

# Emerging Technology Forum

## “International Experience”

Pyromex Ultra-High Temperature Technology Development

April 17, 2006

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# Environmental Factors Driving Development

- In the mid 1980's Germany and the other EC countries started addressing environmental issues regarding waste material disposal and incineration
- The countries began tightening legislation regarding landfills and incinerations
- Demonstrated a desire to derive usable products from non-recyclable waste material
- Initiated efforts to eliminate air emissions from disposal originating from incineration and landfill gases
- Investigated and evaluated alternate waste elimination methods

# Pyromex Initial Technology Development

- 1989 developed a waste neutralization and solidification system
- System processed both liquid and solid waste into a solid inert building material
- 1992 commercial scale demo facility operational in Switzerland
- 1993 European Community in Brussels passed legislation to reclassify waste material.
- New legislation made full scale commercialization and facility permitting impossible
- Pyromex remained committed to developing an alternate technology to address landfill and incineration issues

# Pilot Solidification System

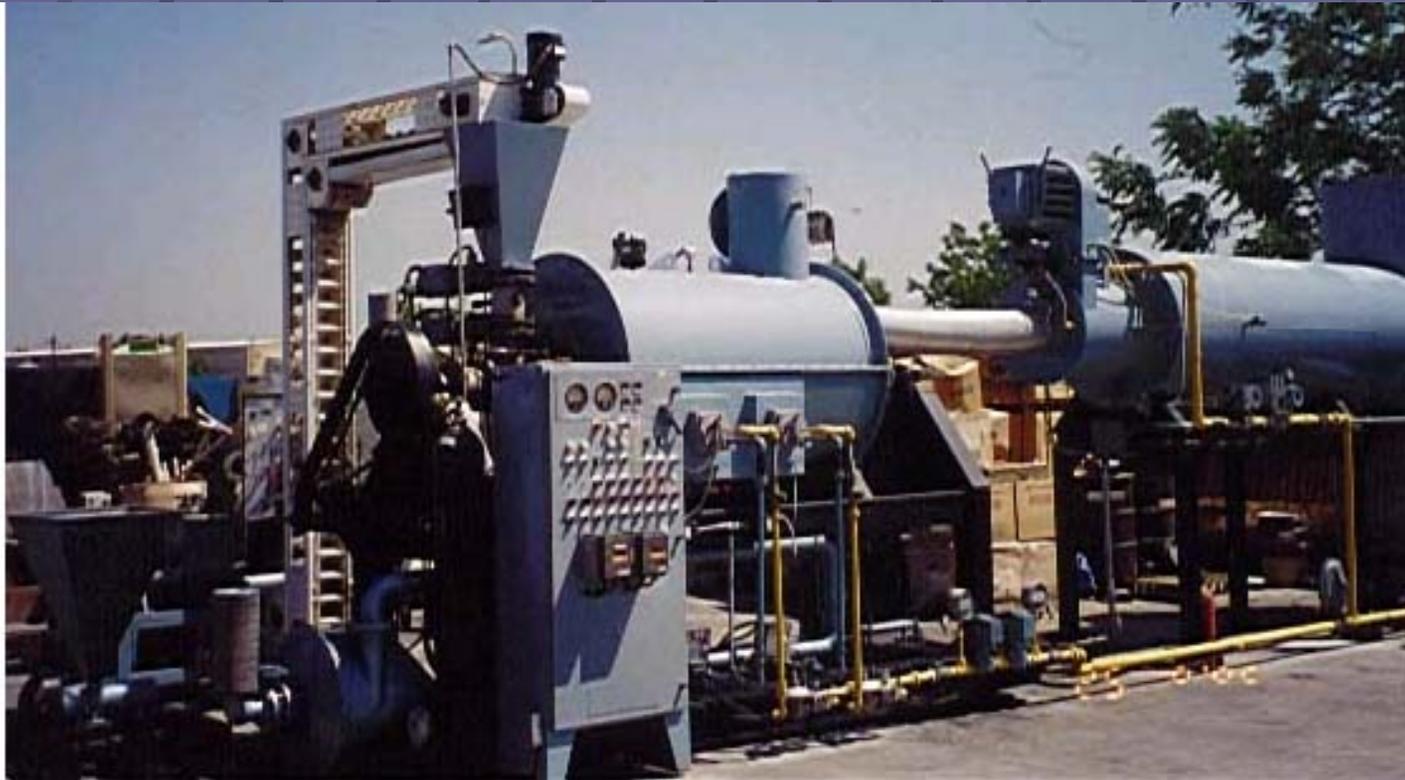


Switzerland 1989 - 1992

# Evolution of Gasification Technology Development

- 1993 Renewed commitment to develop new technology that would meet new legislation while replacing incineration technology and reducing landfill requirements
- Pyromex engineers and scientists had extensive experience with Pyrolysis and Gasification
- Focused effort on developing new gasification process to solve known problems
- Developed Ultra-High Temperature gasification process
- Set out to design technology that would support new theoretical gasification process model

# High Temperature Gasification Prototype



Gasification of pelletized solid waste - 1993

# Development Objectives

- Support multiple waste streams, toxic and non toxic
- Target non-recyclable waste streams
- Maximize reduction of waste material
- Eliminate all toxic residue from the process; no ash or char
- Minimize oxygen within the process; less than 1%
- Eliminate any combustion; no dioxins or furans
- Target total decomposition of organic content
- Maximize the generation of synthetic gas
- Eliminate any oxygenation step in the process
- Minimize or eliminate any emissions; environmentally acceptable

# Ultra-High Temperature Gasification Characteristics

- Operational temperatures between 1200 and 1700 C
- Effective for a wide range of waste streams
- Energy efficient induction heating, direct not indirect
- Thermal decomposition in oxygen free environment
- Continuous feed operation
- Minimal amount of inert, non-leachable residue
- No ash, no char, no tar, emissions and no stack
