New Environmentally Friendly Halon Alternative

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Overview

- Extinguishing Concept
- Methods Used to Prepare Agent, HABx
- Products
- Testing
  - DSC/TGA
  - Density
  - Water Retention
- Performance Data
- Project Status
  - Production of 100 to 200 lbs
  - Testing
  - Current Research
- Future Development
Extinguishing Concept

- Effects of Water
  - Energy Extraction
  - Oxygen Displacement

- Halons
  - Inhibition of Combustion Process
  - Oxygen Displacement

- Environmental Effects
  - Global Warming
  - Ozone Depletion

- Toxicity
  - Materials Used
  - Testing
In-liquid Drying

- Water Phase 1 – Encapsulated Water Solution
- Organic Phase – Fire Retardant Polymer in Organic Solvent
- Water Phase 2 – Gelling Agent in Water
Homogenizers
Selective Polymer Solubility

- Aqueous Phase
- Emulsion of Aqueous Phase in Organic Phase
- Add Second Organic Non-Solvent
- Isolate Encapsulated Agent
- Fire Retardant Polymer In Organic Solvent
Interfacial Polymerization

- Water Solution of Diamine and Emulsifier
- Organic Solution of Diacid Chloride
- Encapsulated Water Solution in Fire Retardant Polymer
Interfacial Polymerization Drop Method
Freeze Drier
Physical Properties

- Density
  - Filled capsules density greater than water
  - Capsules with voids float

- Size Distribution
  - Microscope measurement
  - Sieving

- DSC/TGA Data
Collection of HABx Microspheres

32.00 micron

30.00 micron
Sonic Sieve
DSC/TGA Analysis of HABx

Sample: Polybromostyrene, 4/14/03

Graph shows the weight loss and temperature changes over time for the sample Polybromostyrene.
Encapsulated Water
Water Retention

Microcapsules were stored in open container in laboratory at ambient temperatures 70 to 74°F and 45 to 55 percent relative humidity
Performance Testing

- Apparatus
- Preliminary Test Results
- Final Test Results
- Conclusions
  - Particle Size Distribution
  - Flame Residence Time
  - Unreacted Material
- Recommendations
  - Large-scale Testing
  - Combustion Product Analysis
  - Toxicity Testing
Particle sizes ranged from 1-2 µ to 38 µ with average size 20 to 30 µ. The wall thickness for the larger particles appears to be approximately 0.5 µ and much smaller for small particles.

*Images supplied by Dr. Harsha K. Chelliah, Dept. of Mechanical and Aerospace Engineering, University of Virginia, Charlottesville, VA
Counterflow Burner with Fluidizer

- **Counterflow burner**
  - Pyrex co-annular nozzles with nitrogen co-flow on both fuel (methane) air sides.
  - Produces stable flat flame
  - Hot combustion gases evacuated with mass flow ejector.

- **Particle Seeder**
  - Typical particle mass fraction is 1% or approximately 0.1 gm/min
  - Steady feed rates from <10 to 100 µ
  - Best performance with <30 µ particles

Harsha Chelliah, Dept. Mechanical and Aerospace Engineering, University of Virginia, Final Report, NIST Grant No.: 117680
Initial Testing

Final Report

Data from Initial testing and final report (Harsha Chelliah, Dept. Mechanical and Aerospace Engineering, University of Virginia, Final Report, NIST Grant No.: 117680)
Observations and Conclusions

Observations

- Best performance with particles less than 30 µ
- Mass flow determined by weight of trapped particles on filter
- Orange streaks indicate only small fraction of particles decomposed

Conclusion

- Rate of decomposition too slow
- Heating rate too slow and does not approach decomposition temperature. This is likely for particles greater than 20 to 25 µ
- Calculated mass of a 35 µ particle is 5.34 times that of a 20 µ particle, which suggests that the measured mass percentage may be high if larger particles did not react in flame
Current Status

- Production of 100 to 200 lbs of HABx for Large-scale testing
- Development of new production technologies
- Testing Program
  - Performance Testing
  - Toxicity Testing
- Development of Manufacturing Capabilities