Engineering & Environmental Applications

of

Plasma Arc Technology

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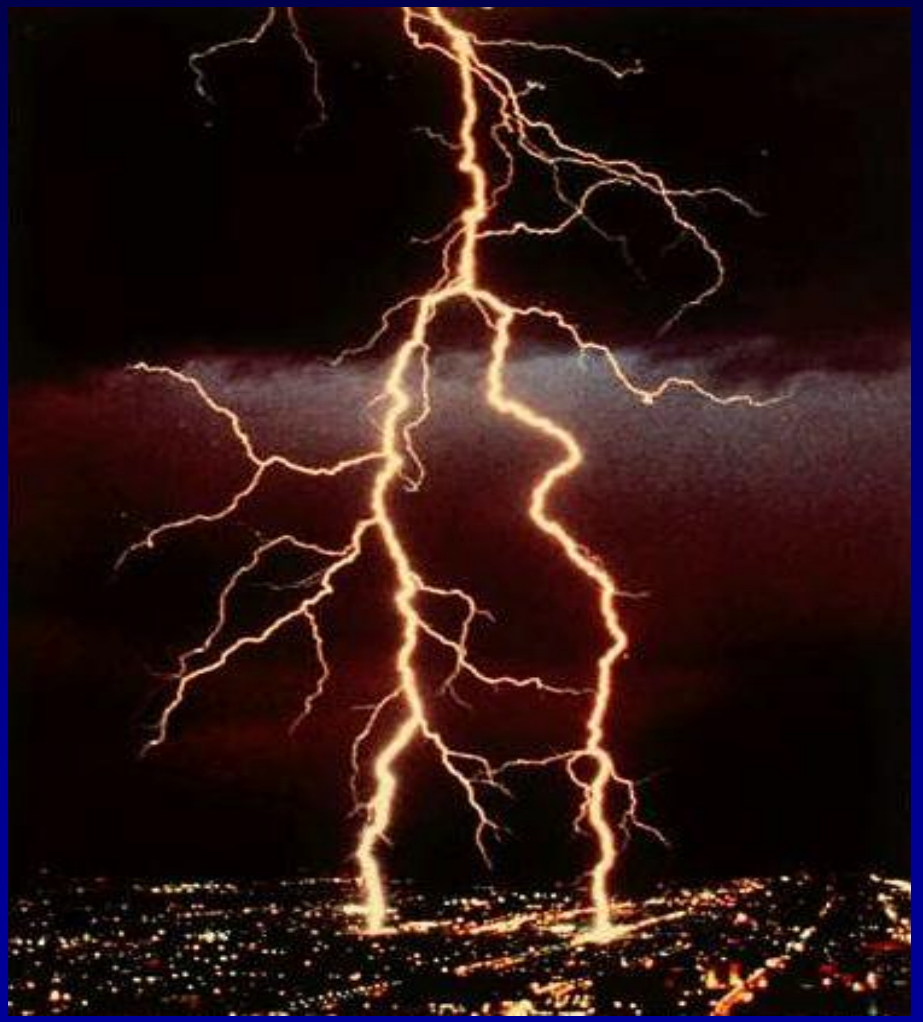
What is PLASMA?

- "Fourth State" of matter
- Ionized gas at high temperature capable of conducting electrical current
- Lightning is an example from nature



