps of Geometric Similarity
- Examples of Traps for Flotation; Precipitation Reactions; Boiling
- Fermentation and Gas Liquid Reactions
- Missed Opportunities
- Trap Reversals
- Overcoming Traps

Session 5: Process Objectives

- Process Failure; Troublesome Areas; Processing Tricks
- Scale and Process Type

SECOND DAY

9:00 - 17:30

Session 6: Basic Concepts as Applied to Mixing and Engineering

- The Economic Situation; Range of Problems
- A Good Mixing Design; Process Specific Designs
- Laminar and Turbulent Mixing Geometries; NDM Principle; Optimum Points
- Proper Perspective; Problem Identification; Mixing Tests
- Technical Literature

Session 7: Power

- Power Analysis; Theoretical Bases, Applications; Chemical Reactors; Boil Down of a Slurry; Emulsion Production
- Power Number for Impellers; Laminar Power; Turbulent Power

Session 8: Fluid Motion

- Flow Regimes Number of Flow Regimes
- Mixing Geometries; Pumping Numbers; Common Impellers
- Good Power Distribution
- The D/T Ratio; D/T Ratio Effects

Session 9: Mixing

- Mixedness; Scale of Scrutiny; Mixing Time
- Correlations: Turbulent Mixing, Laminar Mixing; Jet Mixing; Continuous and Fed-Batch
- Ineffective Mixing

Session 10: Multiphase Systems, Heat Transfer & Chemical Reactors

- Solid Suspension: Simple Solids; Complex Solids; Complete Homogeneity; Solid Submergence
- Gas Liquid Contacting: Interfacial Area; Impeller Design
- Liquid Liquid Contacting: Drop Breakage; Drop Coalescence; Dispersion Effectiveness; Production of Uniform Drops
- Heat Transfer
- Chemical Reactors: Poor Designs; Selectivity; Side Reactions
- Retrofits

THIRD DAY

9:00 - 15:30

Session 11: Scale-Up in Mixing

- Process Similarity; Scale Matching; Exact Identity
- Geometric Similarity; Scaling Objectives; Mixing Mechanisms
- Scale-Up in Turbulent Regime; Scale-Up in Laminar Regime
- Practicality

Session 12: Scaling Research

- General Scaling Objectives: Process Definition; Impossible Expectations; Optimum Operation; Process Mishaps & Mistakes
- Economic Questions and Cost: Negatives & Positives; Basic Economic Balance
- Types of Scaling Studies
- Testing Suggestions and Concerns

Session 13: Pitfalls and Analogies

- Major Pitfalls; Lesser Pitfalls
- Dimensionless Numbers; Correlations
- Boundary Layer Analogy
- Scale of Scrutiny for Correlations; Useful Misapplications
- Food Analogies; Heat Transfer Analogy
- Failure of Boundary Layer Analogy

Session 14: Course Summary

TUITION AND PAYMENT

Early registration: (received before March 4th, 2011)

Euro 1700+VAT/1530+VAT (group discount*)

Regular registration:

(received after March 4th, 2011) Euro 1900+VAT/1710+VAT (group discount*)

(Fee includes course materials, lunches and coffee breaks)

Participants are responsible for their own hotel reservations.

*Group discount is for two or more enrollments from the same company.

Payable by bank transfer upon issuing an invoice to:

SITEC PHARMABIO, SL

BANK: CAIXA CATALUNYA - 0248 - Barcelona - Emancipacio

IBAN: ES55 2013 0248 4502 0070 7044 - BIC: CESCESBBXXX



Registration

Name

Surname

Position

Organization

VAT/C.F.

Address.

Postal Code

City

Country

Phone/Fax

Participant e-mail

Billing e-mail

General information

Cancellations received after April 15 will be invoiced completely. Substitutions may be made at any time. Payment is due once the participant receives an invoice. Certificates will be issued to participants upon completion of the course.

For Information please contact us at:

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