

## Pilot Plant and Scale-Up Studies

### Process Development and Scale-Up Methods

#### How to Perform Pilot Plant Studies and Process Translation

April 5-7, 2017 | New Brunswick, NJ



#### Course Topics Include:

- Systematic Method for Scale-Up
- Scale-Up Traps and Overcoming Traps
- Multiphase Systems
- Pitfalls and Analogies

#### course description

This three day, intensive 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.

#### 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

**SAVE \$200-Register & Pay by February 22**

# 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 outline

### First Day

8:00 a.m.: Registration/Continental Breakfast

8:30–12:00 noon:

#### Session 1: Why? Management Considerations/ Review of Learning Objectives

- 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

1:00–5:00 p.m.:

#### 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

8:00–12:00 noon:

#### 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; Revolutions to Mix Principle; Optimum Points
- Proper Perspective; Problem Identification; Mixing Tests
- Technical Literature

#### Session 7: Power

- Power Analysis; Theoretical Bases, Applications; Chemical Reactors; 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

1:00–5:00 p.m.:

#### 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

8:00–12:00 noon:

#### 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

1:00–3:30 p.m.:

#### 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

#### Assessment Opportunity

## 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 twenty-four years of teaching a highly successful scale-up course in the US and Europe as well as forty years of research and industrial experience in fluid mechanics, 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.

continued

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

Currently, Dr. Tatterson is developing a text in the general area of unit operations in chemical engineering, which will cover areas such as wheel, two fluid and nozzle atomization, spray drying, agglomeration, size reduction and filtration.

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.

## recommended reading

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The Course Director recommends the texts, Scale-up and Design of Industrial Mixing Processes and Process Scale-Up and Design—by Gary Tatterson, as optional reading.

## course location

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This course will be held in the New Brunswick, New Jersey area. Specific hotel information will be sent to you in your final confirmation package which will be emailed to you approximately three (3) weeks prior to the course start date. Please note that participants must make their own hotel reservations; the cost of the hotel accommodations is not included in the course fee. We recommend that travel/hotel arrangements not be made until final confirmation package is received.

- Easy access to Manhattan, Trenton, NJ and Philadelphia, all less than 40 minutes

## accreditations/recertifications for this course

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The Center for Professional Advancement (CfPA) has been approved as an Accredited Provider by the International Association for Continuing Education and Training (IACET), 12100 Sunset Hills Rd., Suite 130, Reston, VA 20190. In obtaining this approval, CfPA has demonstrated that it complies with the ANSI/IACET Standards which are widely recognized as standards of good practice internationally. CfPA is therefore authorized to offer IACET CEUs for its programs that qualify under the ANSI/IACET Standards. CEUs will be awarded for participation in CfPA's courses at the rate of .1 CEU per contact hour upon successful completion of the entire course and 70% accuracy in the required Learners' Assessment. This course offers a total of 18 contact hours, or 1.8 CEUs.

### The American Society for Quality (ASQ) Recertification Opportunities

The following information was provided courtesy of ASQ, and is not meant as an endorsement of CfPA products. It serves only as an informational guide about the certifications offered by ASQ. Many CfPA courses offer training that may be helpful in obtaining required ASQ's recertification education units. To view a list of recommended courses that may be appropriate please visit [www.cfpa.com](http://www.cfpa.com) For more information about ASQ, contact them at: [help@asq.org](mailto:help@asq.org)

## who we are—"Celebrating 50 Years"

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The Center for Professional Advancement (CfPA) is the largest accredited technical training organization in the world with a curriculum of approximately 450 short courses in 15 industries including Pharmaceutical, Biotechnology, Medical Device, Chemical, Cosmetics, Food and more. Since our founding in 1967, we have successfully trained nearly a half million people worldwide in topics ranging from basic and introductory concepts to new advances and cutting-edge technology, and current U.S. and European regulations. CfPA courses are offered in a variety of formats to fit you or your company's training needs:

**In Person:** Away from responsibilities, participants are immersed without distraction

**Client Site:** Training at your site and at your convenience. For further information, please contact Client Site Programs: +1/732.238.1600, ext. 4547 or E-mail [clientsite@cfpa.com](mailto:clientsite@cfpa.com)

**Online:** A convenient and cost-effective way to experience our accredited training. For a list of upcoming courses visit [www.cfpa.com/onlinetraining](http://www.cfpa.com/onlinetraining)

**Virtual Attendee:** Ideal for those who need the training but cannot attend in person. For more information visit: [www.cfpa.com/virtualattendee](http://www.cfpa.com/virtualattendee)

## we also offer

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**Client Site:** Training at your site and at your convenience. This course and any of our other courses are available to be customized and brought to your location. For more information visit [www.cfpa.com/ClientSite](http://www.cfpa.com/ClientSite)

**Online Training:** A convenient and cost-effective way to experience our accredited training. Easily access the knowledge you need through the Internet. For a list of upcoming courses visit [www.cfpa.com/onlinetraining](http://www.cfpa.com/onlinetraining).

## tuition

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**Early Bird—Save \$200—(Must register and pay by February 22, 2017) \$2510**

**Regular Tuition \$2710**

**Group Discount:** Register 2 or more from the same company, at the same time, for this course and receive a 10% discount off each registration. Tuition payable in US funds net of all charges includes continental breakfast, luncheon, breaks and course notes.

