

Contact Information
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Explosive Material Characterization

3 days, 3 instructors

Overall Objective:

The DOE Weapons and DOD Military complexes are based upon integrated manufacturing processes. A key component of this integration is the coupling of material modeling with the design and control of new processes and an understanding of material behavior based on physical (particulate) characteristics of a powder. The purpose of this course is to provide the researcher, process engineer and user with the information needed to describe adequately the particulate system being studied and methods to predict from powder characteristics (e.g. high explosives by particle morphology) the quality and performance of powders and their responses to various processing and fabrication techniques.

Learning Objectives:

At course completion, each student will gain a better understanding of fundamental and applied aspects of the following, so that he/she will be able to recognize powder features that may be controlled to serve well in certain applications, and trouble

1. Purpose of Powder Characterization
2. Bulk System Properties: *density, specific surface area, composition, solid/void structure*
3. Particulate System Properties
 - a. Individual Characteristics: *single unit & particle systems*
 - b. Particle Characteristics: *size and dimensions, shape/habit, distribution, reentrant features, agglomerates and aggregates*
 - c. Particle Morphology
 - d. Physical Properties
 - e. Sensitivity
4. Processing of Powders: *synthesis, precipitation for purification and recrystallization, particle reduction, blending, formulation, compaction, density*
5. Fundamentals of Batch Crystallization: *solubility and supersaturation, nucleation and growth kinetics, why and how to determine the solubility curve and metastable zone*
6. Seeding Batch Crystallization: *seed loading, comparison of seeded vs. unseeded*
7. Antisolvent Addition: *controlled cooling, controlled antisolvent addition, temperature cycling*
8. Factors Contributing to Material Variation: *product variation, categories and causes of variation, quality assurance*
9. Correlation of Powder Characteristics with Performance; *detonation velocity & detonation corner turning; functionality in shaped charges, EBW & slapper detonators, MDF & LSC; responses in laboratory safety characterization tests (friction, spark, gap test, drop-weight impact, rifle bullet, skid test); mechanical properties (compression, tensile)*
10. Thermal Properties
 - a. Bulk Powders
 - b. Individual Particle

- c. HE Melting
- 11. Characterization Methods
 - a. Sampling
 - b. Dispersion
 - c. Drying
 - d. Bulk Density
 - e. Size: image analysis, *sedimentation, sieve analysis,*

- zone classifiers*
- f. Surface: *gas adsorption, permeametry*
- g. Shape: *microscopy*
- h. Void Structure: *porosimetry*
- 12. Energetic Materials
 - a. Explosives
 - b. Formulations

Immediate benefits:

Each student who completes this course will gain an understanding of experimental techniques available for the characterization of explosive powders and the types of information that these techniques yield. Powder technologists will add to their understanding of the characterization process, how powder characterization aids in processing of explosives used in military applications, and those powder characteristics that affect the performance of an explosive. Design and systems engineers will learn the relevant characteristics of explosives used in their products, and how to incorporate controls for consistent manufacturability and performance.

Instructors:

Instructors for this course will be Mr. Arnie Duncan, recently retired from Pantex Plant in Amarillo, TX, Dr. James Kennedy of HERE, LLC and Prof. Jimmie Oxley of URI and HERE, LLC.

Mr. Duncan has been directly involved for the last 47 years in the study and research of particulate systems. He has been directly involved in developing the technologies and instrumentation used to characterize DOE powders (inert and high explosives) for the prediction of their quality and performance, as well as their response to various processing and fabrication techniques. Mr. Duncan has given Powder Characterization Seminars (3 to 4 day sessions) to Atomic Weapons Establishment (AWE, UK), Sandia, Lawrence Livermore and Los Alamos National Laboratories, the Pantex Plant and the DOE complex. He has also given similar training courses to DOE Field Intelligence and DOD Nuclear Response activities DSAP (Disassembly Shielding and Packaging). Dr. Kennedy has 50 years experience in explosives work, mostly at Sandia and Los Alamos National Laboratories, and will address several areas in which powder characteristics affect the success of applications, namely manufacture of linear explosives, development and manufacture of high-power detonators, and experiments and testing on shock initiation and detonation spreading in explosives. Prof. Oxley has worked in explosives chemistry for over 20 years, specializing in thermal decomposition and explosive counter-terrorism activities. She is head of the Forensic Science Center at URI and Co-Director of the DHS Center of Excellence on Explosives Detection, Mitigation and Response. She will present her studies on insensitive RDX and other topics.

SCHEDULE and REGISTRATION: This class will be held from 0800-1600 hours on 12-14 May 2009 at Armament University, Bldg. 3409.