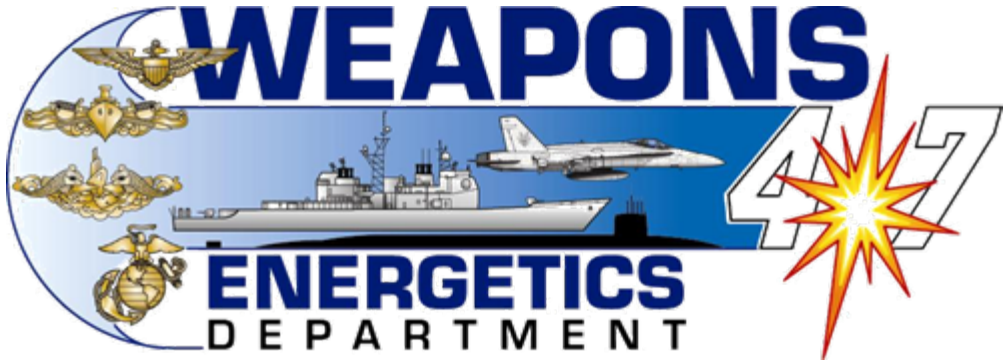
OPEN DETONATION: Metal Emissions PHASE I



Eric Gogley

NAWCWD China Lake

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Technical Partners

- NAWCWD China Lake (Thom Boggs, Dr. Eric Erickson, Laurie Zellmer, Brenda Abernathy)
- Army at DAC
- Chemical Compliance Systems, Inc. (CCS)
  - Background in environmental monitoring
  - Own OD-CRD database
- NOSSA/OESO

Problem Statement

- Incomplete technical data for metal emissions
- Increased public concern
- Facilities under increased scrutiny
- Insufficient alternative technologies to handle entire waste stream
- Lack of storage space

Objective

- Identify and quantify the metal species from an open detonation event and use that data to accurately predict emissions from future events.
- Focus area:
  - Metal emissions
- Future Investigations:
  - Residues (e.g., resins, composites)
  - Perchlorates
  - Soil entrainment

NAWCWD Metals Emissions Report

NAWCWD TP 8528

Metals Emissions From the Open Detonation Treatment of Energetic Wastes

by

T. L. Boggs, T. M. AtienzaMoore, and O. E. R. Heimdahl
Research Department

M. Pepi, J. E. Hibbs, Jr., K. R. Wells, and M. Martyn
Weapons/Targets Department

D. Wooldridge
Ordnance Systems Department

R. L. Gerber
Sverdrup, Inc., Ridgecrest, California

and

L. A. Zellmer and B. M. Abernathy
Environmental Planning and Management Department
Naval Air Weapons Station, China Lake, California

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NAVAL AIR WARFARE CENTER WEAPONS DIVISION
CHINA LAKE, CA 93555-6100

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Data Gaps in Current OD EFF Database

- Large amount of fragment data from lethality tests
- Inadequate emissions data for fine metal particulates (e.g., PM-10)
  - Influence of location and composition on emissions
  - Physical and chemical form of emissions (environmental fate issue)
  - Influence of detonation temperature and pressure on emissions
- High proportion of values in the EFF database were non-detects and assigned 50% MDL

Particle Loss Assessment Tests (PLATs)

- Scoping Tests for Phase I
- Focus on:
  - Sampling techniques
  - Carbon balancing
  - Suspended particulates
  - Plume dilution

PHASE I (Baseline)

1. Was exploratory in nature and scope
2. Utilized NAWCWD China Lake detonation chamber and standardized test device
3. Analyzed emissions as a function of source and chemical form
4. Assessed physical (e.g., gas, particle) and chemical form (e.g., metal, metal oxide, metal salt) in the emission products
5. Analyzed particle sizes above and below PM-10
6. Documented extent to which energetic materials are destroyed

PHASE I (Baseline)

- Brass cases
- 2 baseline shots
- 9 shots with energetics
  - 2 energetics (High Energy, H-6)
  - 3 shots each
  - 1 energetic used twice
    - Differing quantities
- Sweep and vacuum between tests

Detonation Chamber Characteristics

- Ballistic Test Chamber at NAWCWD China Lake, Calif.
  - 12’ x 12’ x 8’ (interior dimensions)
  - 2-foot-thick heavily reinforced concrete lined with ¾” steel
  - Chamber volume (34 m^3) facilitates metal coating analyses
- Explosive limits: Class 1.1 = 910 g (2 lb); Class 1.3 = 2,275 g (5 lb)
- Existing sampling ports, operation and safety protocols
- Previously used for similar tests

