Uranium Metal

Potential for Discovering Commercial Uses

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Summary

Uranium Metal is a Valuable Resource

- Large Inventory of “Depleted Uranium”
- Need Commercial Uses for Inventory
  - Avoid Disposal Cost
  - Real Added Value to Society
- Uranium Metal Has Valuable Properties
  - Density
  - Strength
- Market will Come if Story is Told
Background
The Nature of Uranium

Background

- Natural Uranium: 99.3% U238; 0.7% U 235
- U235 Fissile
  - Nuclear Weapons
  - Nuclear Reactors
- U238 Fertile
  - Neutron Irradiation of U238 Produces Pu239
  - Neutrons Come From U235 Fission
  - Pu239 is Fissile (Weapons, Reactors, etc.)
Post World War II Legacy

Background

- “Enriched” Uranium Product
  - Weapons Program
  - Commercial Nuclear Electricity Production
- Depleted Uranium Byproduct
  - Plutonium Production
  - Miscellaneous Minor Applications
- Depleted Uranium Inventory
  - Much Larger Than Uranium Product
Changing National Priorities

Background

- 1970's Perspective - Resources Running Out
  - Petroleum
  - Uranium
  - “Breeder” Reactors Vital

- Current Perspective
  - Uranium and Petroleum Reserves Large
  - Production of Pu239 from U238 Discouraged

- What Was a Resource Could be a Liability
Prognosis for Finding Uses
Government Depleted Uranium Use

Prognosis for Finding Uses

- U.S. Government Use of Depleted Uranium
  - Production of Pu239
  - Radiation Shielding
  - Counterweights (Boeing 747s)
  - Tank Armor
  - Armor-Penetrating Projectiles

- Armor and Projectile Material Properties
  - Strong
  - Hard
  - Heavy
Common Image of Uranium

Prognosis for Finding Uses

- Properties Similar to Lead
  - Heavy
  - Good Shielding
- Common Impression
  - Material Properties Must be Like Lead’s
- *Nothing Could be Farther From the Truth*
# Tensile Strength Properties of Selected Metals

Prognosis for Finding Uses

<table>
<thead>
<tr>
<th>Material</th>
<th>Strength (KSI)</th>
<th>Elongation (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 304 Stainless Steel</td>
<td>31</td>
<td>73</td>
</tr>
<tr>
<td>Type 316 Stainless Steel Annealed Bar</td>
<td>35</td>
<td>82</td>
</tr>
<tr>
<td>Type 316 Stainless Steel Spring Tempered Wire</td>
<td></td>
<td>230</td>
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<tr>
<td>Carpenter AerMet®-for-Tooling (Specific Heat Treat)</td>
<td>260</td>
<td>300</td>
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<tr>
<td>Grade 18Ni(350) Maraging Steel (Specific Heat Treat)</td>
<td>295</td>
<td>310</td>
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<tr>
<td>Cast Uranium</td>
<td>29</td>
<td>58</td>
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<tr>
<td>Wrought Alpha Phase Uranium</td>
<td>86</td>
<td>147</td>
</tr>
<tr>
<td>Uranium Alloy 0.75Ti (Specific Heat Treat)</td>
<td>140</td>
<td>227</td>
</tr>
</tbody>
</table>

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Other Uranium Alloy Properties

Prognosis for Finding Uses

- Hardness
- Compressive Strength
- Corrosion Resistance
- Electrical Properties
- Uranium Alloys in Other Base Metals
What is Required for Uranium Alloys to be Used Commercially?

Prognosis for Finding Uses

- Out-Perform Other Materials
  - Comparable Properties for the Application
  - Competitive Cost
Uranium Alloy Cost

Prognosis for Finding Uses

- Difficult to Predict Future Commercial Cost
- Estimate Range: $1/lb to $10/lb
  - DOE “Cost Avoidance” Could Reduce Cost
  - Alloying, Heat Treatment Add Cost (and Value)
Uranium Alloy Value

Prognosis for Finding Uses

- **Low End**
  - Density Most Important
  - Still Have Strength Greater Than Steel
  - Compete With Lead - $1/lb

- **High End**
  - “Specialty Steel” Properties
    - Strength
    - Corrosion Resistance
  - Compete With Specialty Steels - $25/lb

- **Mid-Range: Wide Range of Properties**
Barriers to Use
Major Concerns

Barriers to Use

- Early Work Was Classified
- Government Data Not Readily Available
- Mildly Radioactive
## DOE Actions

### Barriers to Use

- Declassification and Publication
- Assure Proper Regulation
- Industry Outreach
- Consensus Code Development
- Alloy Research and Development
- Process Technology Development
- Russian Experience
Conclusions

Broad-Based Market Potential Exists

- Valuable Commercial Properties
- Competitive Cost Likely
- Could be a Significant Benefit to Society