



Call for Proposal n° 11

Brussels, January 19th 2012

***JTI-CS-2012-1-ECO-01-045-Process scale
up for recovery and recycling of glass-
fiber a/c insulation material in pilot scale***

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A/c insulation



How to recycle a/c insulation panels made from

- glass wool packed in
- glass fiber reinforced PE-foil

at large scale

Mineral wool

- ❖ Synthetic mineral wool is the most common fiber type in construction engineering and has two main groups: stone and glass wool
- ❖ Stone wool is mainly coloured grey/green, glass wool yellow and new products with natural based additives are coloured brown
- ❖ Used for thermal insulation, fire prevention, noise reduction and as additives in construction material (e.g. brick filling)
- ❖ Wool produced before 1995 harms human health when inhaled (carcinogenic)
- ❖ Old wool retention time in lung 200 days, new wool not allowed to exceed 20 days
- ❖ Fiber consistence allows an all-over assembly



Source: "Künstliche Mineralfaserdämmstoffe"
Author: Bundesinstitut für Bau-, Stadt- und Raumforschung

Mineral wool

- ❖ Glass wool properties :
 - Easy to handle
 - Compressible
 - Incombustible
 - Low moisture storage capability
 - Low thermal conductivity (0,035 – 0,05 W/m*K)
 - Low thermal storage capacity
 - Low density (~150 kg/m³)
- ❖ Between 1995 and 2005 178 Mio. m³ were produced in Germany
- ❖ Mineral wool is the main insulation material in Germany with 54% market share
- ❖ Additives in mineral wool have a hydrophobic effect and prevent aging of the material
 - ❖ Insulation efficiency decreases with increasing moisture
 - ➔ Water contact causes hydrolysis of resin and glass structure until total fail of material

Source: "Künstliche Mineralfaserdämmstoffe"
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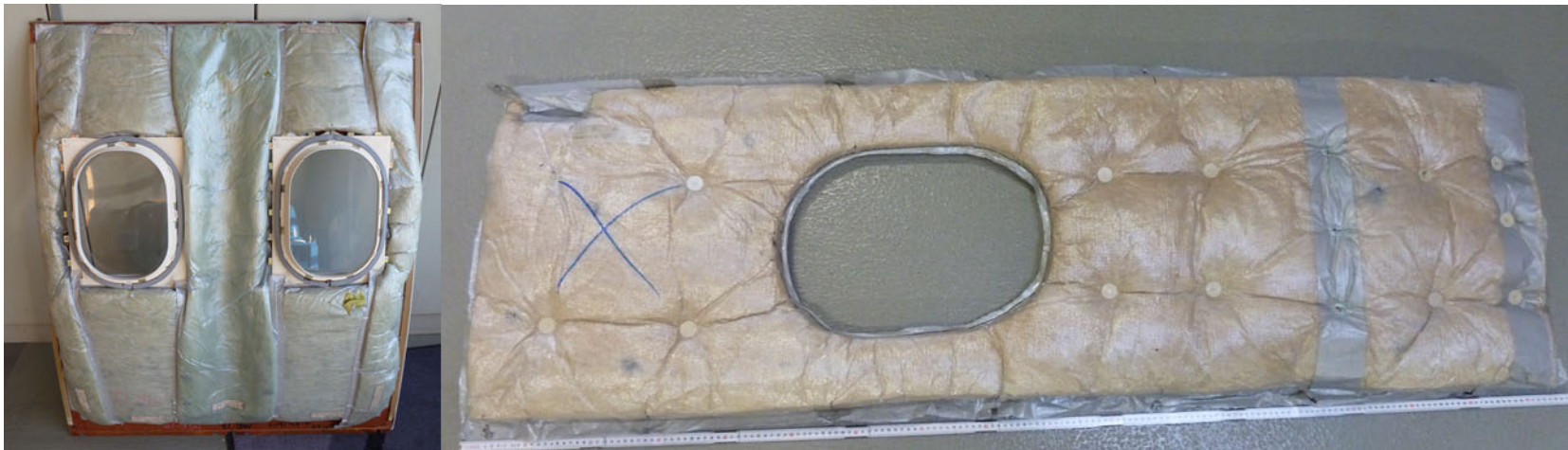
Mineral wool

