

Fundamentals of Explosives

short course on
Chemical & Physical Principles including
blast effects, detection & forensics

May 3-5, 2011

This course examines the chemistry of explosives, the physics of detonation waves and their initiation, and the issues involved in safe handling and characterizing these. Explosive output and coupling to surroundings, with specific application to structural response, will be discussed. We will address terrorist bombings, the gathering, analysis and interpretation of evidence, improvised explosives, and explosive detection. Lecturers are internationally known experts.

Chemistry

Chemical makeup of explosives—minimum requirements to be an explosive and synthetic principles. Initiation of explosives—role of hot spots, critical diameter & detonation failure. Evaluation—strength & safety.

Detonation & Shock Wave Physics

Shock and detonation waves. CJ and ZND models of detonation. Fundamentals of shock response of solids. Spall. Shock growth & decay. Graphical solution of plane-shock transmission. Initiation of detonation.

Applications

Mining and military—setting requirements to match the application--Gurney energies, overpressures, role of metallization, simple models.

Detection & IED's

Critique of the various technologies used in forensics and airport screening -- bulk and trace. New challenges to detection. Post blast examination and laboratory analysis

Response to Blast

Concepts of dynamic loading and response of materials to such. Focus on basic issues that help develop materials and structures resistant to blast.

COURSE INSTRUCTORS

Dr. James Kennedy, retired from Sandia & Los Alamos National Laboratories, specialist in initiation & Gurney model

Dr. Jimmie Oxley, Professor, Chemistry, U of Rhode Island; Co-Director of DHS Center of Excellence Explosives Detection, Mitigation, Response & URI Forensic Science.

Dr. Maurice Marshall, OBE, retired Defense Science & Technology Laboratory UK; specialist in forensics of blast.

Dr. Arun Shukla, Professor, Mech. Engineering; specializes in dynamic behavior of materials

REGISTRATION FEE: \$1450 (US) should accompany registration.

Fee includes course materials, book, coffee breaks, and a dinner. The fee must accompany the registration form. Space is limited and early registration is encouraged. The sponsor reserves the right to accept or decline registrations and to cancel the course and return all registration fees if enrollment is insufficient.

No refunds will be made to participants who fail to substitute or cancel by at least 5 working days before the course starts.

Registrants are responsible for their own travel and lodging arrangements. See <http://www.chm.uri.edu/forensics/introexp.shtm>

Registration Form

Fundamentals of Explosives
May 3-5, 2011

Name _____

Title: _____

Affiliation: _____

Phone: _____ Fax: _____

E-Mail: _____

Address: _____

City: _____ State _____

Zip: _____ Date _____

Make checks (\$1450) payable to:
University of Rhode Island,
Chemistry Dept.

Mail Payment & Registration
to:

University of Rhode Island
Chemistry Dept
Attn: Jimmie Oxley
Kingston, RI 02881

Phone/fax (401) 874-2103 ph/fax
joxley@chm.uri.edu

Credit card payment can be accepted by
HERE. Fax or email Dr. Oxley



Upcoming Classes January-August 2011 Inquire about these or schedule one at your facility. Joxley@chm.uri.edu

New for 2011 Fundamentals for EoD & Related LEOs

| Tracks | days | |
|--------------------------------------|------|---|
| BASIC COURSES | 3 | Basic Definitions and Principles |
| Fundamentals of Explosives | | Chemistry - Conventional Explosives |
| Sept 2008, Oct 2008, Jun 23-25, 2009 | | Chemistry - Unconventional Explosives |
| June 17-19, 2010 (Edwards AFB) | | Explosive Safety |
| Feb 1-3 (Picatinny Arsenal) | | Shock-wave Physics |
| Feb 17-19 (Kirkland AFB) | | Detonation Physics: theory & phenomena |
| May 4-6, 2010 URI | | Initiation of Detonation: initiation criteria, hot spots, shock, DDT |
| July 26-28, 2010 Picatinny Arsenal | | Explosive Devices and Applications |
| May 3-5, 2011 URI | | Explosive Effects |
| Explosive Safety-Protocol | 2 | A walk through the safety manuals |
| Sept 2008, April 23, 24, 2009 | | Commercial Storage Regulations: BATF & NFPA 495 |
| Ap 28-29, 2010 Picatinny Arsenal | | Federal Regulations Relevant to Government Agencies |
| May 10, 11, 2011 | | personnel protection, training & certification, mishap reporting, SOP prep. |
| - | | Required testing (ESD, shock friction, impact, thermal) & what it means |
| | | Specifics of Handling Explosives (individually discussed) |
| | | History of explosive accidents |

