Innovative Technology Reduces Power Plant Emissions – Commercialization Success

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Overview of Emission Control System Development

- Development of new oxidizer scrubber system to eliminate NOx waste and produce fertilizer
- Technology licensed and a 1 to 3 MWatt-scale prototype installed on power plant
- Development of method to oxidize NO to NO₂
- Experience gained from licensing NASA technology
Development of New Scrubber Liquor
Transformation of Waste to Fertilizer

Nitrogen Tetroxide ($N_2O_4$)

Oxidizer Scrubber
(pH 14+)

Sodium Hydroxide (NaOH)

Products are a hazardous waste

Sodium Hydroxide, Sodium Nitrate, Sodium Nitrite, Nitric Oxide

Hydrogen Peroxide ($H_2O_2$)

Nitrogen Tetroxide ($N_2O_4$)

Oxidizer Scrubber
(pH 7)

Water ($H_2O$)

Potassium Hydroxide (KOH)

Potassium Nitrate (KNO₃)

Product is high grade fertilizer
New Scrubber Liquor System
Efficiency vs. Scrubber Liquors

- 25% NaOH: 75.9%
- 0.1% H₂O₂: 95.9%
- 0.5% H₂O₂: 96.5%
- 1.0% H₂O₂: 95.2%
Efficiency vs. pH at Various Peroxide Concentrations

- 0.1% H2O2
- 0.5% H2O2
- 1.0% H2O2
- 5.0% H2O2
NO Oxidation Testbed
Catalyst Support
Catalyst Holder
Laboratory Conversion NO to NO₂

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Time, Minutes
0:00 0:07 0:14 0:21

Concentration, PPM
0 50 100 150 200 250

- NO
- NO₂
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Efficiency vs. NO$_2$ Concentration

![Graph showing efficiency vs. NO$_2$ concentration.](image)
Hydrogen Peroxide Concentration vs. Scrubber Efficiency

- Efficiency, %
  - 100%
  - 80%
  - 60%
  - 40%
  - 20%
  - 0%

- Peroxide Concentration, %
  - 0
  - 1
  - 2
  - 3
  - 4
  - 5
  - 6

Peroxide Concentration, %
Efficiency vs. Scrubber Pump Rate

Efficiency

0%  20%  40%  60%  80%  100%

Pump Rate, mL/min

0  100  200  300  400  500  600  700
Initial Installation
Flue Gas From Furnace Exhaust

- Duct

Blower 40 HP

Cooler/CO Pot
- 6' H
- 3' D
- 5' Normal Level

Gas

H2O

Drain

SOx Scrubber
- 15' H
- 4' D
- 100 gal Normal Level

Duct

NOx Oxidation
- 8' H
- 3' D

H2O Oxidation Pump
4.0 gph Max.

NASA Controller/Analyzer

H2O2 - 3/8" SST

or 3-way valve here

H2O2 - 3/8" SST

Treated Gas to Furnace Exhaust

Grade

NOx Scrubber
- 30' H
- 4' D - 5' D
- 250 gal Normal Level

NOx Sump Pump

Drain

H2O2 Tote

Need PSV
View 2nd Installation
Top View 2nd Pilot Plant
Initial installation of Pilot Plant
Pilot Plant Results
SOx Scrubbing and NO Oxidation
Phoenix Systems International, Inc

- Company Information
- Licensing Experience
- NASA Support
- Patent Protection
- Value of NASA Commercialization Efforts
- Teaming with Other Organization