Golden State Energy

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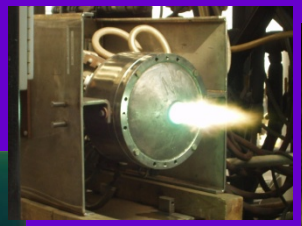
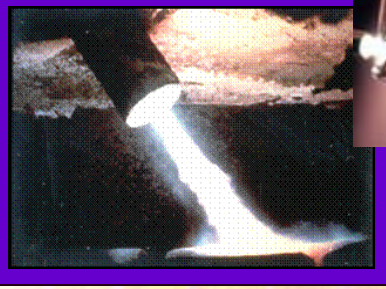
vision values measures concepts tools principles








Plasma Pyrolysis; A Technology Overview

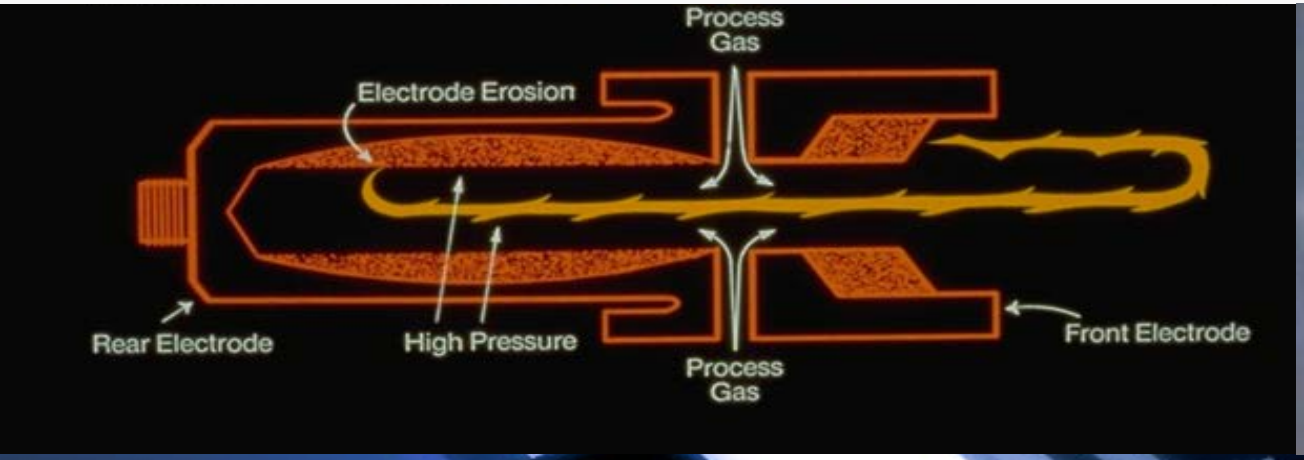
Waste Feedstock to Consumer Products

INNOVATION

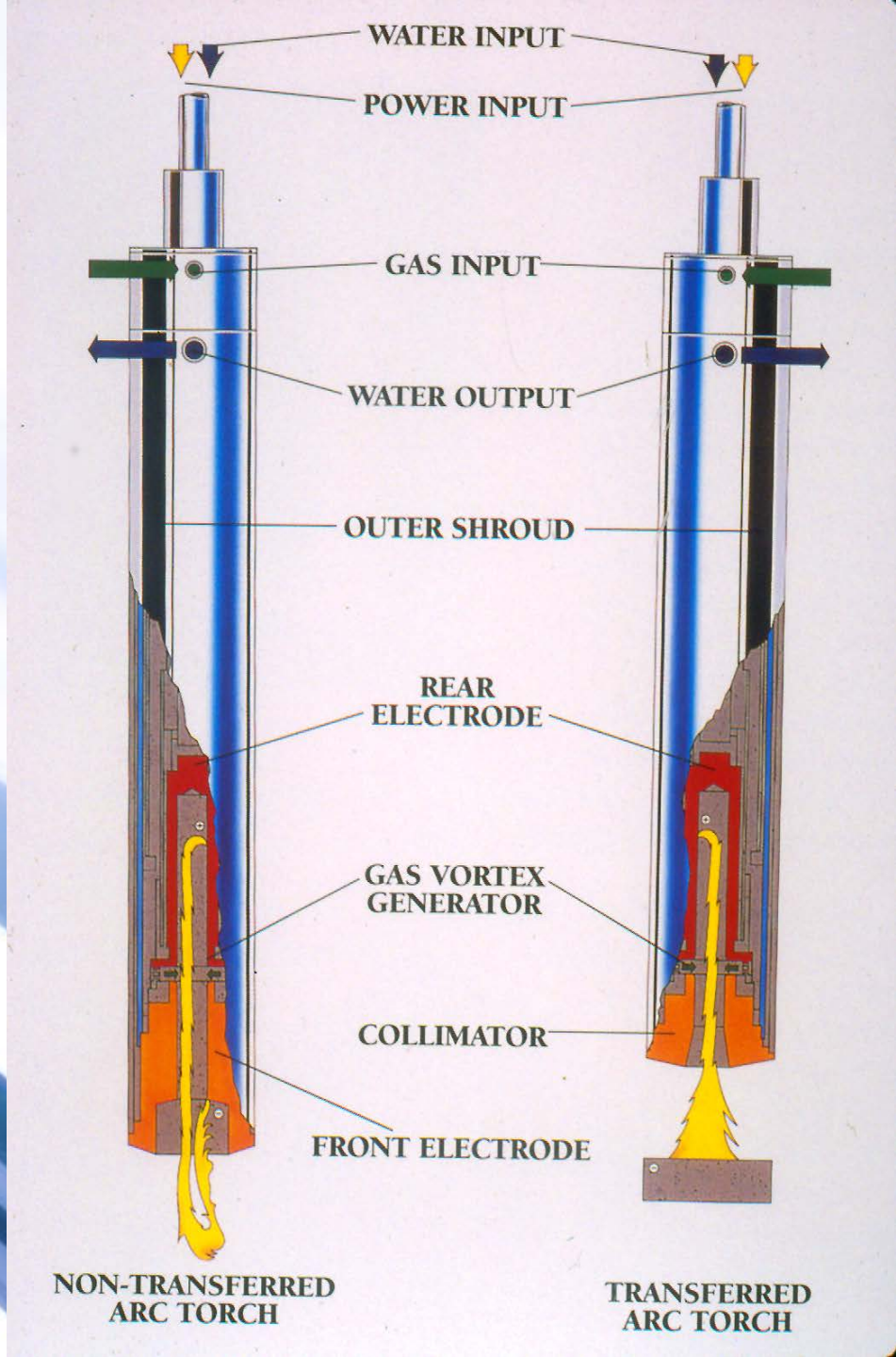
The Plasma Arc Torch