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Commercial Plasma Torch

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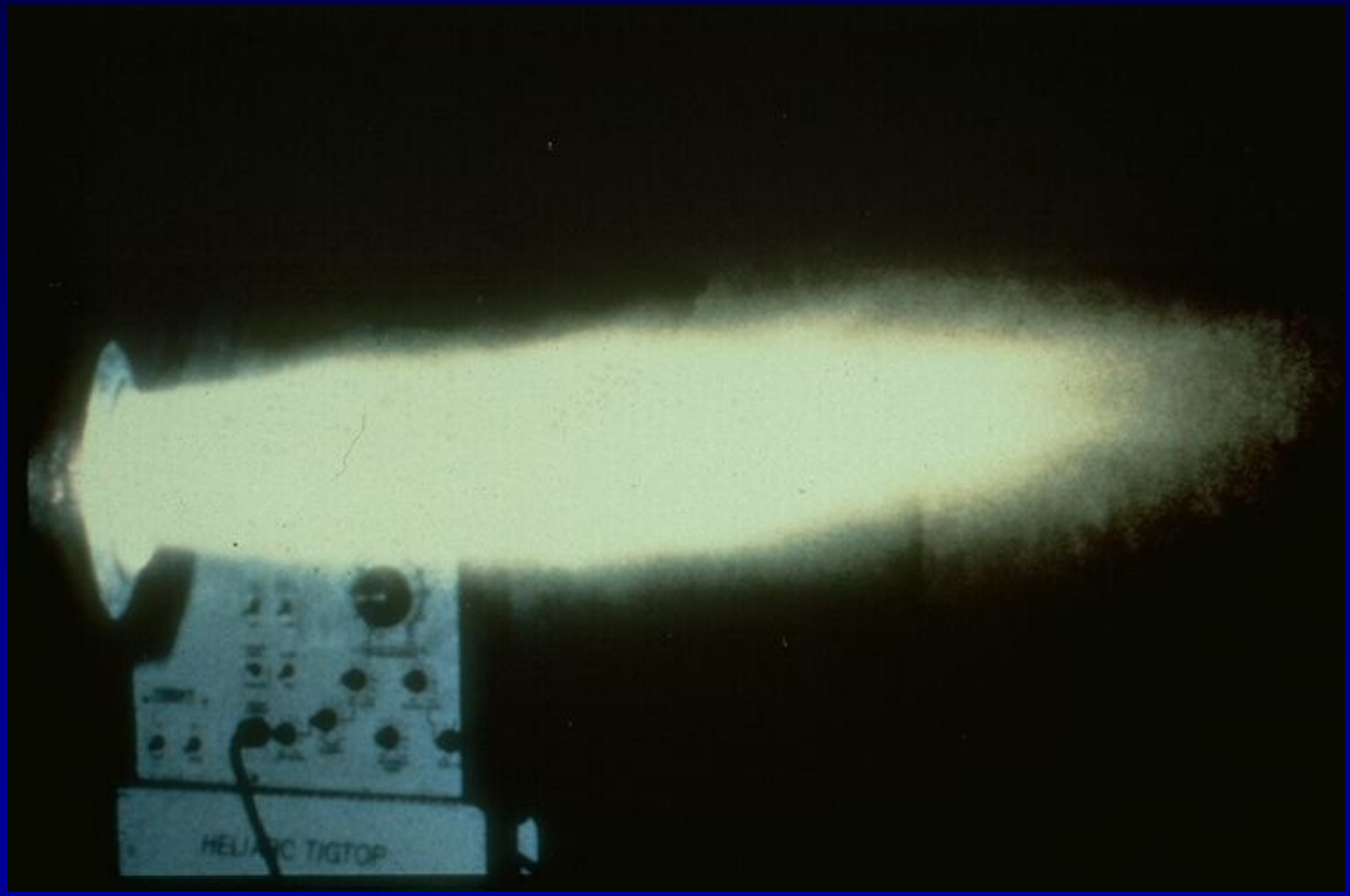
Plasma torch in operation



Characteristics of Plasma Arc Technology

- Plasma acts as a resistive heating element which cannot melt and fail
- Temperatures 4,000°C to over 7,000°C
- Torch power levels from 100kW to 200 MW produce high energy densities (up to 100 MW/m3)
- Torch operates with most gases – not a combustion process
- Elimination of requirement for combustion air
  - Reduces gas volume requiring treatment
  - Reduces potential for formation of dioxins and furans
- Permits in situ operation in subterranean boreholes

Plasma arc technology is ideally suited for waste treatment

- Hazardous & toxic compounds broken down to elemental constituents by high temperatures
- Organic materials
  - Pyrolyzed or volatilized
  - May be converted to fuel gases
  - Amenable to conventional off-gas treatment
- Residual materials (radionuclides, heavy metals, etc.) immobilized in a rock-like vitrified mass which is highly resistant to leaching