- Small footprint
- Most efficient and cost effective means to convert waste to energy
- Delivers energy in the form of heat, steam, electricity or hydrogen

# Ultra-High Temperature Test Unit



Industrial Scale Testing - 1995

# EU Environmental Standards

- EU continues to expand and implement stringent regulations regarding limiting landfill and recycling
- EU standards address both landfill and emission standards
- Many EU countries have additional environmental and emission standards
- Germany developed the most stringent environmental and air quality standards in the world
- EU developing strict end-of-life regulations for most manufactured products

# Municipal Solid Waste Legislation

- Austria –limits landfill of organic material with greater than 5% organic content
- Switzerland –bans landfill of solid combustible waste
- Netherlands – bans landfill of solid combustible waste, paper and cardboard; municipal waste landfill banned since 2000
- France – bans landfill of combustible solid waste
- Great Britain – targets recycling of 25% of municipal solid waste
- Denmark – bans landfill of combustible solid waste

# European Committee Study

- Funded by Energy, Environment and Sustainable Development Committee in Brussels
- Two year study focused on hard-to-treat, non-recyclable organic waste
- Concentrated on Pyromex Ultra-High Temperature gasification technology
- Concluded that Pyromex UHT gasification met all environmental standards and is well suited for waste elimination and generation of clean energy from non-recyclable organic waste
- Full study results available

# 25 ton/day facilities



Commercial Waste Water Sludge Facility  
Emmerich, Germany - 2004

# Current German Permitting

Farming & Animal Waste, including dairy, chickens & hogs

Natural Fiber

Plastic Waste, including chlorinated plastics

Wood chips

Waste from leather and fur industry, including chrome contaminated

Fly-ash from Power Plants, including, slag, dust, rust from incinerators

Packaging material, including paper, cardboard, plastic & wood

Waste from car recycling, including ASR, oils & tires

Medical waste, including hospital waste category A

Sewer sludge, including sludge from waste water works

Shredder waste, including light fractions & dust

Residue from mechanical treatment, sorting, shredding & pelletizing

# Legislative & Regulatory Reality

- EU is serious about environment and emissions
- EU legislation is forcing compliance with new environmental and emission regulations
- They recognizes that legislation and regulations alone can not accomplish the goal; scientifically sound technology is required
- Legislatively they have moved beyond classifying gasification as an incineration technology
- They have a willingness to accept new technologies that meet or surpass new standards
- They have an openness to accept new technology and solid science