- Plasma is created from a column of ionized gas which conducts electricity; it is the “Fourth State of Matter.”

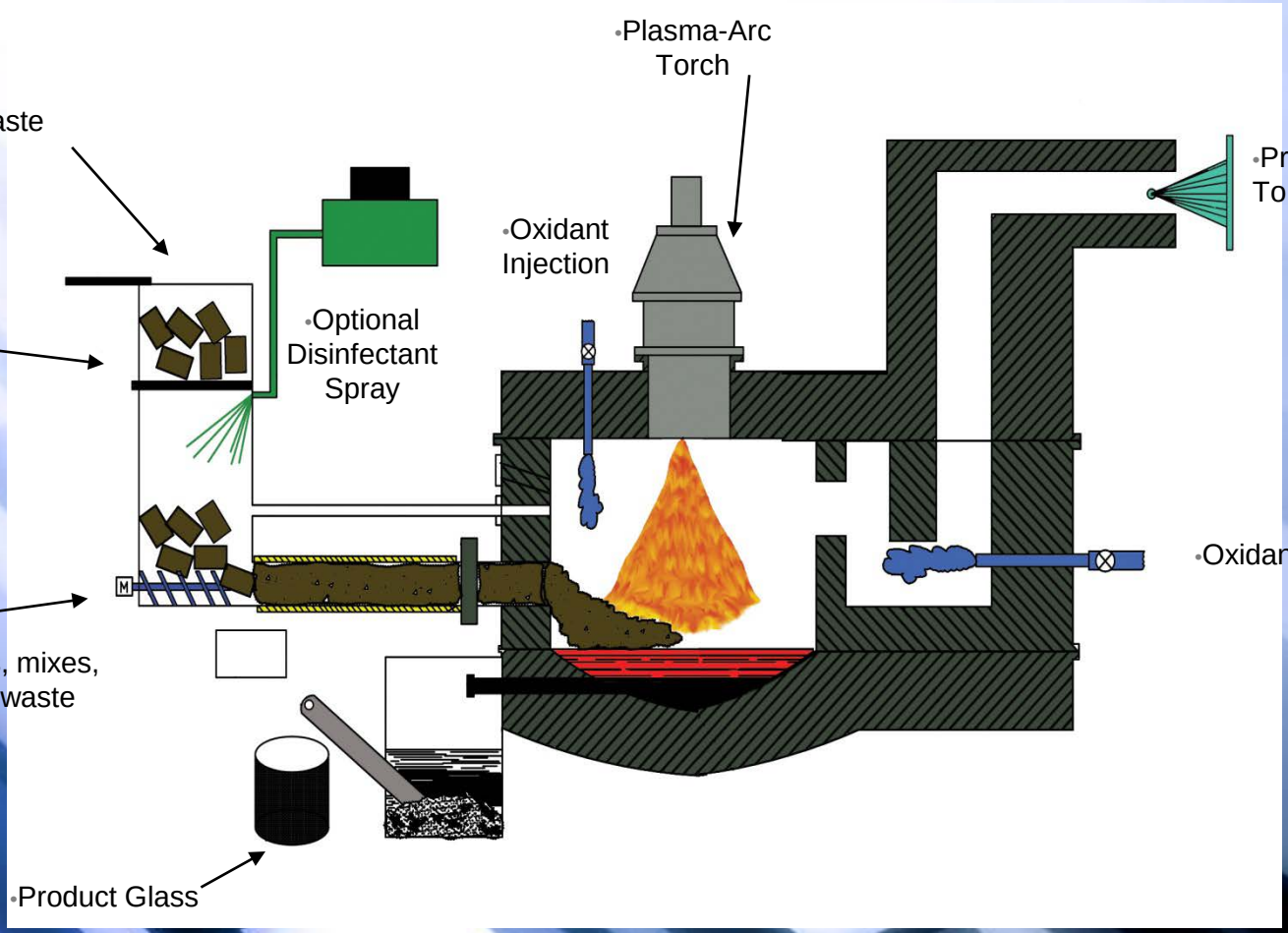
- A plasma torch is a device which converts electrical energy into thermal energy by generating a controlled plasma “field” of ionized gas. This ionized gas generates intense heat in the form of an arc. 25,000^{o}F average temperature in the arc.