Plasma Arc Technology Remediation Facts

- No other remediation technology can achieve the sustained temperature levels (>7000°C) or energy densities (up to 100 MW/m^3)
- All known contaminants can be effectively treated or remediated
- Contaminated soil, rock, and landfill deposits can be readily pyrolyzed or immobilized in a vitrified mass

GTRI Plasma Arc Research

- Furnace

- In-situ

Current GTRI Plasma Research Initiatives

- Asbestos and asbestos-containing materials (ACM) destruction
- Municipal solid waste pyrolysis and energy generation
- Incinerator ash vitrification
- In-situ landfill remediation and reclamation
- In-situ vitrification of contaminated soils
- In-situ soil stabilization

French Asbestos-Containing Materials (ACM) disposal system

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MSW disposal

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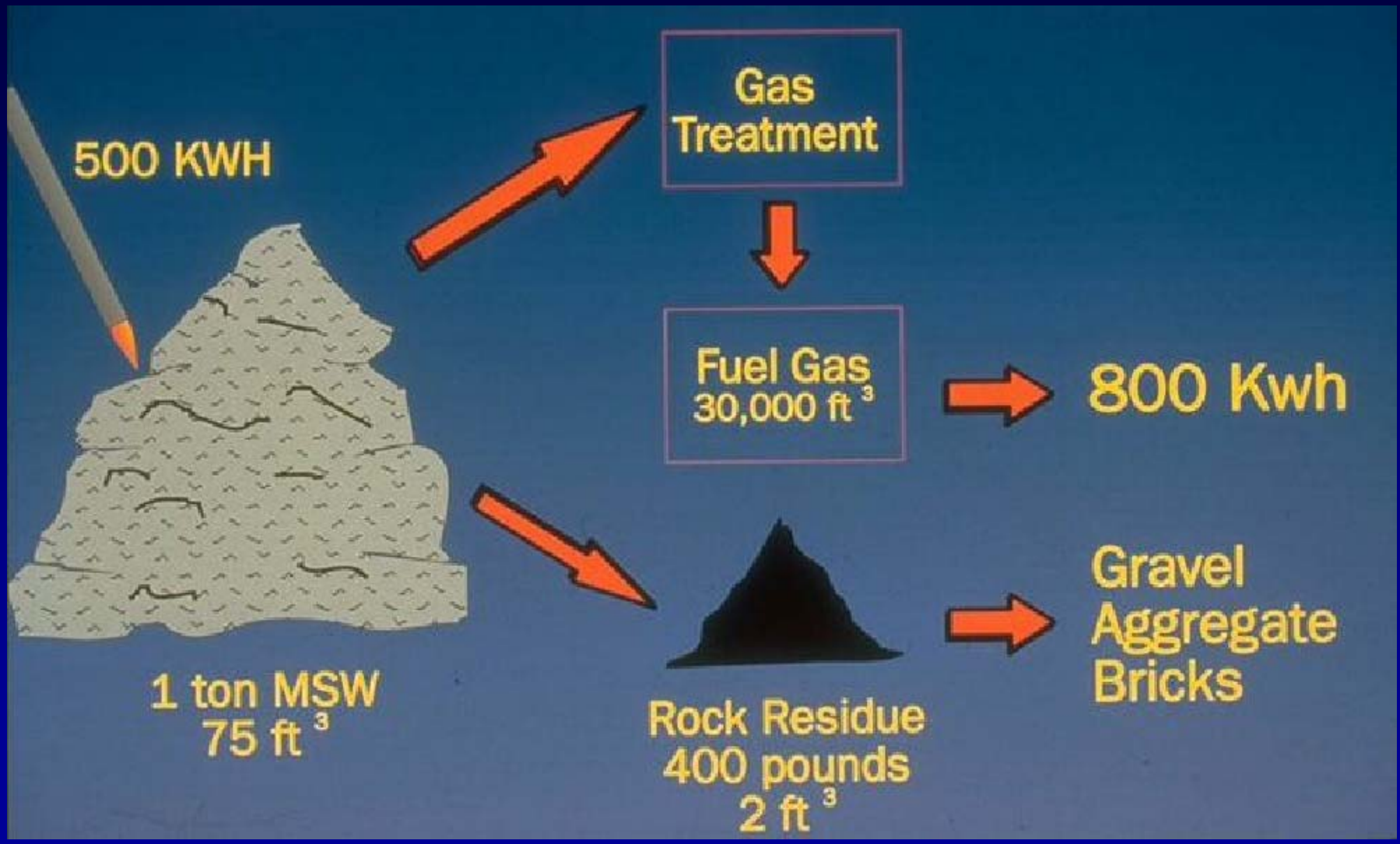
Pyrolysis of MSW



