2011 AIChE Northeast Regional Conference at the CHEM SHOW

AIChE's Engineering Technologies Tutorials – *as of August 4, 2011*

We are pleased to present a series of tutorial sessions that cover four tracks; Plant and Equipment Basics, Essentials in Process & Product Development, Engineering Fundamentals – Unit Operations, and The Art of Solids Handling. These are all three-hour sessions, offered from Tuesday morning through Thursday morning, so you may choose up to five sessions (one per time period). A break between morning and afternoon sessions will allow everyone to visit the Exhibit hall and see equipment, products and services that will help you implement what you've learned.

tuesdayNOVEMBER 1

8:30am – 11:30am sessions

APPLICATIONS OF THIN-FILM TECHNOLOGY FOR PROCESS INDUSTRIES

Thin film evaporators have been around for over a century, solving the most difficult separation problems. Initially, invented in Germany, when engineers discovered that preserving the quality of a thermally unstable material, required exposing the product to temperature for a very short time. This lead to the invention of the first mechanically agitated thin film evaporator. As the technology evolved, engineers across all process industries discovered the unique advantages of these technologies, where today, they are perhaps the most widely used high-tech. equipment installed at most plants around the world. The paper will present the wide range of the applications of thin-film processing in solving difficult separation problems. Specifically, examples will include concentration, distillation, drying, etc. **Instructor:** Perry Alasti, CTO, Artisan Industries.

MICROFILTRATION MEMBRANES FOR PHARMACEUTICAL AND FOOD APPLICATIONS

The Micro- and Ultra-filtration courses are meant to be taken together, but either may be taken alone. This course focuses on the application of Microfiltration membranes, including their device formats, performance attributes, and operational parameters, related to the Pharmaceutical, Food, and Beverage Markets. The membranes discussed will cover polymeric, metallic, and ceramic materials along with the performance attributes such as philicity/phobicity, pore morphology, pore size, pore size distribution, retention capabilities, protein binding, flow, manufacturing technology, plus many more. The mode of application, dead end (DEF) or tangential flow filtration (TFF) will be explained along with their strengths and limitations. The mode of application sections will lead to the appropriate device formats from laboratory discs to high surface area pleated cartridge for DEF. TFF device formats will include flat sheet cassettes, lenticular and spiral to hollow fiber and tubular elements. A section of the tutorial will include the preferred operating parameters for the various device formats, depending on the membrane selected. **Instructor:** Scott Yaeger; President, Filtration and Separation Technology, LLC.

SOLID-LIQUID SEPARATIONS I – PHYSICAL PRINCIPLES AND KEY PARAMETERS

This course is intended to be taken as part of a two-part double session. Part I may be taken alone. This course will equip participants to analyze physical systems accurately then specify suitable and practical means of accomplishing the required separation. It is geared towards common applications in the process industries, including product, waste and recycle streams. Although technology constitutes the primary focus, economic factors are also considered. Mechanisms underlying the two dominant forms of solid-liquid separation, filtration and sedimentation, are examined, and the derivation of design equations from conceptual models is explained. Experimental measurements needed to apply those models and determine key process parameters are described, including basic methods for acquiring essential data which are accessible to most technical staff. The impact of material and transport properties is discussed, along with the uniquely influential role of filter media. The performance of supplementary operations, such as solids washing or deliquoring, is analyzed to evaluate their potential contribution to process objectives. Guidelines for the correct matching of separation technology to the suspension and process are provided. **Instructor:** Dr. Ray Collins, Dow Chemical

1:00pm – 4:00pm sessions

AN INTRODUCTION TO VALVES, ACTUATORS AND CONTROLS

Newcomers to the process industries, as well as experienced engineers and other industry professionals who need a refresher course in valves and actuators will benefit from this 3-hour session: Our presenters describe and discuss the major valve types: gate, globe, check, ball, butterfly, plug and pressure-relief. Also covered are valve standards, basic piping information and application issues that are critical to effective valve specification and usage. In the actuators portion of the program, the speakers describe various actions, including linear and rotary, that are employed to operate the valve types covered earlier. Also included is explanation of the various actuator types—such as electric, pneumatic, hydraulic, etc.—which provide these actions. Finally, control valves and systems are briefly explained, along with typical control valve components. The discussion will touch on linear valves, actuators and positioners, as well as sizing, diagnostics and digital bus communications as they relate to control valves and systems. **Instructors**: Greg Johnson, President, United Valve, Leon Brooks, Director International Sales, Asia Pacific/Latin America—Distributed Valves, Cameron Valves & Measurement, Ed Holtgraver, CEO, QTRCO, Inc., Paul Souza, Quality Assurance Manager, AUMA Actuators, Inc., (VMA)

