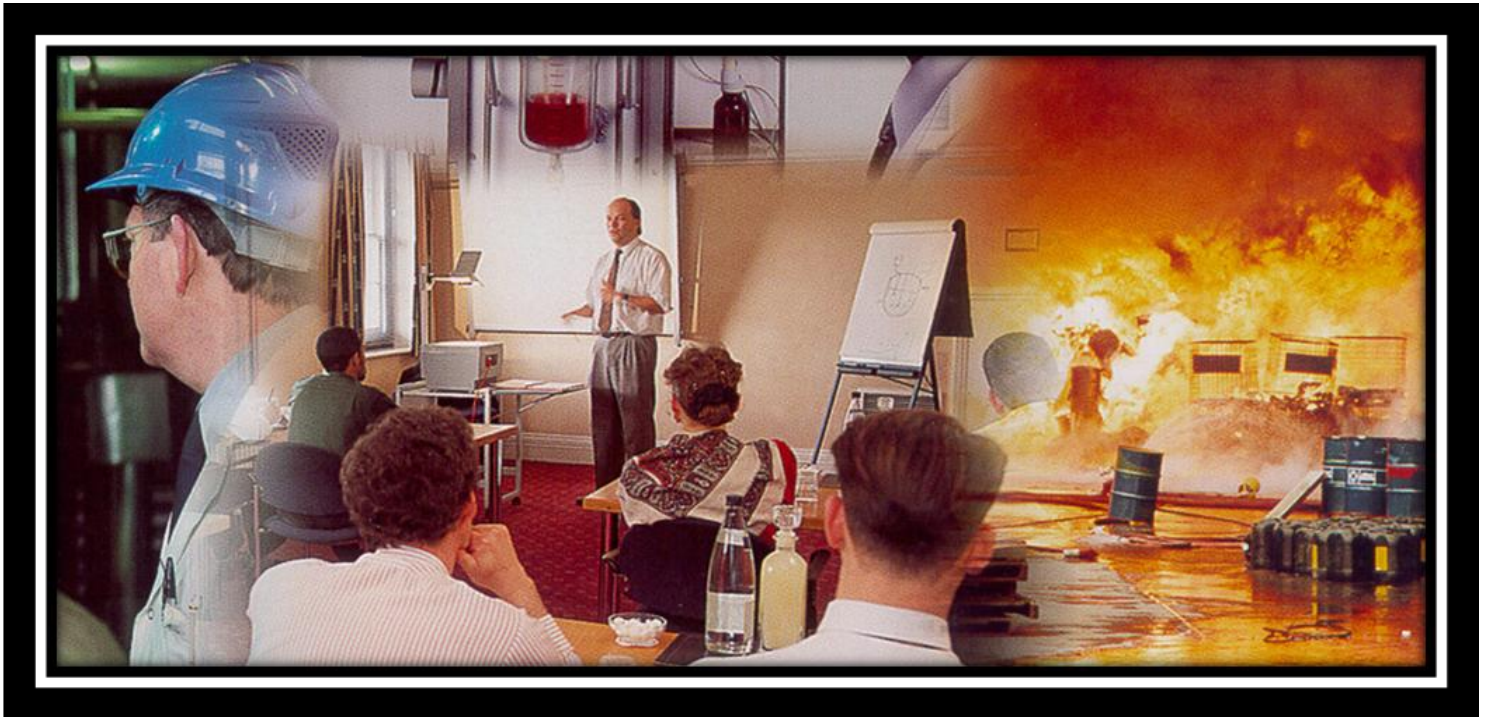


2010

## FIRE, EXPLOSION AND THERMAL HAZARDS TRAINING



**ABIH Accredited Training – CM Approval Codes: 09-4147, 09-4148, 09-4149, 09-4150, 09-4151**

**TRAINING COURSES** – An essential part of safe manufacturing is the evaluation of processes and plant to identify sources of hazard and to prescribe practical safety measures. To do this effectively requires technical knowledge of process safety and the practical experience of implementing safety measures in plant. The international safety consulting group, Chilworth Global, has put together a series of training courses which have been designed to show how both operational and chemical hazards in manufacturing processes can be systematically identified and assessed, and how the most appropriate basis of safety is selected and implemented.