Transferred & Non Transferred Arc Torch



The Plasma Process



Plasma Processing of Waste Streams

Metal recovery and recycling

- When certain metals are present in large quantities they can be recovered in a smelting process and reused
- Glass layer may be used as a floating cap on the molten metal
- Some metals are volatile at high temperatures and require filtration and removal in the gas treatment system

A small subset of the many types of waste found in a typical regulated medical waste (RMW) stream

Vitrified Glass from Medical Waste

Independent Lab TCLP Toxicity Test Results

Solid Glass Residue

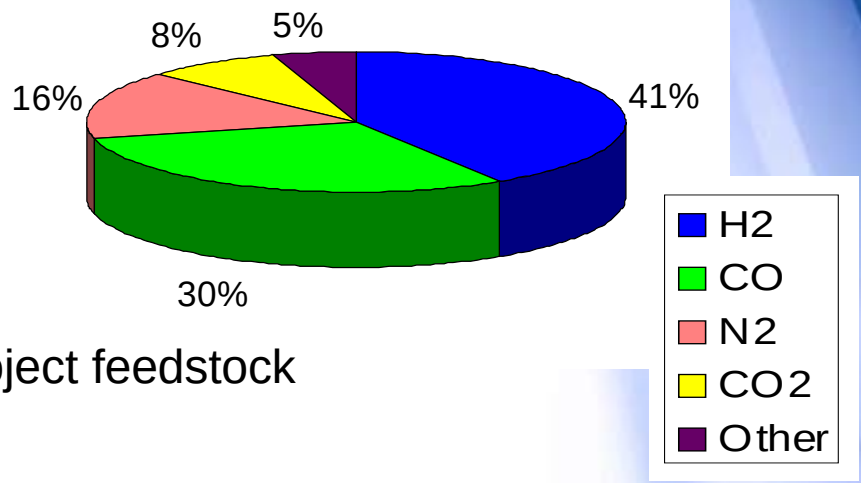
2,000 lbs Medical Waste = 150 Lbs Glass

* Permissible Concentration (mg/L), EP Toxicity

Arsenic	@<0.1	5.0*
Cadmium	@<0.02	1.0
Lead	@<0.2	5.0
Silver	@<0.5	5.0
Barium	@<0.5	100.0
Chromium	@<0.2	5.0
Mercury	@<0.01	0.2
Selenium	@<0.1	1.0

From Feedstock to Useable Products

Synthetic gas – “syngas”

