El Dorado Engineering, Inc.
Advanced Pollution Control Techniques for
Explosive Waste Incinerators (EWI)

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About El Dorado Engineering

- Over 34 yrs. Specializing in the Demilitarization Industry, HQ in Salt Lake City, UT
- Capabilities Include:
  - Design
  - Consulting
  - Fabrication
  - Installation
  - Commissioning
  - Training
  - Permitting
- Specialize in demilitarization of conventional munitions, chemical munitions, bulk propellants, explosives, and pyrotechnics (PEP), and rocket motors
  - Thermal Treatment
  - Pollution Control Systems
  - Recycling/Conversion of energetic materials and munition related waste
  - Disassembly Machines
  - Environmental consulting, permitting and restoration, related to PEP

Take pride in record of safety, project cooperation, and client satisfaction
<table>
<thead>
<tr>
<th>Location</th>
<th>Client</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lubben, Germany</td>
<td>General Atomics</td>
</tr>
<tr>
<td>Kahosiung, Taiwan</td>
<td>Arsenal 203</td>
</tr>
<tr>
<td>Elbasan, Albania</td>
<td>NSPA/NATO</td>
</tr>
<tr>
<td>Shoeburyness, England</td>
<td>QinetiQ - formerly DERA</td>
</tr>
<tr>
<td>Republic of Korea</td>
<td>Kolon for ROK DOD</td>
</tr>
<tr>
<td>Donetsk, Ukraine</td>
<td>NSPA/NATO</td>
</tr>
<tr>
<td>Zutendaal, Belgium</td>
<td>Belgium MOD</td>
</tr>
</tbody>
</table>
Versatile workhorse of demil sector:

- 200-300 lb/hr NEW
- Configured items up to 30mm HE
  - SAA
  - Primers
  - Fuzes
  - Projectiles
  - Initiators, CADs and PADs
  - Bulk PEP
  - Tear Gas canisters
- Larger munitions >30mm, if explosive exposed by preparation (e.g. punched grenades, sawed large projectiles)
- Off Gas Treatment Tailored to Waste Materials and Applicable Requirements
Formation and Control of Emissions

- Workload Chemistry

- Understanding of Combustion
  - Temperature
  - Time
  - Stoichiometry
  - Reaction Rates
  - Minimize pollutant formation when practical
CO, VOC, SVOC

- Can be minimized in primary furnace

**HIGH TEMPERATURE AFTERBURNER**
- Oxidize any unreacted species
- Eliminate organic compounds
- Temperature
- Residence Time
- Stoichiometry
- Mixing

Additional Developments
- Recuperator: fuel savings
- SNCR: NOx Reduction
- Dual Use: Flashing Furnace/CWP
Particulate and Heavy Metals

- Cyclone (High Temperature)
- Gas Cooler
- Baghouse (Low Temperature)
- HEPA (Low Temperature)
• Control Formation

• SNCR (Afterburner)

• SCR
  – Precious metal catalyst
  – >90% NOx Reduction
  – Proper Mixing/Stoichiometry
  – “Sponge” capacity to deal with peaks/valleys
Dioxin and Furan

- Control Formation
- Reaction and elimination in SCR
- Adsorption with Packed Bed
Mercury

- Generated from Mercury Fulminate in Primers
- Removed by Specialized Packed Bed Scrubber
Acid Gases

Options
- Dry Scrubber upstream of Baghouse
- Spray Dryer
- Wet Scrubber

Considerations
- Equipment design to prevent corrosion
- New vs. Retrofit
- Workload
- Stoichiometry
- Reagent Material Supply
- Effluent Disposal Options
Controls, Training, & Maintenance

- Burner Tuning
- Control Loops
- Intuitive HMI
- Interlocks/Alarms
- Diagnostics
- In Depth Training
Environmental Permitting

- Involve applicable regulatory authorities early
- Transparency with regulators
- Detailed understanding of equipment and processes
- Knowledge of common “gotchas” that can limit throughput or increase operating costs
- Understanding of emissions testing methods for acceptance testing
- Consideration of current and future workload requirements
<table>
<thead>
<tr>
<th>ITEM</th>
<th>Average Feed Rate Items/Hr</th>
<th>Max Feed Rate Items/Hr</th>
<th>CEMS Average Daily Values</th>
<th>Stack Sampling Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>NOx (mg/m³)</td>
<td>CO  (mg/m³)</td>
</tr>
<tr>
<td>EU Directive Limits</td>
<td></td>
<td></td>
<td>200</td>
<td>50</td>
</tr>
<tr>
<td>20mm HE-I-T</td>
<td>900</td>
<td>1250</td>
<td>0.2</td>
<td>0.7</td>
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<tr>
<td>20mm SAP-I</td>
<td>1200</td>
<td>1250</td>
<td>0.0</td>
<td>2.1</td>
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<tr>
<td>7.62mm Ball</td>
<td>22700</td>
<td>25000</td>
<td>0.0</td>
<td>1.3</td>
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<tr>
<td>12.7mm API</td>
<td>5000</td>
<td>6600</td>
<td>40.0</td>
<td>0.1</td>
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<tr>
<td>PD Fuze M51 w/Booster</td>
<td>400</td>
<td>400</td>
<td>0.4</td>
<td>0.9</td>
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<tr>
<td>TNT Block</td>
<td>89 kg/hr</td>
<td>120 kg/hr</td>
<td>2.6</td>
<td>0.7</td>
</tr>
<tr>
<td>Bulk M6 Propellant</td>
<td>66 kg/hr</td>
<td>90 kg/hr</td>
<td>0.4</td>
<td>1.7</td>
</tr>
</tbody>
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