ULTRAFILTRATION MEMBRANES FOR PHARMACEUTICAL AND FOOD APPLICATIONS

The Micro- and Ultra-filtration courses are meant to be taken together, but either may be taken alone. This course focuses on the application of Ultrafiltration membranes, including their device formats, performance attributes, and operational parameters, related to the Pharmaceutical, Food, and Beverage Markets. The membranes discussed will cover polymeric, and ceramic materials along with the performance attributes such as philicity/phobicity, pore morphology, molecular weight cut-off, molecular permeability distribution, retention capabilities, protein binding, flux rate,

manufacturing technology, plus many more. The mode of application, tangential flow filtration (TFF), will be explained along with its strengths and limitations. The mode of application sections will lead to the appropriate device formats from laboratory scale to large scale flat sheet cassette, lenticular, spiral, hollow fiber and tubular TFF device formats. A section of the tutorial will include the preferred operating parameters for the various device formats, depending on the membrane and format selected. In addition to the operational parameters, the tutorial will include some trouble shooting suggestions to help maximize TFF for a variety of applications and fluid conditions. ***Please note: Some of the material covered in the afternoon will serve as a brief 'reiteration' of the morning material as foundation for the Ultrafiltration specifics to follow.*** **Instructor:** Scott Yaeger; President, Filtration and Separation Technology, LLC.

SOLID-LIQUID SEPARATIONS I I – SYSTEM DESIGN AND PROCESS TROUBLESHOOTING

It is strongly recommended that the student either take Part I as well, or have a working understanding of the material covered in Part I, The scale-up procedure translates a solid-liquid separation from a validated mechanism with characteristic parameters to process equipment that will satisfy an owner's technical and commercial objectives. Scale-up further incorporates experience and adjusted performance due to larger size or practical execution. Essential steps to scale up typical designs are outlined. The implications of scale-up often guide additional testing and recommend complementary process improvements or alternative approaches, such as multiple or fundamentally different separations. Classes of equipment are derived from their fundamental means and efficiency of phase separation, operating characteristics, such as the scale or continuity of feed suspension, and capital expense. Newer, advanced technologies are compared to conventional methods. By understanding the dependence of the separation mechanism on system properties and the suppositions made in scale-up, troubleshooting less than satisfactory performance becomes more productive. Representative case studies, where testing, analysis and scale-up led to implementation, are investigated, and the outcomes compared to estimates. **Instructor:** Dr. Ray Collins, Dow Chemical

wednesdayNOVEMBER 2

8:30am – 11:30am sessions

SELECTING VACUUM PUMPS FOR INDUSTRIAL APPLICATIONS

There is increasing industry demand for efficient, cost-effective and environmentally friendly process solutions without compromising, functionality, reliability and safety. Choosing the right vacuum pump has wide ranging implications on the cost of ownership and the impact on the environment. It can be a difficult and time consuming decision when lacking the necessary knowledge. Correct sizing and selection of vacuum systems will contribute significantly to optimizing throughput and efficiency, thus reducing energy consumption, capital and running costs, pollution and down-time. This seminar advances your knowledge of vacuum equipment to help you make the best decision and get the most out of your investment. **Instructors:** Jeff Luby, Dr. Don Collins and Mark Nichols, Edwards Vacuum

UNDERSTANDING PHYSICAL PROPERTIES FOR PROCESS AND PRODUCT DEVELOPMENT

Physical properties are essential to the analysis and design of chemical processes and chemical products. However, you often can not find properties for the specific chemicals, temperatures, pressures and compositions you are working with. Physical property estimation techniques may be able to provide values for these missing properties. This course will provide you with an understanding of how to use estimation techniques and, more importantly, how to avoid problems when estimating physical properties. It will cover:

- Importance of molecular structure: atoms, bonding, isomers, stereochemistry, rings
- Physical properties: temperature, pressure, composition dependence
- Physical property diagrams: pressure-volume-temperature, vapor-liquid equilibria, solid-liquid equilibria, liquid-liquid equilibria
- Property estimation methods: parameter models, equation oriented techniques, group contributions, connectivity indices
- Estimating constant properties: boiling point, critical properties, enthalpies of transition
- Estimating temperature dependent properties: heat capacity, vapor pressure, viscosity
- Equations of state: pure components and mixtures
- Activity coefficient models: van Laar, Wilson, NRTL and UNIFAC
- Phase equilibrium calculations: vapor-liquid, liquid-liquid, solid-liquid
- Estimating safety properties: heat of formation, flash point, flammability limits
- Estimating environmental properties: aquatic toxicity, Henry's law constants, biodegradation constants
- Estimating additional properties: polymers, electrolytes, multiphase systems, foods and cosmetics
- Physical properties and process simulators: available methods, data entry
- Using physical properties to guide product design

Instructor: Dr. Kevin Joback, Molecular Knowledge Systems, Inc.