MSW Solid Byproduct Uses

Molten Stream Processing (Product)		Salable Product Uses
Air Cooling (Gravel)		Coarse Aggregate (roads, concrete, asphalt)
Water Cooling (Sand)		Fine Aggregate (concrete, asphalt, concrete products)
Water Cooling (Metal Nodules)		Recyclable metals
Air Blown (“Rock Wool”)		Insulation, sound proofing, agriculture

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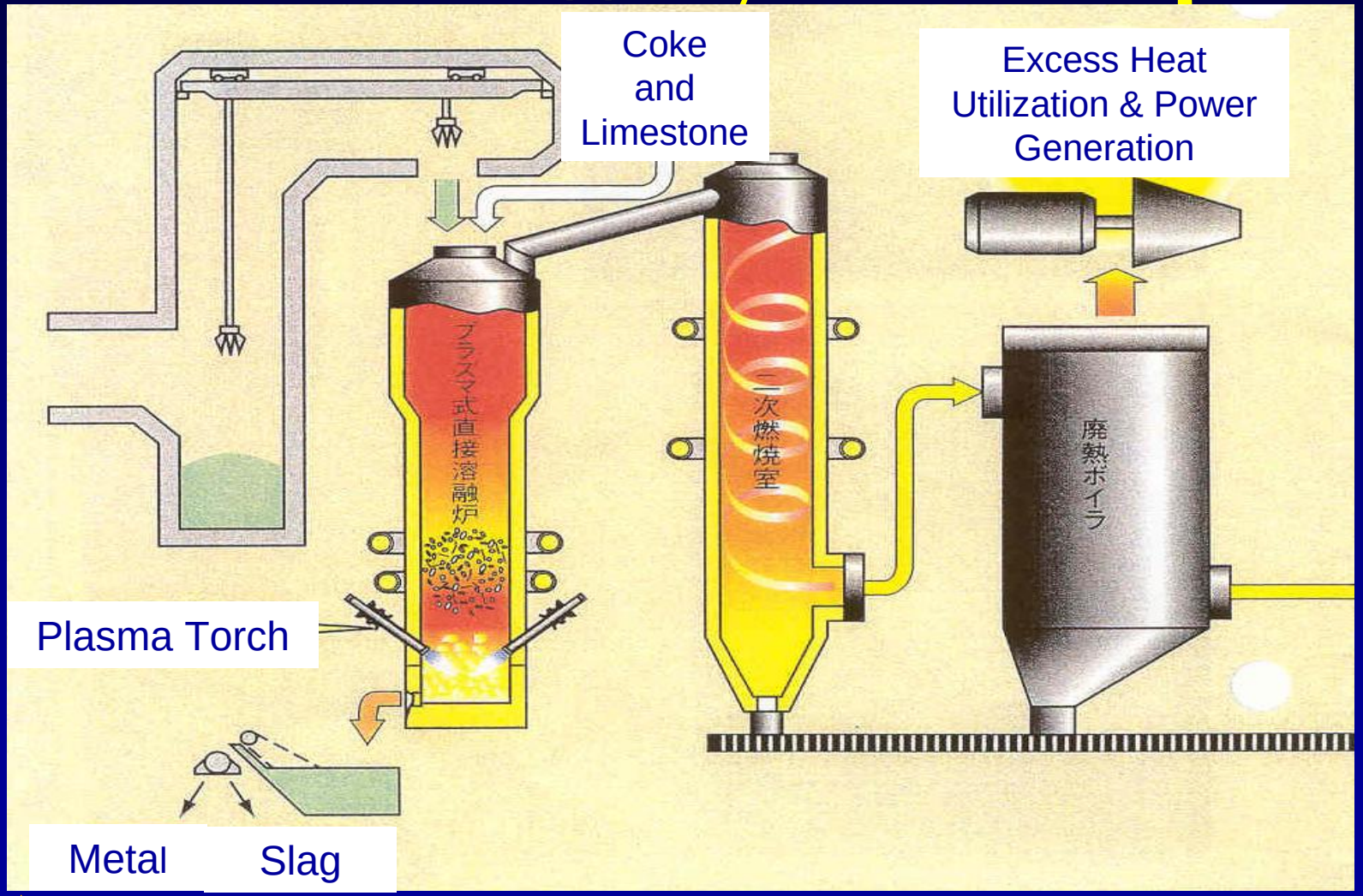
Ultimate MSW Disposal System Requirements

