
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
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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.)
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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
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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
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Prognosis for Finding Uses

Government Depleted Uranium Use

Prognosis for Finding Uses

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- 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*
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Tensile Strength Properties of Selected Metals

Prognosis for Finding Uses

Material	Strength (KSI)		Elongation
	Yield	Ultimate	(Percent)
Type 304 Stainless Steel	31	73	70
Type 316 Stainless Steel Annealed Bar	35	82	57
Type 316 Stainless Steel Spring Tempered Wire		230	
Carpenter AerMet®-for-Tooling (Specific Heat Treat)	260	300	12
Grade 18Ni(350) Maraging Steel (Specific Heat Treat)	295	310	12.3
Cast Uranium	29	58	4
Wrought Alpha Phase Uranium	86	147	27.5
Uranium Alloy 0.75Ti (Specific Heat Treat)	140	227	19

Other Uranium Alloy Properties

Prognosis for Finding Uses

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

Prognosis for Finding Uses

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

Prognosis for Finding Uses

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- 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)
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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
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Barriers to Use

Major Concerns

Barriers to Use

- Early Work Was Classified
 - Government Data Not Readily Available
 - Mildly Radioactive
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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**
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Conclusions

Broad-Based Market Potential Exists

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