SOLIMIDE Foams

Lightweight, Flexible, Thermal and Acoustic Insulating Materials for Use Where Fire Resistance, Extreme Temperatures or Weight Savings Are Critical Considerations

...such as Aircraft!
Background

- SOLIMIDE Foam is supplied by Evonik Foams, Formerly Imi-Tech / Inspec Foams, subsidiary of Evonik Industries
- Developed in conjunction with US NASA following APOLLO fire that resulted in three astronaut deaths
- Possesses unrivalled advantages over traditional insulating materials
- The thermal/acoustic insulation product of choice for solving tough problems aboard marine vessels, aircraft, aerospace and in industry worldwide
Chemistry

- Polymer with predominantly imide linkages formed during polymerization
- High glass transition temperature [235°C]
- Good solvent/chemistry stability

Key Characteristics

- Open cell foam, low weight [5 to 9 kg/m³]
- Temperature stability [cryogenic to 300°C]
- Low off-gassing
- Flexible, semi-rigid, compression recovery
- Heat/Pressure formable to some degree
Marine Market

- Thermal / Acoustic Hull Insulation
- Thermal / Acoustic Bulkhead Insulation
- Ceiling Panels
- Hangar Deck Insulation
- Beam Wrap
- Duct Wrap
Rail Market

- Heating, ventilation & air conditioning systems
- Engine compartments
- General noise and thermal control

SOLIMIDE® FOAMS
Cryogenic Market

- Expansion joints for tanks / pipes
- Pipe supports
- Containers / tanks
Appliance, Electronics, Instrumentation Markets

- Industrial high temperature applications up to 300°C
- Ovens
- Gaskets
- Space-constrained areas
- Sensitive optics / electronics
Aircraft / Aerospace Market

- Duct insulation
- Fuselage blankets
- Bleed air ducts
- Cryogenic fuel tanks
- General noise, vibration and thermal control

- Boeing SeaLaunch
- Ariane 5
- Atlas Centaur
- Atlas V
- NASA Space Shuttle
- International Space Station
Aircraft Benefits

• Low weight with good thermal and acoustic insulating properties

• Excellent fire resistance – passes FAR 25.856 (a)

• Virtually no smoke or toxic gas emission

• Formaldehyde and fiber free

• Rigid, self-supporting foam; fewer fasteners for lower weight, faster installation and inspection

• Proven long term performance (retains properties, shape)
Advantage: Low Weight

- Weight Savings -- Densities from 5 to 32 Kg/m³
- Additional Weight Savings with Installation – fewer fasteners required
Advantage: Acoustics

Open Cell Structure Provides Excellent Sound Absorption Performance at Frequencies From 500 to 2000 Cycles Per Second.

- Excellent Acoustic and Non-burning Combination
- Good Acoustic Absorption to Weight Ratio
- No Fibers to Release
Advantage: Thermal Control

Effective Thermal Insulation on a Per Unit-weight Basis

- Continuous use to 300°C
- Retains thickness and thermal resistance – even in hot and humid environments
- No phenol-formaldehyde binder to break down

Over 300°C Temperature Reduction With 25 mm Thick SOLIMIDE Foam Insulation
Advantage: Fire Resistance, Smoke

Inherently Fire Resistant – Will Not Support Combustion in Air

- Nearly Zero Flame Propagation – FAR25.856a
- Typically Exceeds Fire Regulations
- Numerous Test Results Available
  - NBS Smoke Chamber
  - OSU Heat Release
  - Boeing and Airbus Smoke/Toxicity tests

Emits Virtually No Smoke or Incapacitating Gases When Exposed to Open Flame
Advantage: Formaldehyde and Fiber-Free

Negligible Outgassing at Room Temperature / Minimal Outgassing at Elevated Temperatures

• Minimal Volatile Compounds Released
• No Odors for Consumer Products
• No “Burn In” Requirement or binder to burn out
• No respirable fibers
• No loss of thickness or sagging in hot, humid environments
• No breakdown or disintegration
Advantage: Easy Installation

Self-supporting, but flexible – easy to handle and install

- Faster installation with fewer installers
- Fewer Fasteners – reduced weight
- Wrap Around Structures
Case Study – Qantas Experience

In the early 1990’s, Qantas replaced fiber glass in the bilge areas of their 747 fleet.