- Accept all solid and liquid wastes
  - No preprocessing
  - Include hazardous/toxic materials, medical wastes, asbestos, tires, etc.
- Closed loop system
  - No direct gaseous emissions to the atmosphere
  - No landfill requirements
- Total waste reclamation
  - Recover total fuel value of wastes
  - Produce salable residues (e.g., metal and aggregates)

Hitachi Metals
Plasma MSW System – Japan



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Hitachi Metals Yoshii Pilot Plant

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Hitachi Metals
200 TPD MSW Plant - Utashinai Japan

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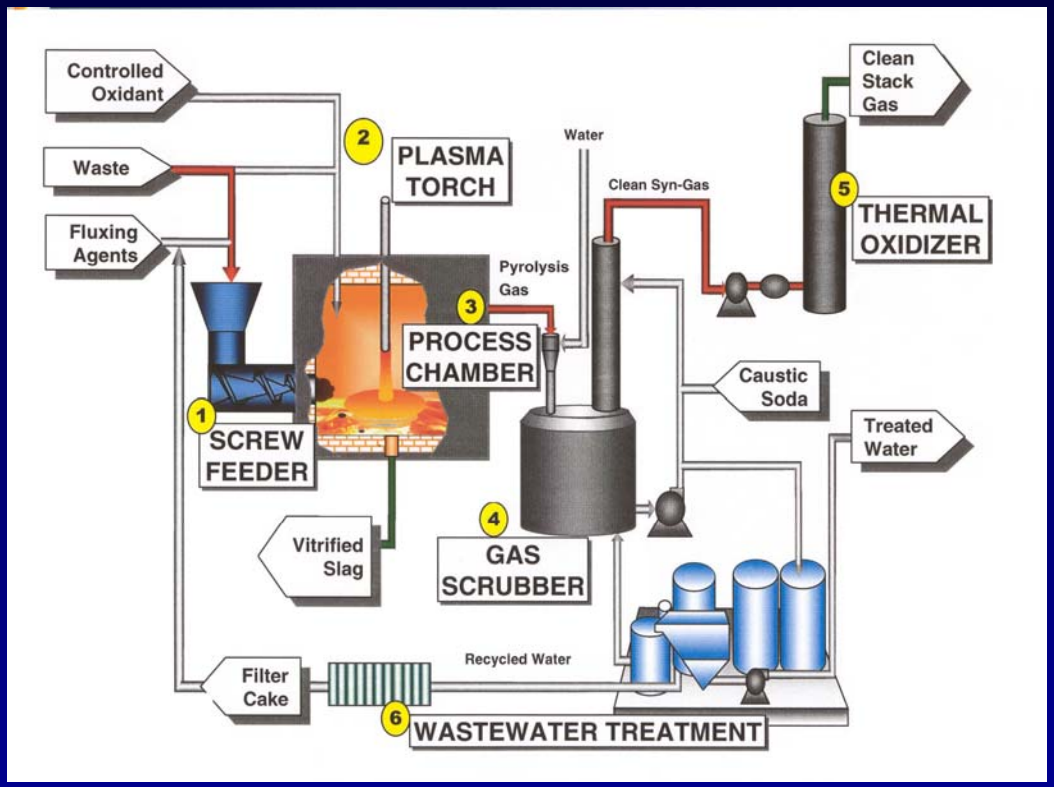
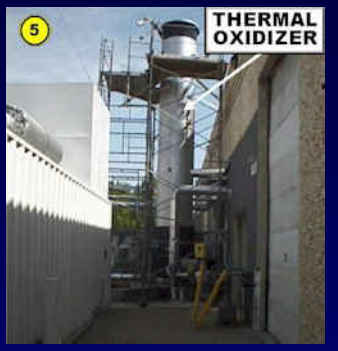
Georgia Tech Plasma Waste Processing and Demonstration System