*Each Course is a One-Day Class from 9:00am – 5:00pm*

- ❖ **Understanding & Controlling Electrostatic Hazards**
- ❖ **Dust Explosion Prevention & Protection Techniques** (including OSHA Combustible Dust NEP)
- ❖ **Gas/Vapor Explosion Hazards**
- ❖ **Evaluation & Selection of Electrical & Non-Electrical Equipment for Use in Hazardous Areas**
- ❖ **Chemical Reaction Hazards**

## Monday

### Understanding & Controlling Electrostatic Hazards

#### COURSE DESIGN AND OBJECTIVES

This course will demonstrate how and where electrostatic charge is generated, how to analyze static problems and how to apply solutions. Practical static control techniques will be illustrated by examining case histories of explosion incidents investigated by Chilworth Technology consultants.

Upon its completion, attendees will be able to assess how electrostatic charge is generated in industrial environments. They will be able to recognize those electrostatic hazards that can trigger industrial fires and explosions, and will be able to choose methods to evaluate and control electrostatic charge in order to reduce or eliminate such risks.

#### COURSE CONTENTS – Slide Presentation

##### Introduction to Electrostatics

- Background Information and Definitions

##### Types of Electrostatic Discharges

- Four Types of "Discharges"
- Evaluation of Each in Terms of their Incendivity in Gas, Vapor, Aerosol and Dust Cloud Flammable Atmospheres
- Hands-on Demonstration of Various types of Discharges in Laboratory

##### Factors Affecting Electrostatics

- > Relative Humidity
- > Temperature
- > Resistivity of Powders and Liquids
- > Transport Mechanism (pneumatic, screw, spray, manual pouring etc)
- > Immiscible Flows

##### Tests to Evaluate Electrostatic Characteristics of Powders and Liquids

- > Volume Resistivity and Charge Relaxation Time – Powder
- > Chargeability – Powder
- > Conductivity – Liquid
- > Chargeability – Liquid
- > Hands-on Demonstration of Various types of Electrostatic Tests in Laboratory

##### Electrostatic Hazards Evaluation

A systematic Approach to the Diagnosis of Electrostatic Problems and Hazards Associated with

- ◆ People, Equipment and Facilities
- ◆ Powder Handling
- ◆ Liquid-Vapor Handling
- ◆ Use of Plastics
- ◆ Use of Flexible Intermediate Bulk Containers (FIBCs) (Super sacks)

##### Video Presentation

##### Case Studies

##### Q&A/Group Discussion

##### Quiz

##### Course Evaluation Feedback Form

### WHO SHOULD ATTEND

Courses are suitable for staff from the chemical & processing industries, including bulk & finished pharmaceuticals, bulk & fine chemicals, detergents & soaps, petrochemicals, food & drink, plastic & rubbers, metals, textiles, paper & lumber, agrochemicals, and dyes & paints.

## Tuesday

### Dust Explosion Prevention & Protection Techniques

#### COURSE DESIGN AND OBJECTIVES

This course will demonstrate the techniques available for both preventing dust explosions and protecting people and facilities from their effects. It constructs a systematic approach to dust explosion hazard assessment directed towards obtaining a Basis of Safety for a process.

Upon its completion, attendees will be able to identify the serious consequences of dust explosions, analyze various conditions under which they can occur, compare the techniques to prevent dust explosions, and apply suitable measures for protection of people and facilities from the effects of an explosion. They will also recognize the role of Codes and Standards in evaluating risks and to choose methods to estimate dust hazard properties.