- ❖ Variation in thermal stress causes progressive destruction of mineral fibers
- ❖ Glass wool includes more additives (mainly phenol and urea-formaldehyde resin) than stone wool
- ❖ Raw material for glass wool are:
 - Scrap glass, silica sand, clay, alkali compounds
 - Melted (at 1300 °C) and centrifuged with jet spin process
- ❖ Raw material for stone wool are:
 - Diabase, basalt, dolomite limestone
 - Melted (at 1500 °C) and treated with jet blow process
- ❖ Mineral insulation waste: 100 ktons/a
- ❖ Currently most of the material is disposed in subsurface repository as hazardous waste (700 Mio. m³ until today)
- ❖ Price for disposal in Germany is currently between 50 and 250 €/t

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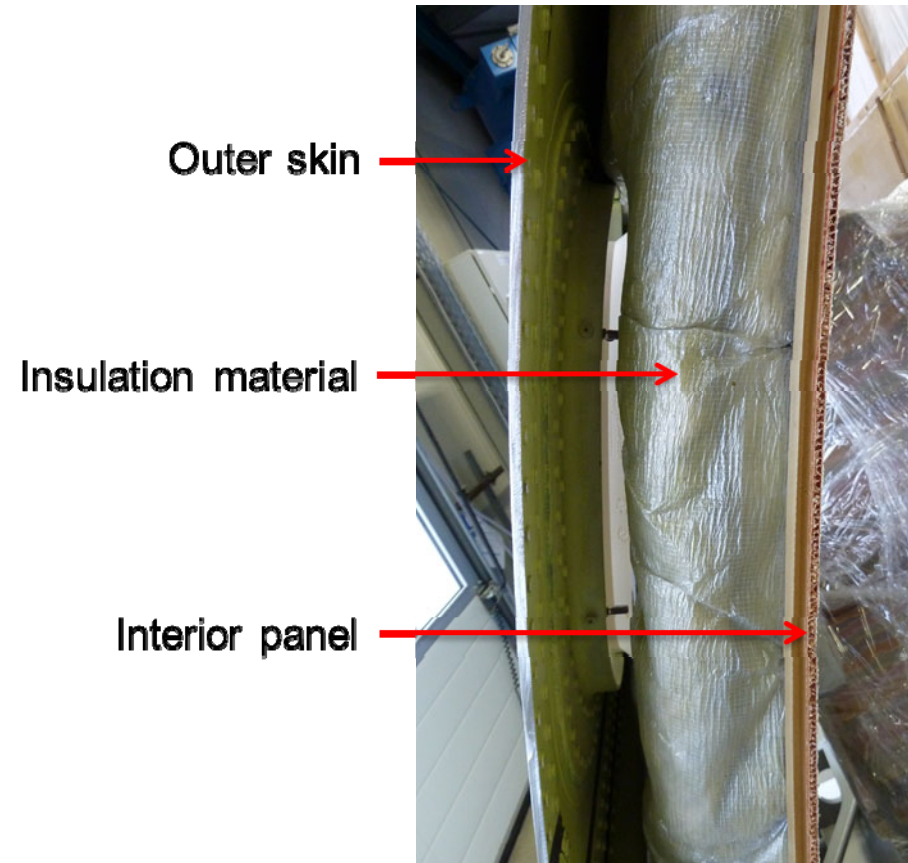
Mineral wool in aviation industry

- ❖ A/c insulation material is mainly used to provide thermal and noise insulation
- ❖ It consists of mineral wool esp. glass wool surrounded by glass fiber reinforced Polyethylene foil
- ❖ Insulation material undergoes thermal and mechanical stresses during life phase
- ❖ A/c sees condensate accumulation in the insulation layer during use phase which contributes to the weight increase of aged a/c.



