AEROMAG

Aeronautical Application of Wrought Magnesium

Funding: European (6th RTD Framework Programme)
Duration: Mar 2005 - Mar 2008
Status: Complete with results
Total project cost: €4,034,660
EU contribution: €2,594,327

Call for proposal: FP6-2003-AERO-1
CORDIS RCN: 75791

Background & policy context:
The aluminium alloys used today for aerospace applications are already optimised as far as aeronautical requirements are concerned, such as strength, fatigue and damage tolerance properties. Magnesium, with a density of only 65% of that of aluminium, could be a breakthrough technology in the aerospace industry if used for cost-efficient, low-weight components and airframe structures. However, to use this low weight material the mechanical and technological properties have to be improved.

Objectives:
The strategic objectives were to increase the operational capacity by 10%, a reduction in the direct operating cost of 10% and finally a reduction in the fuel consumption of 10% and therefore a reduced environmental impact.

The technological objectives were:

- Weight reduction of single components up to 35 % compared to Al components
- Higher specific mechanical properties compared to Al
- Cost efficient processes for manufacturing of Mg products
- Solve the possible 'flammability problem' with Mg (FAR/JAR)
- Environmentally friendly surface protection for Mg and evaluation of corrosion behavior
- Investigation of technologies com. used in aeronautic industry
- Development of material models and failure criteria
- Process simulation of forming processes
- Manufacturing and testing of structural elements
- Preparation of the qualification of Mg for aerospace applications

Methodology:
Magnesium with a density of only 65% of aluminium, could be a breakthrough technology in the aerospace industry if used for cost efficient, low weight components and airframe structures. However, to use this low weight material the mechanical and technological properties have to be improved.

The technical focus of the university-driven project, AEROMAG, which was prepared in close collaboration with the Network of Universities ‘EASN’, is the development of new magnesium wrought products (sheets and extrusions), which provide significantly improved static and fatigue strength properties. The strength properties of these innovative materials are required to be as high as AA5083 for non-structural applications and as high as AA2024 for aluminium alloys for secondary structure applications.

At first new alloys were developed and existing alloys were tested. Appropriate manufacturing (rolling, extrusion), forming and joining technologies required development, simulation and validation for the innovative material and application. Corrosion is a problem that had to be solved with the newly adapted and environmentally friendly surface protection systems and advanced design concepts.
Flammability was addressed with the addition of chemical elements and special surface treatments. A further essential task was the development of material models and failure criteria for the prediction of forming processes, plastic deformation and failure behaviour of components. Finally, material-adapted design and the evaluation of structural behaviour were investigated to close the process and development chain for aeronautic components.

**Parent Programmes:**
FP6-AERO-1.1 - Strengthening competitiveness

**Institute type:** Public institution

**Institute name:** European Commission

**Funding type:** Public (EU)

**Lead Organisation:**

**Eads Deutschland Gmbh**

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Willy- Messerschmitt- Strasse
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**Organisation Website:**
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**EU Contribution:** €0

**Partner Organisations:**

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**EU Contribution:** €0

**Alenia Aermacchi Spa**

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**EU Contribution:** €0

**Vienna University Of Technology**

**Address:**
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**EU Contribution:** €0

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Key Results:

Main Project Conclusions:

- Several product forms and alloys are available; ρ=1.7-1.9 g/cm³
- Advanced alloys with good mechanical/technological properties
- More than 33 % increase in specific strength possible
- HT alloys are applicable until 200°C
- Fatigue strength (Kt=1.0, R=0.1) in rage of 150 - 220 MPa
- Flammability tests and test definition has been initiated by AEROMAG
- Partners with FAA; Full scale test is under progress at FAA
- Intrinsic corrosion behavior of alloys has improved; RE based alloys
- Show in general better corrosion behavior than AlZn systems
- Green surface protection systems are evaluated, dep. alloys
- Forming is possible, under elevated temperatures
- FSW and LBW works well and results in good properties
- Buckling behavior of stiffened panels is comparable to aluminium
- FCP & DT behavior of 2024 T3 can not be fully reached by Mg

Magnesium wrought products are certainly applicable as low weight aeronautic applications.

Technical Implications

Opposite to common opinion about a 'non-metallic' aeronautic future, major European aerospace industries are seriously investigating magnesium as weight-reduction alternative to aluminum.

New high-strength alloys, advanced surface treatment technologies and a correct understanding of 'magnesium flammability' form the basis for magnesium comeback in aerospace industry.

10-15% of magnesium components in civil aircraft in 2015-2020 look like a real target.

Documents:

- Project Presentation on International Conference - Moscow 2007 (Other relevant documents)

STRIA Roadmaps: Vehicle design and manufacturing

Transport mode: Air transport

Transport sectors: Passenger transport, Freight transport

Transport policies: Environmental/Emissions aspects, Societal/Economic issues

Geo-spatial type: Infrastructure Node