Phase I Lessons Learned

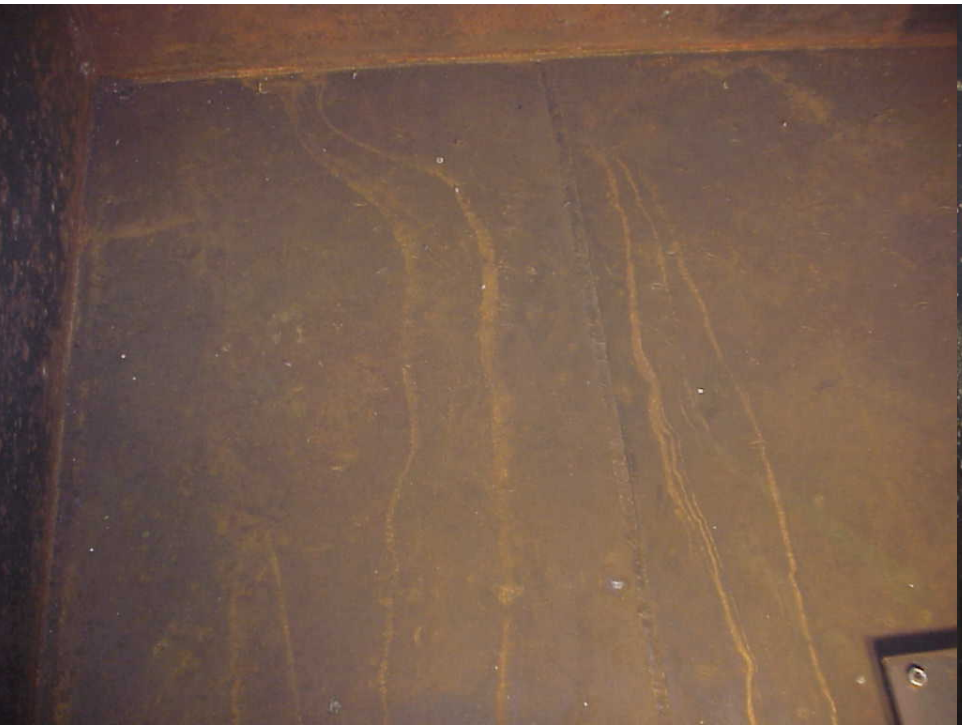
- Wall effects compromise data
  - Introduces non-test materials
  - Changes particle size distribution
- Other investigators have not addressed
  - All test data to date from a cased munition in a chamber fail to account for the wall effects

Phase I Lessons Learned

- Deposition data from the witness plates are unsatisfactory
  - Predictions based on witness plates–300 g
  - Quantities found in sweepings–1,000 g
- Sampling methods could not account for some of the species
  - Aluminum
  - Tin