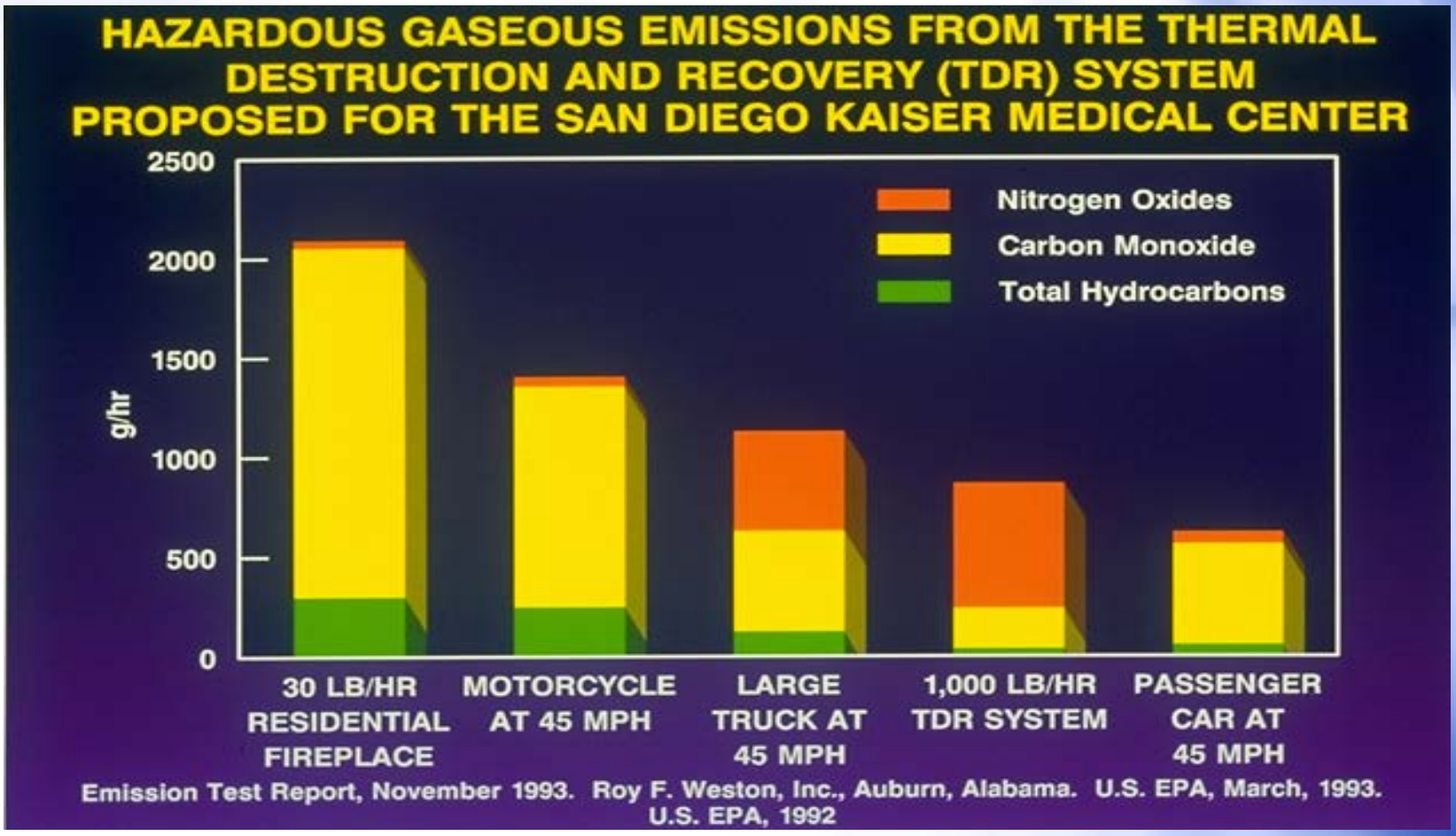


- Principally made up of Hydrogen and Carbon Monoxide
- Used as fuel for cogeneration
- Other uses: Hydrogen recovery, energy project feedstock (i.e. methanol or gas to liquid fuels)
- Approximate heat value: 9 to 11 MJ/Nm3 (~250 BTU/SCF)