#### COURSE CONTENTS – Slide Presentation

##### Introduction

- Basic Theory and Definitions
- History of Dust Explosions
- Conditions for a Dust Explosion

##### Dust Hazard Codes & Standards

- OSHA's & EPA's "General Duty" clauses
- OSHA Instructions on Combustible Dust – National Emphasis Program
- U.S. and Int'l Fire, Mechanical & Building Codes
- NFPA and other Recommended Practices
- How these Codes and Standard Apply to my Facility and Workplace? – An Example Case Study

##### Combustibility Assessment using Standardized Laboratory Testing

- Ignition Sensitivity
  - Explosion Severity
  - Thermal Instability
- Hands-on Demonstration of Various types of Dust Tests in Laboratory

##### Conditions Affecting Combustibility

- Oxidant
- Temperature
- Physical Characteristics
- Moisture

##### Dust Explosion Hazard Control (Basis of Safety)

- Avoiding Flammable Concentrations
- Avoiding Ignition Sources
- Avoiding Oxidant
- A Problem-Solving Workshop to Evaluate Explosion Hazard of A Dust Handling Equipment

##### Explosion Protection Techniques

- Pressure Relief Venting
- Suppression
- Containment
- Isolation

##### Video Presentation

##### Case Studies

##### Q&A/Group Discussion

##### Quiz

##### Course Evaluation Feedback Form

## Wednesday

### Gas/Vapor Explosion Hazards

#### COURSE DESIGN AND OBJECTIVES

This course has been designed to assist engineers and process safety personnel who are involved with chemical processes and operations to identify the hazards associated with flammable gases, vapors, or mists. Various flammability properties, testing methods, practical explosion prevention techniques along with case studies are presented in the course. The course will include a couple of short exercises to increase the interaction between the instructor and the participants. At the end of the course a short-test will be taken by the participants to assess the outcome of the course learning.

Upon completion of the course, participants will be able to assess the flammability hazards associated with gas, vapor and mist atmosphere and they will also be able to apply a Basis of Safety for their operations. Course outline is as follows:

#### COURSE CONTENTS – Slide Presentation

##### Introduction to Flammable Atmospheres

Basic Theory and Definitions

##### Flammability of Vapors, Gases and Mists

- Flammability Properties (Flash Points, Temperature Limit of Flammability, Flammable Ranges, Explosion Severity, Autoignition Temperatures, Limiting Oxidant Concentration)
- Testing Methods
- Operating Conditions that Affect Flammability Properties

##### Conditions Affecting Flammability Properties

Temperature, Pressure, Oxidant, Mixtures

##### Establishing a Basis of Safety

- Avoiding Ignition Sources
  - Static Electricity, Friction, Impact, Electrical Equipment
- Avoiding Flammable Concentrations
  - Ventilation, Temperature Control
- Avoiding Oxidant
  - Inert Gas Blanketing
- Minimizing Consequences of Fire
  - Venting, Isolation, Suppression

##### Q&A/Group Discussion

##### Quiz

##### Course Evaluation Feedback Form

## Chilworth Global

Chilworth Global has international consulting bases and laboratory testing facilities in the USA, UK, France, India, Italy, and Spain with state of the art dust explosion and electrostatic laboratories (with low humidity facility), and a specialist laboratory for the evaluation of thermal runaway reactions. Chilworth's goal is to provide services to business and industry to help **identify, characterize, prevent, and mitigate** potential fire, explosion, and thermal instability (runaway reaction) hazards in their processes by providing expert independent consulting, specialist laboratory testing and process safety training. **Our laboratories are ISO-IEC 17025 accredited as well as GLP compliant.**

Chilworth employs a Doctorate Engineering and Scientific staff along with Graduate Engineers, Scientists and Technicians. Our senior consultants are internationally recognized experts in their specialist fields, and many have served on national and international standards committees.

The client base of Chilworth Technology covers more than 20 countries, and includes manufacturing companies in the fine chemicals/pharmaceuticals, bulk organics, food stuffs, paints, resins/plastics, dyestuffs, pigments, agrochemicals, soaps/detergents, oil/petrochemicals, and the legal and insurance fields.



## Thursday

### Evaluation & Selection of Electrical & Non-Electrical Equipment for Use in Hazardous Areas

#### COURSE DESIGN AND OBJECTIVES

Incorrectly specified electrical and mechanical equipment can provide a significant source of ignition for flammable atmospheres. The hazardous area classification process is designed to identify locations within a process plant where ignitable atmospheres exist, and to determine their likely extent. Using this information, the risk of ignition from equipment and devices in the areas can be minimized by either the specification of suitable equipment/devices, or relocating them to a safe non-hazardous area.

