Development of Aircraft Thermal Acoustic Insulation
Donacarbo Light Wool
(Use of 13 micro meter Carbon Fiber)

Insulation of all the Shinkansen 500 & 700 Series Vehicles
(High Speed Railway of Japan)

Carbon Fiber Factory
Donac Co., Ltd.
Osaka, Japan
Development Points of Aircraft Thermal Acoustic Insulation

1. Fine Carbon Fiber Manufacturing Technology
2. Fine Carbon Fiber Insulation Processing Technology
Development Points

Choice of Raw Material Pitch

Examination of Infusible condition

Spinning

Infusiblization

Carbonization

Development of Fine Carbon Fiber Spinning Nozzle
Fine Carbon Fiber Manufacturing Technology (2)

Raw Material of Carbon Fiber

- Coal Tar
  - Petroleum Tar
  - Heat Treatment
    - Isotropic Pitch
    - Anisotropic Pitch
      - Melt Blow Spinning
      - Continuous Spinning
        - Polyacrylonitrile (PAN)
        - Continuous Carbon Fiber
          (Diameter 7 micro meter~)
        - Short Carbon Fiber
          (Diameter 2 micro meter~)
Fine Carbon Fiber Manufacturing Technology (3)

Spinning Method

Melted Anisotropic Pitch

Hot Air

Pitch Fiber

Japan Patent 61-70567
Mechanism of Infusible Treatment

Suitable Infusible Treatment

Cost

Weight per Unit Area (g)

Rate of Temperature (°C/min)

Possibility Range

Impossibility Range

Best
Fine Carbon Fiber Insulation Processing Technology (1)

Development Points

Fiber Opening Method

Spraying Nozzle & Binder

Carbon Fiber

Pre Opening

Opening

Molding

Raw Blanket

Exhaust
Fine Carbon Fiber Insulation Processing Technology(2)

Development of Carbon Fiber Opening Method

1st Process

Carbon Fiber

Pre Opening

Cylinder with Needle (Low Speed Rotation)

2nd Process

Opening

Cylinder with Needle (High Speed Rotation)

Opened Carbon Fiber
Fine Carbon Fiber Insulation Processing Technology (3)

Development of Spraying Nozzle

Pre Opened Carbon Fiber

Spraying Nozzle

Raw Blanket

Opening

Molding

Exhaust

Development of Binder

* Phenol Resin
* Formalin Free
* No Corrosion
* Low Cost
Evaluation of Fine Carbon Fiber Insulation (1-1)

Burnthrough Test Standard

Proposed Burnthrough Test Standard

www.fire.tc.faa.gov/ppt/bt2.ppt (2nd Slide)
Evaluation of Fine Carbon Fiber Insulation (1-2)

FAA Burnthrough Test (Feb.’99)

Burnthrough Comparison Using 6 GPH Burner, 4 Inches from Sample Holder

FAS = Failure At Seam

www.fire.tc.faa.gov/ppt/bt2.ppt (8th Slide)
Evaluation of Fine Carbon Fiber Insulation

Acoustic Transmission Loss

Transmission Loss for fine carbon Fiber Insulation and Fiber Glass

Thermal Conductivity = 0.26 Btu-in/hr-sq,ft F
## Other Properties

<table>
<thead>
<tr>
<th>ITEM</th>
<th>TEST RESU, k</th>
</tr>
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<tbody>
<tr>
<td>FLAMMABILITY</td>
<td></td>
</tr>
<tr>
<td>SMOKE DENSITY</td>
<td>2 Ds</td>
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<tr>
<td>HEAT RELEASE</td>
<td>27 KW min/ sq,meter</td>
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<tr>
<td>EXIT TIME</td>
<td>0 sec</td>
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<tr>
<td>TOXIC GAS</td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>150 ppm</td>
</tr>
<tr>
<td>NOx</td>
<td>5 ppm</td>
</tr>
<tr>
<td>HCN, HF, HCl, SO2</td>
<td>NOT DETECT</td>
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</table>

<table>
<thead>
<tr>
<th>ITEM</th>
<th>TEST RESU, k</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATER RETENTION</td>
<td>4 g/100in²</td>
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<tr>
<td>MOISTURE ABSORP.</td>
<td>247 gr/100in²</td>
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<td>LOFT RETENTION</td>
<td>80 %</td>
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<tr>
<td>DURABILITY</td>
<td>1.65 lb/in²</td>
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<td>CORROSION</td>
<td>NO CORROSION</td>
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<tr>
<td>ELECTRIC COND.</td>
<td>80 ohm-inch</td>
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</table>
Health & Safety

Subchronic Inhalation Study

Purpose

The sign which causes chronic symptoms such as the tumor in the lung of the mouse is evaluated.

Method

The mouse is made to inhale the fine carbon fiber for 90 days, and pathological change of lung in 45th and 90th is observed afterwards.

Term

about 1 year