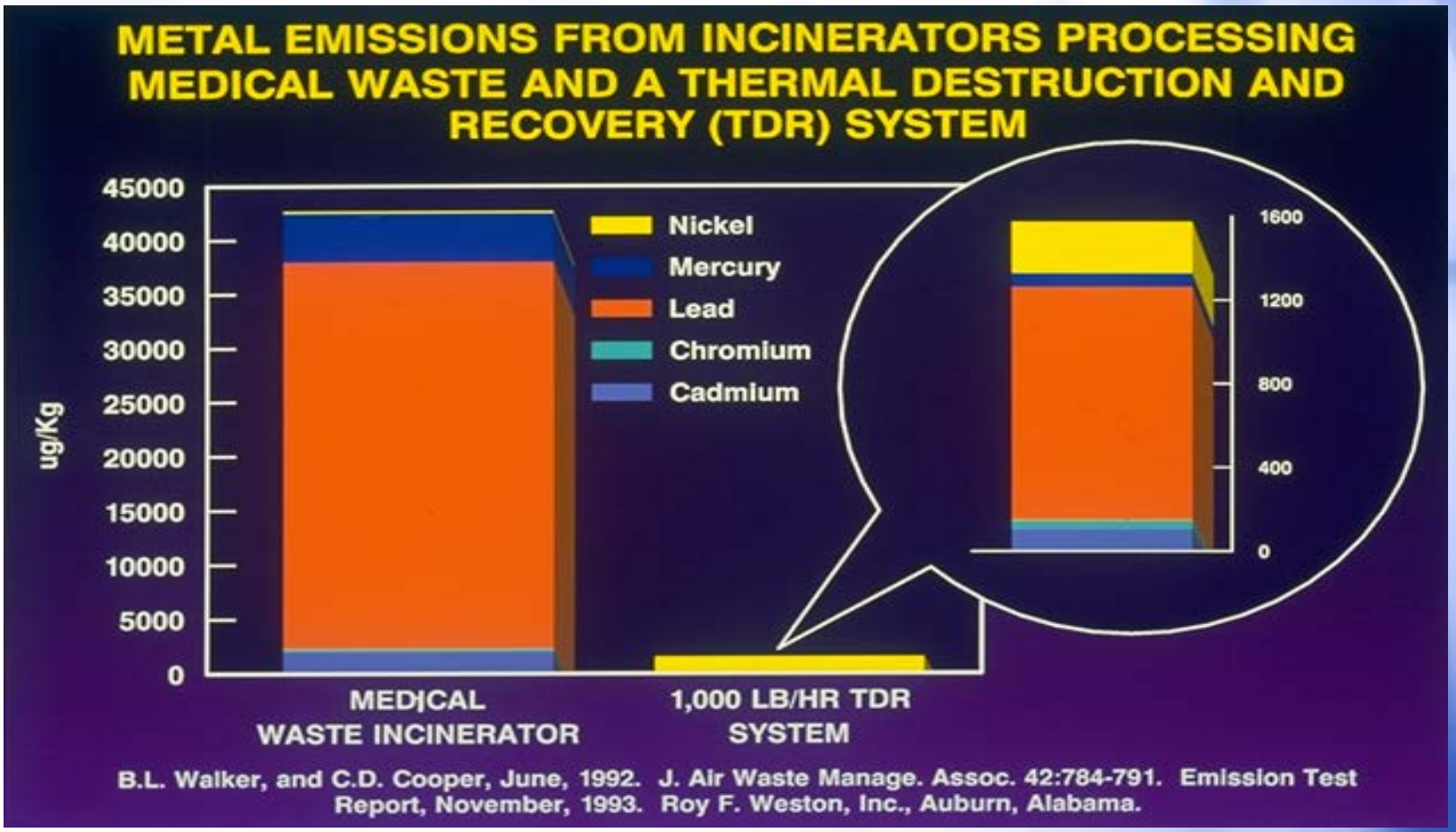
Silicate Slag/Metal Alloys

- Produced from inorganic materials
- Can be used for roadbed construction and concrete aggregate
- Can be used for glass products
- Metals can be sold to metal refiners for re-utilization