**Note: Payment is due 2 weeks prior to course or at time of registration.**



## how to register

- Online: [www.cfpa.com](http://www.cfpa.com) enter Course ID# into Search. Click Register Now button. Group Rates Available: Save 10% on 2 or more attendees.
- Call Customer Service at 732-613-4500 or email: [info@cfpa.com](mailto:info@cfpa.com)
- Fill out the registration form and email it to: [info@cfpa.com](mailto:info@cfpa.com)

## registration form

### Pilot Plant and Scale-up Studies

course id# 1882 /course offering# 170405NJ1882

### instructions:

Please complete Registrant Information, Course Information and Payment Sections. Submit one form per individual registrant.

Check here if group discount applies (two or more enrollments for the same course, from the same company)

**All fields MUST be completed in order for registration to be accepted.**

### registrant information

Registration Type:  In Person Attendee  Virtual Attendee (Live or Recorded)

Prefix:  Ms  Miss  Mrs  Mr  Dr  Prof

First Name \_\_\_\_\_ Last Name \_\_\_\_\_ Designation (i.e.PhD, Jr) \_\_\_\_\_

Email Address \_\_\_\_\_ Alternate Email (copy sent here as well) \_\_\_\_\_

Title \_\_\_\_\_

Your position in the organization is (please check one)

Corporate  Line Operational  Managerial/Supervisory  Staff  Consultant

Your primary job function is (please check one)

Clinical Practice  Project Management  Design Engineering  Quality Control Assurance  
 Environmental Safety  Research & Development  Legal or Regulatory Affairs  Technical Information Services  
 Manufacturing & Operations  Training and/or Education  Marketing or Sales  Other \_\_\_\_\_

\*Primary industry that best describes your area of interest (select maximum of 2)

Analytical Chemistry  Mechanical/ Design Engineering  
 Biopharmaceuticals/ Biotechnology  Medical Devices/ Diagnostics  
 Chemical/ Process Engineering  Packaging Technology  
 Clinical/ Non-Clinical  Petroleum Technology  
 Cosmetics/ Personal Care/ Household Products  Pharmaceutical Technology  
 Environmental and Safety Technology  Technical/ Project Management  
 Food Technology

## contact information

Company Name \_\_\_\_\_

Address \_\_\_\_\_

Zip/Postal Code \_\_\_\_\_ City \_\_\_\_\_ Country \_\_\_\_\_

Phone \_\_\_\_\_ Fax \_\_\_\_\_

## course information

Course Title \_\_\_\_\_

CourseID#/Offering# \_\_\_\_\_

## Tuition

Tuition \_\_\_\_\_

\*How did you hear about us?  Email  Postcard  Colleague  Google Search  Social Media

Trade Show  Advertisement  Course Director  Course Brochure  Other \_\_\_\_\_

## discount code

Discount Code \_\_\_\_\_

## payment information

Credit Card

Visa  Mastercard  American Express  Discover

Card #: \_\_\_\_\_ Exp. Date: \_\_\_\_\_ Security Code: \_\_\_\_\_

Cardholder Name: \_\_\_\_\_ Signature: \_\_\_\_\_

Billing Address (if different from above)

Address \_\_\_\_\_

Zip/Postal Code \_\_\_\_\_ City \_\_\_\_\_ Country \_\_\_\_\_

Wire Transfer  Purchase order (PO# if applicable \_\_\_\_\_)

Send Invoice  Check: Payable in US funds to: **The Center for Professional Advancement**

## terms and conditions

Payment: Tuition payable in US funds net of all charges. Payment is due at time of registration or upon receipt of invoice. If payment has not been received two weeks before the course, a credit card will be required to guarantee registration.

Discounts/Rates: To receive the Early Bird tuition rate, payment is required at time of registration and/or BEFORE early registration tuition expires or the regular tuition rate will apply. The Virtual Attendee Option does not qualify for Early Bird pricing. If choosing invoice/wire transfer, payment must be received prior to expiration of early registration tuition or the regular tuition rate will apply. All tuition prices are a per person rate. To qualify for the Group Rate discount, registration must be for two or more enrollments registering at the same time, from the same company, for the same course. Please note: Group Rate Discount cannot be combined with any other discount. Multiple discounts not applicable.

Cancellations/Substitutions/FEES: ALL cancellations must be in writing and emailed to: info@cfpa.com. All cancellations are subject to a \$300.00 cancellation fee. Applicants may cancel up to four (4) weeks prior to the course start date for a refund less cancellation fee. Applicants that cancel less than four (4) weeks prior to the course will be issued a credit less cancellation fee that can be used towards a future course up to one year from the date of issuance. If you do not cancel and do not attend you are still responsible for the full payment. If for any reason, CfPA decides to cancel this course, we are not responsible for airfare, hotel or other costs incurred by the registrant. Program content, schedule and instructors are subject to change without notice. Substitutions are permitted at any time, must be in writing and emailed to Customer Service at info@cfpa.com.

Confirmation Letters: Before each course begins, all registrants will receive written Final confirmation including detailed information regarding course location – VIA EMAIL. We recommend that travel/hotel arrangements not be made until final confirmation package is received. If confirmation is not received two weeks prior to the course please contact Customer Service at info@cfpa.com.

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Please note: English will be used in all lectures and course notes. For questions/more information contact Customer Service at 732-613-4500 or info@cfpa.com.

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