SINGLE PHASE LOW AND HIGH VISCOSITY MIXING

This session will cover the basics of mixing with applications to single-phase applications. Examples of mixing correlations will be demonstrated on real process applications, and will include rule-of-thumb ranges for most of the parameters. Both low viscosity and viscous mixing applications will be discussed. Shear rates, mixing times, process optimization, pumping capacity, power determination, flow and power numbers and heat transfer are among the topics that will be covered. This course is for engineers and operators that want to become familiar with the science of mixing. A CD of the slides and examples will be provided at the beginning of this course. **Instructor:** Dr. Thomas Post, Post Mixing

FUNDAMENTALS OF POWDER FLOW TECHNOLOGY

Handling or processing powders and bulk solids is fraught with problems, whether you are dealing with chemicals, plastics, pharmaceuticals, foods, metals, or a myriad of other materials. This tutorial will provide solid insights into common flow problems that arise when powders and bulk solids are put into silos, bins, and hoppers. Ways to characterize a material's flow properties will be presented along with proven, practical, and cost effective design solutions. Retrofits to existing equipment as well as design of

new facilities will be discussed. This topic is critical to all industries in which bulk solids are being handled, processed, or refined because greater emphasis is being placed on process optimization, safety, and cost reductions, all of which are often dependent upon reliable bulk solids handling. Topics covered include:

- Typical bulk solids flow problems in silos, bins, and hoppers
- Results of flow problems
- Flow patterns and different hopper designs
- Ways to characterize flow properties (common tests and resulting data)

Instructor: Eric P. Maynard, Jenike & Johanson, Inc.

1:00pm – 4:00pm sessions

PUMPS - LOWERING TOTAL COST OF OWNERSHIP AND OPTIMIZING EFFICIENCY

Using a case study of chemical processing company, you will explore the cycles of culture change and learn what it takes to make it happen in order to optimize your plant's performance and reach reliability excellence. You learn to analyze real data from your company and work though real-life business case scenarios to learn how to apply best practices in nine functional areas within your organization – training; purchasing; inventory; engineering; operations; maintenance; reliability; maintenance planning & scheduling; and execution. **Instructor:** Tom Dabbs and Pat Prayne, Gould Pumps

INTEGRATIVE APPROACH TO CRYSTALLIZATION PROCESS DEVELOPMENT

Developing a crystallization process is a challenging problem for various reasons. The mixture to be separated often involves multiple components, and the solids can be present in various polymorphic forms or as compounds, adducts, and solvates. Thermodynamic models and calculation techniques for solid-liquid equilibrium (SLE) are not as well developed as their vapor-liquid counterparts. Systematic design tools, similar to the well-known residue curve maps for distillation system design, were absent. As a result, many scientists and engineers still deal with the development of crystallization processes on a trial and error, case-by-case basis.

This course presents an integrative approach for crystallization process development - using models to analyze the SLE behavior of the system, validating the model using relevant experimental data, and systematically synthesizing a crystallization process based on the SLE behavior. Starting with fundamental issues such as solubility and physical properties, we will discuss the relevant theories, methods, experimental techniques, and software tools that have been used in many industrial applications for developing an optimum crystallization process. Such an approach is in line with FDA's PAT initiative, which underscores the importance of understanding of the process in achieving an optimized operation that ensures quality outcomes. Topics to be covered include;

How to analyze solubility and SLE phase behavior for the purpose of conceptual design of crystallization processes

- How to use the knowledge of SLE phase behavior in synthesizing crystallization processes and defining the optimum processing conditions
- How to apply fundamental understanding and integrate synthesis, analysis, and experimental effort in developing crystallization processes
- How to solve practical industrial problems in the chemical, fine chemical, and pharmaceutical industries using the integrative approach