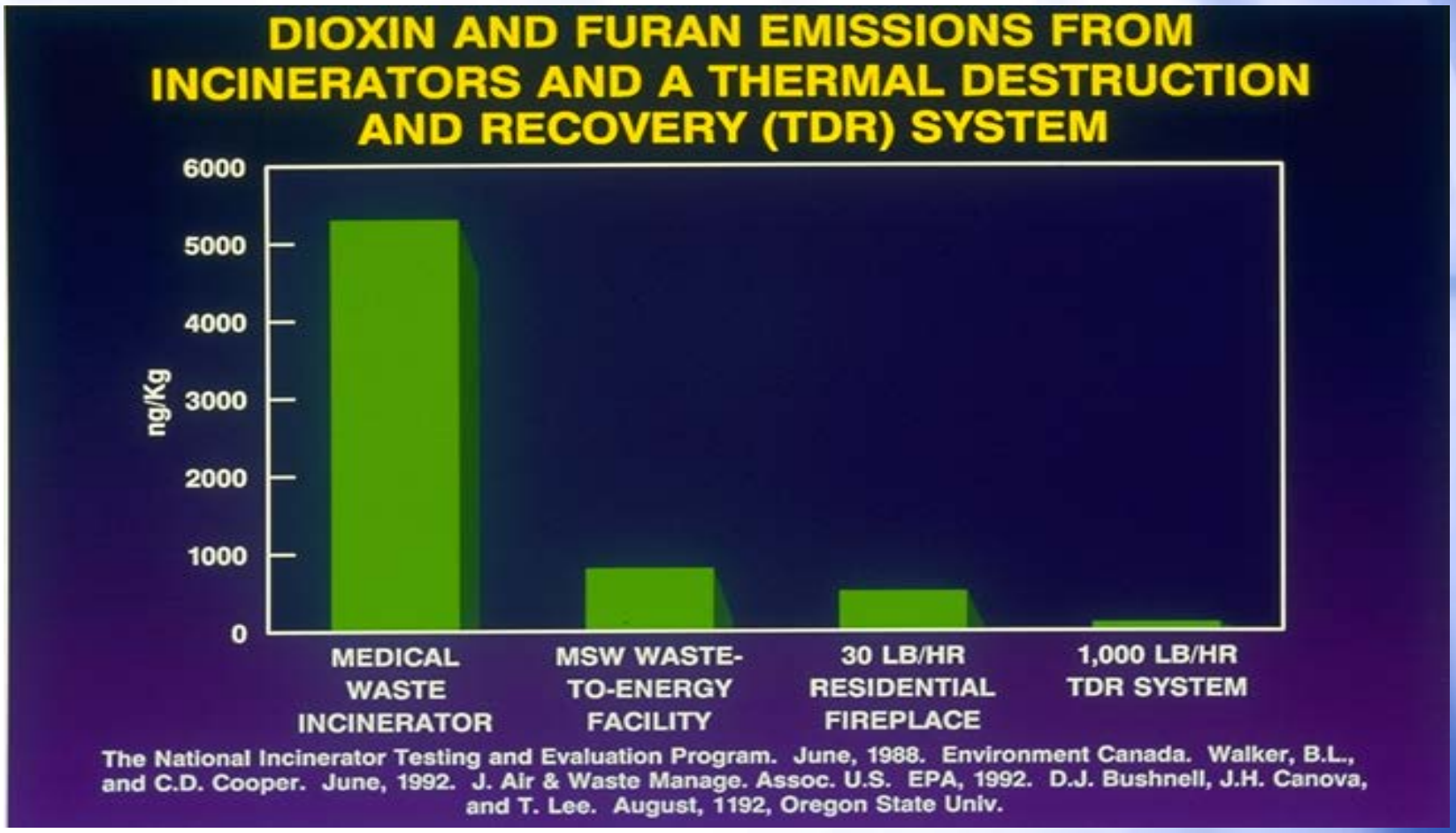
Hazardous gaseous emissions comparisons



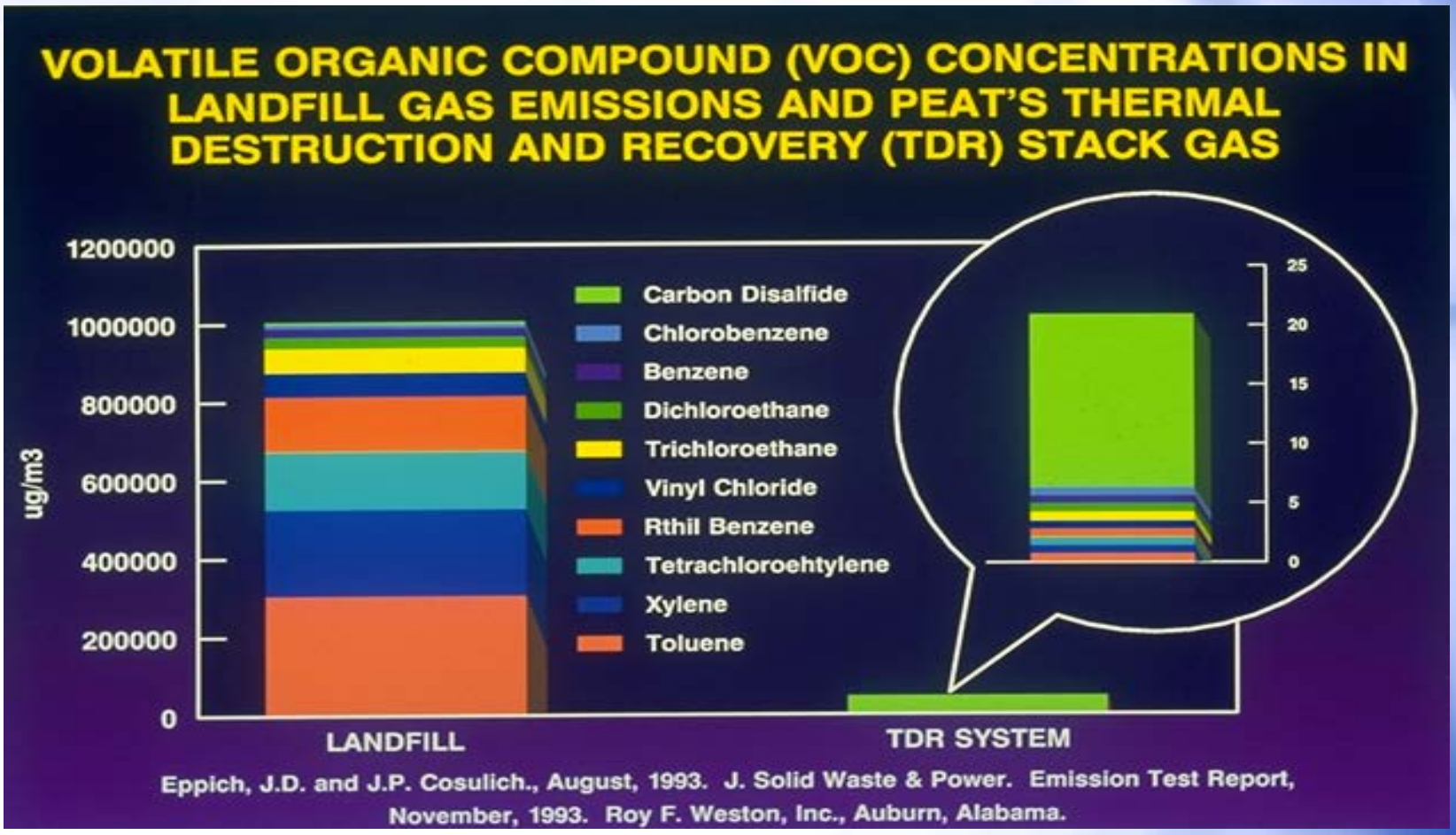
Metal emission comparison - incineration vs. plasma pyrolysis