Benefits reported:

• 300 lb. weight reduction (batting only)
• 60% reduction in blanket manufacturing time
• 80% reduction in blanket installation time
  (1600 fasteners eliminated from FG design)
• 95% reduction in inspection time
• Moisture mitigation -- elimination of cover film penetrations
• Retention of blanket integrity
Advantage: Life-Cycle Performance

SOLIMIDE Foam maintains integrity and thickness in hot, humid environments

- In 2007, Qantas sent a 10-year old insulation blanket to Boeing for evaluation – it was in great shape!
- Fiber glass blankets disintegrate with moisture – more replacements required during inspection
- Fewer fasteners to begin with means fewer fasteners during inspections
In the 1990’s:
Alaska Airlines In-Service Study:
  • A sandwich configuration FG/Foam/FG was installed and flown for a year
  • PI Foam retained 90% of thickness, FG only 50%
  • PI Foam maintained coverage area, FG sagged

System Design, 737 Factory Installation:
  • Blankets fabricated for factory installation trial – two frame bays, all fuselage above floor
  • Blankets installed quickly with minimal fasteners – installers impressed with simplicity and speed
All SOLIMIDE polyimide foams are open-celled, flexible, low off-gassing, fire-resistant, thermal/acoustic insulation materials.

<table>
<thead>
<tr>
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<th>Medium density (5.7 kg/m³)</th>
<th>Maximum continuous use temperature is 200°C</th>
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<tbody>
<tr>
<td>AC-530</td>
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<td>AC-550</td>
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<tr>
<td>HT-340</td>
<td>“Orange” color, medium density (6.4 kg/m³)</td>
<td>Maximum continuous use temperature is 300°C</td>
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</table>

HT-340

Medium density (6.4 kg/m³)
Maximum continuous use temperature is 300°C

AC-550

Medium density (7.1 kg/m³)
Maximum continuous use temperature is 200°C

AC-530

Medium density (5.7 kg/m³)
Maximum continuous use temperature is 200°C

All SOLIMIDE polyimide foams are open-celled, flexible, low off-gassing, fire-resistant, thermal/acoustic insulation materials.
AC-530

Properties:
- Low density (5.7 kg/m$^3$)
- Good acoustical qualities
- Excellent hydrolytic stability

General Applications:
- Aircraft fuselage insulation
- Aircraft equipment insulation
- Aircraft duct insulation

Specifications:
- AIMS 04-14-004, BMS 8-300, MMS 04-001
AC-550

- Properties:
  - Best thermal conductivity
  - Highest density (~7.1 kg/m³)
  - Highest mechanical values
  - Excellent hydrolytic stability

- General Applications:
  - Aircraft fuselage insulation
  - Aircraft air-conditioning duct insulation
  - Launch vehicle insulation

- Specifications:
  - AIMS 04-14-004, BMS 8-300, DMS 2330, Lockheed, General Dynamics, Northrup-Grumman, others
Specific Market:

High temperature thermal insulation

Properties:

- Operational temperature to 300°C
- Chemical stability/resistance
- Excellent hydrolytic stability
- Low weight

Specification:

BMS 8-300
New Product – AC-310

- Lightest density \((5.0 \text{ kg/m}^3)\)
- Maximum continuous use temperature is 200°C

Currently under development for use in multiple Boeing aircraft, including the Boeing 787 fuselage.
Manufactured in Magnolia, Arkansas USA ...

...and Shipped Around the World

Central Location in North America
Supply Chain: Fabrication Sites

Buns Are Converted Into Foam Parts by Authorized Fabricators
With Facilities Around the World:

Australia       Canada       France
Germany       Italy       Japan
South Korea       Switzerland       United States

Authorized Fabricators, Our Primary Customers,
Sell Fabricated Foam Parts/Systems to End Users.
Finished Parts

Fabricators Convert Large Foam Blocks Into:

- Sheets or Panels
- Sheets or Panels of Densified (Felted) Foam
- Profile Cut Shapes, Such As Pipe Insulation
- Die Cut Parts
- Systems, Laminated With Facings And/or Coated Materials Such As Films, Adhesive, Release Liners, Etc. Can Be Added.
Sheet Parts

Thickness from 5mm, Sizes to 1.2m x 2.4m
Solimide Foams Readily Accept Protective Surface Treatments
Profile/Pipe Cut

Inner Diameter Cuts From 6 mm Diameter
Questions?