Instructor: Christianto Wibowo, ClearWaterBay Technology

MULTI-PHASE (SOLID-LIQUID, LIQUID-LIQUID, AND GAS-LIQUID) MIXING

A prerequisite of this course is that you have a good grasp of mixing basics or have attended single-phase mixing course. Multiphase mixing is more complex than the mixing of single phases and examples of these three phase pairs will be discussed. Heavy solids suspension as well as floating solids and hard to wet out solids applications will be handled. Organic and aqueous dispersions and emulsions will be covered as well as their separation in the Liquid-Liquid section. Dispersing gas bubbles using various methods and impeller arrangements will be highlighted in the Gas-Liquid section. There will also be a discussion about reaction and mass transfer limitations and how to optimize these. If you are interested in a specific example, you are encouraged to contact the presenter well in advance of the course so that it can be incorporated into the materials. A CD of the slides and examples will be provided at the beginning of this course. **Instructor:** Dr. Thomas Post, Post Mixing

TROUBLESHOOTING COMMON PNEUMATIC CONVEYING PROBLEMS

Problems such as pipeline wear, particle attrition, reduced system capacity, and plugging frequently plague poorly designed and operated pneumatic conveying systems. These problems negatively effect system efficiency and create costly bottlenecks and safety hazards in many industries. By applying proven design principles for pneumatic conveying systems, many of these problems can be alleviated so that a system runs efficiently and operates safely. Topics covered include:

- Types of problems experienced in pneumatic conveying systems
- Cause of problems
- Reducing or eliminating pipeline wear
- Reducing or eliminating particle attrition (degradation)
- Increasing system conveying capacity
- Eliminating pipeline plugging or buildup

Instructor: Eric P. Maynard, Jenike & Johanson, Inc.

thursdayNOVEMBER 3

8:30am – 11:30am sessions

MANAGING ENERGY USAGES IN A CHEMICAL PLANT SITE

Have you ever wondered why your utility bill is higher than other plant sites with similar conditions? What shall be the appropriate transfer price for various levels of utilities?

Moreover, how to identify the bottleneck of energy consumptions and to reduce the total utility cost of your site? In this three-hour short course, we shall discuss the application of the “Total Site Utility Model”. Using the model, we would understand the “true steam cost” and its interaction with the electricity contract and demands from the site. Furthermore, we also discuss the basic principles and applications of Pinch Technology for reducing the energy consumption of the process. Topics covered include:

- How to determine the utility consumption of plants and processes.
- The basic theory and applications of Pinch Analysis.
- Why certain process modifications will reduce the energy consumption.
- How to determine the true cost of steam and electricity.
- What you should know about your plant when making fuel purchase contracts.
- Tools to better evaluate projects for energy related capital expenditures.
- How to identify mistakes that your operations are making that cost you money.
- How to develop comprehensive energy reduction programming for your company.

Instructor: Christianto Wibowo, ClearWaterBay Technology

CHEMICAL PRODUCT DESIGN AND ENGINEERING

In years past, most new chemically based products were formulated primarily through experimentation, a costly and time-consuming process. As today's global marketplace demands an ever-greater rate of product innovation, there is good reason to re-examine your approach to new product development. This workshop, aimed at product development chemical engineers and chemists in the chemical and allied industries, will discuss what Chemical Product Design and Engineering are all about, explain why they are superior to experimental based techniques (including high throughput screening and statistical experimental design), and provide a framework that can be exploited to find better new products in less time. **Instructors:** Michael Hill, Columbia University; Kevin Joback, Molecular Knowledge Systems, Inc.

BLENDING AND SEGREGATION

Obtaining a uniform blend of dry bulk solids is a problem faced daily by engineers and operators in industries as varied as chemicals, pharmaceuticals, foods, plastics, and battery production. Even if a "good" blend is achieved, the next problem is how to maintain that blend through downstream equipment. Poor blending, or the inability of maintain a blend (i.e. segregation) at the point where it is needed, is always costly in terms of rejected material, extra blending time, and defective end products. This topic is important to industry because once the mechanisms of blending and segregation are understood, they can be used to analyze particle segregation problems and to determine ways to eliminate such problems. Topics covered include:

- Advantages and disadvantages of various types of bin flow patterns
- Analysis of blend uniformity
- Sample collection, splitting, and analysis
- Solids flow problems, such as no flow and segregation
- Flow patterns within a bin or blender
- Effects of bin and blender design on flow patterns
- Common mechanisms of particle segregation
- Methods to quantify segregation tendencies
- How flow patterns affect segregation
- How to modify/design solids handling equipment to minimize segregationBlending mechanisms and types of blenders
- Attendees' questions

Instructor: Eric P. Maynard, Jenike & Johanson, Inc.