Dioxin & furan emission comparisons - incineration vs. plasma pyrolysis



Emissions comparison of toxic-air contaminates; landfills vs. plasma pyrolysis



Lab Packs - Hazardous & Non-Hazardous Waste

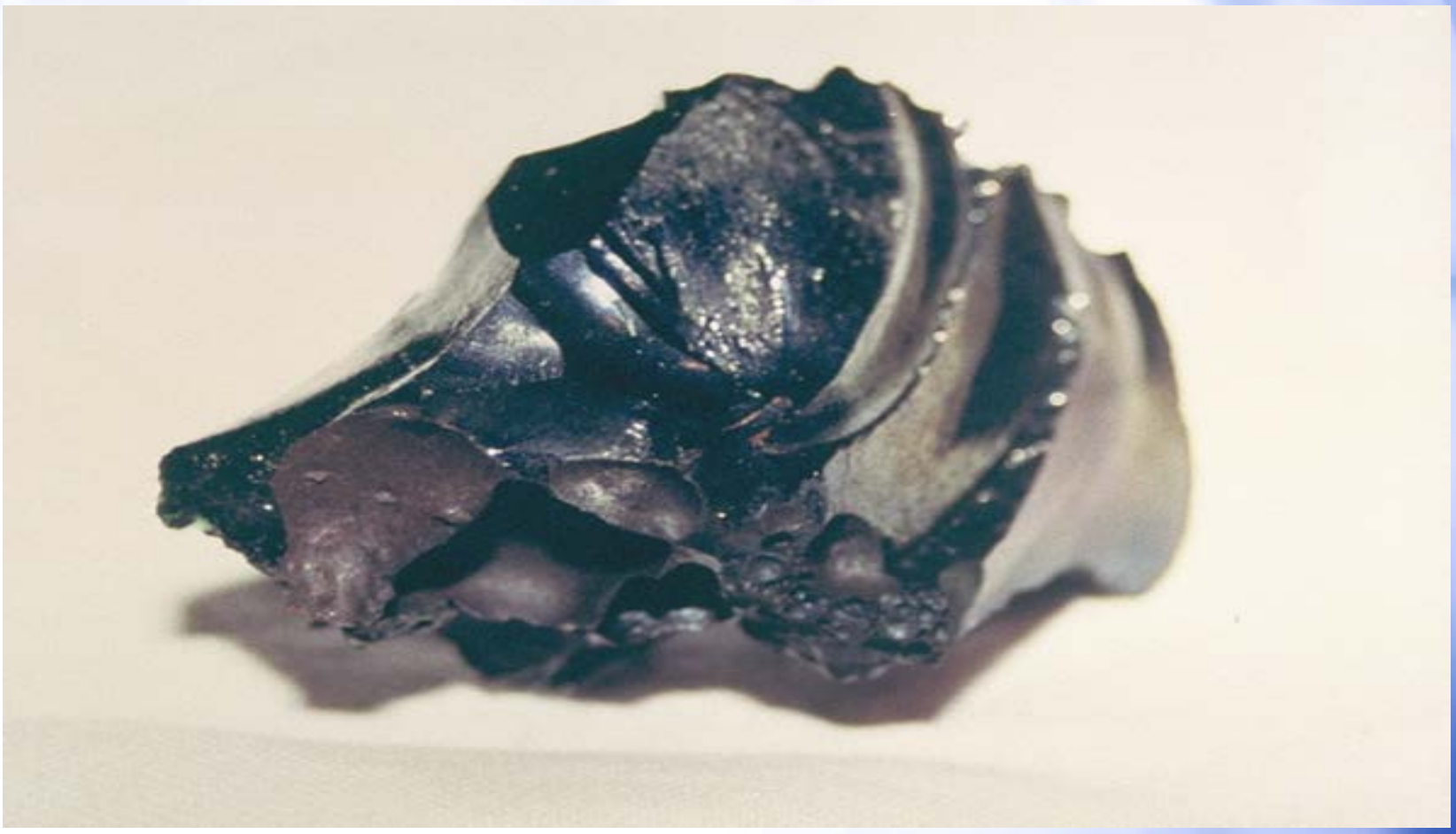
Successfully tested the destruction of illegal drugs for the U.S. D.E.A.