Upon completion of this course, attendees will know the regulatory requirements of codes and standards for the classification of hazardous areas, the hazards of fires and explosions, and how to perform a hazardous area classification study. The course covers the classification of areas where flammable atmospheres can arise from the presence of combustible dusts, or flammable gases, and vapors, and ignition hazards that could be created by electrical and non-electrical equipment and devices.

#### COURSE CONTENTS – Slide Presentation

##### Introduction

- Overview of Regulatory Requirements
- Relevant Codes, Standards, and Guidelines – NFPA, EN, ATEX, etc.
- Introduction to Fire and Explosion Hazards
- Flammability Characteristics relevant to Ignition Sensitivity and Hazardous Area Classification

##### Methodology for Hazardous Area Classification

- Identification of Hazardous (Classified) Areas or Zones, Class I, Class II and Class III
- North American and International Hazardous Area Designation
- Classifying and Determining the Extent of Areas Containing Flammable Gases, Vapors, and Dusts
- Effects of Ventilation, Temperature, and Pressure on the Extent of Zones

##### Assessment of Non-Electrical Equipment and Components Intended for Use in Ignitable Atmospheres

- Ignition Hazards associated with Non-Electrical Equipment and Devices
- Methodology of the Assessment

##### Selection of the Electrical Equipment for Hazardous Areas

- Methods of Protection and Summary of Commonly Used Protection Methods for Different Divisions & Zones
- Ingress Protection: IP Codes. NEMA and UL Types of Enclosures
- Intrinsic Safety

##### Workshops

##### Q&A/Group Discussion

##### Quiz

##### Course Evaluation Feedback Form



## Friday

### Chemical Reaction Hazards

#### COURSE DESIGN AND OBJECTIVES

The risk analysis of reactive systems is an essential tool to ensure safety prior to process operations. Reaction study provides an insight into the complex interaction of a wide range of factors that influence the probability and consequences of undesired safety incidents involving chemical reaction, energies, equipment, personnel and productivity. This course will benefit attendees from a broad spectrum of backgrounds and job responsibilities including chemical engineers, process engineers/scientists, plant/process safety/risk managers, facilities managers and all others who need to be aware of the risks and hazards that can lead to accidents, injuries, property damage and business interruptions to the plant.

The course will help the attendees assess chemical reactivity by

- Use of Chemical Engineering Principles to study the potential runaway reactions for storage and reactor risk assessments
- Small-scale studies
- Performing risk analysis of chemical processes
- Development of inherently safer processes

Problem solving sessions are included throughout the course. The course is designed with the expectation that problems will be used to amplify and extend the material. It has been our teaching experience that these workshops are an essential part of the learning process.

In general this course is designed to identify and recognize the thermal and chemical reactivity hazards associated with a chemical process based on the principles of scale-up and development. The participants will be able to decipher the results of the preliminary screening tests by using the chemical engineering concepts relating to safe plant operation and will be well-versed with the latest techniques for the optimization of the processes.

#### COURSE CONTENTS – Slide Presentation

##### Introduction

##### Where Hazards Arise

- Case Histories Involving Runaway Reactions and Current Legislation

##### Chemical Reaction Hazard (CRH) Assessment Strategy

- CRH vs. Process Life Cycle

##### Fundamental Principles of Scale-up and Reaction Runaway

- Vapor Pressure Effects
- Heat of Reaction
- PHI Factor
- Adiabatic Temperature Rise
- Reaction Rate
- Reaction Kinetics
- Kinetics of Heat Release/Loss
- Heat Loss Considerations
- Reactant Accumulation

##### Small Scale Screening Tests

##### Identification of Highly Energetic Materials

- Strategy for Assessing Explosivity
- Oxygen Balance
- CHETAH Calculations
- Testing for Explosive Properties

##### Reaction Characterization Through Calorimetry

##### Characterization of Thermal Runaway Reaction Through Adiabatic Calorimetry

- Accelerating Rate Calorimetry
- Adiabatic Dewar Calorimetry
- Pressure Compensated Calorimetry

