COUNTERSOL: SCALABLE CONTAINMENT & REMEDIATION

For
RADIOLOGICAL DISPERSAL DEVICES (RDDS) & DIRTY BOMBS

Dr. Mark Krekeler
DIRTY BOMBS AND RDDS

• High Probability
• Radiological charges
  – $^{137}$CsCl
  – $^{60}$Co
  – $^{90}$SrTiO$_3$
• Limited Options
THE RDD THREAT

• UN's International Atomic Energy Agency (2004)

• Some related events
  – Moscow’s Ismailovsky Park - 1995
  – 375 lbs of $^{137}\text{CsCl}$ seized in Ukraine May, 2004 (AP)
  – 66 pounds seized in Thailand 2003 (CNN)

• Exact amount of $^{137}\text{CsCl}$ in existence is arguable
  – ~3000 collective seed trucks missing in Soviet Union
  – Greensboro, N.C. 19 $^{137}\text{Cs}$ Rods missing never found
# Containment & Remediation Options

<table>
<thead>
<tr>
<th>Performance</th>
<th>Time / Dilution</th>
<th>Water Rinse</th>
<th>Gel</th>
<th>Foam</th>
<th>Countersol</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost</strong></td>
<td>LOW</td>
<td>LOW</td>
<td>MED</td>
<td>HIGH</td>
<td>LOW</td>
</tr>
<tr>
<td><strong>Availability</strong></td>
<td>HIGH</td>
<td>HIGH</td>
<td>LOW</td>
<td>LOW</td>
<td>HIGH</td>
</tr>
<tr>
<td><strong>Applicability</strong></td>
<td>EASY</td>
<td>EASY</td>
<td>SPEC.</td>
<td>SPEC.</td>
<td>MODERATE</td>
</tr>
<tr>
<td><strong>Disposal</strong></td>
<td>N/A</td>
<td>LOW</td>
<td>MED</td>
<td>??</td>
<td>STABLE SOLID</td>
</tr>
<tr>
<td><strong>Scaleability</strong></td>
<td>N/A</td>
<td>HIGH</td>
<td>LOW</td>
<td>MED</td>
<td>HIGH</td>
</tr>
<tr>
<td><strong>Shelf Life</strong></td>
<td>N/A</td>
<td>N/A</td>
<td>??</td>
<td>??</td>
<td>&gt;5 years</td>
</tr>
</tbody>
</table>
## Containment & Remediation Options

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<th>Foam</th>
<th>Countersol</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ionic Exchange</strong></td>
<td>LOW</td>
<td>LOW</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td><strong>Containment</strong></td>
<td>LOW</td>
<td>LOW</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td><strong>Remediation</strong></td>
<td>LOW</td>
<td>LOW</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td>- $^{137}$Cs</td>
<td>LOW</td>
<td>MED</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td>- $^{60}$Co</td>
<td>LOW</td>
<td>MED</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td>- $^{90}$Sr</td>
<td>LOW</td>
<td>MED</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td><strong>Bio Friendly</strong></td>
<td>N/A</td>
<td>HIGH</td>
<td>MED</td>
<td>LOW</td>
<td>HIGH</td>
</tr>
</tbody>
</table>
Water Decon

Cations Attracted to Surface by Chemical Drive

Water

Some Cations Washed Away

Surface Boundary

Oxygen Atoms in Surface Have a Negative Charge (-)
After Water Decon

Chemical Equilibrium = Permanently Radioactive Surface

Water Has Evaporated

Surface Boundary

Oxygen Atoms in Surface Have a Negative Charge (-)
Countersol™, Pat. Pend. Decon

Countersol™

Has Negative Charge + Site

Surface Boundary

Oxygen Atoms on Surface Have a Negative Charge (-)
Countersol™, Pat. Pend. Decon

Countersol™ Permanently Binds Cesium

Surface Clean

Oxygen Atoms on Surface Have a Negative Charge (−)
Countersol –
A Containment and Remediation Technology
SPRAY MONTMORILLONITE SLURRY

~2.5 cm pile of CsCl

Prevents Secondary Dispersal

One time spray -does not disrupt pile

20 - 30 sprays isolate CsCl
FEATURES

• Aqueous suspension – pour or spray
• Expands and absorbs, penetrates porous structures
• Immediately and irreversibly sequesters cesium and other radioactive cations
• Absorbs radioactive chloride, carbonate and sequesters particulate oxides
• Complete scalability
• Ecologically friendly
• Made in the USA
Na-montmorillonite  
(Starting)

Cs-montmorillonite  
(Ending)
Reaction is spontaneous - limited only by the amount of nanomaterial present (always can add more)

Molecular structure preferentially exchanges sodium for cesium and all cations larger than Na.
Countersol Demonstration
SUMMARY

• Threat of Dirty Bomb and radiological contamination is real
• Current methods of decontamination are not fully effective
• Countersol™, Pat. Pend. is a non-toxic, easily applied, total solution
• Alternative dispensing methods are available to match the assessed threats
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