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Mobile Plasma Energy Pyrolysis System (PEPS)

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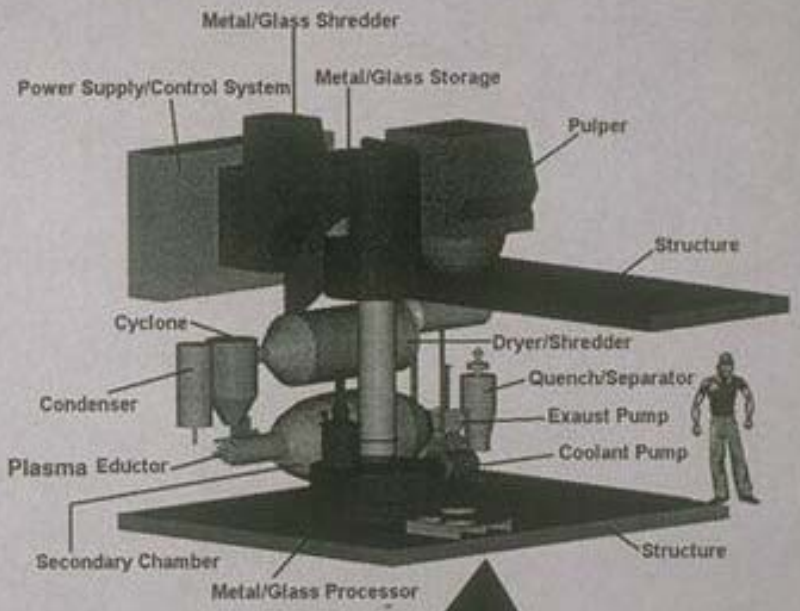
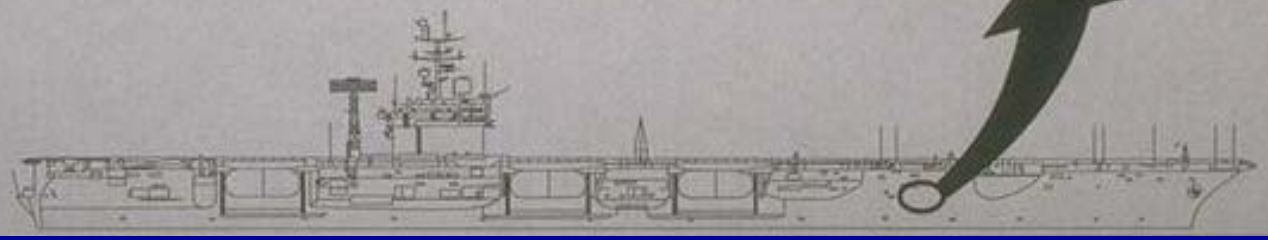
Navy Shipboard System

Basic components of shipboard PAWDS

- Two units operating, processing 425 lbs/hr – 18 hours/day
  - Organic 300 lbs/hr
  - Inorganic 125 lbs/hr
- Option for one or two deck installation
- Unit volume under 3333 cubic feet
- Pulpers could be used to transport much of the organic waste