Mineral wool – recycling

- ❖ Insulation material is changed during rebuilding passenger a/c to cargo a/c or every 5-7 years during standard maintenance and need to be treated at the end of their life
- ❖ **So far there are only limited recycling options for insulation material**
- ❖ Glass wool can be melted and reused in glass industry but:
 - High purity is needed (problem: additives)
 - Low density and large volume cause high energy input
→ strong increase of costs



Mineral wool – recycling

- ❖ Since 1993 German Rockwool offers withdrawal of mono-fraction as well as of laminated mineral wool construction site waste, but only for material produced by Rockwool and for a charge
- ❖ In Switzerland FLUMOROC AG offers a collecting system through selling polymer bags for a save transport to the manufacturer

Smelting in top loader, gutter or tank furnace

- ❖ Process is influenced by lamination material like paper, polymers, metals from fastening, glue or felt → avoid insertion of these materials or preprocessing necessary before production of smeltable “briquette”
- ❖ Carbon containing material reduces the durability of the material significantly

Source: “Künstliche Mineralfaserdämmstoffe”
Author: Bundesinstitut für Bau-, Stadt- und Raumforschung

Mineral wool – recycling

Alternative process for mineral wool

- ❖ Mixing of mineral wool with clay, gelatin and water
- ❖ Grinding and forming of the material
- ❖ Using the material for production of bricks
- ❖ During the baking process wool material is smelting and its structure is destroyed
- ❖ New chemical connections with ceramic structure

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Mineral wool – recycling

Alternative process for mineral wool

- ❖ Treatment of wool with microwave technology to a slag
- ❖ Nearly total slagging of wool after a few minutes treatment
- ❖ Currently no use for mineral slag

Mineral wool – recycling

Recycling of mineral wool production waste

- ❖ In the late 90ies Rohleder and Fleckenstein developed with Basaltwolle GmbH an internal recycling process to re-melt production waste and save cost of disposal
- ❖ Internal reuse of materials save 25 % of raw materials and the cost of disposal
- ❖ Nearly all residues of production as well as incorrect insulation material are shredded, mixed with flint-shaped raw materials and cement as binder and pressed to molded padding
- ❖ Material gets melted again (30 wt.-% of total smelting material)
- ❖ Recycled stones are bundled with clay – dolomite, limestone can be saved
- ❖ Standard procedure with manufacturers



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Mineral wool – recycling

How to proceed with separated PE-foil and glass fibers after separating them from glass wool?

- ❖ PE-foil can be recycled if not contaminated by glass wool
- ❖ separation necessary

Source: “Künstliche Mineralfaserdämmstoffe”
Author: Bundesinstitut für Bau-, Stadt- und Raumforschung

Call for Proposal – Goal

- ▶ Identification and testing of real life recycling options of a/c insulation materials (mineral wool) including polymer bags consisting of glass fiber reinforced polymer-foil

- ▶ This includes:
 - Samples acquisition for trials
 - Detailed description of the recycling process
 - Production of recycling samples from these materials

- ▶ Saving of subsurface storage space and raw material

Call for Proposal – Objectives

- ▶ Quantification of insulation material mass in end of life a/c (commercial aircraft, business jet, rotocraft) and description of their end of life quality / properties including fiber length, moisture, assessment of hazardousness of insulation and bag material
- ▶ Identification and description of general recycling options of the insulation (mineral wool) and bag material (glass fiber reinforced polymer-foil)
- ▶ Acquisition of a/c insulation material samples for analytical tests and processing trials
- ▶ Treatment of the insulation material in order to recycle the materials at the highest materials properties and value retained possible.
- ▶ Data for Life Cycle Assessment



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A/c insulation material samples