##### Inherently Safe Process

- Safe Process
- Integrating Safety Considerations into Process Design

##### Problem Solving Sessions

##### Video Presentation

##### Q&A/Group Discussion

##### QUIZ

##### Course Evaluation Feedback Form

**You will need to bring a scientific calculator to this course.**

## The Speakers

**Vahid Ebadat**, Ph.D., M.Inst.P, MIEE, C.Eng., C.Phys. is the CEO of Chilworth Technology, Inc. He has worked extensively as a process and operational hazards consultant for the chemical, pharmaceutical and food industries. Dr. Ebadat is a regular speaker at training courses on gas and vapor flammability, dust explosions, and controlling electrostatic hazards. He is a member of NFPA 77 Technical Committee on Static Electricity, NFPA 654 Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particular Solids and ASTM E27 Committee on Hazard Potential of Chemicals. Dr. Ebadat's research has culminated in the publication of numerous technical papers and articles.

**David E. Kaelin, Sr.**, B.S.Ch.E., Mr. Kaelin has over 25 years experience in the specialty chemical manufacturing industry and 15 years specializing as a Process Safety Engineer. He has participated in the design and construction of numerous chemical processing facilities and provided support and training in all areas of PSM. As a Process Safety Engineer he has led process hazard analysis, risk assessments and facility siting reviews. At the corporate level he has created and taught courses in PSM and hazard recognition methods. Mr. Kaelin is an active member of AIChE, and NFPA.

**Anand Kenchenpur**, B.S., M.S., Ch.E., is the Flammability Group Manager. He has extensive experience in design, simulation and testing of highly customized tests for our clients in areas such as gas/vapor flammability, dust explosion hazard testing, thermal instability testing and electrostatic hazard testing. Being a chemical engineer, he is also experienced in characterizing the combustion, fire, and explosion properties of gases, liquids and solids. Anand received his Master's degree from South Dakota School of Mines and Technology, SD. His other areas of experience include thermodynamics, heat transfer, reaction kinetics, data acquisition systems, and characterization of advanced materials using SEM, TEM, X-ray diffraction and Surface area analyzer.

**Muhammad Qureshi**, Ph.D., is a Process Safety Specialist and Test Engineer at Chilworth Technology, Inc. He provides consulting services in dust explosion and electrostatic hazard assessment and is also responsible for standard and customized electrostatic testing. He received his Ph.D. degree in mechanical engineering from the New Jersey Institute of Technology (NJIT) in 2006. His background research includes phase interactions in multiphase flow, fluid mechanics, thermodynamics and computer aided engineering. He received the Excellence Award from NASA for his services in NASA's SHARP Student program in 2003. He is also the recipient of Best Presenter Award of the graduate student at New Jersey Institute of Technology. He is an "invited reviewer" for the Mechanics Research Communications on a regular basis. He is also a member of the American Society of Mechanical Engineering.

**Swati Umbrajkar**, Ph.D. is the Acting Manager of the Chemical Process Evaluation Group. Dr. Umbrajkar received her Doctorate from the New Jersey Institute of Technology. Her research interests include the synthesis of metal/metal oxide nanocomposites; analysis of highly energetic materials using X-ray diffraction, scanning electron microscopy (SEM), differential scanning calorimetry (DSC), and a number of post analysis techniques to characterize the thermodynamic and kinetic parameters of a test system. Dr. Umbrajkar consults with clients on a variety of process safety issues including but not limited to high-pressure DSC cell tests, adiabatic calorimetry (ARC and ADC), reaction calorimetry (RC-1), all of which allow for the safe scale-up of batch and semi-batch processes. She has expert in determining self-acceleration decomposition temperature (SADT) and time to maximum rate (TMR), which are critical issues associated with the storage of bulk materials.