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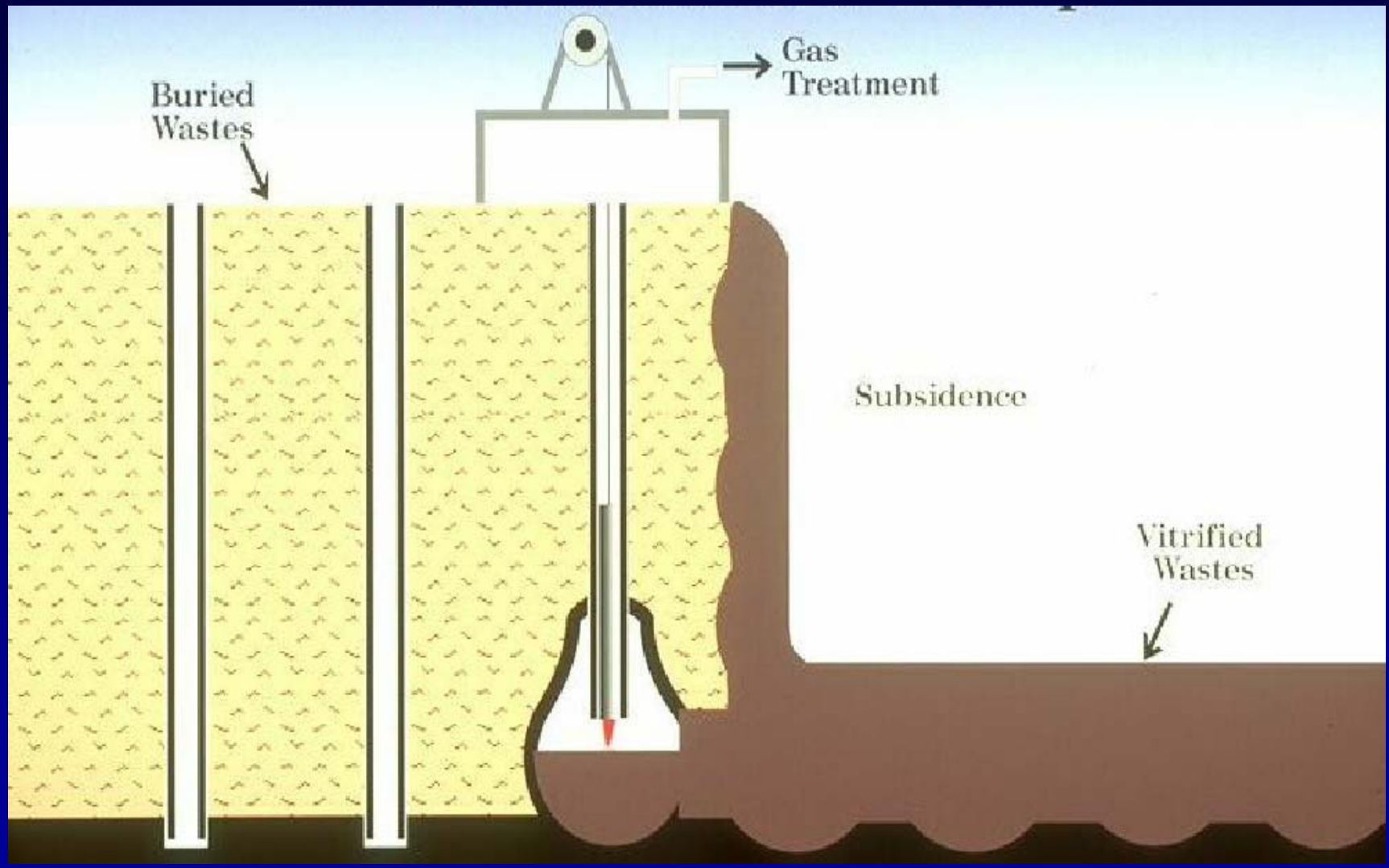
Landfill remediation concept