Rubbleized mix of organic and inorganic materials

Weapons Components Tests - Mechanical switches, hardened printed circuit boards, etc.

Thermal battery containing asbestos, mercury, lead, cadmium, arsenic, chrome, and other problematic materials

Non-leachable aggregate composed of various metals (including heavy metals) molecularly bound to glass. From thermal battery tests



Smoke grenades of all types

Munitions of all types and sizes

Energetic materials such as propellants, initiators and explosive bolts

Red water from the manufacture of TNT

Waste Materials Successfully Tested

Data compiled by PEAT and Independent Laboratories

1 = non-hazardous 2 = hazardous 3 = both

- 1 Municipal Solid Waste
- 1 Medical (infectious) Waste
- 1 Coal Ash
- 3 Contaminated Soils
- 3 Industrial Waste
- 3 Suspended Volatile Metals
- 2 Thermal Batteries
- 3 Oxidants
- 3 Weapons Components
- 2 Small Explosive Components
- 1 Marijuana and Cocaine
- 3 Solid and Liquid Organics
- 2 Lab Packs (Chemical Lab Wastes)
- 3 Lab Packs (Biological Lab Wastes)
- 2 Lab Packs (Adhesives and Paints)
- 1 Municipal Solid Waste Incinerator Ash
- 1 Surrogate Waste, Potting Materials & Gold
- 3 Pharmaceuticals
- 2 Pyrotechnic Ordnance
- 3 Contaminated Ash
- 2 Redwater Surrogate
- 1 Reactive Metals
- 3 Contaminated Dunnage
- 2 High Explosives
- 1 Remediation Waste
- 1 Refuse Derived Fuel
- 2 Bulk Liquid Organics (Solvents/Paints)
- 1 Asphalt and Municipal Waste
- 2 Weapons Components (crushed/rubble)
- 2 .50 Caliber Small Arms Ammunition
- 2 Small Energetic Components/DOD Weapons

Additional Proposed Applications

- m Chemical Warfare Agents
- m Radioactive Contaminated Waste
- m Mixed Waste

Plasma Process Designations

Non-Incinerator Designations

- Certified as a Non-Incinerator for Medical Waste in **California**
- Approved as Non-Incinerator for LLMW in **Washington** State
- Permitted in **Alabama** as Non-Incinerator for the Testing of Hazardous and Non-Hazardous Waste
- Permitted as Non-Incinerator in **Indiana** for Medical Waste and Special Waste Streams

Permits & Governmental Approvals

Other US permits received

- Huntsville, AL – 2 TPD, former R&D facility (Successfully performed hundreds of campaigns)
- San Diego, CA – 11 TPD at Kaiser Permanente Hospital, Certified as “Alternative to Incineration”
- Indianapolis, IN – 30 TPD at local industrial park

Numerous regulatory approvals throughout the globe

- ✓ United States EPA
- ✓ Taiwanese EPA
- ✓ Taiwan Ministry of Education
- ✓ Kaohsiung DEP
- ✓ Virginia DEQ
- ✓ Washington State
- ✓ Alabama Dept. of Environmental Management
- ✓ City of Huntsville Natural Resources Division
- ✓ San Diego Air Pollution Control District
- ✓ State of California (DHS approval)
- ✓ Indiana Dept. of Environmental Management

Possible Uses of Product Glass

For More Information:

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