**Peter Engstrom**, BS, ChE, CSP, PE, is Senior Process Safety Specialist with 30 years of industrial experience, including 13 years of dedicated experience in process/general safety, risk, and health, and 17 years as a process/project engineer. Mr. Engstrom's work experience includes over 20 years in the petroleum industry, including refining and oil production/drilling. Mr. Engstrom's expertise include: 1) Process Hazards Analysis (PHAs) using the HAZOP, FMEA, PrelimPHA (HAZID), and What-If Techniques, 2) Incident Investigation using Causal Factors Charting and Root Cause Analysis (RCA) based on TapRoot<sup>®</sup> and Source<sup>™</sup> methodologies, 3) PSM and RMP Program Auditing using OSHA's PQV and recent NEP protocols, 4) OSHA Compliance using one-on-one interaction with employees discussing practical solutions to both OSHA 1910 and 1926 regulations as well as NFPA and API best practices, and 5) Safety Training using the Criterion Referenced Instruction (CRI) to develop and teach both process and general safety course tailored to participant's needs.

# REGISTRATION FORM

## 2010 - DATES & LOCATIONS

Please choose which location you will be attending.

<input type="checkbox"/> <b>PLAINSBORO, NJ</b> <b>March 22-26, 2010</b> Chilworth Technology, Inc. 250 Plainsboro Rd, Bldg #7 Plainsboro, NJ 08536 (609) 799-4449 (Tel) (609) 799-5559 (Fax)	<input type="checkbox"/> <b>PLAINSBORO, NJ</b> <b>May 10-14, 2010</b> Chilworth Technology, Inc. 250 Plainsboro Rd, Bldg #7 Plainsboro, NJ 08536 (609) 799-4449 (Tel) (609) 799-5559 (Fax)	<input type="checkbox"/> <b>LAS VEGAS, NV</b> <b>Oct 18-22, 2010</b> Harrah's Las Vegas Hotel & Casino 3475 Las Vegas Blvd South Las Vegas, NV 89109 1-888-458-8471 (Tel)
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Name: \_\_\_\_\_  
Company: \_\_\_\_\_  
Address: \_\_\_\_\_  
City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_  
Tel: \_\_\_\_\_ Fax: \_\_\_\_\_  
Email: \_\_\_\_\_

### Please choose which day(s) you will be attending.

- Monday - Understanding & Controlling Electrostatic Hazards**
- Tuesday - Dust Explosion Prevention & Protection Techniques**
- Wednesday - Gas/Vapor Explosion Hazards**
- Thursday - Evaluation & Selection of Electrical and Non-Electrical Equipment for Use in Hazardous Areas**
- Friday - Chemical Reaction Hazards**

*Each Course is a One-Day Class from 9:00am – 5:00pm*

### How Can We Help?

Chilworth Global also offers in-company training courses. For a fixed price plus the cost of the speakers travel & subsistence expenses, you can have a unlimited number of attendees and the contents and the duration of the in-company training courses can be tailored to meet your company's specific requirements.

We can offer a variety of training course topics. For more information, please log onto our website at [www.chilworth.com](http://www.chilworth.com) or contact Ms. Victoria R. Jones at 609-799-4449 or email: [safety@chilworth.com](mailto:safety@chilworth.com).

### PRICE

**\$ 495.00** each day  
**\$1,395.00** for three days  
**\$1,995.00** for all five days

*Please attend as many days as you wish.*

All course fees must be received before course commences. We accept Visa, Mastercard, Amex or company checks. Course fees including continental breakfast, lunch and course notes.

**Fax or email this registration form to:**

**Chilworth Technology, Inc.**  
250 Plainsboro Rd, Bldg #7  
Plainsboro, NJ 08536  
**ATTN: Victoria R. Jones**  
Tel: 609-799-4449  
Fax: 609-799-5559  
Email: [safety@chilworth.com](mailto:safety@chilworth.com)

### Cancellation Policy

Absolutely NO refunds will be made if cancellations are made within 30 days prior to the course date; a possible credit may be arranged. Chilworth reserves the right to make last minute changes and/or cancellations.

### Hotel Reservations

Hotel Reservations must be made directly with each hotel. The cost of accommodations is NOT included in the course fee. Hotel parking fees may apply. We strongly recommend making reservations as early as possible since the Hotels will only keep the Chilworth Group Block of rooms until 30 days prior to the course start date; after 30 days our group rates no longer apply and reservations are on a first come, first serve basis.