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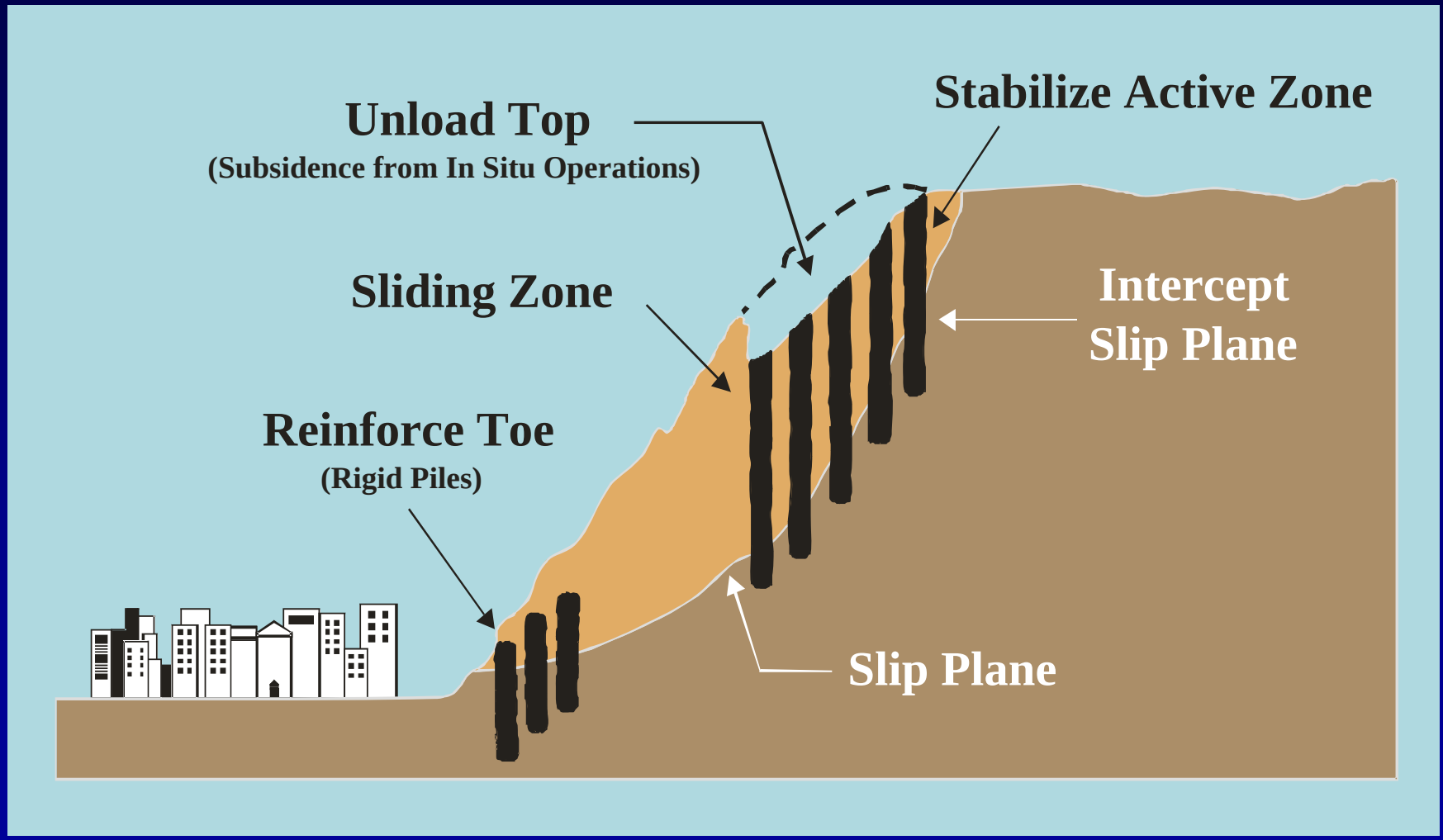
In Situ Plasma Vitrification (ISPV) Slope/Landslide Stabilization Options



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Plasma Processing of Waste Materials

Summary

- Plasma processing of municipal and industrial wastes has unique remediation capabilities unequaled by existing treatment technologies
- Plasma can provide permanent treatment of difficult-to-treat contaminants and wastes
- Plasma has the potential for significant reductions in the cost and time required for treatment of municipal and industrial wastes
- Recent demonstrations with industrial prototype plasma systems have verified that plasma processing of waste materials is ready for commercialization