A/c insulation material bags

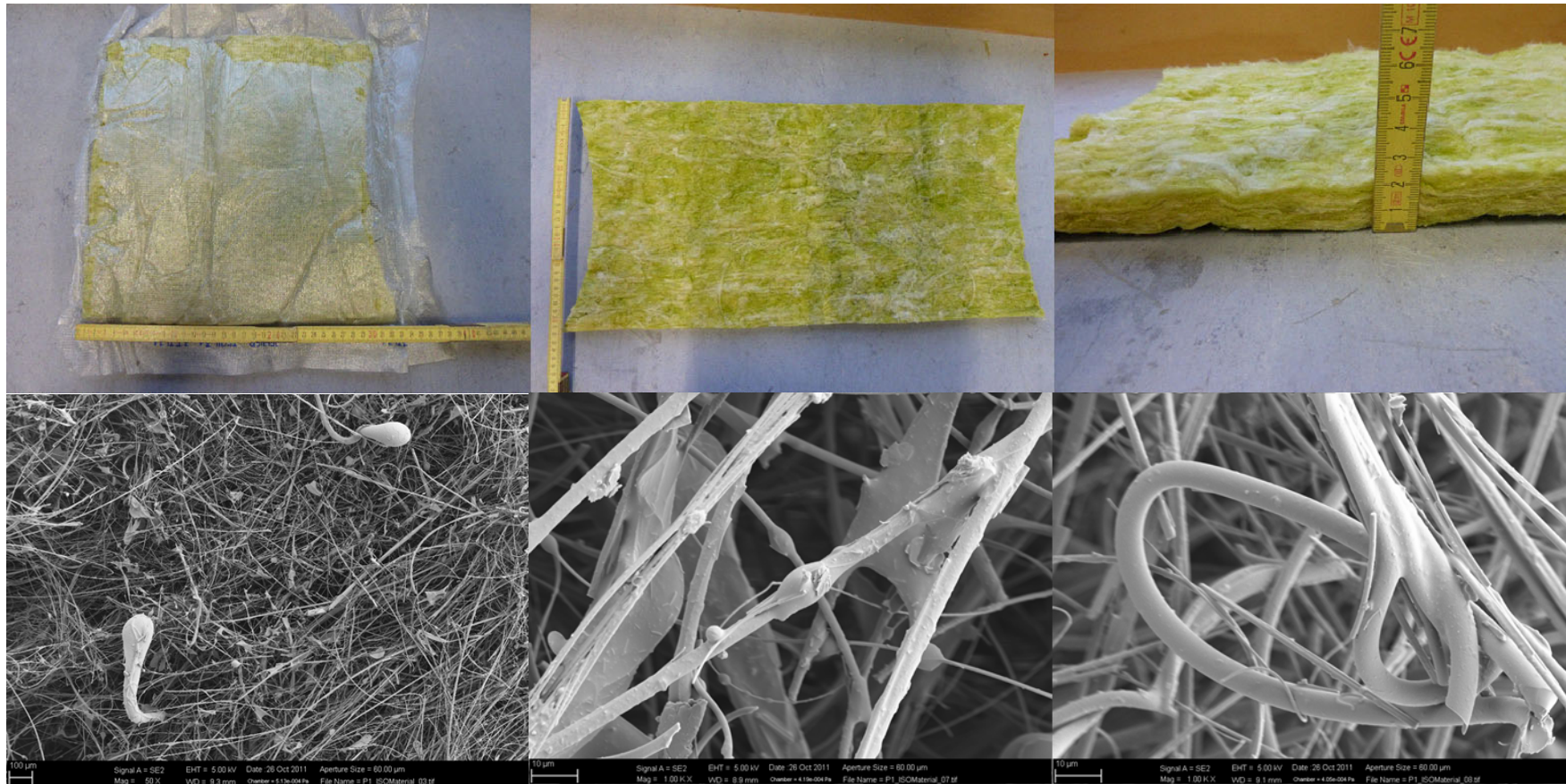


Glass fibers out of PE foil

PE foil

A/c insulation material samples

A/c insulation material



Microscope pictures of glass wool from a/c insulation bag

Expected skills of applicant

Skills the applicant should have:

- ▶ A proven track record in hands-on processing and recycling of fibrous insulation materials (especially for hazardous glass and mineral wool materials)
- ▶ Business operations in this field are highly appreciated
- ▶ Access to or operation of chemical / analytical equipment for qualification of the initial material
- ▶ Access to polymer processing and testing facilities (extrusion, injection molding, testing facilities for materials properties, fiber length measurement)

CfP Budget and duration

Duration: 20 Months

Topic value: not to exceed 220k€