| ENERGETIC MATERIAL BEHAVIOR & PERFORMANCE | |
|--|---|
| Stability, Compatibility & Surveillance Aug 3-4, 2009 August 2011 | 2 Thermal safety--1st steps to full-up systems-tests, use of results, precautions Complete analysis of thermal stability & compatibility Surveillance issues Cook-off - thermal explosion models |
| Propellants & Combustion Feb 25-26, 2009 May 9-10 2011 | 2 Combustion of energetics: Theory & Experiments Flame spread and convective burning Flame spread in cracks Surface ignition (laser) Propulsion equations |
| Detonation & DDT July 28-30, 2009 July 2011 | 3 Detonation models and phenomenology Detonation theory: mathematics and thermodynamics Detonation Shock Dynamics Deflagration-to-detonation (DDT) phenomenology & testing DDT: Theory & modeling |
| Unintended Ignitions Sources/Hazards Feb 2009; Feb 3-5, 2010 (DND Canada) Feb 17-19, 2010 (Kirkland AFB) October 20-22, 2010 | 3 Fundamentals of explosives behavior related to hazards Deflagration-to-detonation (DDT) phenomenology & testing Characterization of & flame spread in damaged explosives Ignition sources: mechanical shear, electrical, case studies Insensitive munition policy and test requirements Initiation sources: ordnance-velocity fragments, jet penetration Insensitive high explosives (IHEs) |
| Nano-energetics May 25-26, 2010 Picatinny Arsenal | Combustion propagation in pyrotechnics Thermites & metastable interstitial compositions (MIC) |
| Insensitive Munitions June-July 2011 | 2 Definitions & Hazard Classification Munition Components & associated hazards Approaches for achieving insensitivity--engineering design Approaches for achieving insensitivity--formulation NATO STANAGs and relationship to insensitivity |

EXPLOSIVES CHEMISTRY**Terrorism Issues**

April 26-27, 2010 Picatinny Arsenal, NJ

Apr 26, 27, 2011 Picatinny

- 2 Terrorist Threats: Peroxide Explosives-preparation, performance & safety
Pre-blast / Detection of Explosives
Fragment hazards
Performance codes by law enforcement
Case Studies

Environmental Issues with Explosives

Nov. 4,5, 2009, Picatinny Arsenal

- 3 This can serve as a stand-alone course for environmental folks or an indepth look at health and environmental impact of explosives
General explosive issues and toxicity
Explosive residue from blast
Fate & transport of explosives in soil, water, plants
Sampling protocols & analytical methods

Laboratory Analysis & Forensics

Dec 2008

Apr 27, 28, 2011 Picatinny

- 2 Review of actual protocols for explosive analysis (by specific explosive)
Operational safety
Case studies from former forensic scientists

Material Characterization & Processing

May 2009

Sept 21-23, 2010

- 3 Characterization & effects of particle morphology
Controlling particle morphology - recrystallization
Formulation
Particle size effect on performance
Laboratory and processing safety

Explosive Chemisty for NonChemists

- 3 Fundamentals: from basic nomenclature to reading chemical equations to recognizing explosophors

Synthetic Processes for Energetics: Classic to C**August 2011 Picatinny Arsenal**

- 2 Synthesis of common military explosives
New materials and preparations
Advanced and high-nitrogen energetic materials

EXPLOSIVES APPLICATIONS AND EFFECTS

Dynamic Diagnostics

Oct 2008

- 2 Simple & complex measurements
TECHNIQUES: witness plates, make switches, detonation waveshaping, gas guns, piezo pressure gauges, multiple embedded gauges, ultrahigh-speed framing & streak cameras, multiple embedded gauges, interferometry, pulsed radiography
APPLICATIONS: device performance, wave arrival times, pressure histories in solids and air, HE output, shock wave evolution for use with hydro codes, detonation spreading, shock-wave shapes within solids

Air Blast & Structural Response

April 27-29, 2009

Mar 24-26, 2010 DND Canada

December 2011

- 2 Blast wave from high explosives - scaling laws
Coupling to structures
Stress & strain, single-degree-of-freedom systems
Pressure-impulse failure estimates
Gaseous combustion and detonation
Heterogenous Blast

Dynamic Response of Materials

Sept 29-30, 2009

Mar 22-23, 2010 Canada

March 10-11, 2011

- 2 Detonation wave as a driver; shock interactions
Material structure and mechanical behavior
Material response under impulsive loading - experiments
Inelastic continuum mechanics & material damage
Material response modeling and wavecodes

Explosive Devices & Train Design

Oct 27-29, 2009 Picatinny Arsenal

- 2 Low-energy electroexplosive and laser-ignited devices
High-power detonators & arrays, includes slapper detonator (ESAD) tech.
Explosive train design and statistical reliability testing
Hazards with explosive devices and trains
Manufacturing explosive devices

Warhead Mechanics

March 24-26, 2010 Picatinny Arsenal

- 3 Explosive output - concepts, Gurney model
Detonation wave interactions and effects on metal
Shaped charges and jet penetration
Fuzes, esp. in-line electronic safing, arming & firing (ESADs)

Pyrotechnics

June 7-10, 2010

- 3 General principles and chemistry of pyrotechnics
Roles for pyrotechnics: heat, ignition, light, thrust producers
Pyrotechnic devices
Flares & luminosity
Manufacturing including twin-screw extrusion

Field Instrumentation

pressure measurements
VOD measurements