Test Chamber Walls

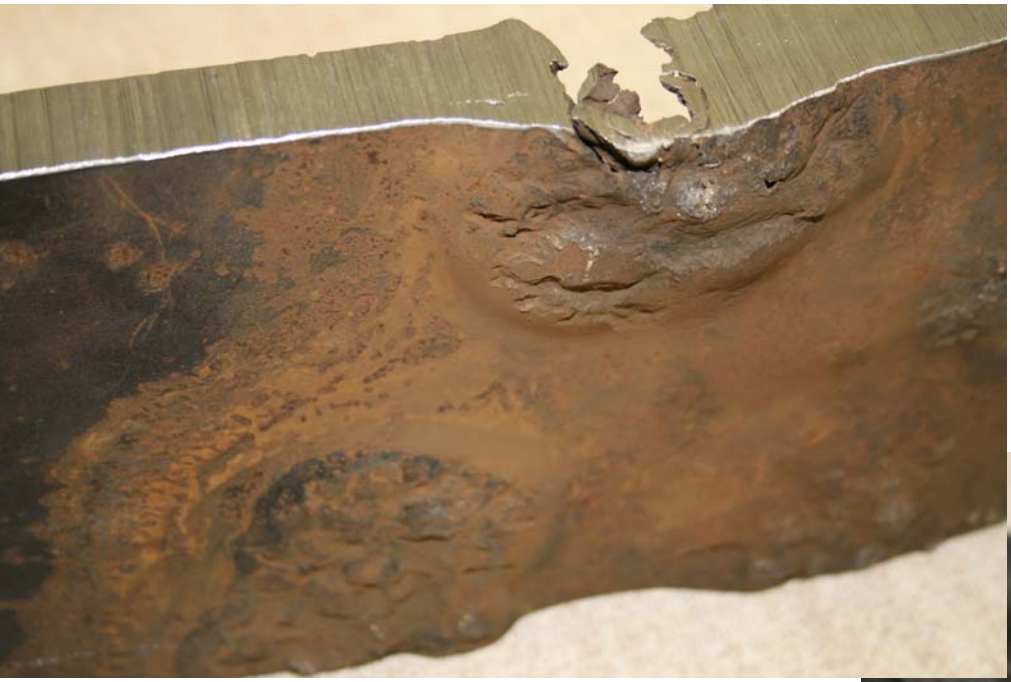
BEFORE

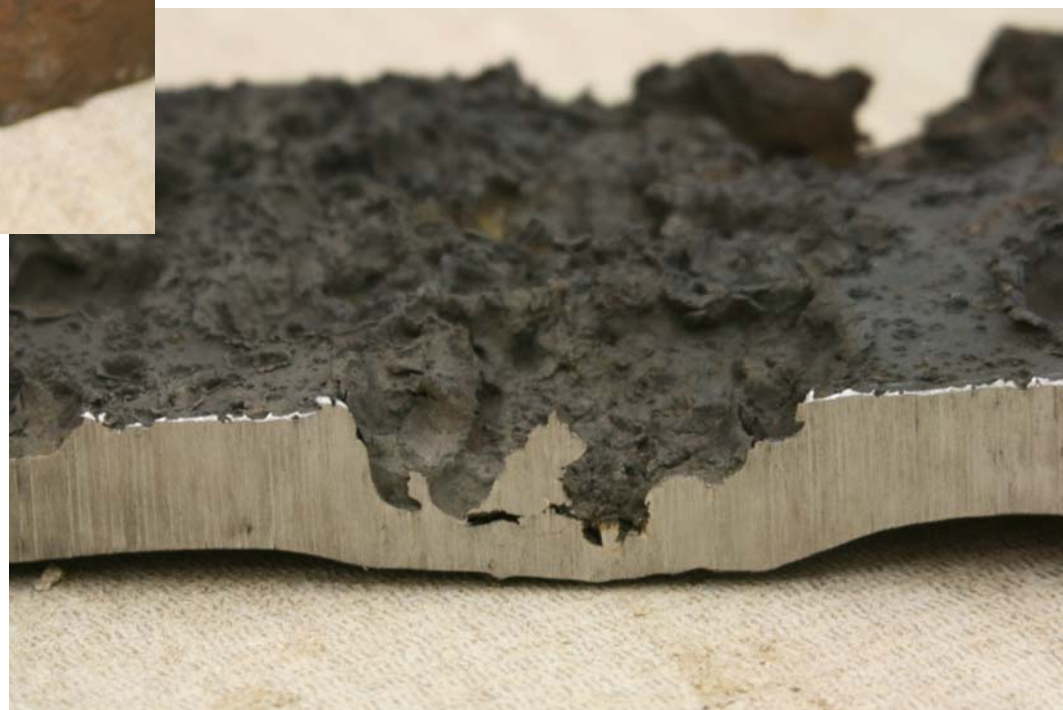


AFTER

Test Chamber Walls–Close-up

Test Chamber Floor–Close-up

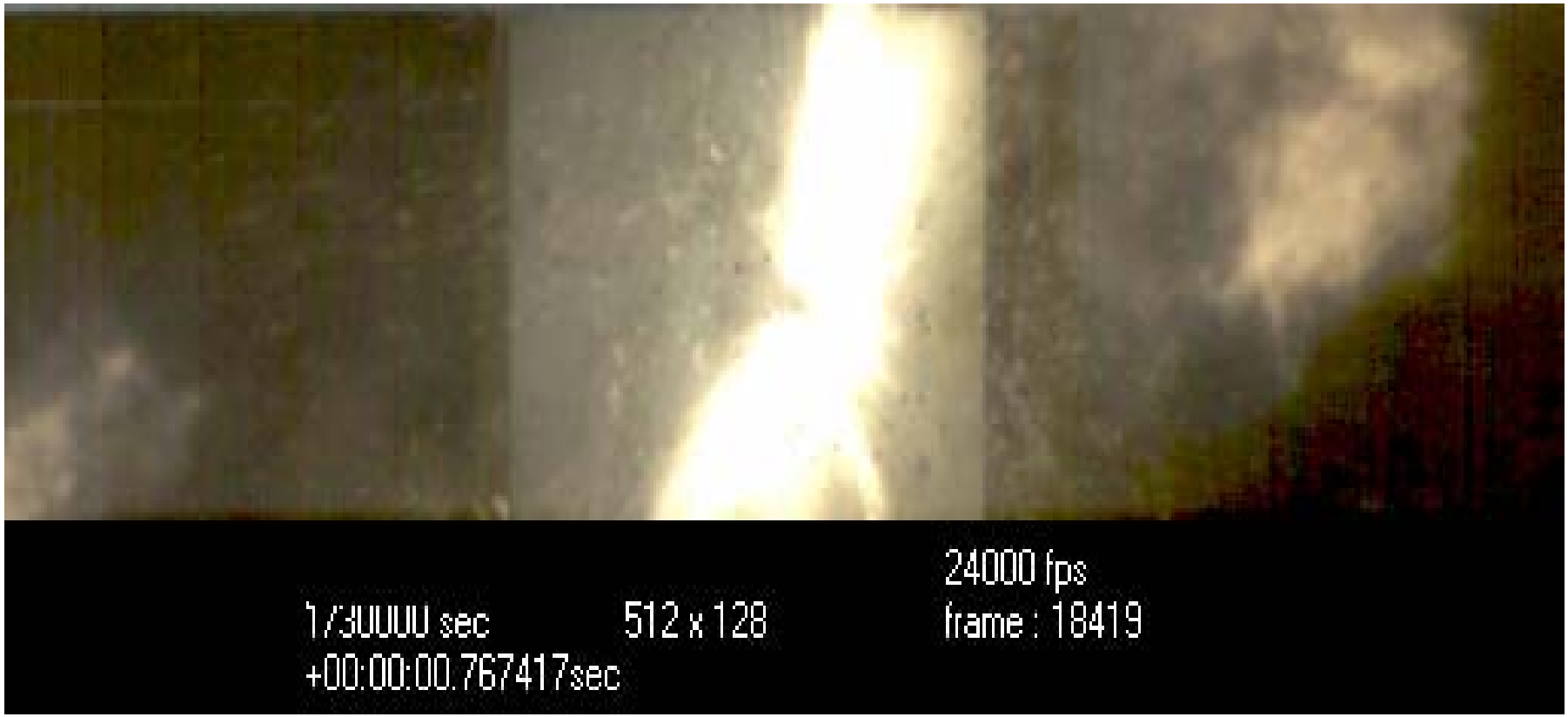




Cross section of protective floor plate 3’ below sample

Wall Effects

- Video of wall effects



FY07 Tasking

PHASE IIA

1. Conduct “bumper” evaluation study to mitigate wall effects
2. Repeat/replicate some/all Phase I tests w/o wall effects
3. Utilize NAWCWD China Lake detonation chamber and standardized test device
4. Assess physical (e.g., gas, particle) and chemical form (e.g., metal, metal oxide, metal salt) of the emission products
5. Analyze particle sizes above and below PM-10
6. Assess and quantify the impact of wall effects on metal particulate emissions

Future Work

PHASE IIB

1. Build on the results of Phase IIA
2. Utilize NAWCWD China Lake detonation chamber and standardized test device
3. Use three energetics: one from Phase I/IIA, one high in AP, and one high in lead stearate
4. Examine SVOC, interior coating, and chemical composition data
5. Provide more definitive particle size and chemical composition data
6. Elaborate on X-tunnel lead emissions results

Future Work

PHASE III

1. Assess the ability of other munition constituents, or "additive" materials (e.g., dirt, sand, solid peroxides, limestone, etc.) to "quench" emissions
2. Utilize NAWCWD China Lake detonation chamber and standardized test device
3. Evaluate mechanisms to alter sulfur and chlorine products

These tests may run simultaneously with Phase IIB to reduce setup and analytical costs.

Contact Information

Eric J. Gogley

NAWCWD China Lake

(760) 939-7664

eric.gogley@navy.mil